

27
5/11/82 to NTIS
24 copy - 1.5-

(1)

R-4214
MASTER

DOE/NV/00597-2

Advanced Energy Systems Division



Spent Fuel Dry Storage Technology Development: ELECTRICALLY HEATED DRYWELL STORAGE TEST (1KW and 2KW Operation)

JUNE 1980

Prepared For
THE UNITED STATES DEPARTMENT OF ENERGY
Contract No. DE-AC08-76NVO0597

Westinghouse Electric Corporation
Advanced Energy Systems Division
P.O. Box 10864
Pittsburgh, Pennsylvania 15236

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

DISCLAIMER

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Department of Energy, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, mark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Printed in the United States of America

Available from:

National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22161

Price: Printed Copy \$15.50
Microfiche \$3.50

DISCLAIMER

This book was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DOE/NV/00597-2
UC-85

Spent Fuel Dry Storage Technology Development:
**ELECTRICALLY HEATED
DRYWELL STORAGE TEST**
(1KW and 2KW Operation)

JUNE 1980

Prepared For
THE UNITED STATES DEPARTMENT OF ENERGY
Under Contract No. DE-AC08-76NVO0597

CONTRIBUTORS: C.A. Holder	D.F. Moran
D.H. Kurasch	P.S. Sherba
W.L. Lundberg	R. Unterzuber

PREPARED BY: R. Unterzuber
R. Unterzuber

APPROVED BY: [Signature]

Manager, Waste Isolation Programs

WESTINGHOUSE ELECTRIC CORPORATION
Advanced Energy Systems Division
P.O. Box 10864
Pittsburgh, Pennsylvania 15236

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED *RP*

ABSTRACT

An electrically heated drywell storage cell test has been in operation since March 1978 at the Engine Maintenance Assembly and Disassembly (E-MAD) facility on the Nevada Test Site in support of spent fuel dry storage technology development. This document presents the test data obtained to date at electric heater power outputs of 1.0 kW and 2.0 kW.

The simulated drywell storage cell consists of a representative stainless steel spent fuel canister containing an electrical heater assembly, a concrete filled shield plug to which the canister is attached, and a carbon steel liner that encloses the canister and shield plug. The entire test drywell is grouted into a hole drilled in the soil adjacent to E-MAD. Temperature instrumentation is provided on the canister and drywell liner, in the grout around the liner, and at a number of radial locations in the soil surrounding the drywell. Peak measured canister and liner temperatures are 276°F and 232°F for 1.0 kW and 510°F and 458°F for 2.0 kW, respectively.

A computer model was developed to predict the thermal response of the test configuration. Computer predictions of the transient and steady-state temperatures of the drywell components and surrounding soil are presented and they show good agreement with the test data.

TABLE OF CONTENTS

<u>Section</u>	<u>Page No.</u>
LIST OF TABLES	v
LIST OF FIGURES	vi
1.0 INTRODUCTION	1
1.1 Purpose of Report	1
1.2 Organization of Report	3
1.3 Background	3
2.0 CONCLUSIONS	9
3.0 TEST OBJECTIVES	10
4.0 TEST HARDWARE	13
4.1 Test Arrangement	13
4.2 Drywell Liner	13
4.3 Canister Assembly	17
4.4 Electric Heater Assembly	22
4.5 Soil Instrumentation Wells	23
4.6 Heater Power Control	24
4.7 Data Acquisition System	27
5.0 TEST OPERATIONS AND RESULTS	29
5.1 Test Sequence	29
5.2 Initial Preparation and Heatup Check	30
5.3 Accelerated Heatup (3.0 kW Power Operation)	30
5.4 1.0 kW Power Operation	31
5.5 2.0 kW Power Operation	36
5.6 Ambient Temperature Measurements	37
5.7 Heater Power Variations	42

TABLE OF CONTENTS

<u>Section</u>	<u>Page No.</u>
6.0 THERMAL ANALYSIS MODEL	44
6.1 Analysis Purpose and Method	44
6.2 Model Description	45
7.0 THERMAL ANALYSIS RESULTS	69
7.1 Model Evaluation Criteria	69
7.2 Model/Data Comparisons	69
7.3 Comparison of Drywell Thermal Response	87
8.0 REFERENCES	89
APPENDIX A SOIL TEMPERATURE TEST HARDWARE AND INSTALLATION	90
APPENDIX B TEST DATA AND MODEL PREDICTIONS	113
APPENDIX C SOIL TEMPERATURE TEST DATA	121
APPENDIX D TAP-A INPUT AND OUTPUT	149

LIST OF TABLES

<u>Table No.</u>	<u>Title</u>	<u>Page No.</u>
1	TAP-A Model Node Description	48
2	E-MAD Site Outdoor Air Temperatures - Monthly Averages	52
3	Canister and Liner Thermocouples Used in Canister Heat Flux Calculations	56
4	Soil Temperature Test Material Thermal Properties	60

LIST OF FIGURES

<u>Figure No.</u>	<u>Title</u>	<u>Page No.</u>
1	Soil Temperature Test Arrangement	2
2	Drywell Configuration	5
3	Surface Storage Cask Configuration	6
4	Fuel Temperature Test Configuration	8
5	Soil Temperature Test Configuration	14
6	Soil Temperature Test Schematic	15
7	Plan View of Thermocouple Locations	25
8	Soil Temperature Test Instrumentation Well Configuration	26
9	Peak Temperature Readings for Initial Test Phases	33
10	Canister and Liner Axial Temperature Profiles at 1 kW Power Level Thermal Stabilization, April 1, 1979	34
11	Soil Isotherms at 1 kW Power Level Thermal Stabilization, April 1, 1979	35
12	Peak Temperature Readings for 2 kW Test Period	38
13	Canister and Liner Axial Temperature Profiles at 2 kW Power Level Thermal Stabilization, April 1, 1980	39
14	Soil Isotherms at 2 kW Power Level Thermal Stabilization, April 1, 1980	40
15	Reference Well Thermocouple Temperature Distributions as a Function of Time	41
16	Reference Well Axial Temperatures Profiles	43
17	Near-Field Thermal Model Node Locations	46
18	Far-Field Thermal Model Node Locations	47
19	Reference Well Temperature Comparison - Test Data and Predictions	54

LIST OF FIGURES (Cont'd)

<u>Figure No.</u>	<u>Title</u>	<u>Page No.</u>
20	Canister Axial Heat Flux Distributions Derived from Canister and Liner Temperature Data	58
21	Test Data and Predictions at 40 Inch Depth Showing Canister Heat Flux Modeling Effects, 1 kW Operation, August 31, 1978	59
22	Laboratory Measured Grout Thermal Conductivity	61
23	Radial Temperature Profile Predictions at Canister Midplane as a Function of Soil Thermal Conductivity, 1 kW Operation, August 31, 1978	63
24	Laboratory Measured E-MAD Soil Thermal Conductivity	64
25	E-MAD Soil Thermal Conductivity Test Data and Predictions	66
26	E-MAD Soil Thermal Conductivity as Derived from Test Data and Prediction Comparisons	68
27	Canister and Liner Axial Temperature Profile Comparison for 3.0 kW Operation, Accelerated Heatup Period, April 30, 1978	70
28	Canister and Liner Axial Temperature Profile Comparison for 1 kW Operation, August 31, 1978	71
29	Canister and Liner Axial Temperature Profile Comparison for 2 kW Operation, August 31, 1979	72
30	Soil Temperature Test Data and Predictions for the 3 Foot Depth During 1 kW Operation	74

LIST OF FIGURES (Cont'd)

<u>Figure No.</u>	<u>Title</u>	<u>Page No.</u>
31	Soil Temperature Test Data and Predictions for the 11 Foot Depth During 1 kW Operation	75
32	Soil Temperature Test Data and Predictions for the 3 Foot Depth During 2 kW Operation	77
33	Soil Temperature Test Data and Predictions for the 11 Foot Depth During 2 kW Operation	78
34	Radial Temperature Profile Comparison for the 3 foot Depth During 1 kW and 2 kW Operation	80
35	Radial Temperature Profile Comparison for the 8 Foot Depth During 1 kW and 2 kW Operation	81
36	Radial Temperature Profile Comparison for the 13 Foot Depth During 1 kW and 2 kW Operation	82
37	Axial Temperature Profile Comparison in Grout and Soil During 3 kW (Accelerated Heatup) Operation, April 30, 1978	83
38	Axial Temperature Profile Comparison in Grout and Soil During 1 kW Operation, August 31, 1978	84
39	Axial Temperature Profile Comparison in Grout and Soil During 2 kW Operation, August 31, 1979	85

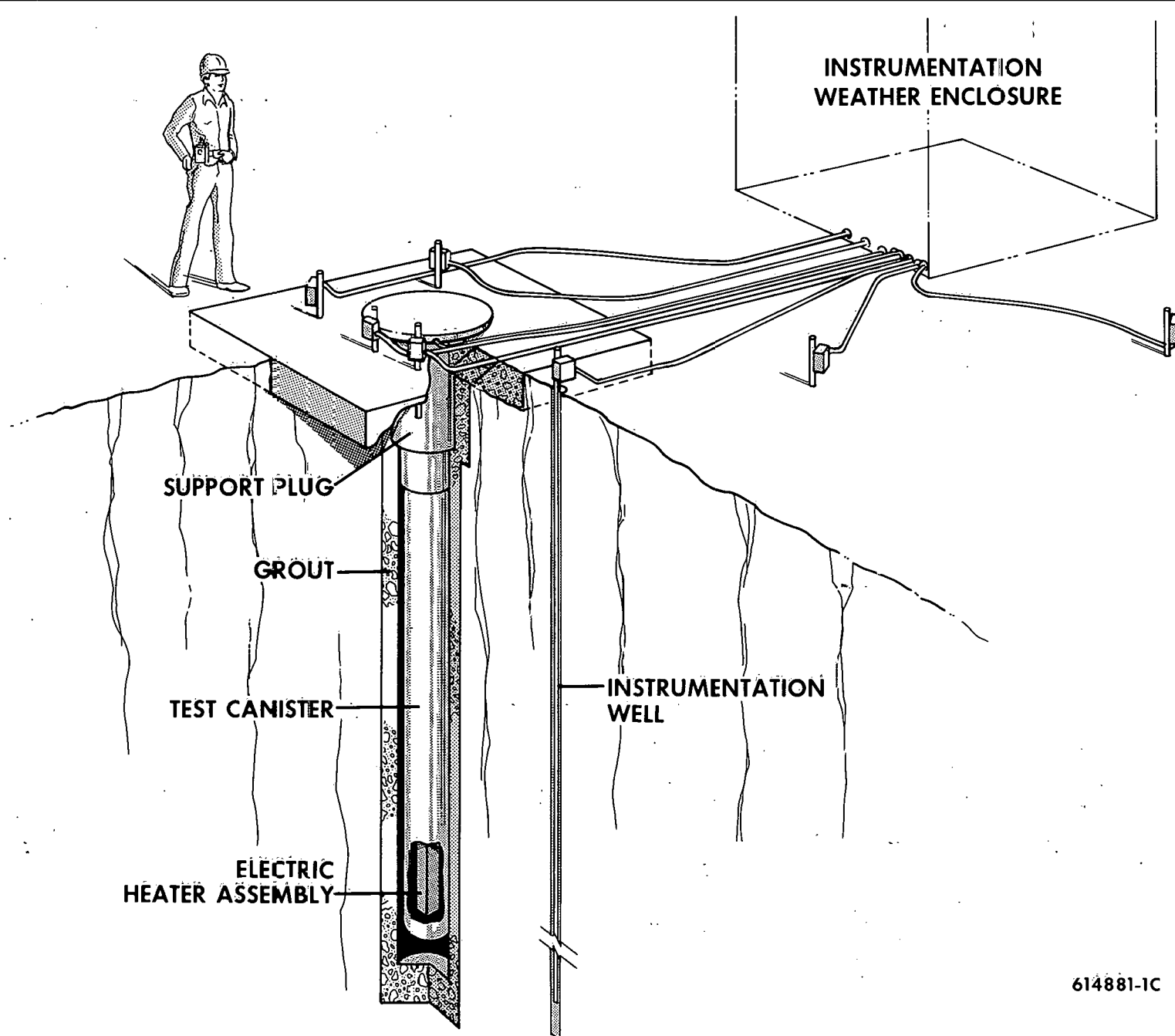
1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

The purpose of this report is to provide a test description, the test results, and the conclusions drawn from the Electrically Heated Drywell Storage Cell Test performed at the Nevada Test Site. This test was entitled "Soil Temperature Test" under Contract No. DE-AC08-76NV00597 and is referred to as such throughout this report. This test was started as part of the Spent Fuel Handling and Packaging Program (SFHPP) 1978 Demonstration (further discussed in Section 1.3) and is presently being conducted as part of the Commercial Waste and Spent Fuel Packaging (CWSFP) Program.

The Soil Temperature Test was begun in March 1978, and has been operated at various power levels over the past two years. The test arrangement (shown in Figure 1) consists of an extensively instrumented carbon steel drywell liner, a stainless steel canister containing an assembly of electric heaters in an air atmosphere, and a concrete shield plug which supports the canister from the top of the liner. The drywell liner is grouted into a hole in the soil. An array of thermocouple wells was installed to measure ground temperature response to the electric heat source. Throughout the test, readings from the thermocouples, heater input voltage and current, and atmospheric conditions have been recorded.

A finite difference computer model was developed in conjunction with the Soil Temperature Test to calculate canister, drywell and soil temperatures under test conditions. Results from the computer model (described in Section 6.0) were compared to the test temperature data, and the model was refined to provide predictions that are in good agreement with the actual test results. Comparisons of the analytical predictions with the test data are presented in Section 7.0.



614881-1C

FIGURE 1. Soil Temperature Test Arrangement

1.2 ORGANIZATION OF REPORT

This report is organized to present the Soil Temperature Test and its results in the following order:

- Introduction (including background of Spent Fuel Handling and Packaging and Commercial Waste and Spent Fuel Packaging Programs).
- Conclusions drawn from the test results.
- Test objectives.
- Test hardware description.
- Test operation and results.
- Thermal model description.
- Comparison of test results with model predictions.
- Test temperature data.
- Computer code input and output data.

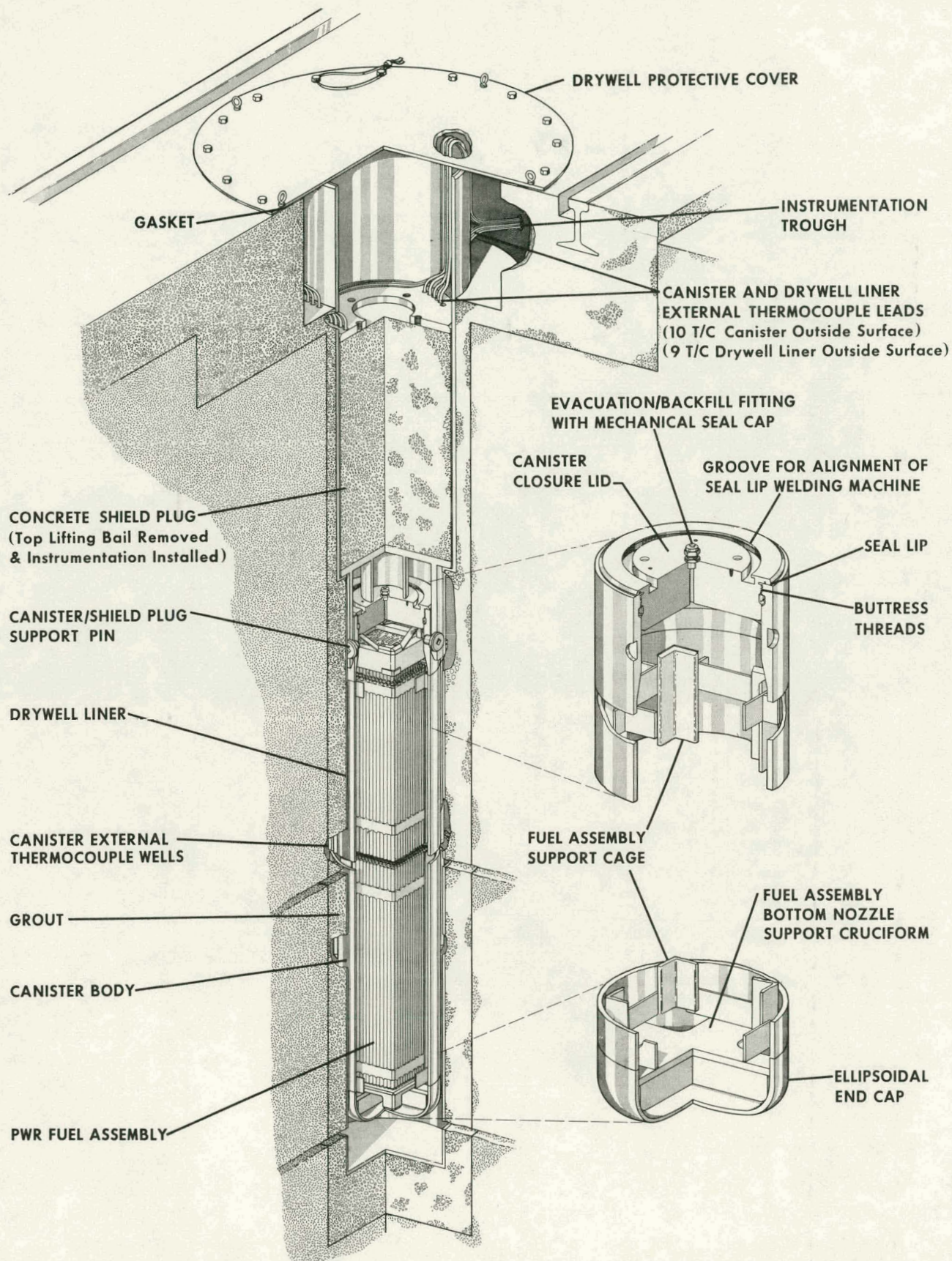
1.3 BACKGROUND

The Soil Temperature Test described in this report was initiated as part of the Spent Fuel Handling and Packaging Program (SFHPP) 1978 Demonstration at the Nevada Test Site. The objective of the SFHPP 1978 Demonstration was to develop and test the capability of satisfactorily encapsulating typical spent fuel assemblies from commercial nuclear power plants and to establish the suitability of one or more surface and near-surface concepts for the interim dry storage of the encapsulated fuel assemblies.

The E-MAD (Engine Maintenance, Assembly, and Disassembly) facility, constructed at the Nevada Test Site as part of the Nuclear Rocket Development Station, was chosen as the location for this demonstration because of its extensive capabilities for handling highly radioactive components and because of the desirable site characteristics for the proposed storage concepts. The E-MAD facility, operated for the Department of Energy by the Advanced Energy Systems Division (AESD) of the Westinghouse Electric Corporation, is described in more detail in Reference 1.

Near-surface and above-surface storage concepts were chosen for testing during the SFHPP 1978 Demonstration. Each storage cell is designed to accommodate one canister, and the canister is designed to contain either one pressurized water reactor (PWR) fuel assembly or two boiling water reactor (BWR) fuel assemblies. The near-surface storage concept, or drywell, shown in Figure 2, consists of a steel liner grouted into a shallow hole drilled in the alluvial soil at the E-MAD facility. A sealed canister containing the fuel assembly in a helium atmosphere is suspended from a shield plug which in turn is supported by a step in the liner. The above ground storage concept, or Surface Storage Cask (SSC), is shown in Figure 3. Here, a steel liner identical to that used in the drywell is encased in a reinforced concrete silo, and the canister/shield plug package is supported in the liner in the same manner as in the drywell. In both of these storage systems, the decay heat of the fuel assembly is passively transmitted to the storage cell and then dissipated to the environment. Encapsulation of the fuel assemblies was performed inside the shielded Hot Bay of the E-MAD facility, and the drywell and SSC storage cells themselves were constructed in an area immediately adjacent to the facility.

An overriding requirement for the SFHPP 1978 Demonstration Program was that the spent fuel storage system and associated activities not result in an undue risk to the public, property, environment, or site employees. One means of assuring that this requirement would be met was to maintain the leak tight integrity of the fuel cladding and the canister. Because high temperature can affect the long term integrity of both of these barriers to fission product release, thermal considerations were an important concern in the design of the storage cells. Preliminary analyses performed by the Hanford Engineering Development Laboratory (HEDL) established 715°F (380°C) as the fuel cladding temperature limit below which fuel cladding integrity would be maintained in a helium environment for long storage times (100 years). Scoping thermal analyses of the storage cell concepts indicated that cladding temperatures reached in the SSC would be well below the limit, but that those reached in the drywell could approach the limit for the fuel assembly decay heat levels being considered.



614828-1FB

FIGURE 2. Drywell Configuration

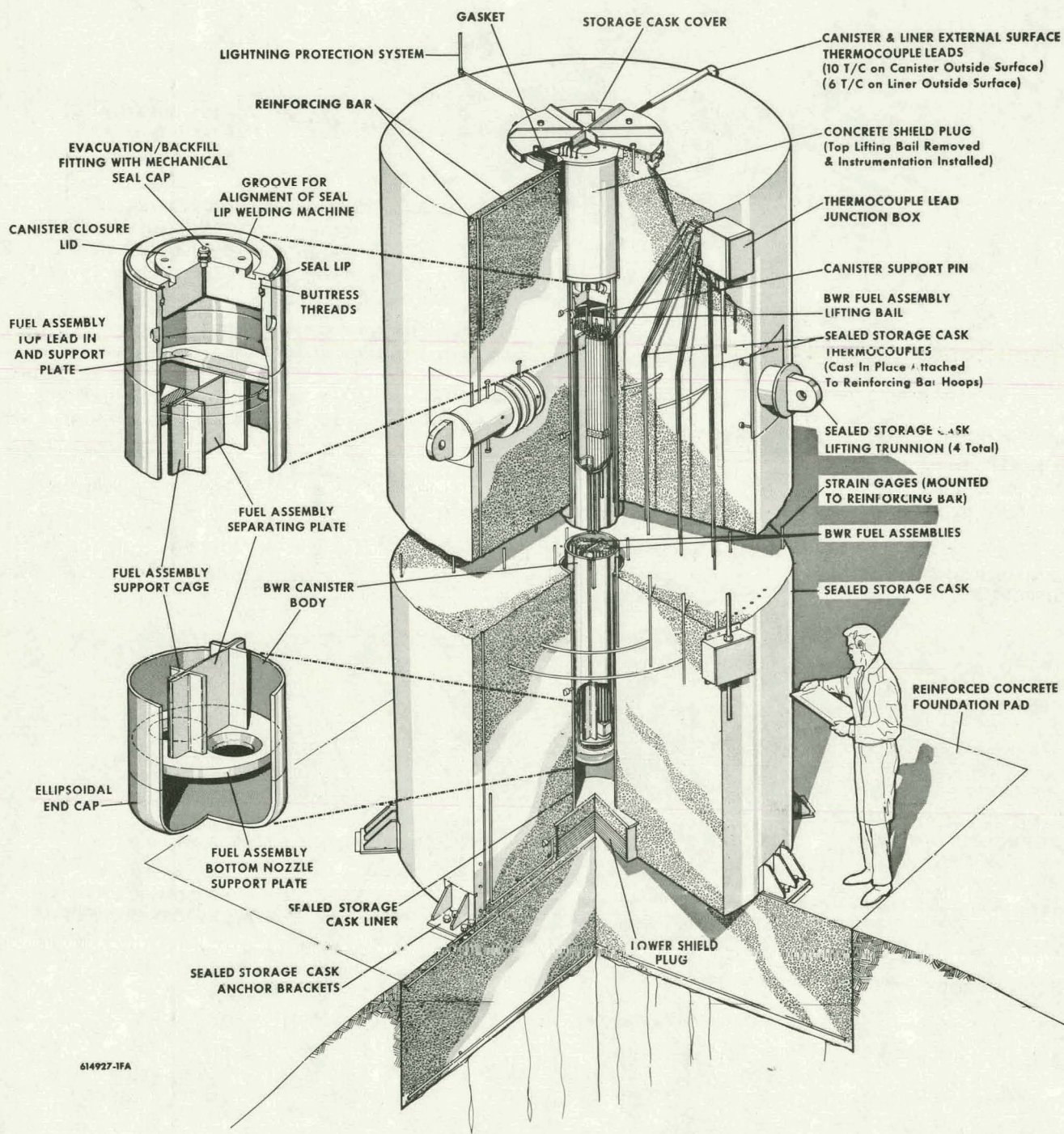


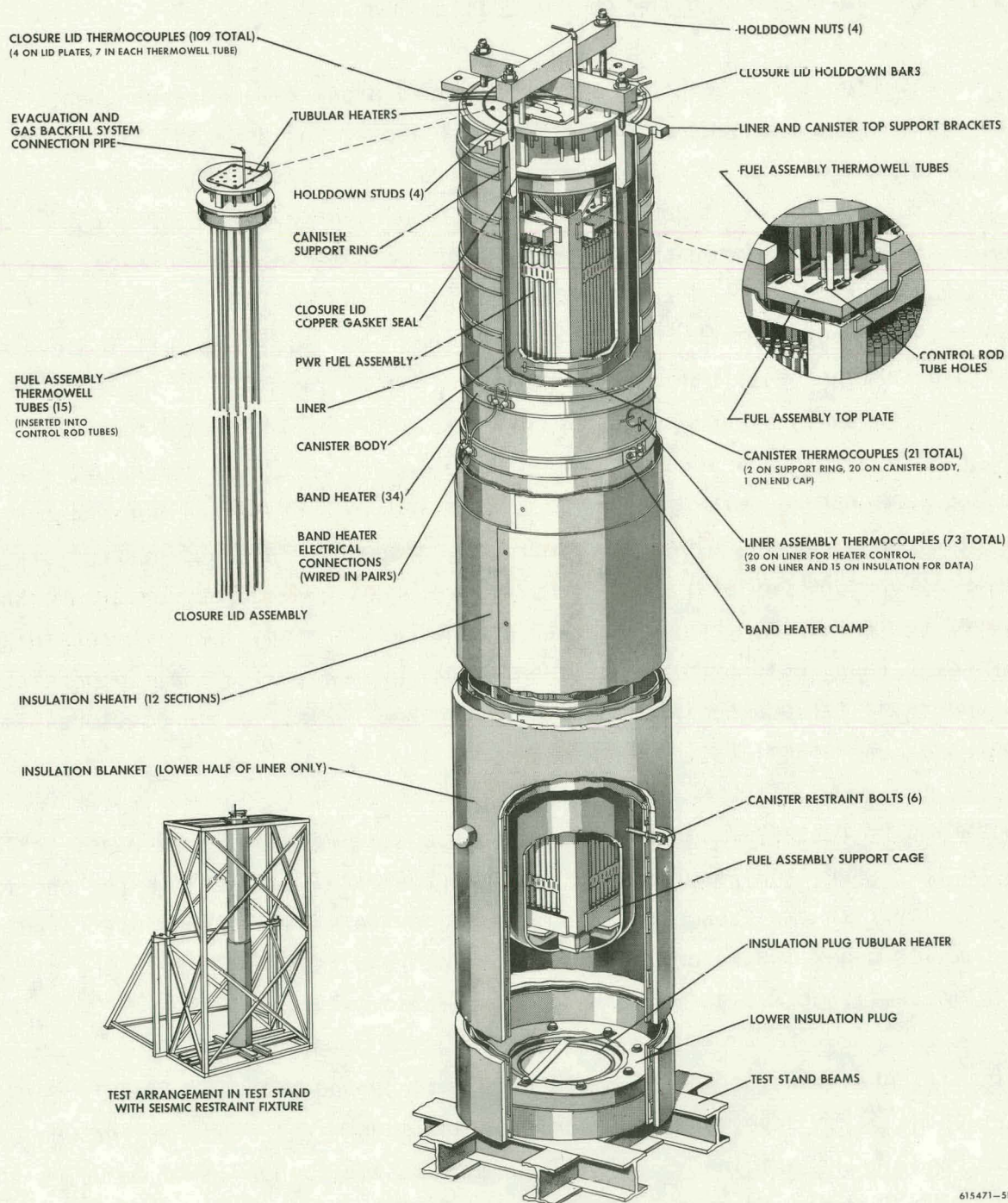
FIGURE 3. Surface Storage Cask Configuration

Therefore, a series of tests was initiated to experimentally verify that fuel cladding temperatures would remain below the established limit and to obtain data for use in qualifying the thermal design model.

Two verification tests were defined which would provide temperature measurements 1) from the canister out into the soil and 2) inside a canister containing a spent fuel assembly. The first test, the Soil Temperature Test, was designed to utilize an in-ground electrically heated drywell configuration to measure the spatial temperature distributions on the canister surface, the drywell liner surface, and in the surrounding grout and soil. Canister temperatures from the Soil Temperature Test would then be input to a Fuel Temperature Test to determine peak fuel cladding temperatures. The Fuel Temperature Test apparatus (shown in Figure 4) was designed to utilize a canister containing a spent fuel assembly and internal temperature instrumentation to measure fuel cladding temperatures. The canister is installed in a drywell liner which has electrical band heaters along the liner axial length. The band heaters are used to impose the canister axial temperature profile measured during the Soil Temperature Test on the Fuel Temperature canister to approximate the thermal environment that would be present in an actual drywell. The Fuel Temperature Test apparatus is located in one of the large hot cells (West Process Cell) inside the E-MAD facility.

In addition to these two verification tests, a Soil Properties Test was initiated to take core samples of the soil in the test area and measure the thermal conductivity. Thermal conductivity measurements were made on reconstituted soil samples under laboratory conditions. The results of this test are discussed in Section 6.2.5 and are included in Table C-1.

The initial phase of the Soil Temperature Test coupled with the Fuel Temperature Test have, to date, provided canister and spent fuel clad temperature data for storage of the original SFHPP 1978 Demonstration spent fuel assemblies at E-MAD. The Soil Temperature Test is described and results to date are provided in this document. The Fuel Temperature Test is described and results of initial spent PWR fuel assembly (approximately 0.9 kW heat output) tests are provided in Reference 14.



615471-5F

FIGURE 4. Fuel Temperature Test Configuration

2.0 CONCLUSIONS

The following conclusions can be drawn from the results of the Soil Temperature Test:

1. The peak canister temperature for a 1.0 kW spent fuel assembly stored in a drywell configuration in soil typical of the Nevada Test Site will be on the order of 275°F for drywells spaced a minimum of 40 feet apart. The 40 foot spacing is judged to thermally isolate the drywells.
2. The peak canister temperature for a 2.0 kW spent fuel assembly stored in a drywell in Nevada Test Site soil will be on the order of 510°F for isolated drywells.
3. Day-night and seasonal variations in ground and ambient air temperature have little effect on the peak canister temperatures which occur at about 10 feet below the ground surface.

Combining the Soil Temperature Test results with data from the Fuel Temperature Test and canister temperature measurements made in actual drywells containing spent fuel indicates that a dry PWR spent fuel assembly with a decay heat level in excess of 2.0 kW contained in a helium filled canister could be stored in an isolated drywell configuration in the Nevada Test Site alluvium soil without the peak fuel temperature exceeding the current temperature limit of 715°F. Further analytical effort and tests with drywells containing spent fuel are planned to investigate the temperature regime associated with an array of drywells.

3.0 TEST OBJECTIVES

The objectives of the Soil Temperature Test (as defined for the SFHPP 1978 Demonstration) were 1) to provide data in the form of prototype drywell canister temperatures which could be used, in conjunction with the Fuel Temperature Test, to verify that spent fuel assemblies with a decay heat level of about 1.0 kW could be stored in Nevada Test Site soil without exceeding design temperature limits, 2) to checkout instrumentation, construction and installation methods for drywells prior to installing actual drywells for spent fuel storage, and 3) to provide storage cell thermal response data so that thermal properties and boundary conditions could be accurately determined to calibrate and verify a drywell thermal model. The engineering approach applied to assure that the Soil Temperature Test met the above stated objectives included an extensively instrumented drywell and soil test arrangement and a two phase confirmation test program. Confirmation Phase I was designed to generate data to support the spent fuel encapsulation in late 1978 (objectives 1 and 2 above) and Confirmation Phase II was designed to collect test data to support the verification of a drywell thermal model (objective 3 above).

Soil Temperature Test Confirmation Phase I data generation and evaluation were directed towards providing a very basic understanding of the drywell storage cell thermal response to verify that the original drywell thermal analyses were sufficiently conservative to negate any concern over spent fuel temperatures. It was decided that data evaluation concentrate on steady-state canister mid-plane (i.e., hottest) temperatures, on near-field (drywell liner and canister only) temperatures, and on checking out installation and construction methods. In addition, sufficient test data would be generated so that evaluations of the effects of atmospheric temperature variations and of any unforeseen problems in support of necessary design changes could be made. For test data to be available on a schedule consistent with the SFHPP 1978 Demonstration goal of having PWR spent fuel assemblies in drywell storage cells by the last quarter of calendar year 1978, an accelerated rate of test arrangement heatup was defined.

This accelerated heatup rate would drive the canister and liner temperatures above those temperatures calculated for steady-state to force test thermal stability within schedular requirements.

Recognizing that the Soil Temperature Test is a pure thermal test and that it is a tool for thermal model verification, Confirmation Phase II activities were directed towards generation of test data over a long period of steady-state operation and evaluation of test data to reduce any uncertainties and/or conservatisms in the drywell thermal model. Specific areas where test data evaluation was identified were soil and grout thermal properties, far-field effects, axial temperature effects, seasonal and day-night temperature variations, canister and liner end effects, and transient and steady-state temperature trends. Data evaluation was expected to provide a thorough understanding of the various heat transfer mechanisms present in the test arrangement. The results of the Confirmation Phase II would be an isolated drywell thermal model in which all these heat transfer mechanisms were adequately modelled as demonstrated by close test data and model prediction agreement. However, it was understood that the drywell thermal model would not include effects such as gamma heating, etc. which would be present in drywells containing spent fuel assemblies and, as such, its use in drywell evaluations should be limited.

As part of the CWSFP Program, an additional objective was identified for the Soil Temperature Test. Since the results of the SFHPP 1978 Demonstration showed that peak canister temperature and associated fuel cladding temperatures for a 1.0 kW spent fuel decay heat level were well below the design limits, it was decided to utilize the Soil Temperature Test to evaluate the drywell response to higher power levels. The objective of this additional work was to provide canister temperature data which could be used, in conjunction with the Fuel Temperature Test and/or fuel assembly/canister thermal models, to determine the maximum decay heat level which could be accommodated by a drywell storage cell in Nevada Test Site soil. To meet this objective, an additional Soil Temperature Test confirmation test program was defined.

Confirmation Phase III was designed to provide test data for power levels of 2.0 kW and higher if necessary, which could be used to establish a relationship between canister peak temperature and power level and to verify that the heat transfer mechanism modeling in the drywell thermal model is acceptable over the entire range of drywell storage capability. The results of Confirmation Phase III would be qualified modeling techniques which could be applied to evaluations of:

- High power level (greater than 1.0 kW) spent fuel storage
- Drywell design changes
- In-line drywells
- Arrays of drywells
- Storage of other types of spent fuel
- Storage of other nuclear waste forms
- Drywells in soils other than that at E-MAD

4.0 TEST HARDWARE

4.1 TEST ARRANGEMENT

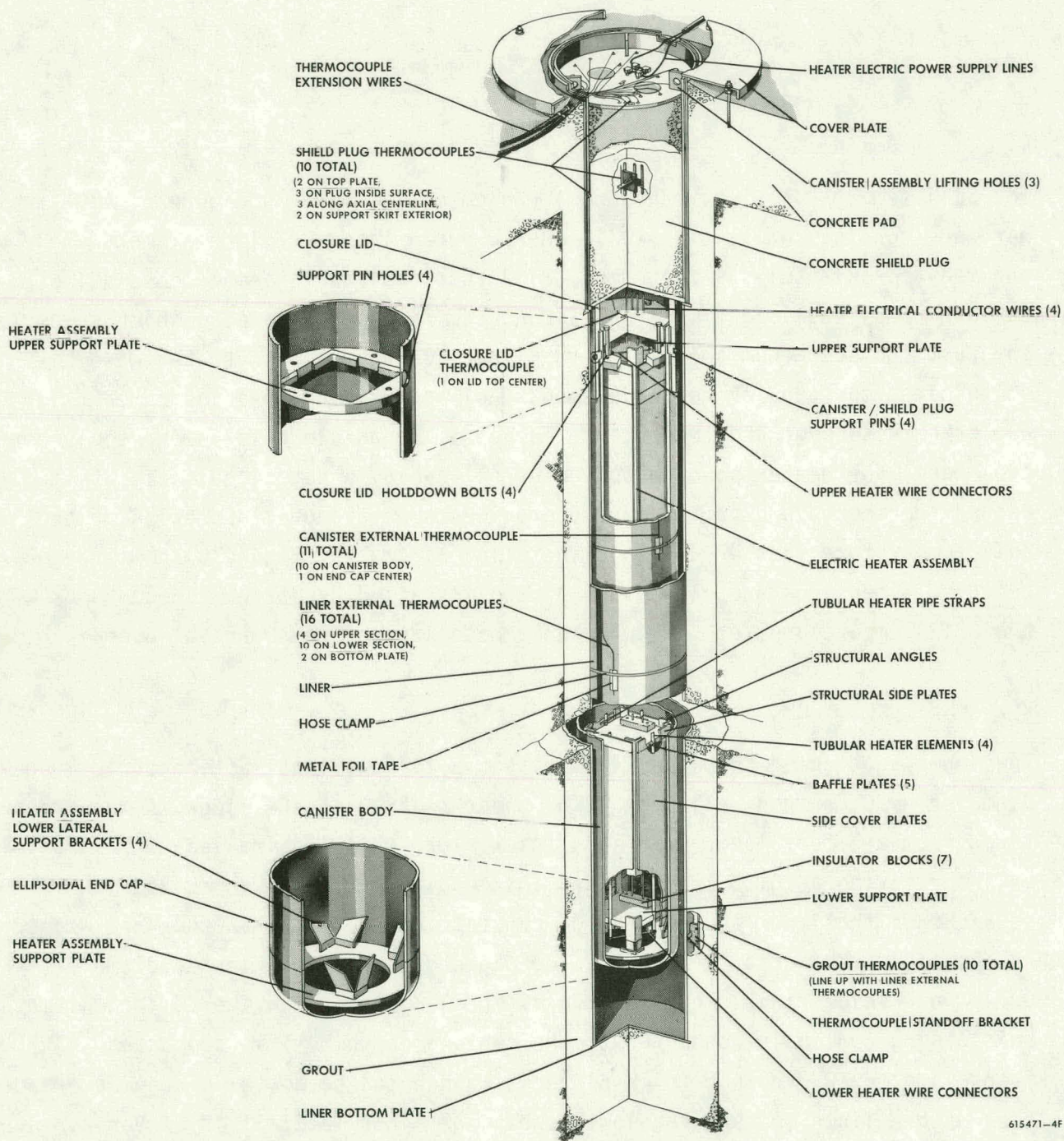
The Soil Temperature Test hardware arrangement is shown in Figure 1. The test hardware consists of 1) a drywell liner grouted into a 26 inch diameter hole drilled approximately 19 feet deep, 2) a test canister assembly consisting of a canister body, a closure lid, and a concrete filled shield plug which supports the test canister from the top of the liner, 3) an electric heater assembly containing four tubular heater elements, 4) an array of soil instrumentation wells to measure ground temperature response, 5) an electric power supply control panel for heater power output control, and 6) a data acquisition system to record thermocouple data. Figure 5 provides a detailed illustration of the Soil Temperature Test drywell and installed hardware. Figure 6 shows the relative dimensions and elevations of the installed hardware. Photographs of the Soil Temperature Test hardware and installation are shown in Appendix A.

4.2 DRYWELL LINER

The lower section of the liner consists of a 15 foot long section of 18 inch diameter by 0.25 inch wall pipe. The upper section of the liner is manufactured from a 3 foot long, 0.25 inch thick plate which was rolled to form a cylinder having a 20.25 inch nominal inside diameter. The upper and lower sections of the liner are positioned concentrically to one another and welded to opposite sides of a 21 inch outside diameter, 17.5 inch inside diameter, 0.375 inch thick ring. This ring forms the ledge on which the 20 inch diameter shield plug (which is connected to the canister assembly) is supported. A 20 inch diameter, 0.375 inch thick plate is welded to the bottom of the lower portion of the liner to seal the lower end. The liner material is carbon steel.

4.2.1 LINER INSTRUMENTATION

There are a total of 26 thermocouples secured to the liner. Sixteen thermocouples are attached directly to the liner exterior surface and 10 thermocouples are supported away from the outside surface of the liner so as to



615471-4F

FIGURE 5. Soil Temperature Test Configuration

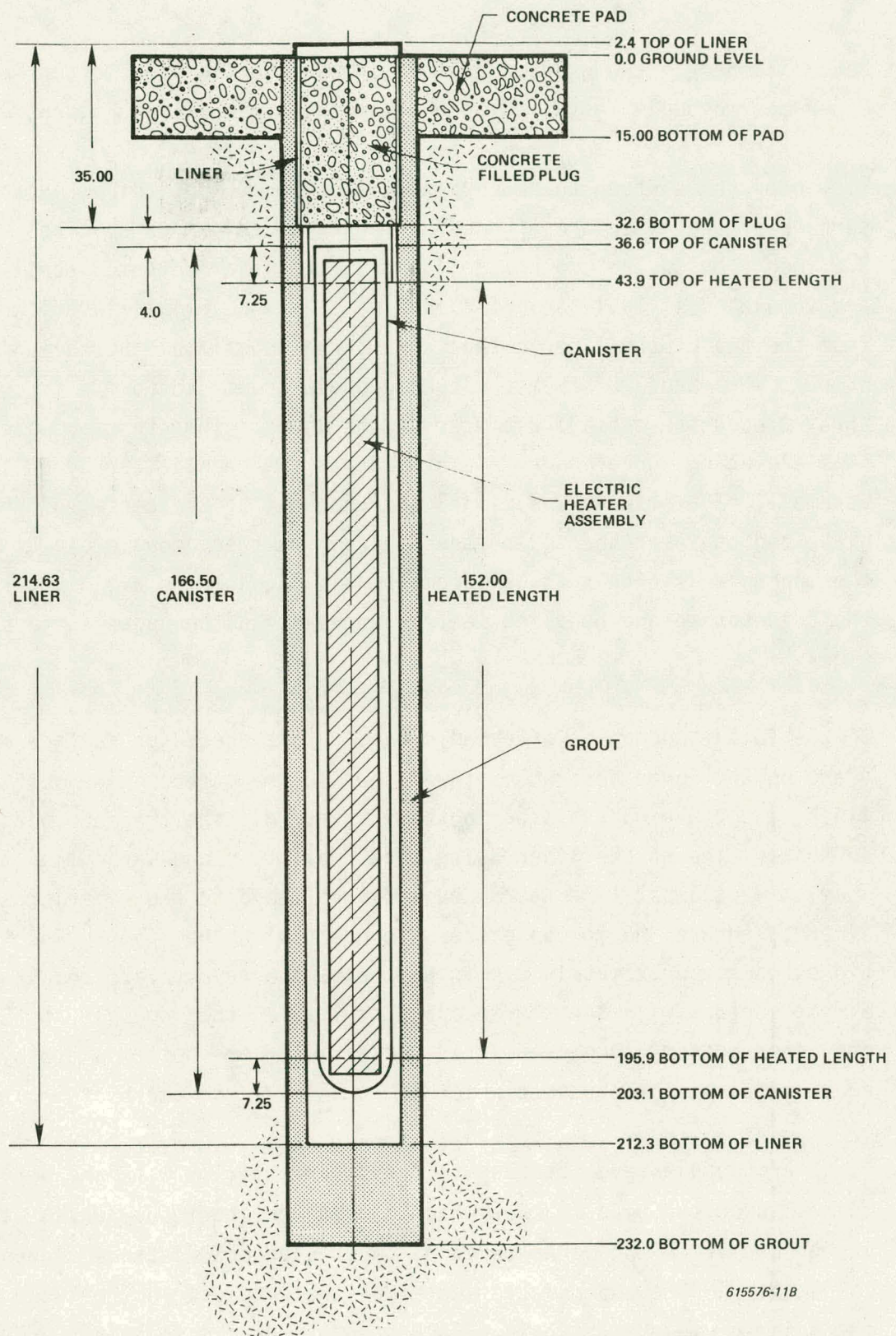


FIGURE 6. Soil Temperature Test Schematic

be positioned in the grouted region surrounding the liner after installation. Liner thermocouple installation photographs are shown in Figures A-7 and A-8.

Eleven of the sixteen thermocouples which are attached directly to the exterior surface of the liner are arranged in an axial column at spacings varying from 8.8 inches below the top of the liner to the liner bottom plate. The positions are tabulated in Table A-1 of Appendix A. At one axial elevation (98.7 inches from the top of the liner), there are three additional thermocouples oriented at 90°, 180° and 270° from the thermocouple column to form a circumferential array around the outside diameter of the liner. This thermocouple array at this elevation corresponds to a similar circumferential array on the canister assembly. There is an additional thermocouple at the center of the bottom plate and one near the top of the liner. The thermocouple tip of the top-most thermocouple is offset at 30° from the axial column to avoid interference with the orientation and handling features present on the upper surface of the liner.

Of the 16 thermocouples attached directly to the outside surface of the liner, 4 are on the upper portion of the liner, 10 are on the lower portion of the liner, and 2 are on the liner bottom plate. All the thermocouples are secured to the outside of the liner using metal foil tape and large diameter stainless steel hose clamps. The thermocouples were taped to the exterior surface of the liner to ensure thermocouple sheath contact with the liner. The thermocouple tip extends approximately 0.5 inches below the tape (i.e., the tape is not in direct contact with the thermocouple tip). The thermocouple at the center of the liner bottom plate is held in contact with the bottom plate by a small sheet metal dimpled bracket which is tack-welded to the bottom plate.

Ten thermocouples are attached to the liner exterior with the bottom 6 to 12 inches supported by a bracket which places the thermocouple tip about 1.8 inches away from the liner surface. This standoff distance places the thermocouple tip in the approximate center of the ring of grout between the liner and the drilled emplacement hole. Each standoff bracket consists of a 0.25 inch

thick, 3 inch long PVC plate which is strapped to the liner using large diameter hose clamps and epoxied into position on the liner exterior. The thermocouple sheathing is bent away from the liner and wire wrapped in two places to the 0.25 inch by 3 inch long face of the standoff bracket. The axial elevations of the tips of these 10 thermocouples correspond to the tips of the thermocouples secured directly to the liner exterior surface.

4.2.2 LINER INSTALLATION

The fully instrumented liner assembly was positioned and leveled inside of a 26 inch diameter 19 foot deep hole drilled into E-MAD soil. Photographs of the liner and its installation are shown in Figures A-9 and A-10. Prior to drilling the emplacement hole, an 84 inch square by 15 inch thick concrete pad was poured at the location chosen for the Soil Temperature Test. This pad simulated that which would exist at the top of an actual storage cell and served to stabilize the soil and provide a reference datum to aid in drilling and liner installation operations. The pad construction is shown in Figure A-6. After the positioning of the liner into the emplacement hole, grout was pumped into the bottom of the emplacement hole until it reached a level about 1 to 2 feet above the bottom of the liner. This grout was allowed to set to secure the liner in its properly aligned position and to reduce the bouyancy effect of the grout on the liner assembly. After this grout set, the entire annulus between the liner and the emplacement hole was filled with grout to the top of the concrete pad.

4.3 CANISTER ASSEMBLY

The canister assembly consists of the following components: canister body, closure lid, and shield (support) plug. The canister assembly is shown in Figure A-3 during a trial fitup with the liner. The following describes these components.

4.3.1 CANISTER BODY

The canister body for the Soil Temperature Test consists of a 160 inch long section of 14 inch outside diameter, 0.375 inch wall 304 stainless steel pipe welded to a standard 14 inch diameter, 6.5 inch high ellipsoidal end cap.

Welded into the end cap is a 13.25 inch outside diameter, 8.5 inch inside diameter, 0.5 inch thick 304 stainless steel ring. Welded to this ring are 4 sheet metal brackets which form the corners of an 8.26 inch square which mate with the lower end of the electric heater assembly. The brackets also serve as funnels to guide and center the heater assembly (which sits on the ring welded into the ellipsoidal end cap). These features are shown in Figure 5.

Welded into the canister body 4.5 inches below the canister top surface is a 13.25 outside diameter, 1.0 inch thick 304 stainless steel plate containing an 8.5 inch square chamfered opening. This plate and opening provides centering and support for the upper end of the electric heater assembly. The outside upper surface of the canister body contains 4 blind holes equally spaced around the pipe circumference for the attachment of the shield plug (described later).

This canister body simulates the actual storage canister in terms of material, size and shape. These are judged to be the most important parameters for this canister since they provide for proper thermal simulation of the conductivity, thermal diffusivity, and total radiating area of an actual canister. There are some differences between the test canister and an actual storage canister. The major difference between the two is found in the canister internal features. An actual storage canister contains an internal cage formed by four structural angles tied together laterally by sheet metal plates at six elevations. This internal cage provides support along the entire length of an encapsulated PWR spent fuel assembly. Thermally, it acts as a thermal radiation barrier at the corners of the fuel assembly. Although the test canister body does not contain this cage, its presence is simulated in the completed canister assembly by the electric heater assembly which uses four structural angles along its entire length.

An actual storage canister differs from the test canister in the following additional areas:

- Different bottom support for a fuel assembly
- No top support plate

- Instrumentation tubes on the exterior of the canister body
- Helium rather than air in canister

The mechanical differences are all judged to have a negligible effect on the applicability of the thermal results from this test to the actual storage canister. The air backfill media in the canister is judged to have a small effect on the applicability of the thermal results in that the air conductivity and density differences are expected to produce a canister temperature profile which differs in shape from that of the helium filled canister.

4.3.2 CANISTER BODY INSTRUMENTATION

There are 11 thermocouples which are attached to the canister body exterior surface. These thermocouples are attached at various angular orientations and at 6 different elevations, including one on the bottom center of the ellipsoidal cap. The thermocouple attachment method is the same as used for the liner (see Section 4.2.1). The thermocouple locations are described in Appendix A, Table A-1.

4.3.3 CLOSURE LID

The closure lid for the test canister is a 13.25 inch outside diameter, 2.5 inch thick 304 stainless steel plate. It contains 4 through holes which accept 0.5 inch diameter bolts which thread into the upper support plate of the canister body. Four small spacers extend from the bottom surface of the lid to control the axial positioning of the closure lid when installed in the canister body. After assembly, the annular gap between the closure lid and the canister body is filled and sealed with adhesive cement. This annulus was sealed to better simulate a sealed canister containing fuel.

There are four additional holes in the closure lid through which the electric heater assembly conductor wires are routed. These holes are lined with a stack of high temperature interlocking ceramic tubes which are cemented in place. These ceramic insulators protect the conductor wires from inadvertently grounding to the closure lid.

4.3.4 CLOSURE LID INSTRUMENTATION

There is one thermocouple attached to the top center of the canister closure lid. The attachment of this thermocouple is by a small sheet metal dimpled bracket which is tack-welded to the top surface of the closure lid. The thermocouple tip is inserted through the dimple on the bracket and thereby held in contact with the closure lid top surface. A second thermocouple is supported from the shield plug and contacts the closure lid near the outside diameter of the lid after assembly. This thermocouple is attached to the underside of the shield plug bottom plate by a tack-welded sheet metal bracket and extends at a 45° angle from the shield plug plate.

4.3.5 SHIELD PLUG

The test shield plug simulates the concrete filled shield plug design for the drywell to be used for actual spent fuel storage. The canister assembly is supported from this plug which, in its installed condition, rests on the ledge in the top of the drywell liner.

The shield plug consists of a 34 inch long section of 20 inch outside diameter 0.25 inch wall thickness carbon steel pipe which has a circular plate welded to both ends. The top plate is a 19.5 inch outside diameter, 0.25 inch thick carbon steel plate which is positioned about 2 inches from the top surface of the pipe. This 2 inch indentation provides space at the top of the shield plug for the bundling and connection of instrumentation and power leads from the canister assembly. The top plate contains two 4 inch diameter holes for the installation of concrete and 3 lifting brackets for handling the entire assembled canister assembly. These features are shown in Figure A-4.

The shield plug bottom plate is a 20 inch outside diameter, 0.5 inch thick carbon steel plate which is welded to the face of the 20 inch pipe. Extending from and welded to the bottom plate is an 11 inch long "skirt" of 16 inch outside diameter, 1.031 inch thick wall carbon steel pipe. The inside diameter of this "skirt" is machined to provide a reasonably close fit with the outside of the canister body. There are 4 threaded holes in this skirt which line up

with the 4 blind holes machined into the top portion of the canister body. These threaded holes accept large diameter threaded pins. It is through these pins that the canister is supported from the shield plug.

Fifteen 0.375 inch outside diameter, 0.035 inch wall carbon steel tubes extend from the top to the bottom shield plug plates. Thirteen of these tubes are spaced on a 16.5 inch diameter circle and provide a routing path for the 11 canister thermocouple leads and for two shield plug skirt thermocouple leads. The canister thermocouple leads are routed along the canister exterior surface, past the shield plug skirt into these tubes, and exit the top surface for connection to the data acquisition system.

Two additional tubes are located on a 10.0 inch diameter circle and provide for routing of canister and closure lid upper surface thermocouples. One provides a routing path for the thermocouple leads for the thermocouple attached to the top center of the closure lid. The other provides a routing path for a spring loaded thermocouple which contacts the outer rim of the canister body after it is installed inside of the shield plug skirt. There are an additional four 0.5 inch outside diameter by 0.035 inch wall carbon steel tubes extending from the top to the bottom shield plug plates. These four tubes are arranged in a close rectangular pattern (1.76 inches by 1.5 inches) and provide for routing the four conductor wires from the heater assembly. The shield plug instrumentation and conductor wire tubes are shown in Figure A-4.

4.3.6 SHIELD PLUG INSTRUMENTATION

In addition to two thermocouples attached to the outside surface of the shield plug skirt, 8 additional thermocouples are attached to the shield plug. Two of these thermocouples are attached to the top plate of the shield plug using the small dimpled sheet metal brackets described earlier. One of these thermocouples is at the center of the top plate, and the other is at the outside edge. Three thermocouples are located in the internal cavity of the plug slightly offset from the axial centerline at a radius of 0.7 inches. These thermocouples are supported from small gusseted brackets which are attached to the two innermost 0.5 inch diameter by 0.035 inch wall tubes described

earlier. These thermocouples were installed prior to the installation of concrete into the shield plug cavity. The remaining three thermocouples are installed along the inside wall of the shield plug body at the same axial elevation as those along the axial centerline of the plug. These thermocouples are inserted into holes in small pins which are threaded through the shield plug wall.

4.4 ELECTRIC HEATER ASSEMBLY

The electric heater assembly consists of four tubular heater elements mounted in an 8.42 inch square steel frame. The frame outer dimensions and the heater power profile approximate those of a PWR fuel assembly. Details of the heater assembly are shown in Figure 5 and A-2.

The electric heater assembly frame consists of four 1.5 inch by 1.5 inch by 160 inches long by 0.12 inches thick 304 stainless steel angles which are tied together by a series of four stainless steel plates welded to the angles at nine elevations. These structural side plates are 1.5 inches high by 0.109 inches thick. Inside the angles, five baffle plates (7.92 inch square, 0.048 inch thick 304 stainless steel) and a top and bottom plate (7.92 inch square, 1.25 inch thick and 0.75 inch thick, respectively, 304 stainless steel) are welded at various elevations. Outside the angles, cover plates of 0.050 inch thick 304 stainless steel are welded to the angles between the structural side plates to enclose all but the top and bottom 2.50 inches of the frame.

Four tubular heaters are secured inside the heater frame by screw mounted pipe straps on the middle seven structural side plates. Each heater is located at the center of one side of the heater frame. Clearance holes are provided in the internal baffle plates and the top and bottom plates for the heaters. The tubular heaters are 0.430 inches in diameter by 156 inches long with a 0.049 inch thick incoloy sheath. The heaters have a precision wound nickel chromium wire heating element rated at 4 kW heat output at 240 volts. The heaters have

2 inches of unheated section at each end and have threaded stud terminals at each end for electrical connections. A locator ring is welded to the heater sheath about 0.5 inches from one end. The heaters are capable of operating at about 1600°F at rated power.

The tubular heaters are interconnected at the top and bottom by a series of four 0.125 inch diameter 304 stainless steel wire assemblies. Each assembly has a 0.06 inch thick steel washer welded to both ends which fits over the heater stud terminal. Two of the wire assemblies at the lower heater end have 210 inch long wires which extend through the interior of the heater assembly to approximately 50 inches above the heater frame. Two of the wire assemblies at the top of the heaters have 54 inch long wires which extend approximately the same distance above the heater frame. All of the wire assemblies are secured to the heater stud terminals between the two hex nuts provided and then brazed to the nuts. The two heater conductor wires which extend through the interior of the heater pass through all seven of the interior plates. Clearance holes are provided in each plate and insulator blocks of marimet (through which the conductor wires pass) are bolted to each of the plates. The four conductor wires are arranged in a rectangular pattern and pass through ceramic insulators in the closure lid and through tubes in the shield plug.

Prior to the completion of heater assembly fabrication, the heater subassembly was heated to approximately 4.0 kW. This power output was maintained for 48 hours to allow heater off gassing and to verify proper heater operation. The photograph of the electric heater assembly shown in Figure A-2 was taken prior to this heater "burn-in" period. After "burn-in", the insulating blocks were tightened and the heater cover plates were installed. Prior to electric heater assembly installation into the test canister, a stack of high temperature interlocking ceramic tubes were assembled on each of the conductor wires and cemented together. This provided insulation between the conductor wires and the shield plug tubes to prevent inadvertent grounding of the wires.

4.5 SOIL INSTRUMENTATION WELLS

The soil surrounding the test drywell was instrumented with a total of 58

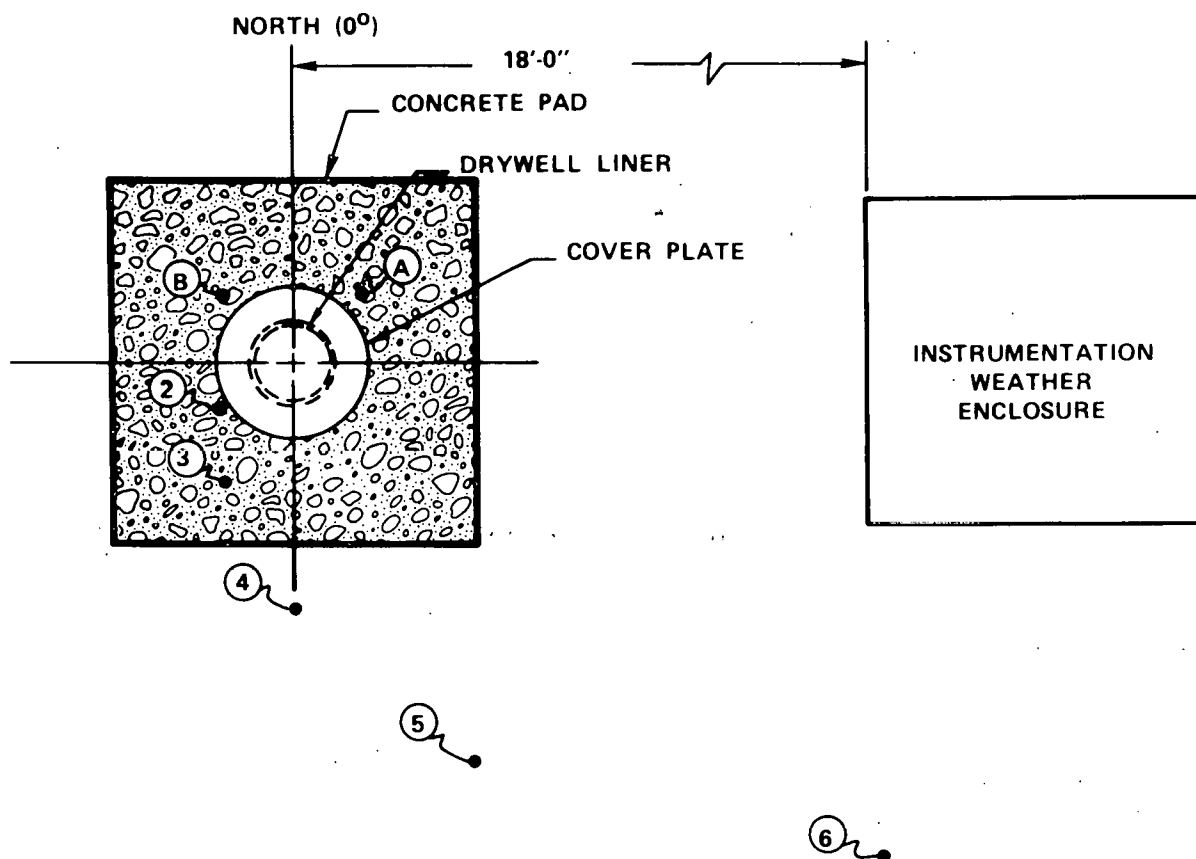
thermocouples divided and grouped into 6 wells. The instrumentation wells are oriented in a spiral pattern around the drywell so as not to affect the soil thermal conductivity between the heated drywell and instrumentation well and thus not affect soil thermal response readings. The spatial location is defined by a radius and angle with respect to the test axial centerline and an arbitrarily defined 0° reference point. The arrangement of the soil instrumentation wells is shown in Figures 7 and A-1. One of the six instrumentation wells was spaced 60 feet from the center of the liner and designated as a reference well to provide soil temperatures unaffected by the test heat source.

Each instrumentation well consists of a 1.0 inch diameter schedule 80 CPVC pipe grouted into a 3 inch diameter hole drilled into E-MAD soil. A typical instrumentation well is illustrated in Figure 8. The length of each well and the depth of each drilled hole varied between 16 and 30 feet. The sheathed thermocouples for each well were attached to the outside surface of a length of the CPVC pipe at various axial locations. The thermocouples were attached using wire ties and epoxy cement. Table A-1 in Appendix A provides the location data for each of the instrumentation wells as well as the depth of its thermocouple array.

Each instrumented pipe was inserted into one of the 3.0 inch diameter holes and grouted in place. Figures A-12 and A-13 show photographs of thermocouple well installation. The top of each pipe extended above ground level. At the top of each pipe, an enclosure box was provided to attach the flexible conduit routed to the instrumentation weather enclosure. The enclosure boxes were used to route the thermocouple leads through the flexible conduit after installation of the well and conduit.

4.6 HEATER POWER CONTROL

Power to the four tubular heaters in the electric heater assembly is controlled by a variable voltage power transformer located in the Soil Temperature Test instrumentation weather enclosure. The environmentally-controlled instrumentation weather enclosure is shown in Figure A-14 and its location shown in Figure 7. The transformer is mounted on the cover of a waterproof, dustproof



INSTR. WELL	RADIUS	THERMOCOUPLE ORIENTATION	WELL DEPTH	NO. OF THERMOCOUPLES
A	9"	0°**	(ON LINER)	16
B	10.8"	315°	(SUPPORTED OFF LINER)	10
2	21.0"	240°	303"	13
3	33.0"	210°	220"	10
4	60.0"	180°	303"	11
5	108.0"	155°	201"	8
6	189.0"	130°	153"	7
*REF	60.0'	30°	314"	9

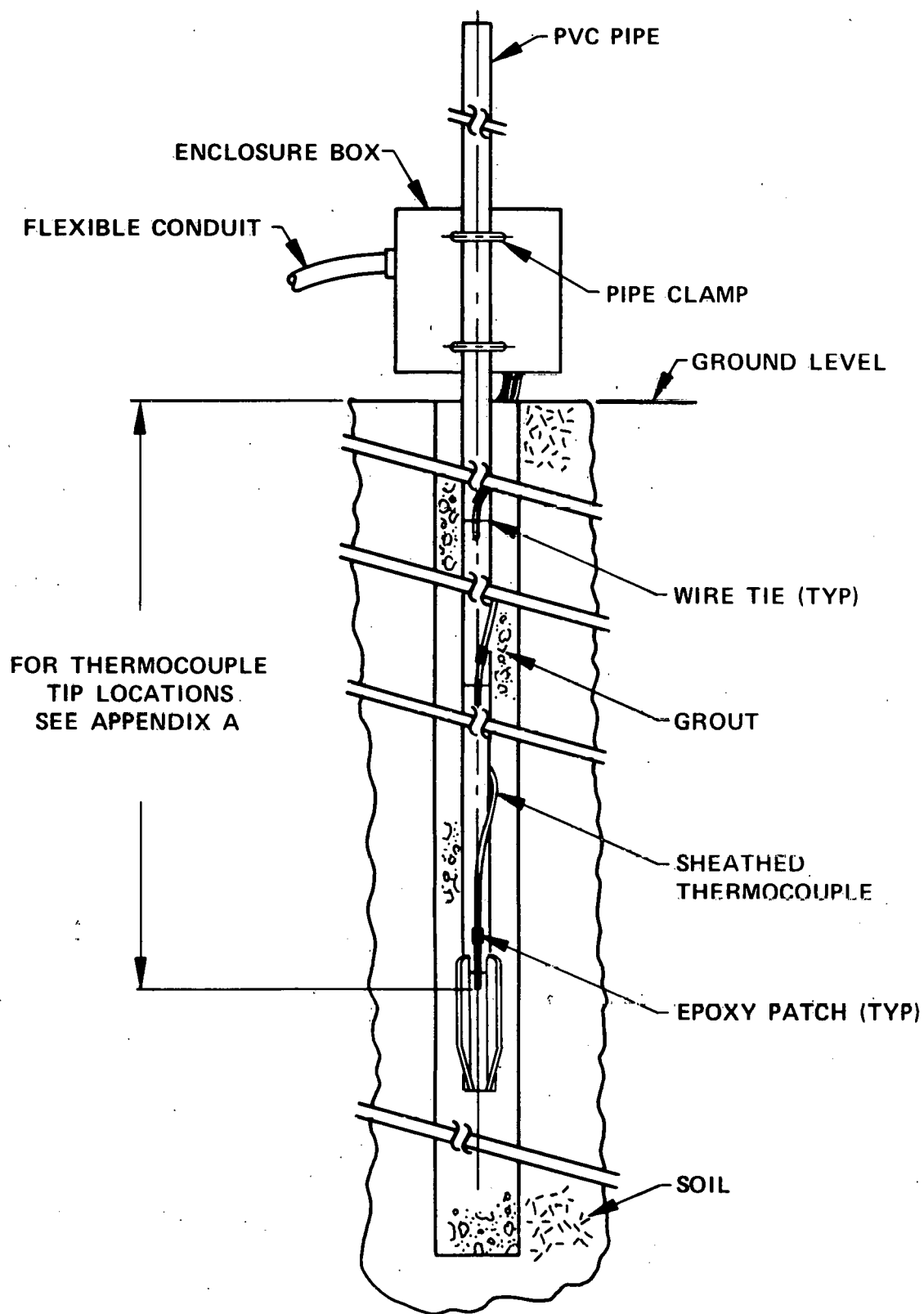
-ADDITIONAL THERMOCOUPLES: 11 ON SHIELD PLUG & 13 ON CANISTER
 -ALL INSTRUMENTATION WELLS ARE 1" IN DIAMETER
 -A & B ARE STAND PIPES FOR THERMOCOUPLES SUPPORTED BY THE LINER

*REFERENCE WELL NOT SHOWN

**THERMOCOUPLE LOCATED AT 0°, STAND PIPE LOCATED AT 45°

615261-8AA

FIGURE 7. Plan View of Thermocouple Locations



615576-1A

FIGURE 8. Soil Temperature Test Instrumentation Well Configuration

electrical enclosure. The transformer accepts a 120 volt AC input and has an adjustable output capability of 0 to 140 volts, and is rated for 7 kW.

Mounted to the controller electrical enclosure are two meters to determine transformer power output. A 0 to 150 volt AC voltmeter and a 0 to 50 amp ammeter are mounted above the transformer on the electrical enclosure cover. Adjustments to the test power level are made based on the voltage and current measurements of these meters.

Also mounted to the controller electrical enclosure is a powerline monitor chart recorder. The recorder continuously monitors the input voltage for voltage fluctuations, and the strip chart recording provides a permanent record of applied voltage. The electrical wiring from the heater power control to the electric heater assembly is enclosed in underground flexible conduit for protection.

4.7 DATA ACQUISITION SYSTEM

The data acquisition system for the Soil Temperature Test consists of the array of thermocouples, a data logger, and remote scanning/multiplexing units. The thermocouples are attached to the test hardware as described earlier in this section of the report. The thermocouple leads are routed through flexible conduit to the multiplexing units located in the instrumentation weather enclosure. Multiplexer signal cables are routed through underground conduit to the data logger which is located inside the E-MAD building in the West Operator Gallery.

4.7.1 THERMOCOUPLES

All thermocouples used in the Soil Temperature Test described in the previous following sections consist of a 24 gage type K, chromel-alumel thermocouple with ungrounded junction enclosed in a 0.125 inch diameter 304 stainless steel sheath. Two 24 gage type K extension wires are brazed to the thermocouple wires and are enclosed in a 0.187 inch diameter by 0.028 inch wall by 2.75 inch long stainless steel transition boot. The transition boot is crimped onto the end of the thermocouple cable sheath and filled with epoxy.

4.7.2 DATA LOGGER SYSTEM

An Acurex Autodata IX data logger and two remote scanning/multiplexing units are used for the Soil Temperature Test. Each scanning/multiplexing unit is capable of handling 100 thermocouples. The data logger is shown in Figure A-16 in its installed configuration. The data logger is also used for other experiments at E-MAD (drywell and surfaced storage cask fueled storage cells and the Fuel Temperature Test) and for monitoring spent fuel temperatures within the E-MAD hot cells. The data logger operates on 120 volt, 60 Hz AC electrical power and is rated for operation in the range of 32°F to 110°F and 0 to 90 percent relative humidity.

This data logger system was selected with capabilities to meet the test needs of the SFHPP 1978 Demonstration with considerations for future expansion. Some of the capabilities being utilized for the Soil Temperature Test are as follows:

- Measurement of Type K thermocouple temperatures from up to 1000 thermocouples.
- Thermocouple open detection circuit (to determine failures).
- Remote signal conditioning and multiplexing for remote instrumentation up to 5000 feet from data logger mainframe.
- Console digital readout in identified engineering units, (selectable on the front panel).
- Printer for output data with header and engineering unit identification.
- Variable scan modes (single, continuous, and intervals) with adjustable scan intervals.
- High performance analog to digital conversion.

5.0 TEST OPERATION AND RESULTS

5.1 TEST SEQUENCE

For the Soil Temperature Test to provide thermal data to meet Confirmation Phase I objectives consistent with the SFHPP 1978 Demonstration design and spent fuel emplacement activities, an accelerated heatup period to reach thermal stabilization was required. The steady-state test heater output was established as 1.0 kW based on the PWR spent fuel assemblies (25,000 MWD/MTU burnup and approximately 3 years out of the reactor) to be encapsulated and stored at E-MAD. The Confirmation Phase I thermal model predicted a time of about 12 months to reach thermal stabilization (time when maximum canister temperatures occur) with a constant 1.0 kW heater output. With a March 1978 startup date, confirmatory thermal data from the Soil Temperature Test was needed within about 5 months.

A parameter study of heater output versus time to reach 1.0 kW thermal stabilization was performed using the Confirmation Phase I thermal model. Based on the study results, a 3.0 kW heater output was chosen to accelerate the time to stabilization to about one month.

The Confirmation Phase I test sequence consisted of a low power level heatup rate phase to verify the operation of heaters and instrumentation, an accelerated heatup phase at 3.0 kW heater output level to get the test hardware and surrounding soil at or above the thermal stabilization point, and operation at a constant 1.0 kW heater output level until thermal stabilization was achieved.

The Confirmation Phase II test consisted of an extended period of 1.0 kW heater output level. In April 1979, Confirmation Phase III testing was initiated, as part of the CWSFP Program, by increasing heater power level to 2.0 kW. The Phase III testing was completed in April 1980. Based on the Phase III test data, it was concluded that extension of the testing to a 3.0 kW heater power level would be desirable. Therefore, in April 1980, testing at 3.0 kW was

initiated. This phase of the Soil Temperature Test operation, termed Phase IV, is currently in progress and the results of this phase will be reported in a subsequent test report.

Phases I, II and III of the Soil Temperature Test are described in detail in the following sections. A discussion of the test thermal response is also included for each phase.

5.2 INITIAL PREPARATION AND HEATUP CHECK

Prior to Soil Temperature Test startup, the entire array of test thermocouples was checked to assure proper operation. The heater and control panel were calibrated so that an accurate power level (wattage) at the heaters could be determined by the voltage and amperage measured at the control panel. The data logger was also tested to verify proper operation. A data logger scan and printout of all thermocouples was made just prior to start of the heatup check.

The heatup check was started on March 6, 1978, at a power level of 0.5 kW for about 19 hours, to verify that the system was operating properly. Thermocouple data were recorded at one hour intervals on the data logger and compared to the ambient data recorded. The input power applied to the heaters was checked and recorded.

A printout of the thermocouple readings at the start of the heatup check period (3/6/78 at 3:51 PM) and at the end of the heatup check period (3/7/78 at 10:57 AM) are shown in Appendix C, Tables C-2 and C-3, respectively. Figures 7 and A-1 show the identification and location of the thermocouples.

5.3 ACCELERATED HEATUP (3.0 kW POWER OPERATION)

On March 7, 1978, at 11:00 AM, the power level was raised from 0.5 kW to 3.0 kW. As expected, the canister and liner began to heat up rapidly. Thermocouple readings were recorded at one hour intervals for the first day of 3.0 kW power operation and then recorded at 4 hour intervals until the tenth day. Thermocouple readings after 10 days were recorded at 12 hour intervals.

Thermocouple readings at 24 hour intervals for the first 5 days of 3.0 kW operation are shown in Appendix C, Tables C-4 through C-8. Data are also shown for the end of the 3.0 kW time period in Table C-9.

Thermal data after one day of 3.0 kW operation (see Table C-4) shows the canister maximum temperature (located about midway down the heated length) rising from about 117°F to about 310°F. The canister maximum temperature gradually rose from 310°F to 515°F at the end of 55 days of 3.0 kW operation. At this time, the liner maximum temperature has risen to about 450°F (50°F above the predicted 1.0 kW liner thermal stabilization temperature), so the test power level was reduced to 1.0 kW. The corresponding inground soil thermocouple at the 21 inch radial position and same depth was at about 270°F.

Confirmation Phase I thermal model studies indicated that only one month of operation at 3.0 kW would be necessary to reach a liner temperature of 400°F. The moisture that had accumulated around the test area from concrete pad construction, grout installation and rain apparently had a large effect on the test transient behavior. During installation of the liner in the Soil Temperature Test, the weather was very rainy. The combination of rain in the hole and water in the grout surrounding the liner caused the soil around the liner and grout to have a high moisture content. During the 3.0 kW power operation phase, the temperatures measured by the thermocouples in the grout and at a 21 inch radius in the soil rose to around 205°F (the approximate boiling point of water at E-MAD). The temperatures remained at this value for about 16 days and then started to steadily rise. The constant temperature period was caused by the vaporization of the water in the grout and soil. Once the soil was free of excess water, the thermocouple readings rose above 205°F.

Figure B-7 has been included in Appendix B to show the temperature distribution within the soil using isotherms (constant temperature lines) interpolated from thermocouple data at the end of 3.0 kW operation.

5.4 1.0 kW POWER OPERATION

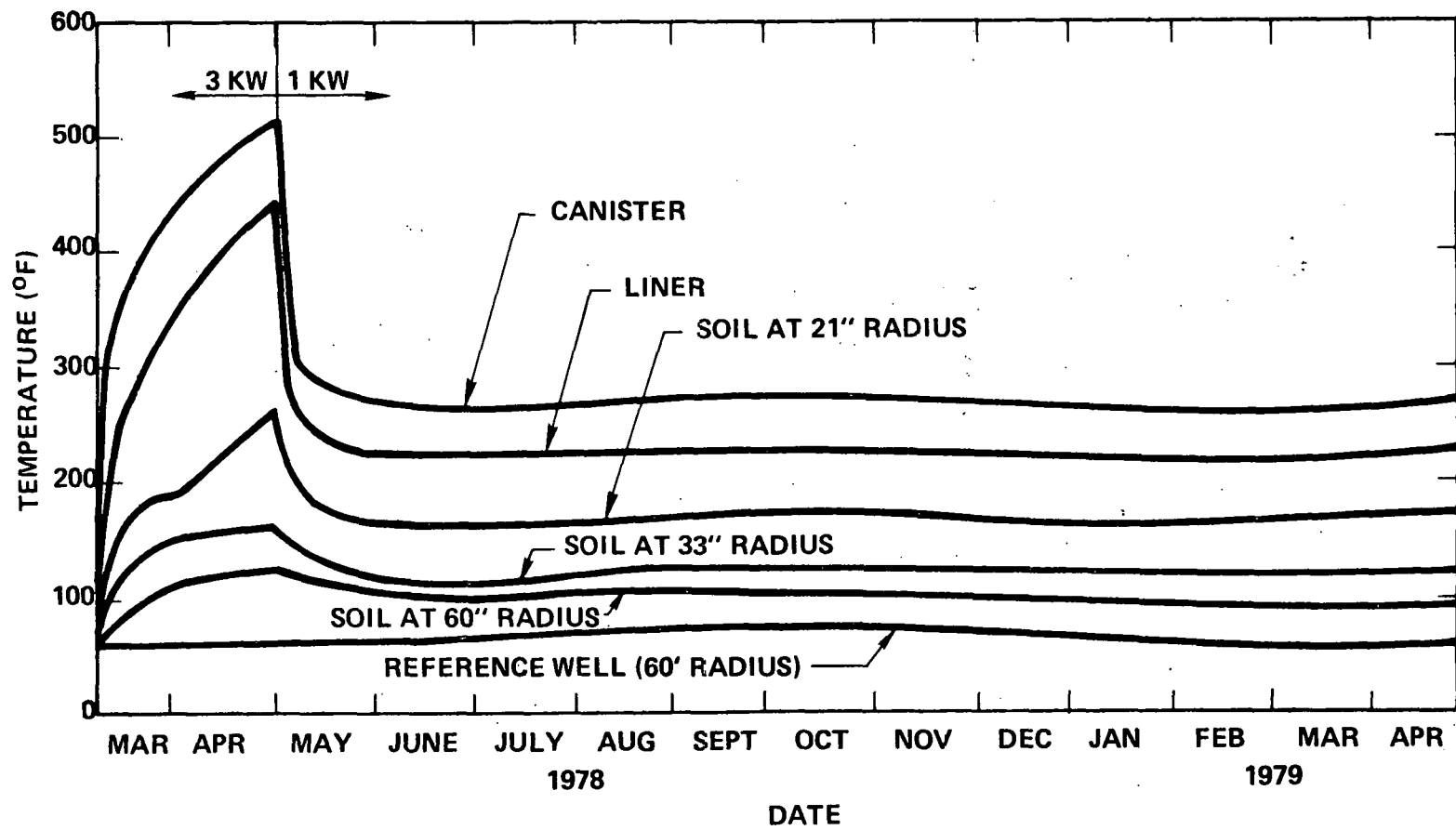
On May 1, 1978, at 11:00 AM, test power was reduced to 1.0 kW and maintained at

this power level for a period of about 12 months. To record the transient temperatures more closely, thermocouple readings for the first two weeks were taken every four hours. The thermocouple readings after the first two weeks were recorded twice a day at 4:00 AM and 4:00 PM. Thermocouple readings at the start of 1.0 kW power operation, for the first 5 days, and after 5 months and 11 months of 1.0 kW power operation are shown in Appendix C, Tables C-9 to C-16, respectively.

It should be noted that on February 6, 1979 at 4:00 PM, data channels were rearranged to eliminate use of the second scanning multiplexing unit. Four redundant canister and three redundant liner thermocouples were disconnected and the reference well thermocouples connected to their channels on the remaining scanning multiplexing unit. Figure A-19 shows the revised thermocouple identifications.

When test power was reduced from 3.0 kW to 1.0 kW, the canister and liner temperatures began to drop rapidly as shown in Figure 9. This indicated that for a 1.0 kW heat source, the test had been heated to above the thermal stabilization temperature. About 25 days after the power was reduced to 1.0 kW, a steady-state canister peak temperature of about 276°F and a liner peak temperature of about 232°F were achieved. These peak temperatures were measured about half way down the canister heated length (about 127 inches below ground level) and represent the thermal stabilization temperatures. Throughout the nearly 1 year at 1.0 kW, peak measured canister temperatures varied from 276°F to 261°F and peak liner temperatures varied from 232°F to 214°F due to seasonal temperature effects.

Thermal results for 1.0 kW operation are shown in Figures 9, 10 and 11. Figure 9 presents the temperature distributions for the canister, liner and soil at a depth of about 10.5 feet for the entire test period which represent the peak temperatures recorded. Included in Figure 9 is the reference well temperature plot for comparison with seasonal temperature variations at the same depth. Figure 10 shows the canister and liner axial temperature profiles on April 1, 1979 after 8045 hours of 1.0 kW power operation. Figure 11 shows the



615671-21A

FIGURE 9. Peak Temperature Readings for Initial Test Phases

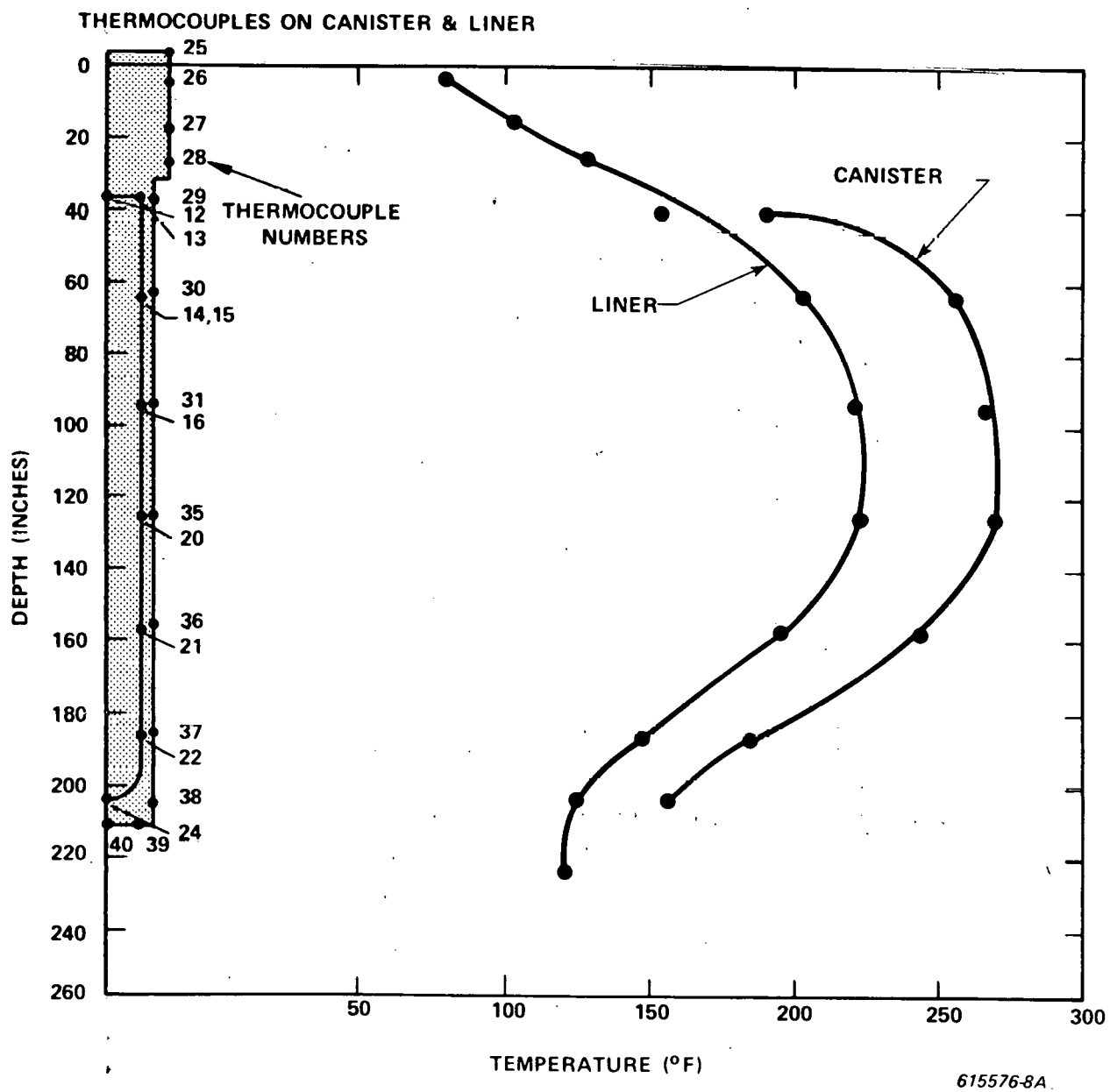


FIGURE 10. Canister and Liner Axial Temperature Profiles at 1 kW Power Level Thermal Stabilization, April 1, 1979

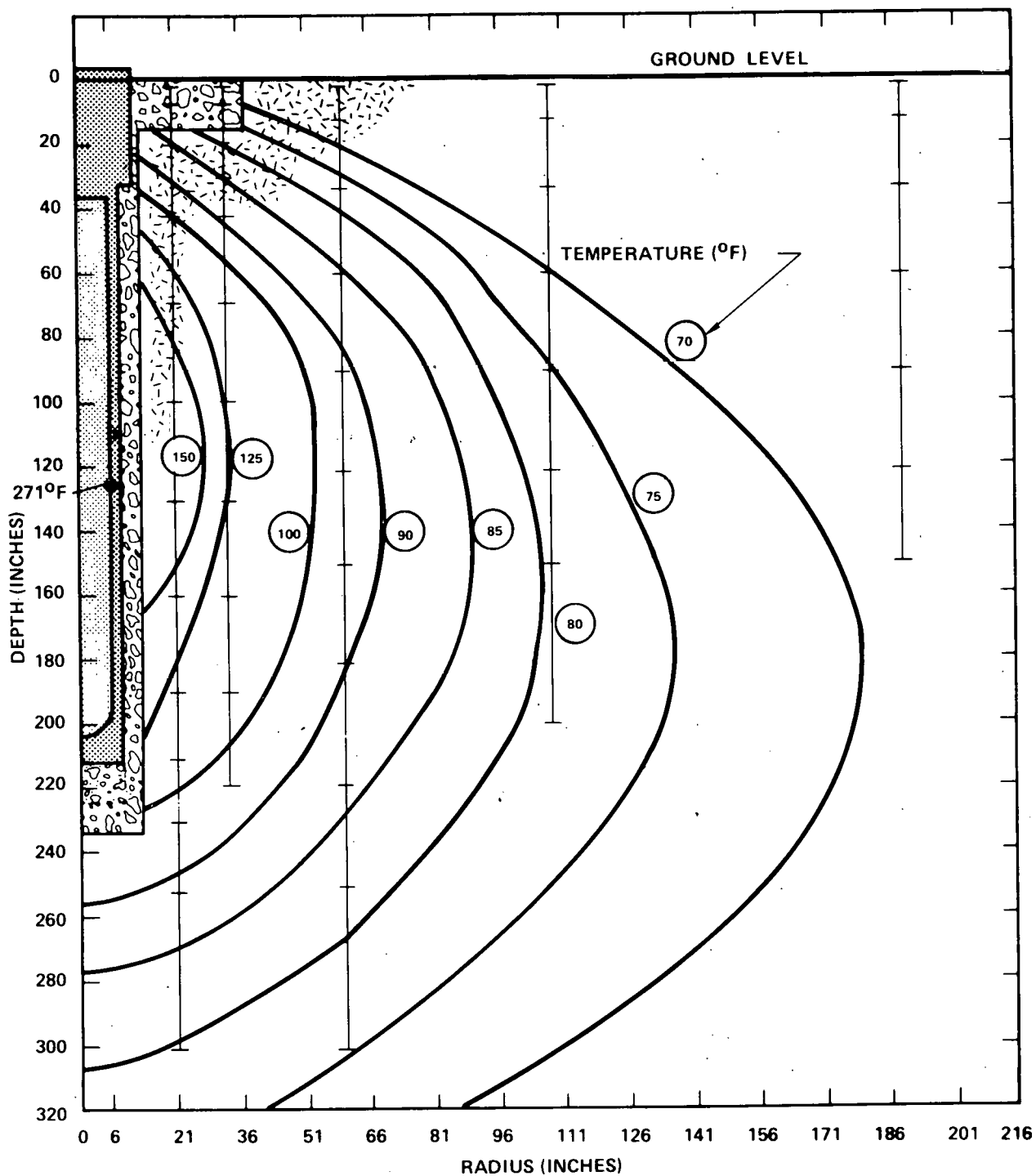


FIGURE 11. Soil Isotherms at 1 kW Power Level Thermal Stabilization, April 1, 1979

temperature distribution within the soil using isotherms (constant temperature lines) which were interpolated from the thermocouple data on April 1, 1979. The data shown in Figures 10 and 11 are representative of thermal stabilization conditions.

When the test power level was reduced from 3.0 kW to 1.0 kW on May 1, 1978 shrinkage cracks between the drywell grout and the concrete pad appeared. These cracks are shown in Figures A-17 and A-18. These cracks are assumed to have occurred due to the fairly rapid decrease in liner temperature. Cracks such as these would not be expected for an actual drywell fuel storage experiment where the thermal transient is much less severe.

5.5 2.0 kW POWER OPERATION

On April 26, 1979, at 12:00 noon, test power was increased from 1.0 kW to 2.0 kW. For the first seven days of increased power operation, thermocouple readings were taken every four hours. After this initial period, thermocouple readings were recorded 3 times a day at midnight, 8:00 AM and 4:00 PM. Thermocouple readings at the start of 2.0 kW power operation and for the first 5 days are shown in Appendix C, Tables C-17 to C-22, respectively. In addition, thermocouple readings for July 1, 1979; September 1, 1979; January 1, 1980; and April 1, 1980 are included in Tables C-23 to C-26 respectively. The readings shown on April 1, 1980 were taken just prior to raising the test power level to 3.0 kW for the Phase IV test.

Thermal data during this test period showed a rapid canister and liner temperature rise in the first 2 days at 2.0 kW power level followed by a steady increase to thermal stabilization. The peak canister temperature rose from 271°F at the start of the period to 365°F after 48 hours and reached a maximum reading of 506°F in December 1979. The peak liner temperature rose from 227°F to 294°F after 48 hours and reached its maximum of 458°F in December 1979. These peak readings occurred about 127 inches below ground level. The canister and liner temperatures reached thermal stabilization (neglecting the variations due to seasonal temperature effects) in about 6 months. Peak temperatures at thermal stabilization were about 500°F for the canister and 450°F for the

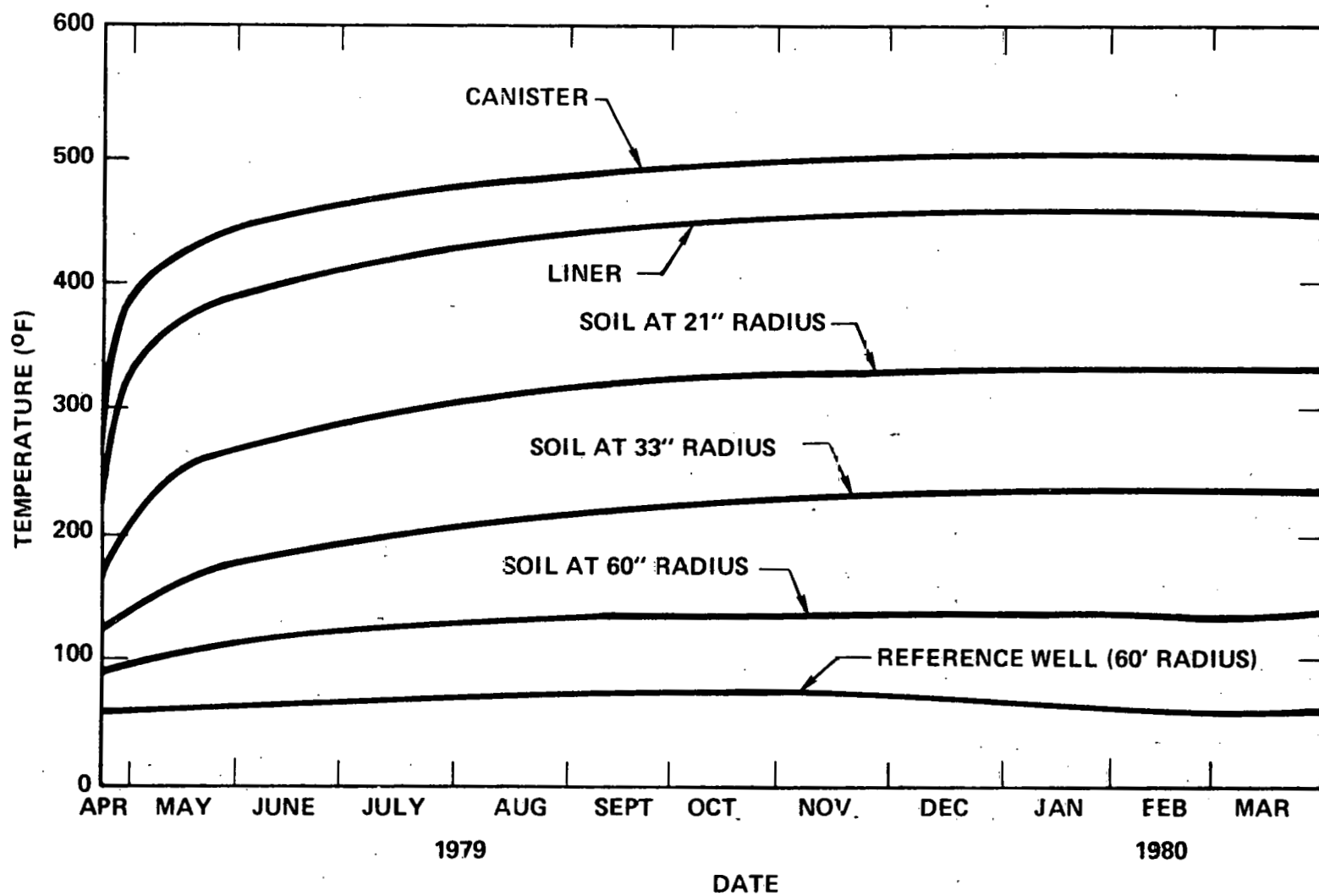
liner. The soil temperatures below the level of canister and liner peak temperatures (unaffected by seasonal variations) continued to slowly rise until reaching stabilization in March of 1980 (approximately 11 months into the test period).

The 2.0 kW test thermal results are shown in Figures 12, 13 and 14. Figure 12 shows the peak temperature distribution (at about 10.5 feet deep) for the canister, liner and soil for the entire test period. Figure 12 also shows the reference well temperatures recorded for the same depth. Figure 13 shows the canister and liner axial temperature profiles on April 1, 1980 after 8184 hours of 2.0 kW operation. Figure 14 presents the soil temperature distribution on April 1, 1980 using isotherms interpolated from the thermocouple data.

5.6 AMBIENT TEMPERATURE MEASUREMENTS

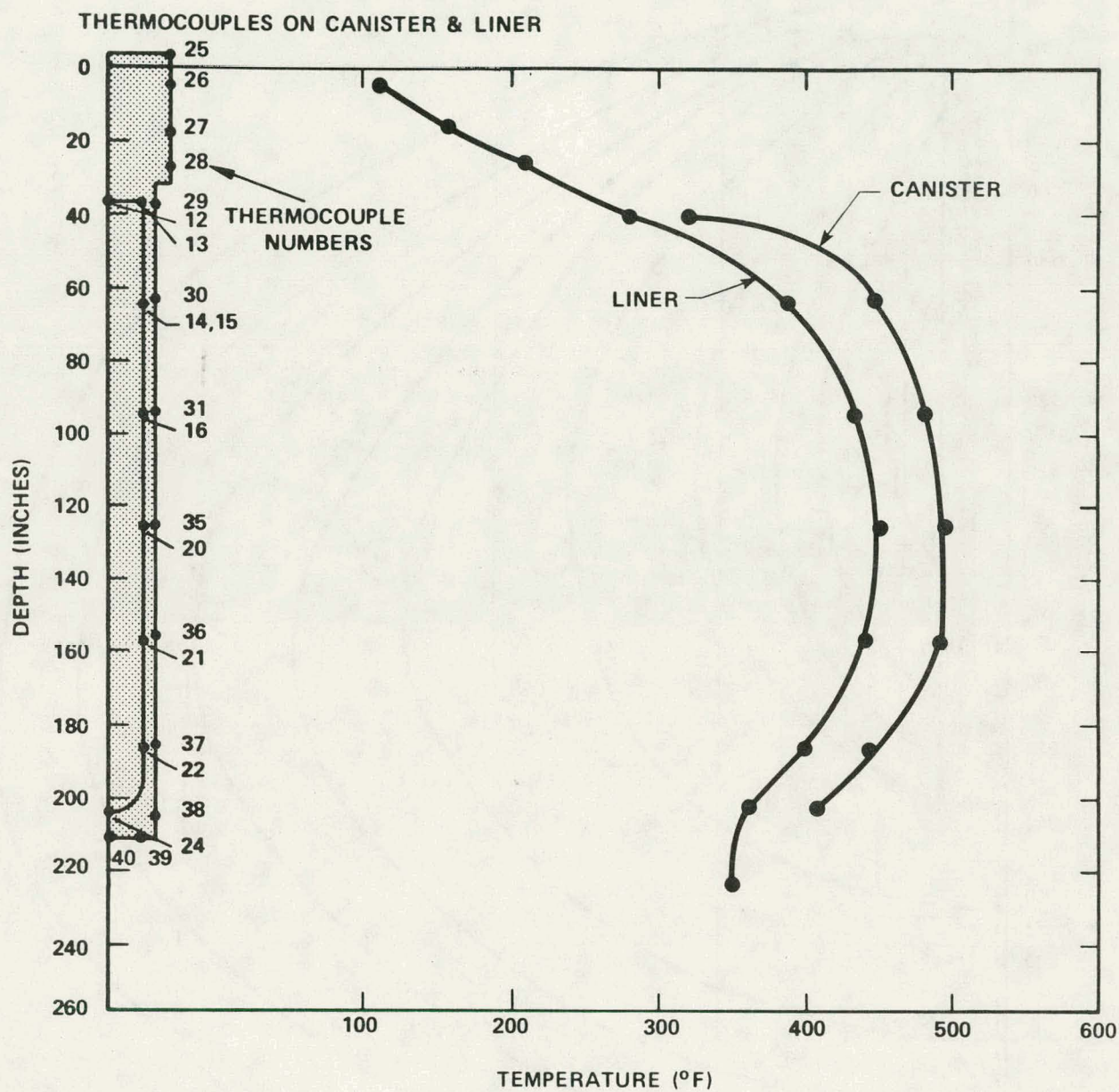
In addition to Soil Temperature Test near-field soil temperature measurements, ambient air temperatures and ambient soil temperatures were recorded. A weather station was installed near the Soil Temperature Test about 3 months after testing began. A continuous record of atmospheric conditions at E-MAD has been kept from that point on. Ambient air temperatures in the E-MAD area were not initially recorded, however, data was available from the Yucca Flat Weather Station (see Reference 1) to provide data prior to weather station installation.

Thermocouple readings from the reference well located about 60 feet from the Soil Temperature Test drywell provided a record of the axial soil temperature variations from atmospheric temperature changes during the test period. Figure 15 shows reference well thermocouple readings for depths 6 inches (thermocouple 101), 18 inches (thermocouple 102), and 192 inches (thermocouple 107) below ground level. The thermocouple readings from the 6 inch soil depth provide a good record of daily atmospheric temperature variations from test startup out to about one year of 1.0 kW power operation. The thermocouple readings at the 192 inch soil depth show that atmospheric temperature variations have little effect deep into the soil. The seasonal variation in soil temperature as a function of depth is shown in the plot of the reference well temperatures in



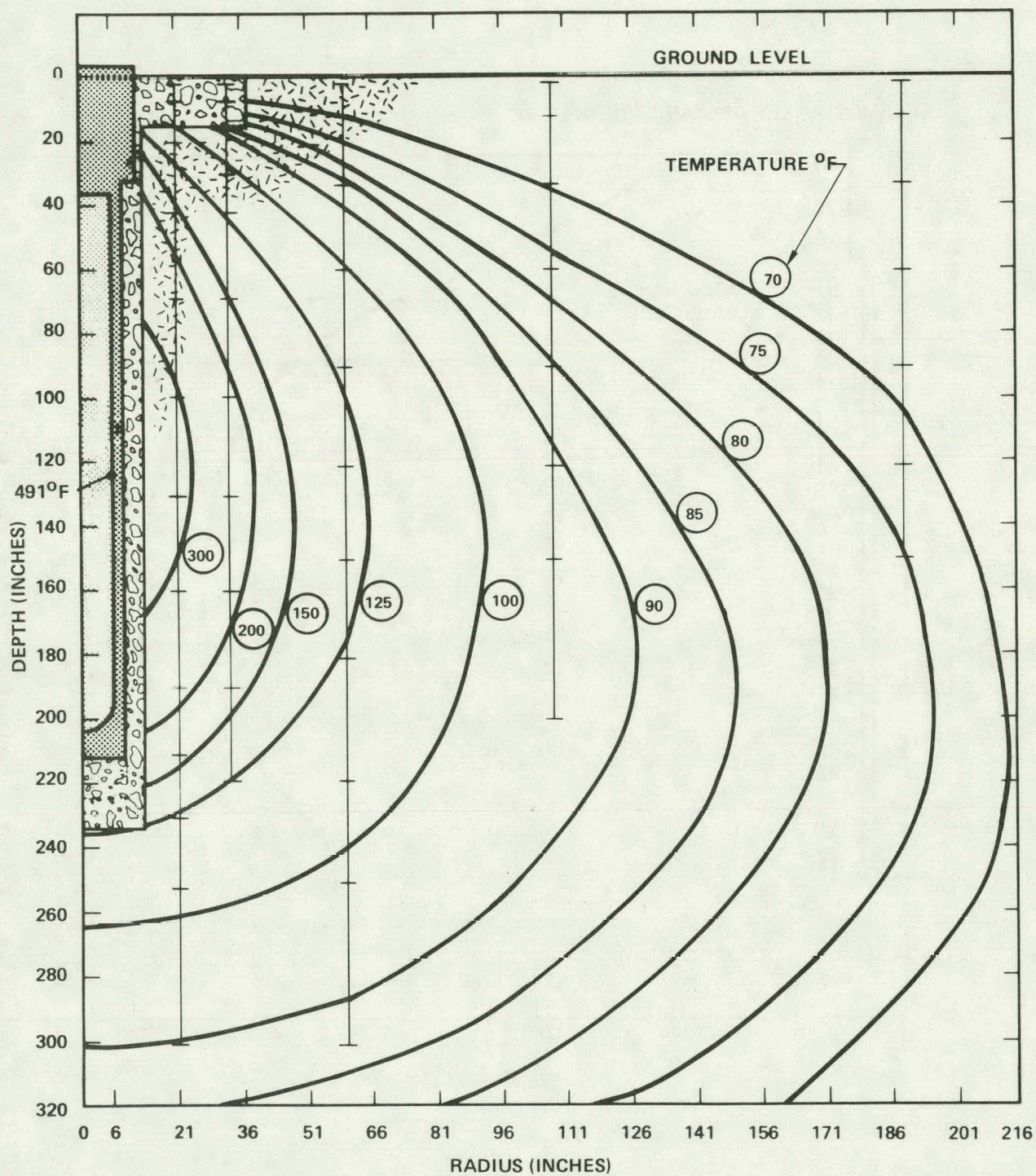
615671-22A

FIGURE 12. Peak Temperature Readings for 2 kW Test Period



615576-7A

FIGURE 13. Canister and Liner Axial Temperature Profiles at 2 kW Power Level Thermal Stabilization, April 1, 1980



615671-23A

FIGURE 14. Soil Isotherms at 2 kW Power Level Thermal Stabilization, April 1, 1980

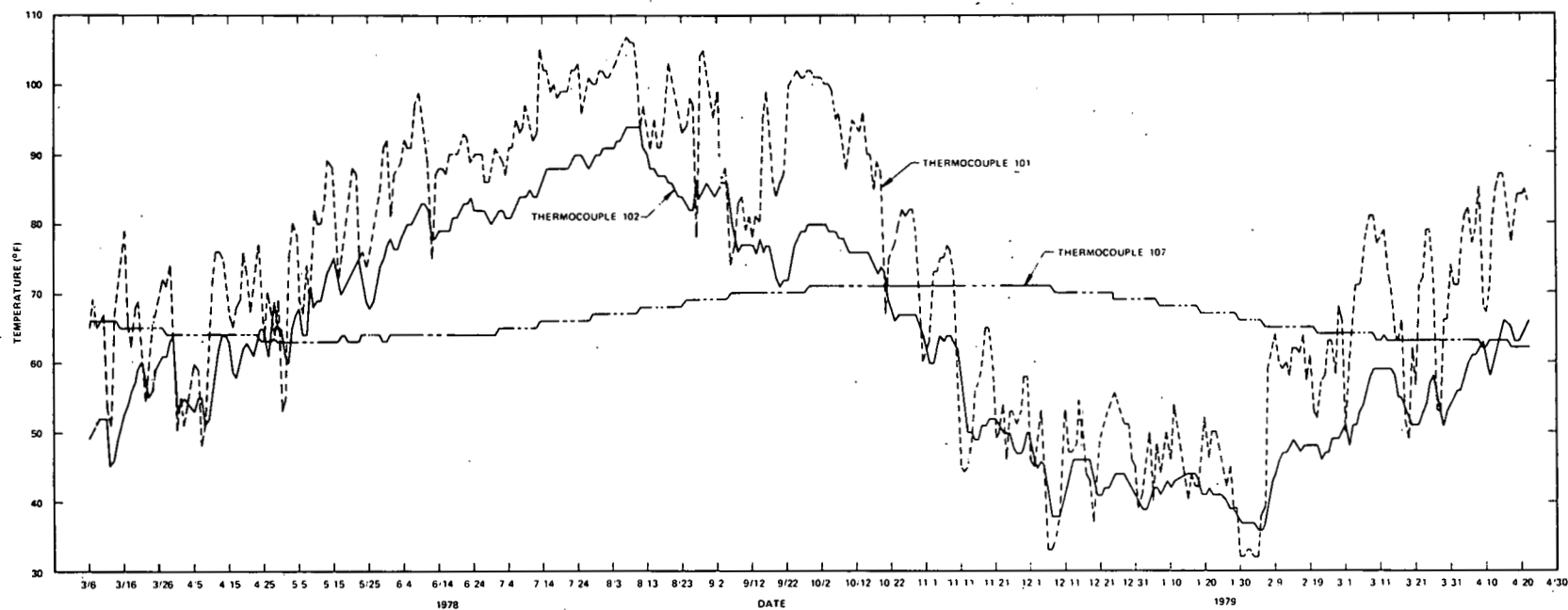


FIGURE 15. Reference Well Thermocouple Temperature Distributions as a Function of Time

Figure 16. The near surface soil temperature varied from 35°F in March to above 90°F in September. In spite of this range of seasonal ambient air temperatures, the soil temperature at the depth of canister maximum temperature (approximately 127 inches) varied about 12°F over the 12 month 1.0 kW power operation period. This shows that the heated test section is deep enough in the ground that peak canister temperatures are unaffected by transient day and night ambient temperatures and only slightly affected by seasonal changes.

5.7 HEATER POWER VARIATIONS

Throughout the Soil Temperature Test, measurements were made of input voltage to the heater power controller and power applied to the test heater. Input voltage variations were recorded by the strip chart recorder mounted to the power controller cabinet. The power applied to the heater was checked and recorded twice daily during weekdays at about 8:30 AM and 3:30 PM. Power levels were determined from the current measured by the power controller ammeter and from the voltage measured at the top of the heater conductor wires. Frequently, the voltage was adjusted to compensate for minor input powerline changes and heater resistance changes with temperature.

The heater power adjustments were made as necessary to maintain variations during normal working hours to within 2 percent of the nominal power levels. However, during non-working hours, input voltage variations resulted in heater power levels exceeding this 2 percent value during the months of April through September. The shutdown of air conditioning systems throughout the Nevada Test Site after the final daily heater power check caused a line voltage increase which raised the heater power level overnight and during weekends about 5 percent above the recorded power levels. This effect is estimated to have raised the average power level by about 3 percent over the five summer months.

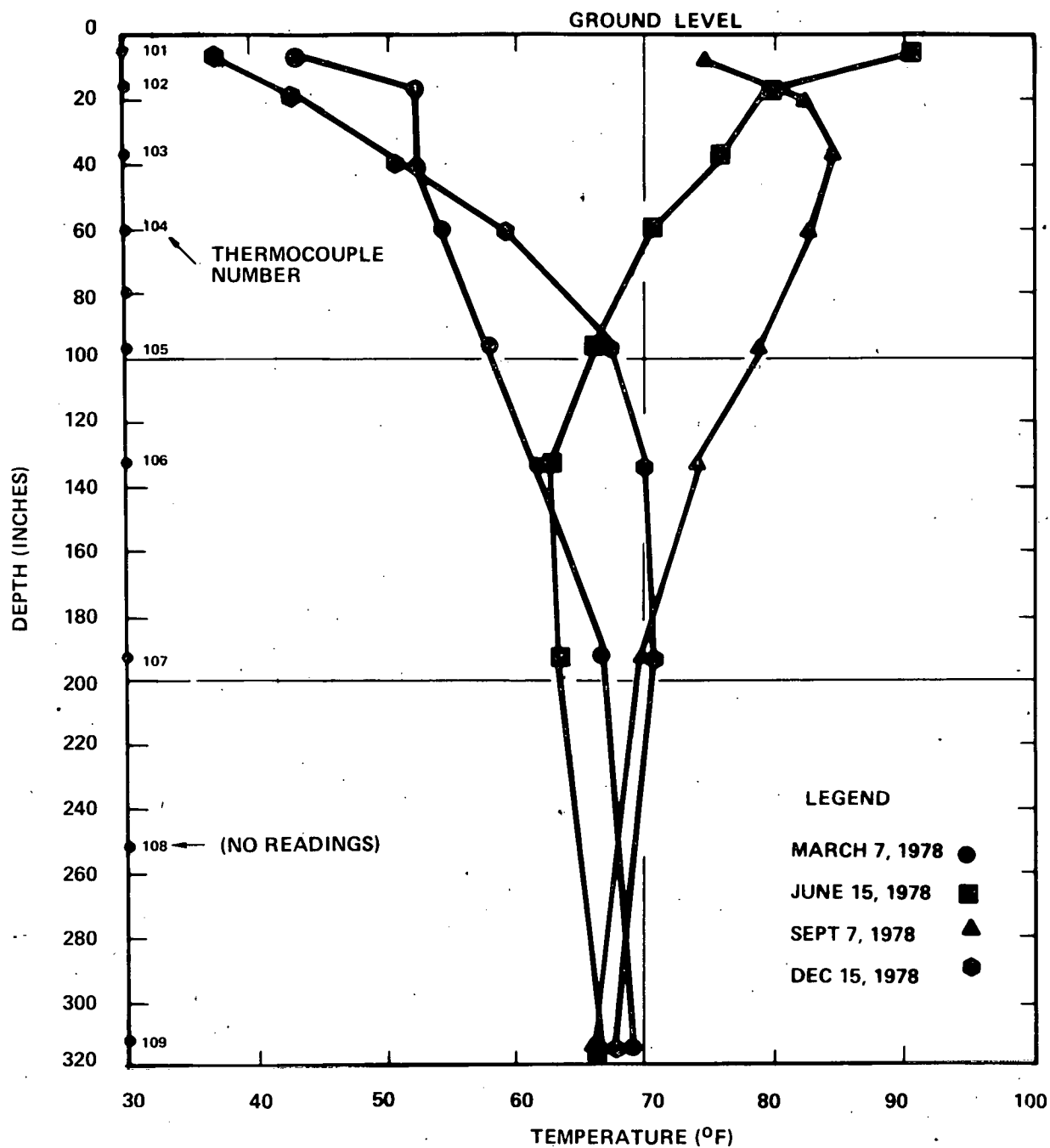


FIGURE 16. Reference Well Axial Temperatures Profiles

6.0 THERMAL ANALYSIS MODEL

6.1 ANALYSIS PURPOSE AND METHOD

The purpose of the Soil Temperature Test thermal analysis is to establish a thermal model for the isolated drywell configuration and to demonstrate that the model can produce satisfactory predictions of soil and drywell temperatures. Once that goal is achieved, the model and/or the modeling techniques may be applied to spent fuel storage configurations such as the fueled drywells, the surface storage casks, inline drywells and arrays of drywells. By comparing model predictions with test data, the passive heat dissipation process, soil properties, and the effects of power level and seasonal ambient variations will be sufficiently understood and predictable that the model can then be applied with confidence.

Soil Temperature Test predictions and data analyses have been performed using the TAP-A digital computer program, Reference 2. TAP-A was developed at AESD and has been used extensively during the past ten years at that division and at the Westinghouse Advanced Reactors Division. TAP-A is a finite difference program which calculates steady-state and transient temperature distributions in a configuration of solid materials utilizing the radiation, convection and conduction modes of heat transfer. To apply the program, a two- or three-dimensional configuration is divided into elements called nodes. The nodes, which are connected to each other by heat transfer links having lengths and cross-sectional areas, can have time and temperature dependent thermal properties (density, heat capacity and conductivity) as well as time dependent heat generation rates. Outer surfaces are assigned time dependent temperatures or convective heat transfer coefficients that may also vary with time or with a surface-to-ambient temperature differential.

In the analysis reported herein, test data have been compared with temperature predictions generated by the Confirmation Phase I TAP-A thermal model and model

refinements have been made to improve the agreement. The rationale supporting these refinements and the sensitivity of temperature to variations in certain parameters are discussed in the following sections and in Section 7.0.

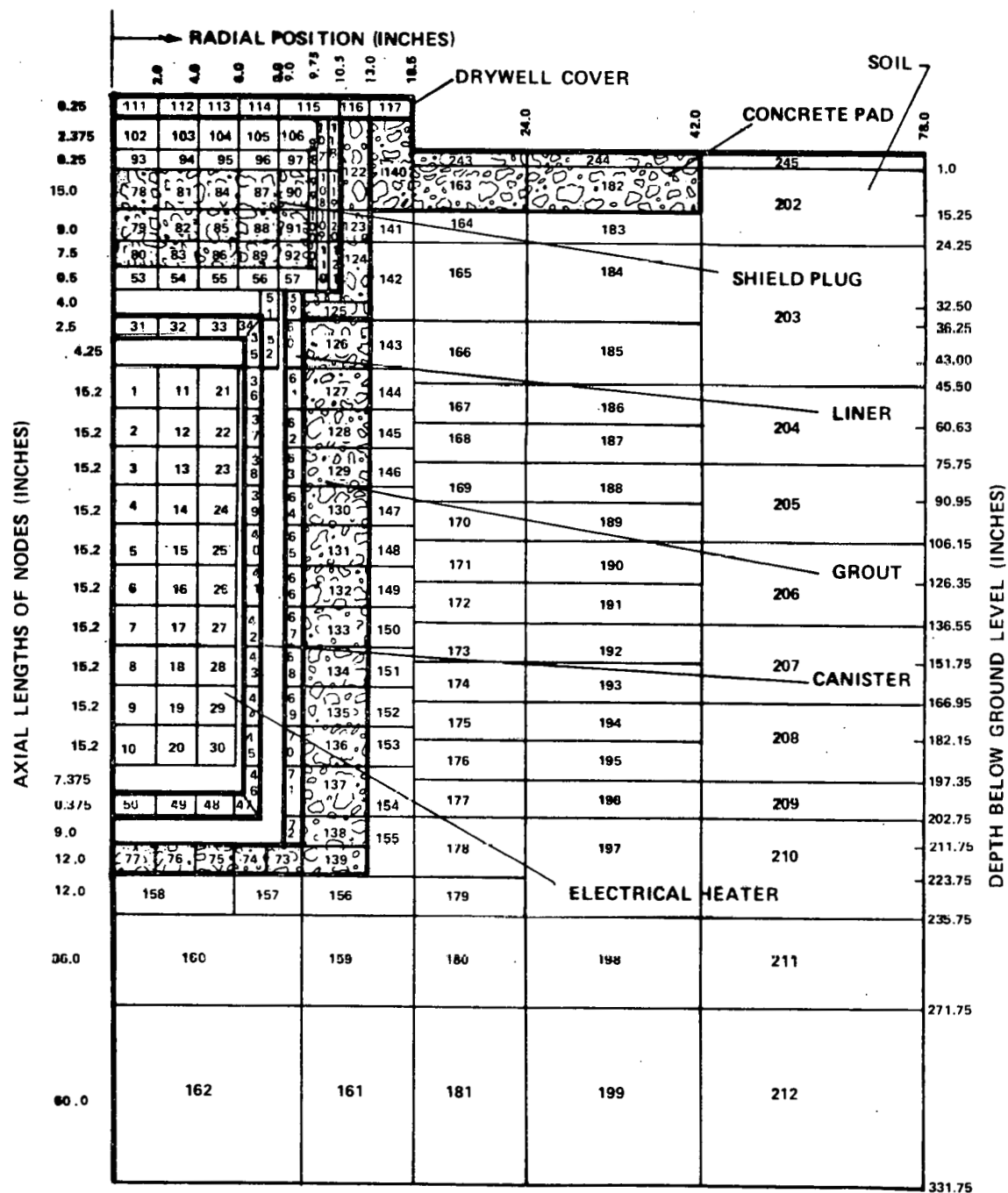
6.2 MODEL DESCRIPTION

6.2.1 MODEL SIZE AND BOUNDARY CONDITIONS

The TAP-A nodal model of the Soil Temperature Test is depicted in Figures 17 and 18 and the nodes representing each test component are identified in Table 1. The model is two dimensional in the r and z directions (radius and depth, respectively) with no variations circumferentially. In the Confirmation Phase I analysis, the model's outer radius was fixed at 20 feet where a constant temperature boundary condition was applied. This combination of radius and boundary condition was found to underpredict temperatures in the soil region. In the present model, the outer radius has been extended to 60 feet (corresponding to the thermocouple reference well location) and combined with an adiabatic boundary condition. This change was derived from a study of radial direction heat transfer from a constant temperature cylindrical cavity. Radius and boundary conditions were varied until the temperature predictions agreed favorably with the exact analytical solution that exists for the problem. Based on this analysis, predictions of far-field (radii greater than 5 feet) soil temperatures should be most accurate for a 1 to 3 year modeling period if the model radius lies in the 40 to 60 foot range and is coupled with the adiabatic boundary.

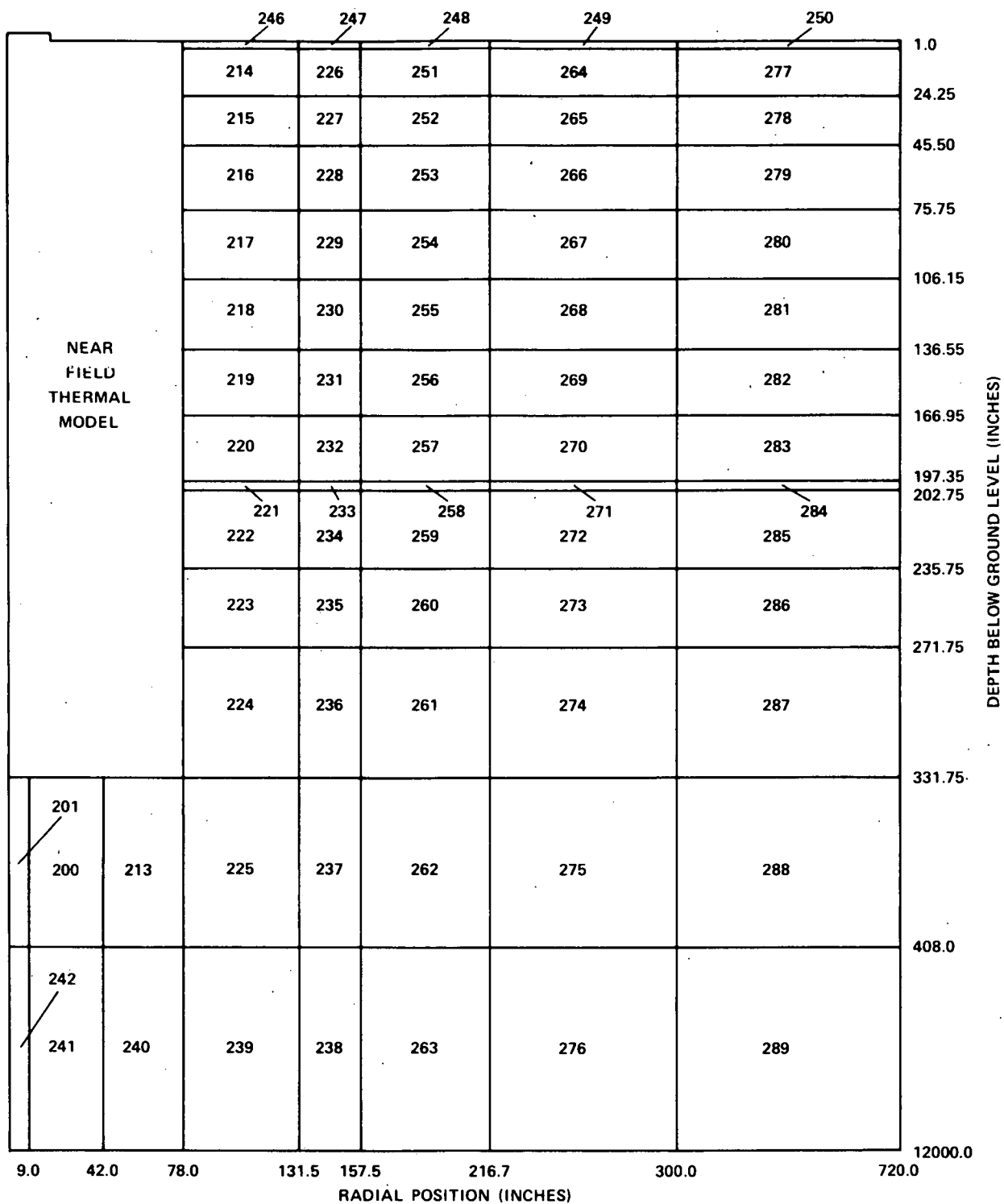
Ideally, the thermal model should extend in the z direction to the water table which can then be treated as a constant temperature heat source or sink. At E-MAD, the water table lies approximately at the 1000 foot depth. The present thermal model extends to that depth where a constant 70°F boundary condition is applied. It should be noted that most of the thermal energy from the drywell and from the absorbed solar radiation remains in the vicinity of the drywell and is eventually dissipated to the atmosphere. Therefore, model detail at depths greater than 75 to 100 feet should have little effect on the near-drywell temperatures.

As shown in Figure 18, the radial mesh spacing in the far-field region is very



615576-9A

FIGURE 17. Near-Field Thermal Model Node Locations



615576-108

FIGURE 18. Far-Field Thermal Model Node Locations

TABLE 1
TAP-A MODEL NODE DESCRIPTION

<u>Nodes</u>	<u>Test Components</u>
1-30	Heater Assembly
31-50	Canister
51-52	Shield Plug Skirt
53-57	Shield Plug Bottom Plate
58-72	Liner Lower Section
73-77	Grout at Bottom of Liner
78-92	Concrete in Shield Plug
93-97	Shield Plug Top Plate
98-101	Shield Plug Body Pipe
102-110	Air Gap Around Shield Plug
111-117	Drywell Cover
118-121	Liner Upper Section
122-139	Grout Between Liner and Soil
140	Concrete Pad
141-162	Soil
163	Concrete Pad
164-181	Soil
182	Concrete Pad
183-242	Soil
243-244	Concrete Pad
245-289	Soil

coarse, consisting of only four rows of nodes between the 6 and 25 foot radii. Radial temperature gradients in that region were found to be less than 10°F/ft during 3.0 kW operation and less than 6°F/ft at 1.0 kW. Thermal model studies in which the radial mesh spacing was varied over a wide range show satisfactory far-field temperature predictions using this coarse mesh.

6.2.2 HEAT TRANSFER MECHANISMS

Heat transfer between the electric heater assembly (nodes 1 to 30) and the canister is modeled by conduction. Heat transfer from the heater to canister actually occurs by convection and radiation (primarily by radiation at high temperatures). Since TAP-A has no mass flow capability and therefore cannot model convection effects, a simplifying assumption was made in the Confirmation Phase I model to calculate canister temperatures utilizing an arbitrarily chosen conductivity value to represent the combination of radiation, convection, and conduction heat transfer. A temperature dependent conductivity, calculated over the anticipated range of canister temperatures using a 1000°F peak heater temperature, is used in the model. To compensate for the effects of convection inside the canister, the present model includes a nonuniform axial heat generation rate for the heater assembly as described in Section 6.2.4. The heater assembly heat capacity which is small compared to that for other system components (canister, liner, grout, etc.), is modeled accurately to produce fairly accurate transient predictions for the entire drywell system.

Heat transfer from the canister to the liner and shield plug occurs by radiation, conduction and free convection and the thermal model includes all three modes. Convection and conduction were treated using the effective thermal conductivity approach with appropriate conductivity values in the r and z directions. The radiation calculation for canister to liner heat transfer uses the shape factor expression for concentric gray cylinders as follows:

$$F_{12} = \frac{1}{\frac{1}{\epsilon_1} + \frac{A_1}{A_2} \left(\frac{1}{\epsilon_2} - 1 \right)}$$

where

- ϵ = emissivity
- A = surface area
- 1 = canister outer surface
- 2 = liner inner surface

Emissivity values for the canister (0.45) and liner (0.60) were obtained from References 12 (p. 475) and 13 (p. 15 - 21), respectively, for Type 304 stainless steel (canister) and hot-rolled iron (liner). The resulting shape factor value (0.36) is applied to calculations in the radial (canister to liner) and axial (canister to shield plug and canister to liner section at the bottom of the drywell) directions. The axial radiation heat transfer model is judged to be acceptable since data show heat transfer rates vertically through the shield plug and from the canister's lower end to be typically less than 2 percent of the total heat generation rate in the electric heater assembly.

Heat transfer from the shield plug sides to the upper liner occurs primarily by radiation and free convection and by convection from the upper surface of the shield plug to the drywell cover plate. For modeling purposes, conduction through an air-filled space is assumed in each direction. This approach is used since TAP-A has no mass flow capabilities. This simplifying assumption is judged to be acceptable since, due to the relatively small shield plug heat transfer rates, even large modeling inaccuracies in these regions would have little effect on canister temperature predictions.

Heat transfer through the steel, concrete, grout and soil is modeled by conduction. The transfer of heat through porous materials such as concrete, grout and soil can occur by a combination of conduction, radiation and convection. Conduction can be a factor at points of granular contact, heat can radiate across the voids between grains and convection heat transfer can occur throughout the medium on both the microscopic and macroscopic scales. However, in compacted sandy soils with fines present, conduction would be the dominant mechanism and in this analysis, heat transfer in all solid materials, including soil, is modeled based upon that heat transfer mode.

The interface between two solid materials in contact produces a resistance to the flow of heat across that boundary. Since the extent of actual contact is not known, intimate contact is assumed between the various material pairs (liner and grout, grout and soil, concrete and soil) and all contact resistances are assigned zero values.

6.2.3 GROUND TO AMBIENT HEAT TRANSFER

At ground level, several heat transfer processes occur: solar insolation, solar reflection, radiation back to sky and convection to and from the ambient air. A simplified radiation and convection model was used in the Confirmation Phase I analysis to calculate ground to ambient heat transfer. This was based on the assumption that if radiation parameter values are conducive to significant radiation heat transfer from the soil surface to sky (e.g., high surface reflectivity, high emissivity and low sky temperature), then it may be possible to satisfactorily predict the seasonal variations by equating air and soil surface temperatures and ignoring solar insolation, radiation back to sky and convection to and from the air. Since drywell thermal response to relatively high decay heat levels and in drywell arrays or various spacings are not yet available, it was decided to include a more detailed ground to surface heat transfer model. The present thermal model includes various modes of heat transfer at the surface as detailed in the remainder of this section.

The solar insolation model is based upon an empirical method described in Reference 3 (Eq. 3.4.2). For a specified location on the earth's surface, the method relates insolation on a horizontal surface as a function of time over the course of a one-year period. After assuming 10 percent reflection, the absorbed fraction is then included in the thermal model by assigning volumetric heat generation rates to the drywell cover plate (nodes 111 to 117) and to the concrete pad and surface soil (nodes 243 to 250).

Heat transfer by convection from the soil to the air is modeled by a convective heat transfer coefficient at the soil/air interface and monthly air temperature averages calculated from E-MAD site weather data (see Table 2). The heat transfer coefficient was assigned a constant value of $2.6 \text{ Btu/hr-ft}^2\text{-}^\circ\text{F}$

TABLE 2
E-MAD SITE OUTDOOR AIR TEMPERATURES - MONTHLY AVERAGES

<u>Month</u>	<u>Temperature (⁰F)</u>
January	36
February	50
March	55
April	60
May	75
June	82
July	90
August	88
September	80
October	75
November	50
December	35

(obtained from Reference 3, Eq. 4.14.4) which applies to a wind speed of 5 miles/hour for a direction parallel to the soil surface.

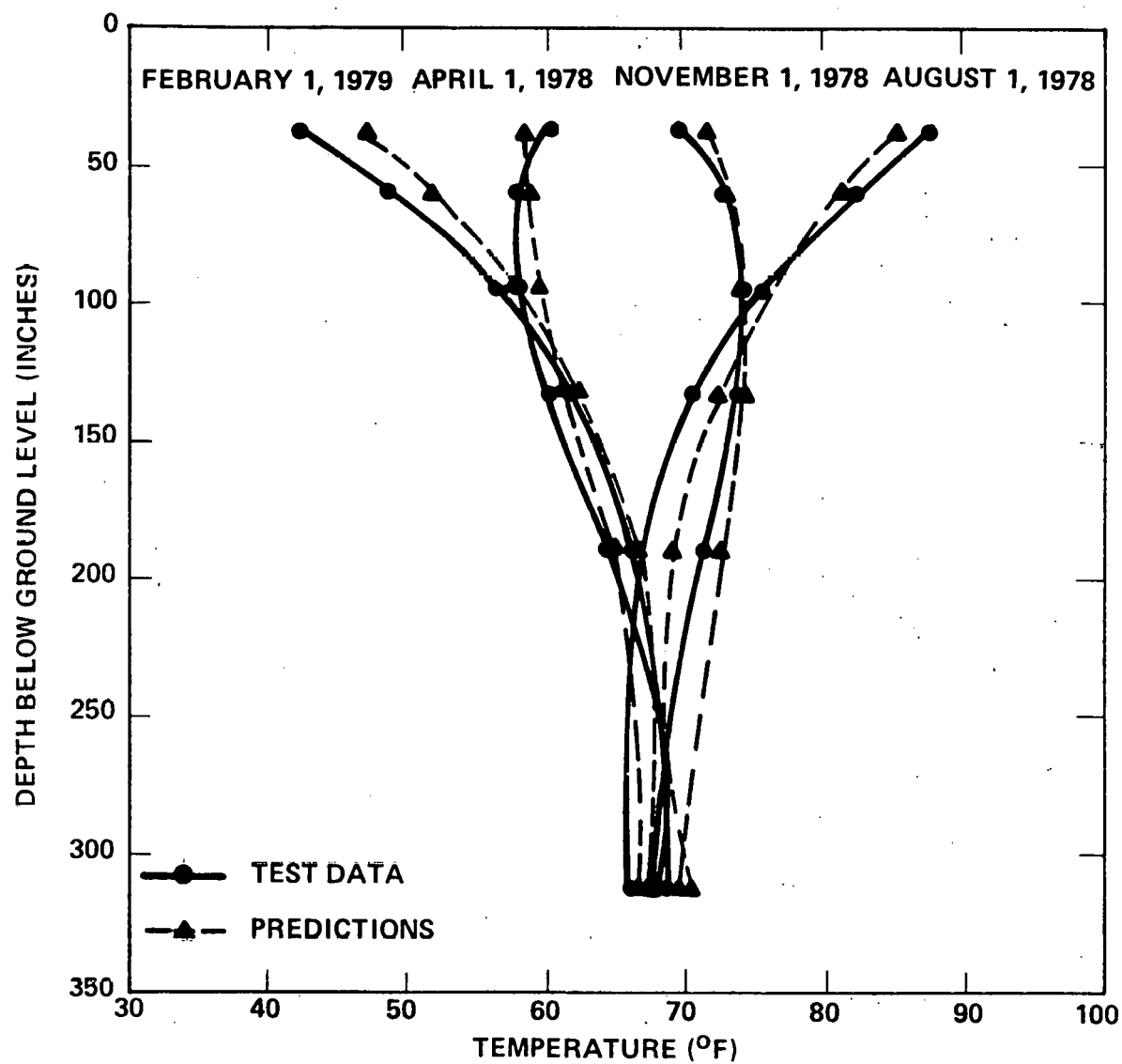
Radiative heat transfer to the sky from the soil, concrete pad and the drywell cover plate is modeled using the following emissivity values from Reference 4, p. 699:

	<u>Emissivity</u>
Drywell cover plate-gray paint	0.95
Concrete	0.9
Soil (desert surface, dry sand)	0.9

The radiation calculations are based on a constant sky temperature (T_{SKY}) of -50°F . This particular value was determined from a study in which the seasonal temperature variations at the thermocouple reference well (unaffected by drywell heat source) were predicted and compared with test data. The quality of the agreement between the data and calculations is indicated in Figure 19. It is noted that a T_{SKY} of -50°F , while not physically impossible, is lower than expected. However, the T_{SKY} obtained by this analysis method may compensate for model inaccuracies such as low surface reflectivity, high insolation, etc. elsewhere in the model. In addition, the soil surface temperature is not particularly sensitive to T_{SKY} variations in that a 50°F change in T_{SKY} corresponds to a surface temperature change of only 6°F . Therefore, the actual sky temperature could easily be different from -50°F and not have much effect on drywell temperature predictions.

6.2.4 CANISTER HEAT FLUX DISTRIBUTION

The Confirmation Phase I model contained a uniform heat generation rate distribution in the heater assembly region (nodes 1 to 30). Consequently, the canister model typically exhibited a flat axial heat flux profile except near the top and bottom where the distribution tapered off due to end effects. A comparison of measured temperatures with calculations produced by that model showed the model consistently underpredicts soil temperatures in the near-surface region (0 to 40 inch depth). That discrepancy could be due to



615671-24A

FIGURE 19. Reference Well Temperature Comparison - Test Data and Predictions

insufficient heat flow from the upper end of the canister model. To evaluate canister heat flow, the actual canister heat flux distribution was calculated using temperature data from the pairs of adjacent canister and liner thermocouples identified in Table 3.

Assuming the canister and liner are positioned concentrically and that temperatures and heat flow do not vary circumferentially, the local canister heat flux at a particular elevation can be expressed as follows in terms of the canister and liner temperatures at that location:

$$\Phi = \frac{K_e}{2b} \left(1 + \frac{r_L}{r_C} \right) (T_C - T_L) + F \sigma (T_C^4 - T_L^4)$$

where

- Φ - heat flux, Btu/hr-ft²
- b - radial clearance between liner and canister, ft
- K_e - effective thermal conductivity of the gas in the clearance region (considering both conduction and free convection), Btu/hr-ft-°F
- r_C - canister outer radius, ft
- r_L - liner inner radius, ft
- F - shape factor
- σ - Stefan-Boltzman constant, 0.1714×10^{-8} Btu/hr-ft²-°R⁴
- T_C - canister temperature, °R
- T_L - liner temperature, °R

The first term on the right hand side of this equation describes heat transfer between the canister and liner by the combined effects of conduction and free convection. The effective thermal conductivity, K_e , was calculated using the method discussed in Reference 5 (p. 331, 332) and is typically greater than the thermal conductivity of air [evaluated at $1/2 (T_C + T_L)$] by a factor of 2 to 3. Radiation, the dominant heat transfer mode between the canister and liner, is accounted for by the second term.

The analysis procedure consisted of first determining local heat flux values at

TABLE 3
CANISTER AND LINER THERMOCOUPLES USED IN CANISTER HEAT FLUX CALCULATIONS

Thermocouple Pair	Elevation* (in.)	<u>Canister</u>		<u>Liner</u>	
		Thermocouple No.	Angle** (Deg.)	Thermocouple No.	Angle (Deg.)
1	29.5	014	0	030	0
2	29.5	015	135	030	0
3	60.0	016	0	031	0
4	60.0	017	90	032	90
5	60.0	018	180	033	180
6	60.0	019	270	034	270
7	90.4	020	0	035	0
8	120.8	021	180	035	0
9	151.2	022	180	037	0
10	151.2	023	315	037	0

*Measured from top of canister.

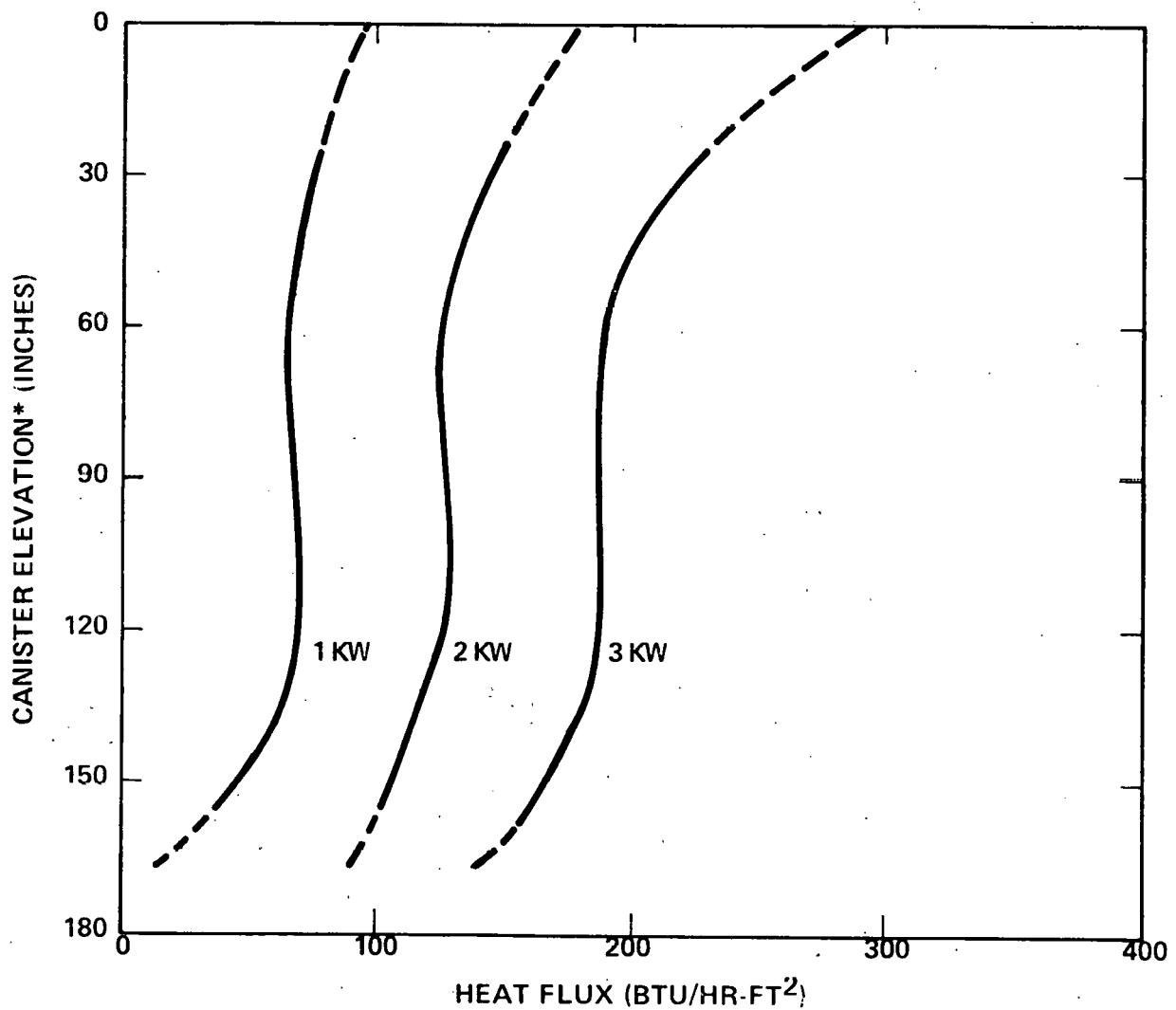
**See Figure 7 for 0° position.

the five thermocouple elevations. The resulting heat flux profile was integrated over the canister length and the estimated drywell power level was compared with the known actual power level. Their ratio (actual/estimate) was always less than 1.0 (typically 0.55 to 0.65) and this was attributed primarily to the shape factor value of 1.0 which was used in the radiation calculations. This ratio was then applied as a multiplier on the heat flux estimates at the five thermocouple elevations. While the need for the multiplier stems primarily from the radiation calculational method, it was applied to both the radiation and the convection/conduction term to simplify the calculations. This approach resulted in variations between test data and predicted local heat fluxes of less than 8 percent at 1.0 kW and less than 4 percent at the 2.0 and 3.0 kW power levels. The corrected heat flux profiles obtained in this manner are shown in Figure 20.

The main difference between these profiles and the uniform flux distribution is that a peak heat flux peak now occurs at the canister's upper end. A flux peak at that location could be expected due to natural circulation effects within the canister. The canister heat flux distributions of Figure 20 have been input in the present model, and, as shown in Figure 21, their use has led to improved soil temperature predictions in the near-surface zone. It is therefore apparent that the canister heat flux distribution does have an appreciable influence on drywell and soil temperature predictions and that the canister model needs to include the appropriate heat flux distribution.

6.2.5 MATERIAL PROPERTIES

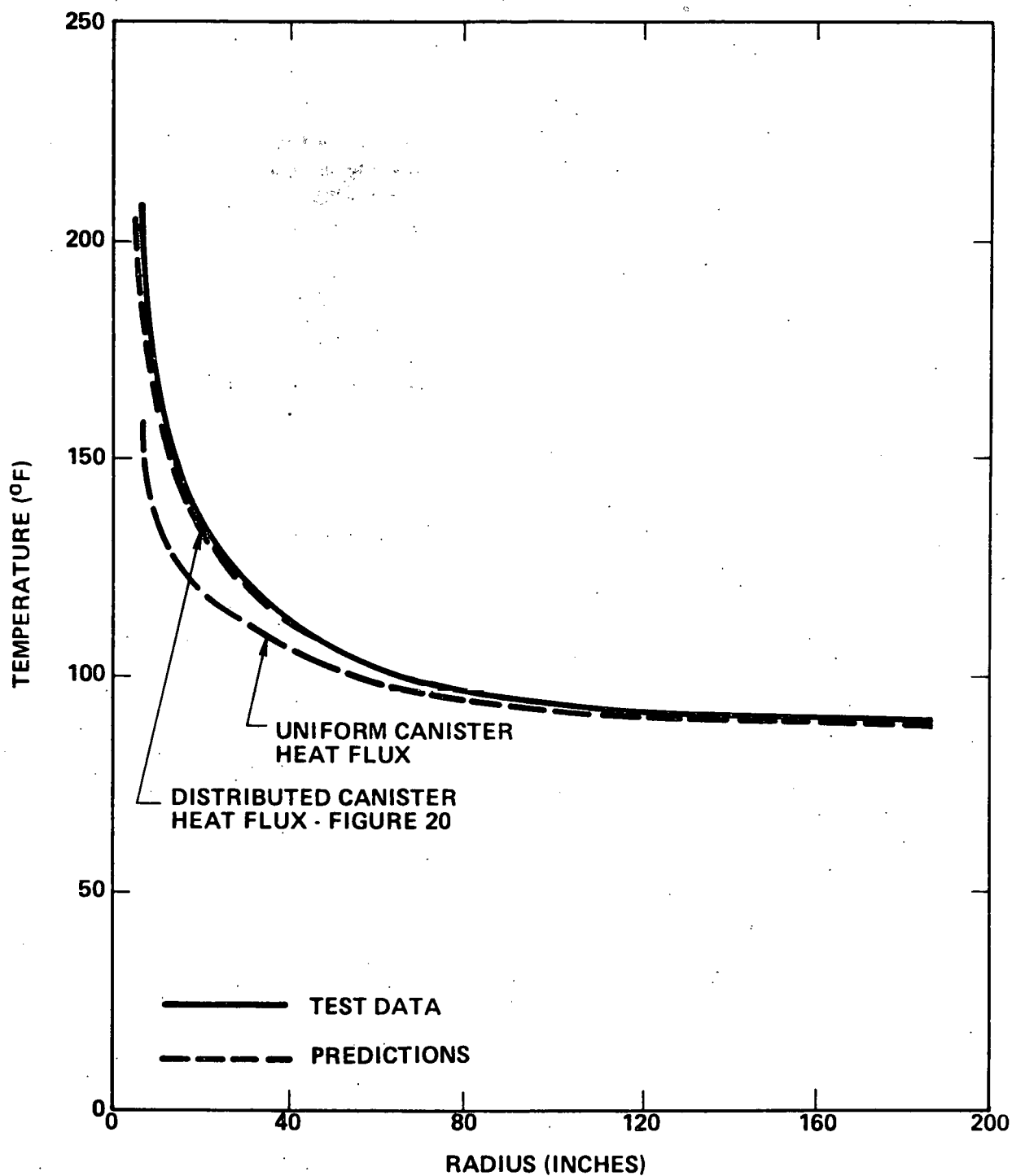
The various materials used in the Soil Temperature Test and the thermal properties input to the thermal model are identified in Table 4. Thermal conductivities of the grout and soil were determined experimentally since they are specifically applicable to the E-MAD area. The thermal conductivity of grout (a two-to-one mixture by weight of soil and cement) was measured as a function of temperature in laboratory tests performed by Holmes and Narver, Inc. Test samples of the grout were poured during drywell installation for use in the laboratory tests. The results of that work are shown in Figure 22.



615671-3A

*REFERENCED TO CANISTER UPPER END

FIGURE 20. Canister Axial Heat Flux Distributions Derived from Canister and Liner Temperature Data



615671-4A

FIGURE 21. Test Data and Predictions at 40 Inch Depth Showing Canister Heat Flux Modeling Effects, 1 kW Operation, August 31, 1978

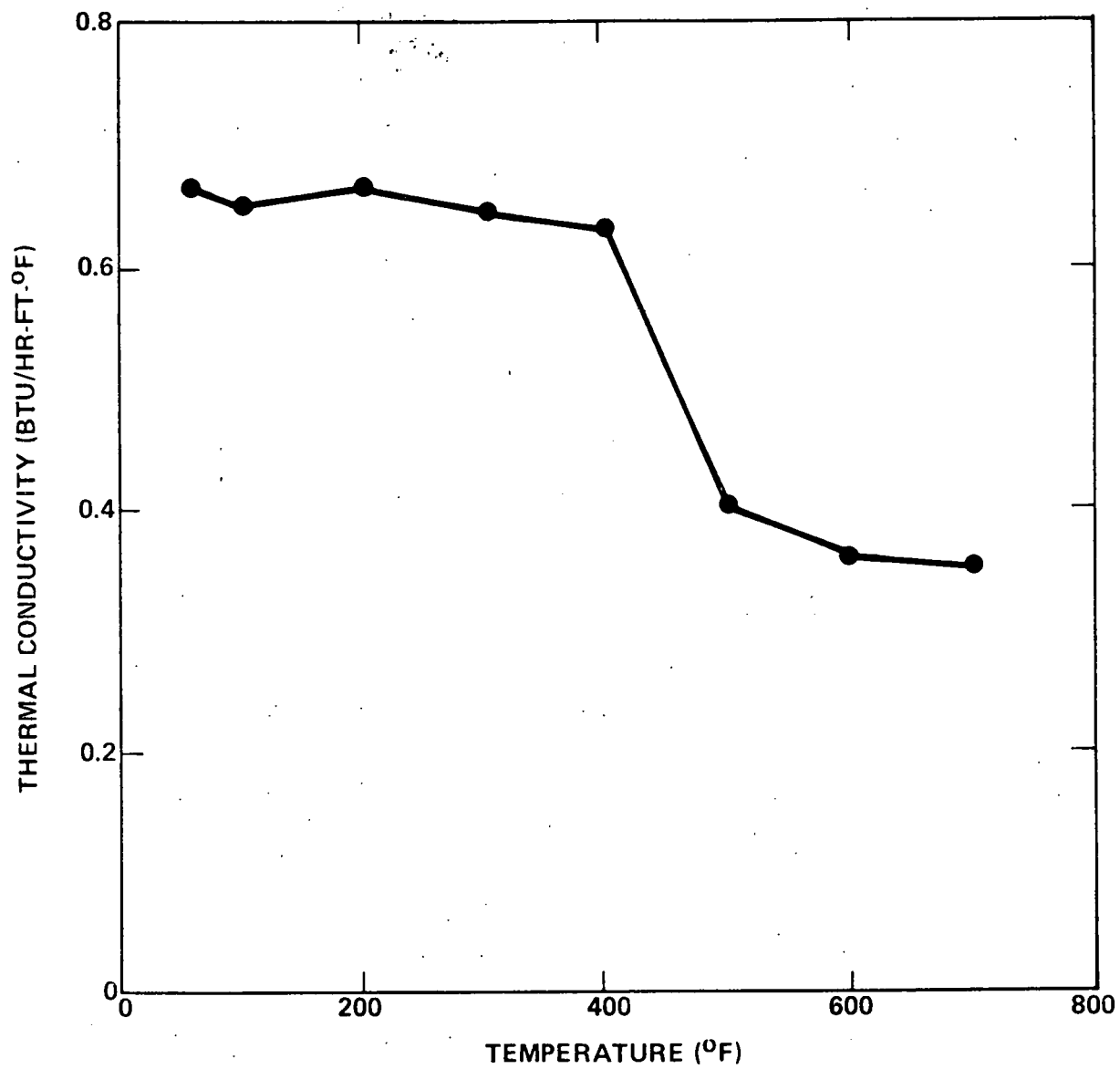
TABLE 4

SOIL TEMPERATURE TEST MATERIAL THERMAL PROPERTIES

<u>Material</u>	<u>Drywell Component</u>	<u>Density ρ (lb/ft³)</u>	<u>Heat Capacity C_p (Btu/lb-°F)</u>	<u>Thermal Conductivity K (Btu/hr-ft-°F)</u>	<u>Source</u>
Concrete	Shield plug, ground level pad	142.0	0.2	1.05	Ref. 6, pp. 4-9, 4-97
Stainless Steel	Canister	490.0	0.11	10.0	Ref. 7, p. 533
Carbon Steel	Liner, drywell cover plate, shield plug can	490.0	0.11	23.0	Ref. 7, p. 533
Grout	Grout	117.0	0.20*	See Fig. 22	
Soil	Soil	105.0	0.25**	See Fig. 26	

*Value based on dry soil, dry concrete C_p values.

**Dry soil plus 5 percent moisture assumed.



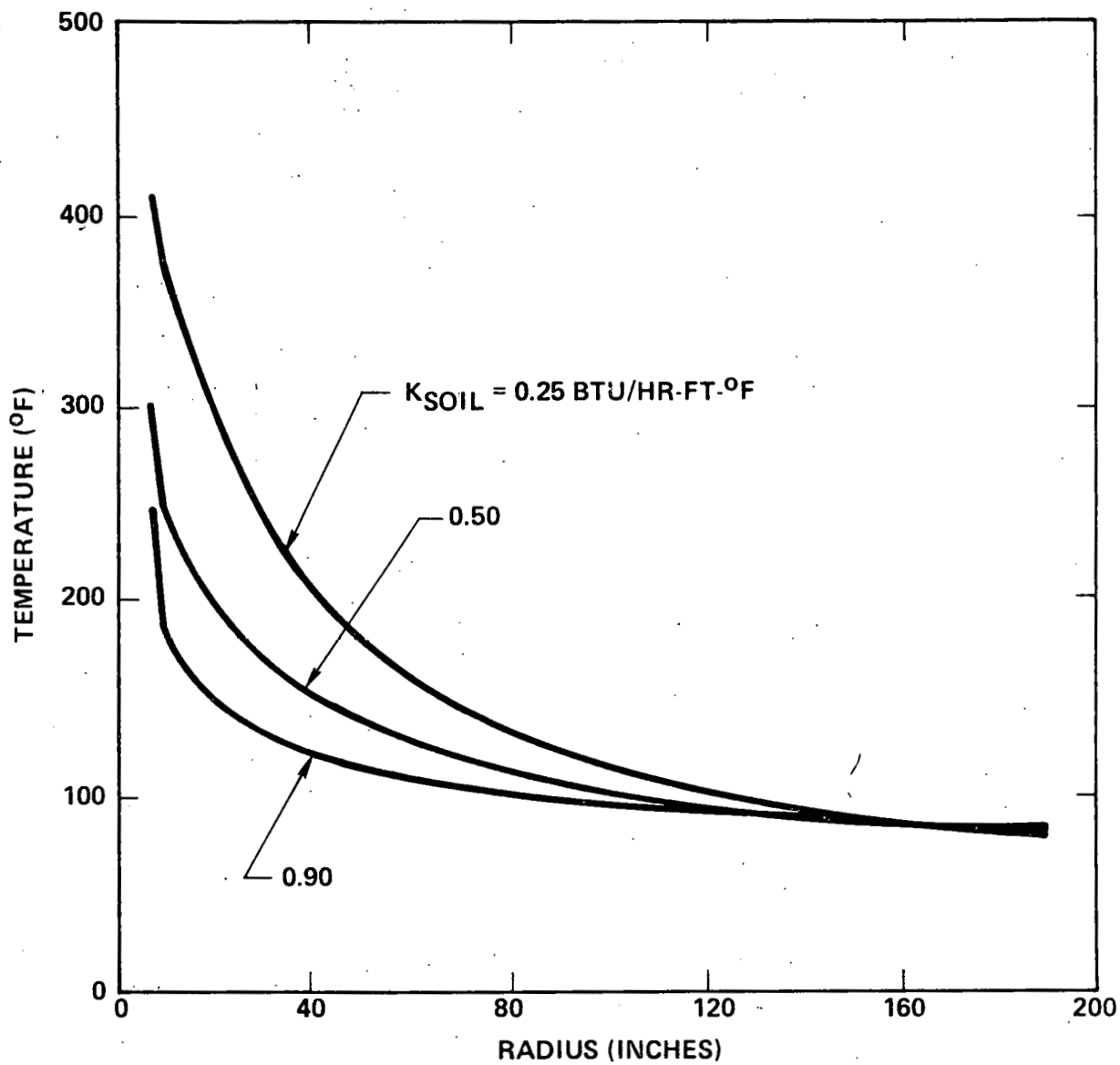
615671-2A

FIGURE 22. Laboratory Measured Grout Thermal Conductivity

Since soil thermal conductivity is a parameter of major importance in the analysis of drywell thermal performance, the conductivity value or relationship used must be selected carefully. To illustrate its influence, steady-state predictions of temperature versus radius at canister mid-plane are plotted in Figure 23 for three typical values of soil conductivity with all other parameters held constant. The conductivity values were obtained from Reference 8 and they apply to a variety of soils covering a range of moisture contents and densities. Generally, low conductivities are associated with dry, lightweight soils while moist, high density soils exhibit higher conductivities. It is apparent from Figure 23 that the drywell temperature field in general and the canister temperature in particular are sensitive to soil conductivity variations.

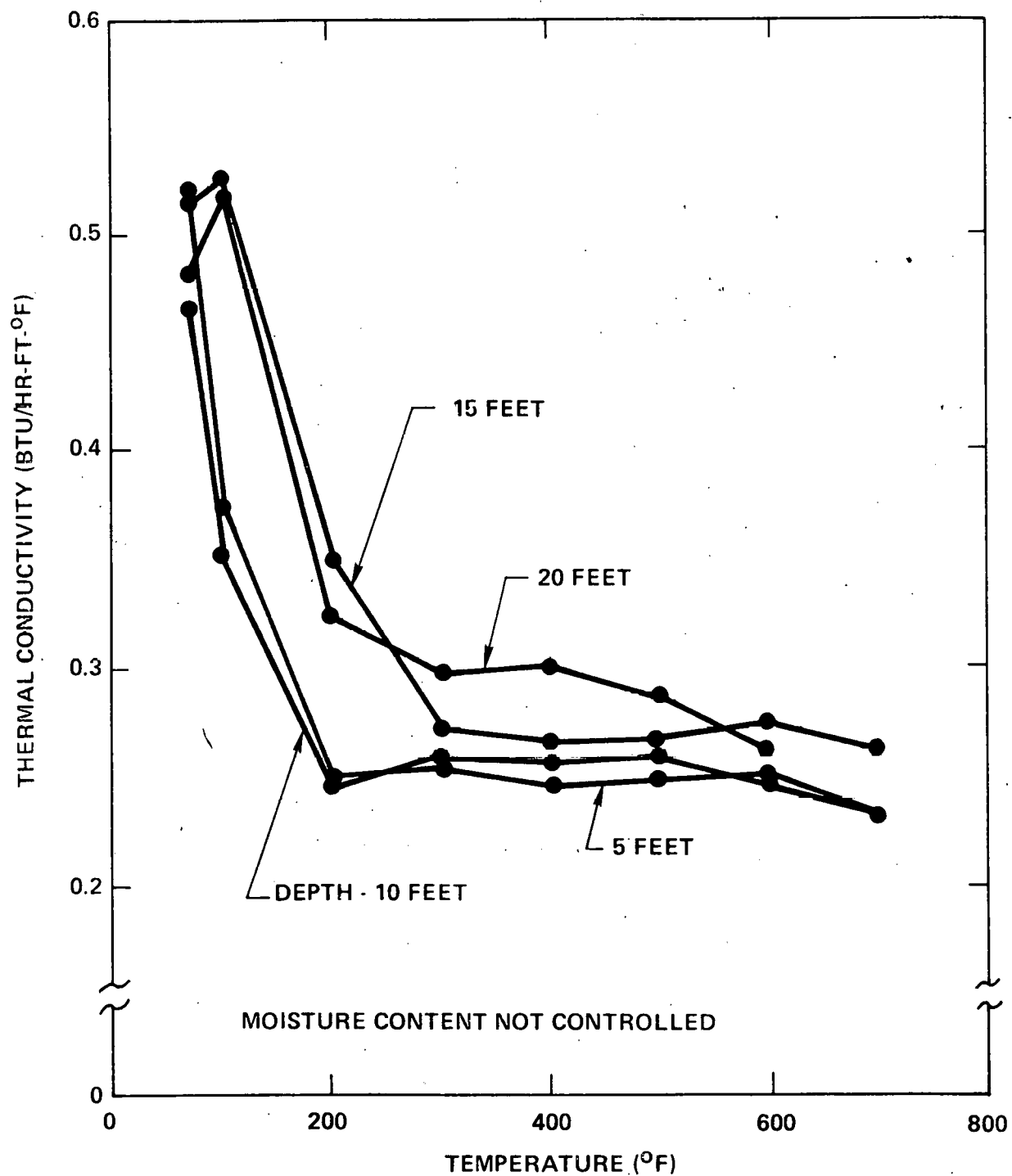
For the Soil Temperature Test, E-MAD soil density and thermal conductivity were measured by Holmes and Narver, Inc. in laboratory tests using borehole samples. The samples were taken at four depths (5, 10, 15 and 20 feet) and their moisture contents, densities and compositions were determined. At a later date, the dried samples were recombined with the correct moisture (typically 5.0 to 5.2 percent by weight at each level) and compacted to the correct density to form cylinders (2.8 inches in diameter by 5.6 inches in length) on which conductivity tests were performed. The tests employed the transient line source method described in References 9 and 10. By placing the samples in an electrically heated furnace, the thermal conductivity versus temperature measurements were obtained which are tabulated in Table C-1 and graphed in Figure 24.

As noted above, the soil samples contained 5 percent moisture at the beginning of the test. However, nearly 20 hours were allowed to elapse between tests at each temperature and since the furnace was not air-tight, it is virtually certain the samples quickly lost their initial moisture. Above 200°F, all moisture would have vaporized and the data obtained apply to dry soil conditions. However, during the tests below 200°F, the samples could have contained some moisture but at levels less than the original moisture content due to evap-



615671-5A

FIGURE 23. Radial Temperature Profile Predictions at Canister Midplane as a Function of Soil Thermal Conductivity, 1 kW Operation, August 31, 1978



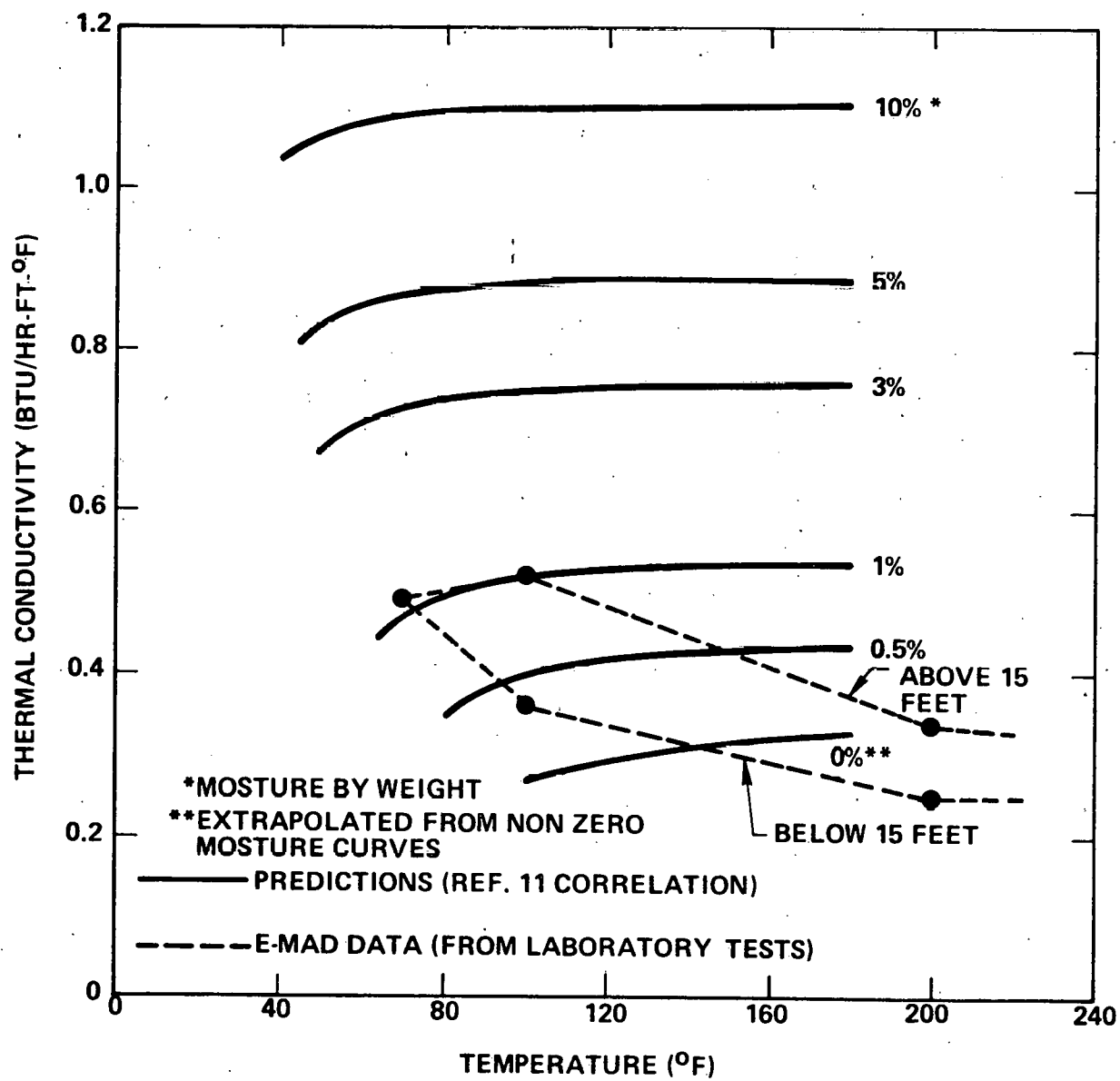
615671-1A

FIGURE 24. Laboratory Measured E-MAD Soil Thermal Conductivity

oration during the stabilization period. Therefore, the measured thermal conductivities at 70 and 100°F are expected to be lower than conductivities at the same temperature with 5 percent moisture.

The Confirmation Phase I model utilized the thermal conductivity data from the E-MAD soil samples and the resulting predicted drywell temperatures were significantly higher than the test data. An assessment of the potential thermal conductivity discrepancy in temperature range of 70 to 200°F was made by comparing the E-MAD soil data with published soil data and conductivity correlations. A correlation described in Reference 11 was used since it was developed for sandy soils comparable to that at E-MAD. The E-MAD samples contained approximately 70 percent sand (SiO_2). Although the correlation assumed the other main soil component is clay (E-MAD samples showed no clay), the correlation has been used in this study primarily to illustrate the influence of moisture on soil thermal conductivity. A comparison of the correlation conductivity predictions with E-MAD soil test data are shown in Figure 25. The correlation as published in Reference 11 only covers a temperature range of 40 to 100°F. For a fixed moisture content, the correlation shows a weak dependency on temperature; and therefore, the correlation can probably be safely extrapolated between 100 and 200°F, as was done in Figure 25.

Several observations can be made concerning Figure 25. First, the low moisture predictions are similar to the high temperature (above 200°F) conductivities measured for the E-MAD soil samples. Since the samples tested were dry above 200°F, the reasonable agreement at high temperatures supports the use of this correlation for the high sand content soil at E-MAD. Second, the correlation predicts low temperature conductivities of nearly 0.9 Btu/hr-ft-°F for moisture levels of 5.0 percent as compared with 0.5 Btu/hr-ft-°F measurements from the E-MAD soil samples. Third, the measured E-MAD soil conductivity continued to fall between 70 and 200°F instead of following the slight rising trend predicted by the correlation. These three observations support the contention that the E-MAD test samples, after being mixed and molded with the correct moisture content, lost a portion of that moisture by evaporation even before the room temperature tests were performed.



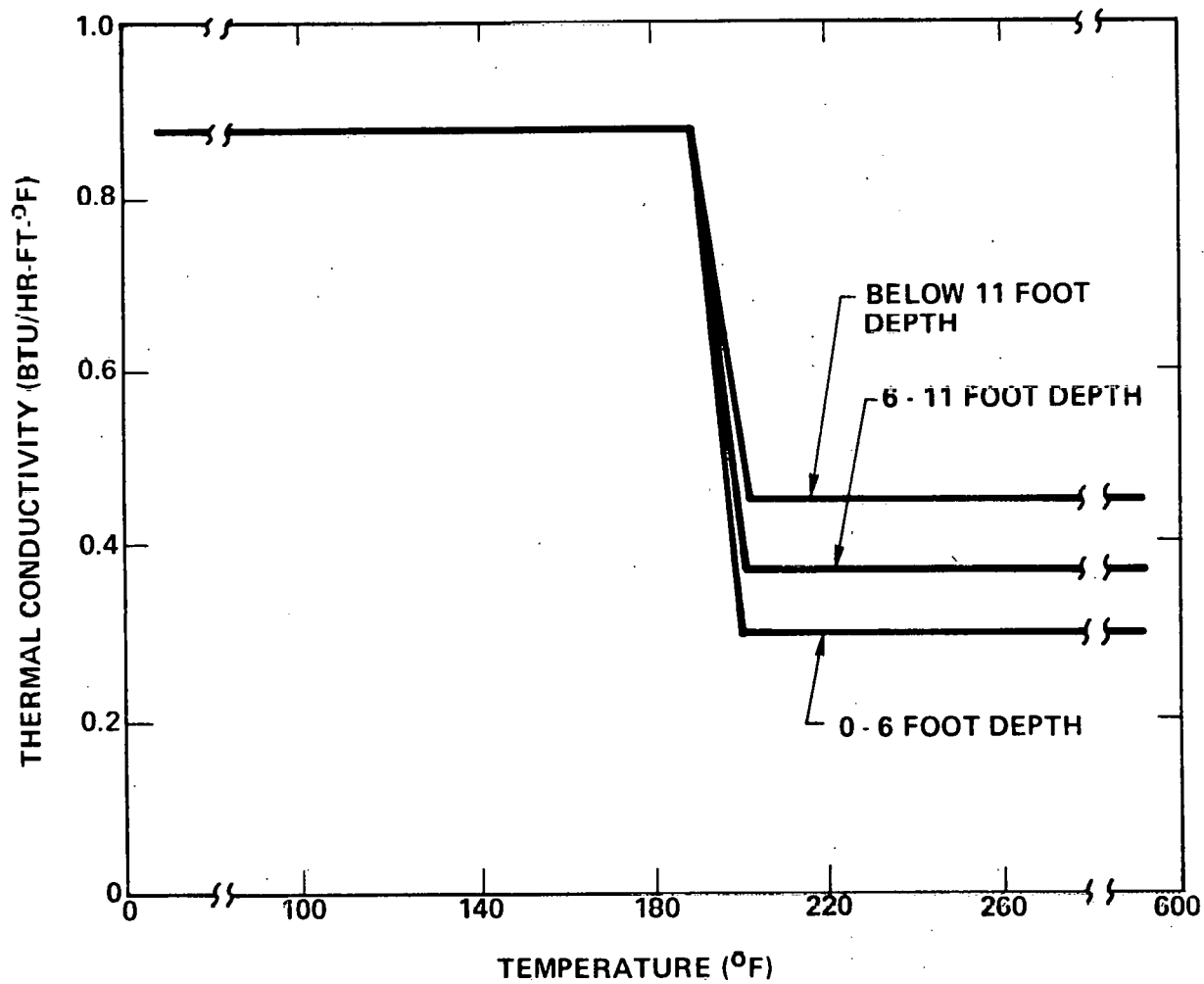
615671-7A

FIGURE 25, E-MAD Soil Thermal Conductivity Test Data and Predictions

To improve the thermal model predictions based on the above described evaluation, the thermal conductivity versus temperature relationship shown in Figure 26 has been input to the model. It will be observed that the high temperature (about 200°F) conductivities are comparable to the E-MAD sample test data while the conductivities at low temperatures are higher than the E-MAD data and reflect in situ moisture effects.

6.2.6 ELECTRIC HEATER POWER VARIATIONS

As noted in Section 5.7, voltage variations at the electric heater terminals occurred during the warm months of the year apparently in response to the cycling air conditioning load. The heater controller setting which was checked and adjusted (if necessary) during the warm daytime hours was not adjusted to account for the voltage variations after working hours and resulted in a higher voltage across the terminals at night. Heater controller input voltage data records were analyzed to determine the overall effect on heater power level. The analysis for the 1.0 and 2.0 kW periods indicated that the integrated power output by the heater was higher than nominal by about 3 percent during the April to September period but virtually equal to the nominal value during the remaining months of the year. This variable power effect has been included in the thermal model to more accurately represent actual test conditions.



615671-6A

FIGURE 26. E-MAD Soil Thermal Conductivity as Derived from Test Data and Prediction Comparisons

7.0 THERMAL ANALYSIS RESULTS

7.1 MODEL EVALUATION CRITERIA

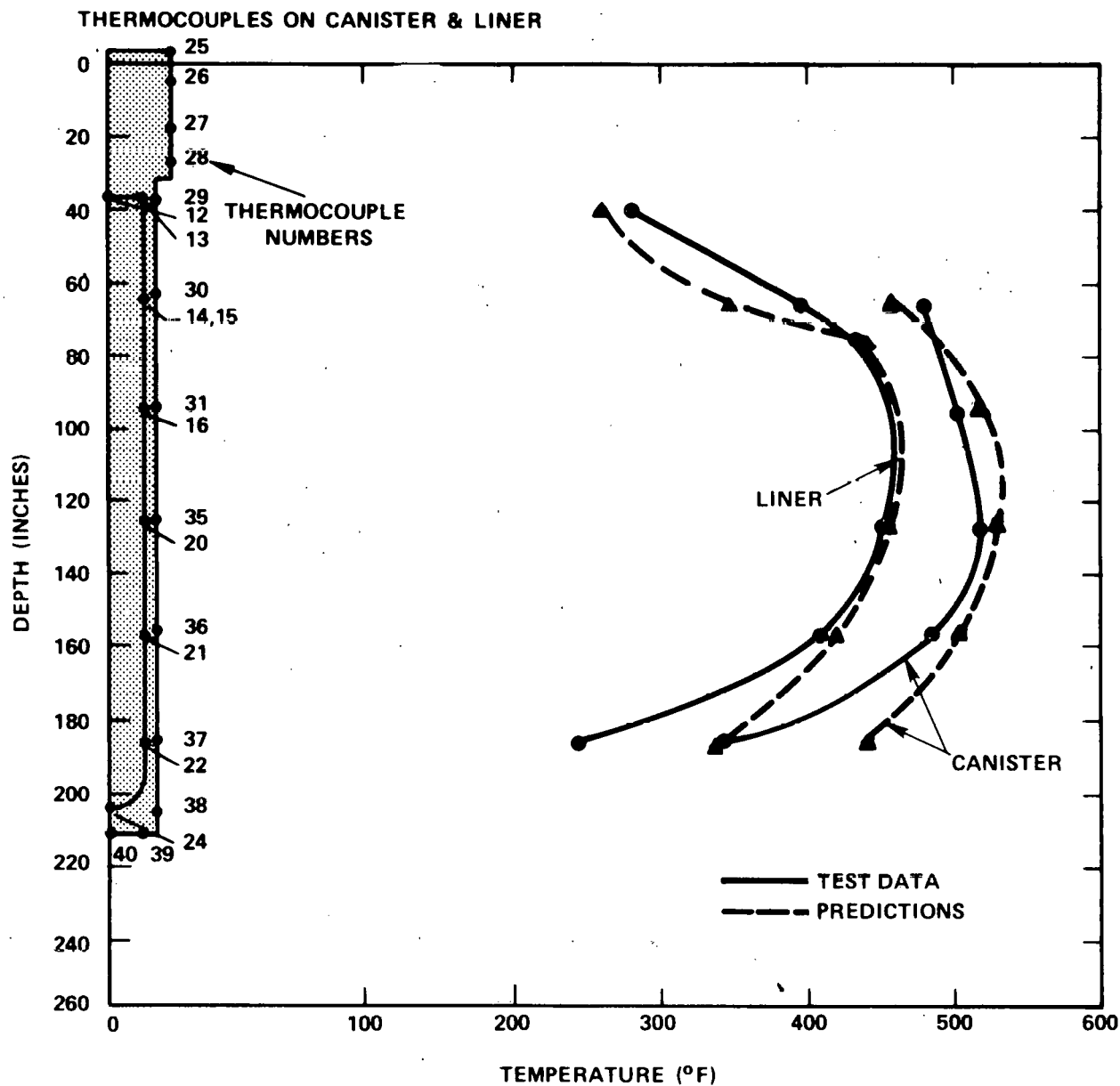
With proper input, the Soil Temperature Test drywell thermal model should produce accurate temperature predictions for the canister, liner, and nearfield soil zone. Accurate canister temperatures are important as input to independent fuel assembly studies (Fuel Temperature Test, etc.) while accurate soil temperatures are important for drywell array and thermal interaction analyses. The most important model evaluation criteria is to correctly predict temperature trends and relationships for a range of power levels and for the variations in seasons. Satisfying this third criteria will demonstrate that the thermal model correctly models the appropriate heat transfer mechanisms and maintains the proper relationships between these mechanisms as system forcing functions and boundary conditions change. As long as the model satisfies this criteria, small differences between predicted and measured temperatures should not be of concern. In most cases, the differences can be recognized and explained based upon inaccuracies in model input, actual test configuration uncertainties and/or heat transfer mechanism uncertainties.

The following sections present a comparison of thermal model temperature predictions with data from the Soil Temperature Test. The discussion will focus on the 1.0 kW and 2.0 kW operating periods with selected results from the accelerated heatup period (3.0 kW).

7.2 MODEL/DATA COMPARISONS

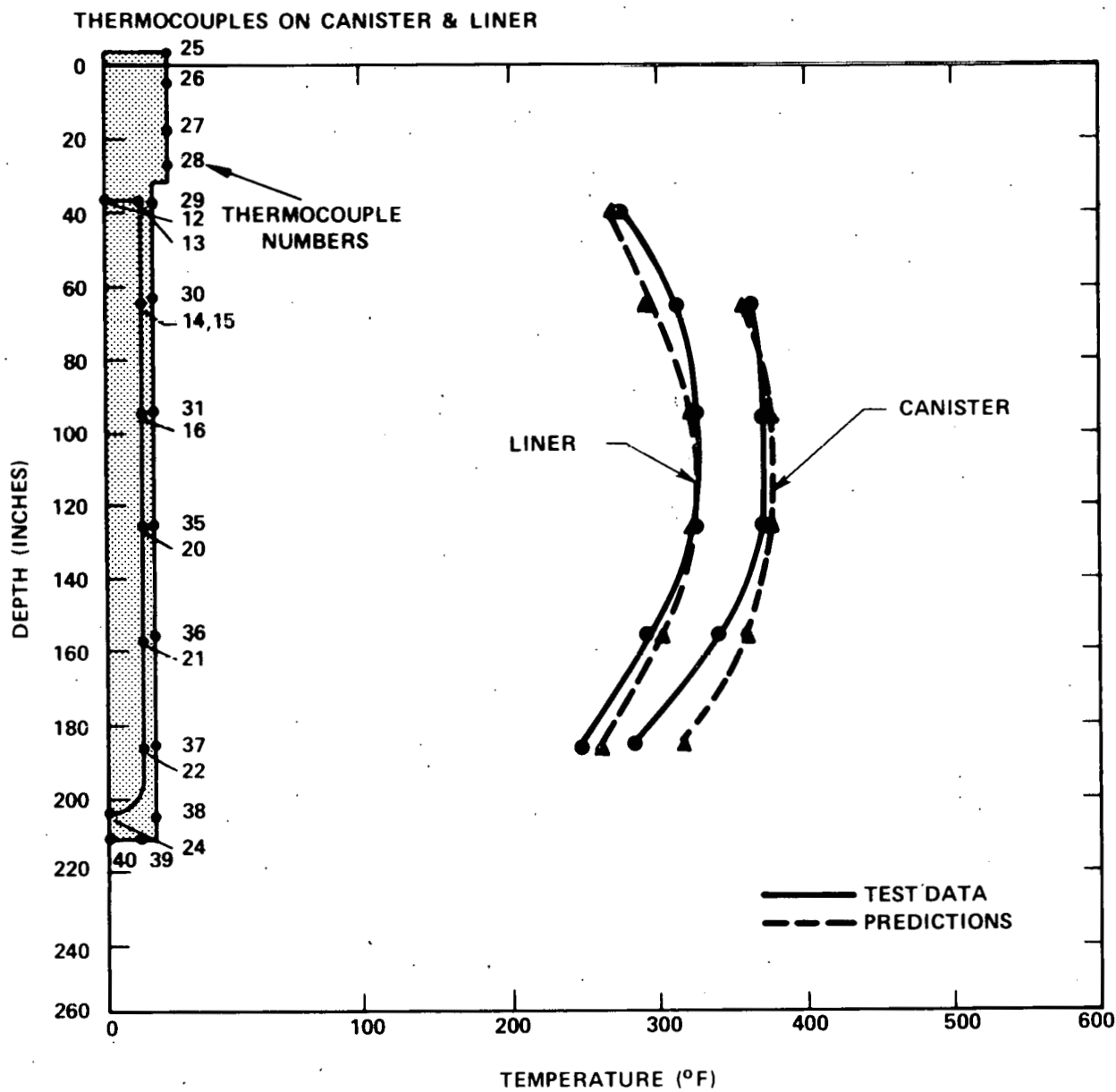
7.2.1 CANISTER AND LINER AXIAL TEMPERATURE PROFILES

Predicted temperature profiles for the canister and liner are compared with the test data in Figures 27, 28, and 29. Generally, the predicted relationships between the canister and liner temperatures agree well with the data, especially at the 1.0 kW and 2.0 kW power levels. During the accelerated heatup period (3.0 kW), low liner temperatures were recorded at the bottom of the drywell and are reflected in low canister temperatures at that elevation.



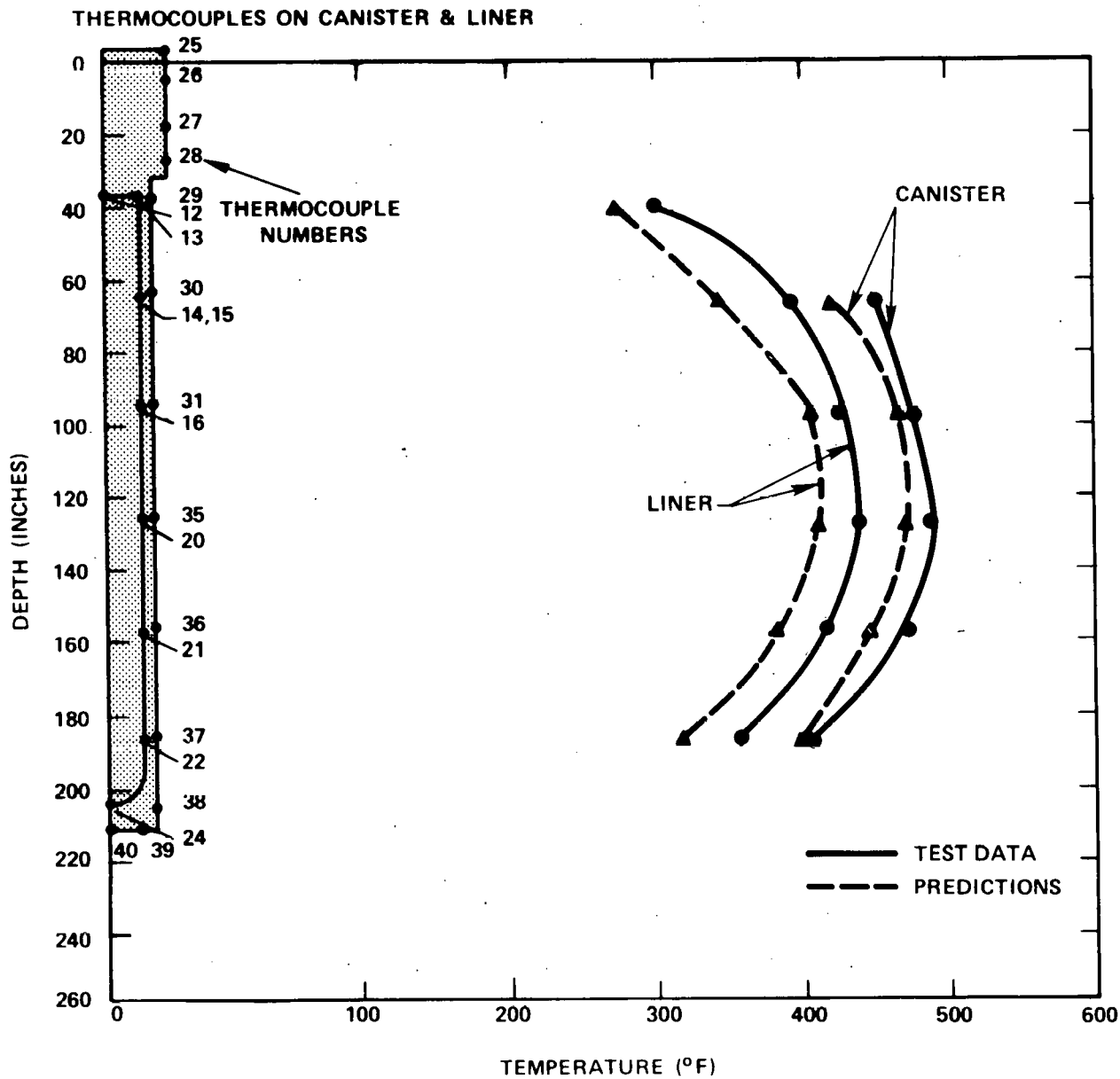
615671-26A

FIGURE 27. Canister and Liner Axial Temperature Profile Comparison for 3 kW Operation, Accelerated Heatup Period, April 30, 1978



615671-25A

FIGURE 28. Canister and Liner Axial Temperature Profile Comparison for 1 kW Operation, August 31, 1978



615671-27A

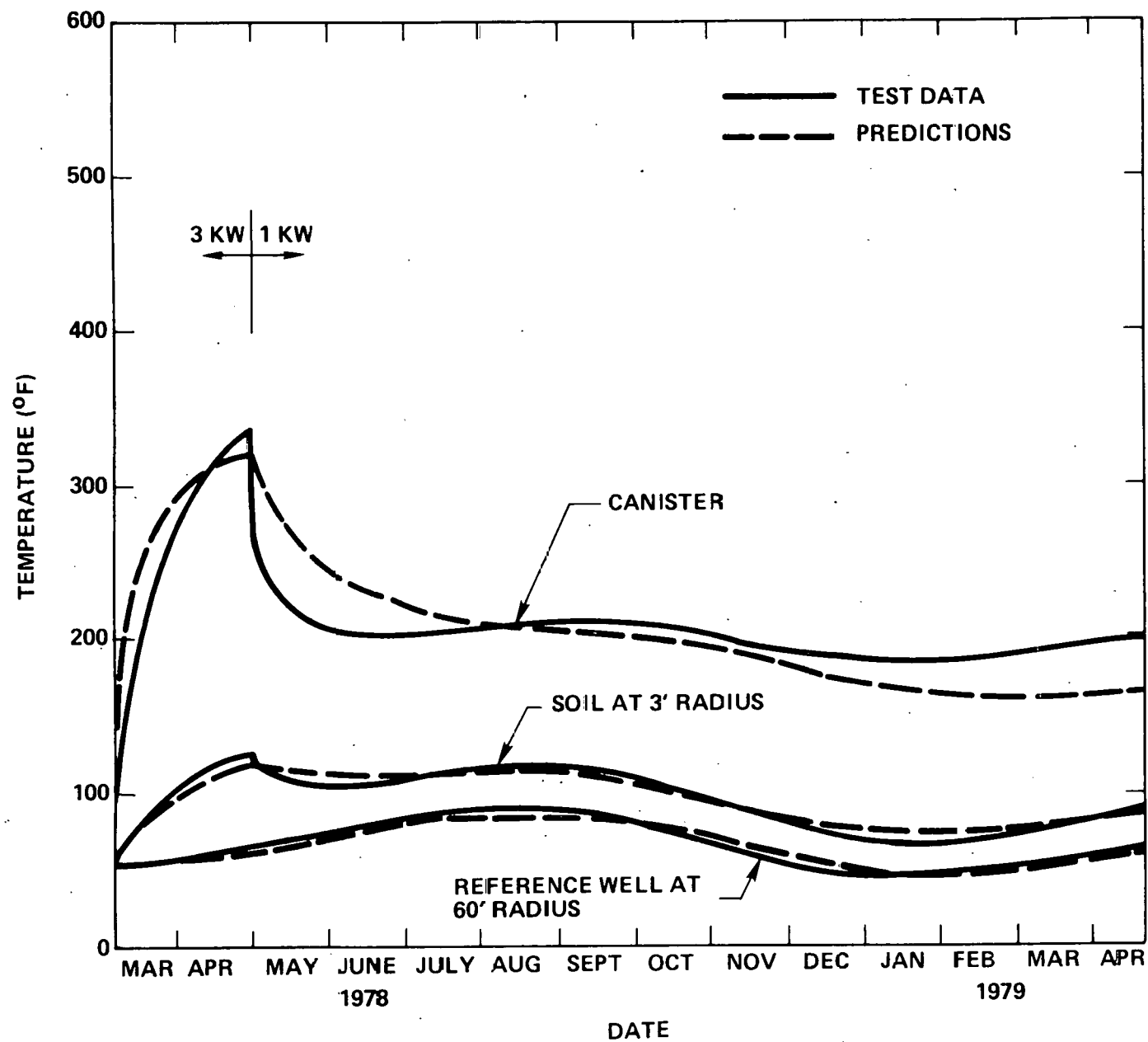
FIGURE 29. Canister and Liner Axial Temperature Profile Comparison for 2 kW Operation, August 31, 1979

As shown in Figure 27, the low temperatures were not predicted by the thermal model. This discrepancy is attributed mainly to the high moisture conditions that existed in the drywell at the beginning of the Soil Temperature Test (see Section 5.3). Until the excess moisture was driven off by vaporization or other mechanisms, it acted to increase both the thermal conductivity and the heat capacity of soil beneath the drywell, thereby suppressing temperatures at that location. Once that region dried, the soil conductivity decreased thus raising the canister and liner temperatures relative to the midplane temperatures and causing them to approach the predicted values. Evidence of this is shown Figures 28 and 29.

7.2.2 TRANSIENT CANISTER AND SOIL TEMPERATURES

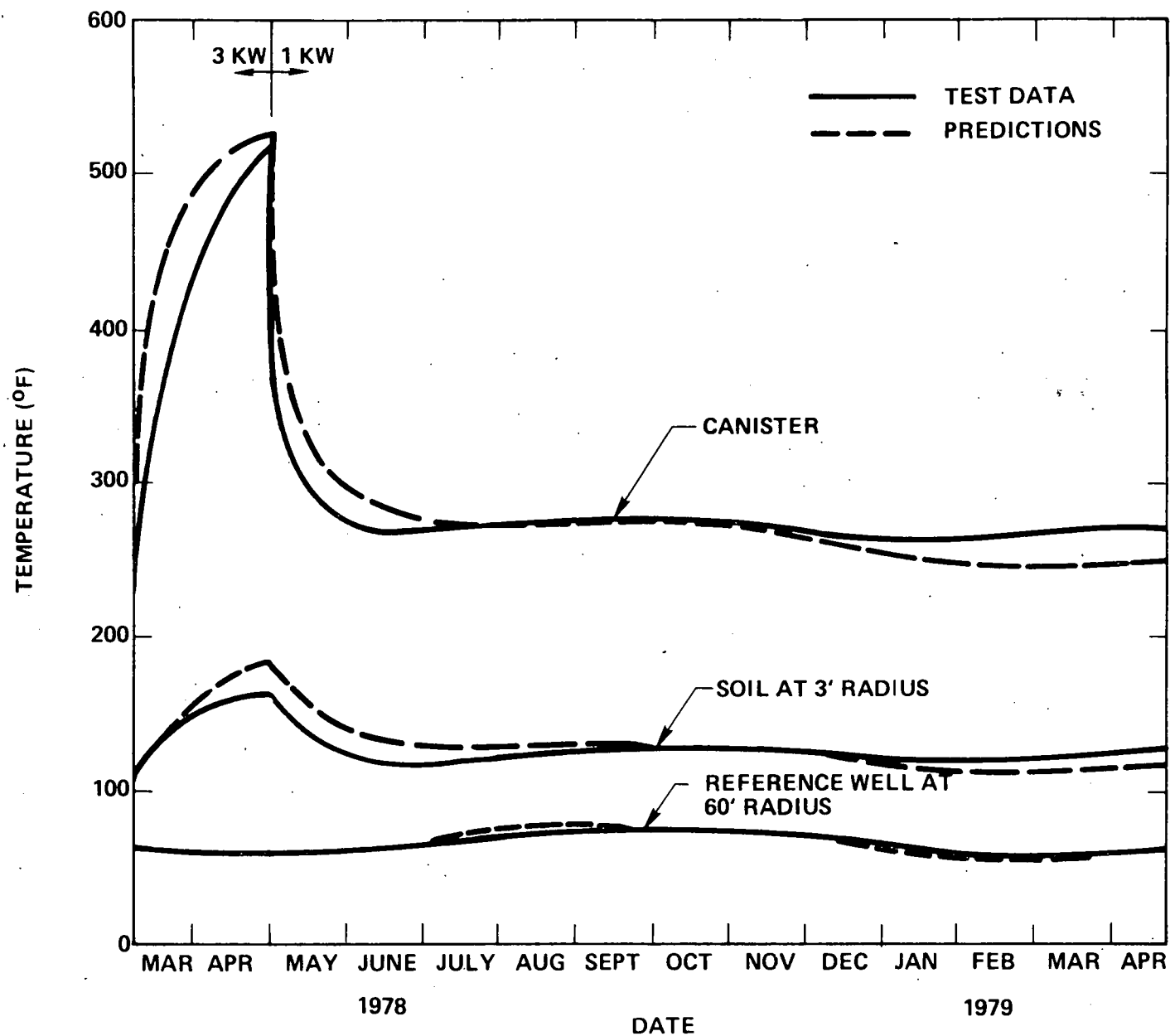
Canister, soil and reference well temperature data from the 3 and 11 foot depths are compared with predictions in Figures 30 and 31 for power operation at 1.0 kW. The soil and reference well predictions at both elevations show the correct seasonal effects and are therefore satisfactory. The canister predictions, however, lag the measurements after the power change from 3.0 kW to 1.0 kW and, more importantly, they also lag the seasonal variations during the last five months of the 1.0 kW period. Initially, this was thought to reflect a possible inaccuracy in heat capacity for the grout and shield plug models (the soil heat capacity appears to be satisfactory since the predicted soil temperatures do track the measured seasonal variations). However, thermal model analyses in which the grout and concrete specific heat capacities were reduced 50 percent from the handbook values (see Table 4) had virtually no effect on the predicted canister temperatures.

An alternate explanation for the canister temperature discrepancy pertains to the effects of natural circulation of air within the canister. In the test canister, air circulation would transmit temperature changes at one point on the canister more quickly and more extensively along the canister's length than would be possible if conduction were the only heat transfer mechanism present. As noted in Section 6.2.2, the heater to canister heat transfer model considers only conduction with free convection being neglected.



615671-19A

FIGURE 30. Soil Temperature Test Data and Predictions for the 3 Foot Depth During 1 kW Operation

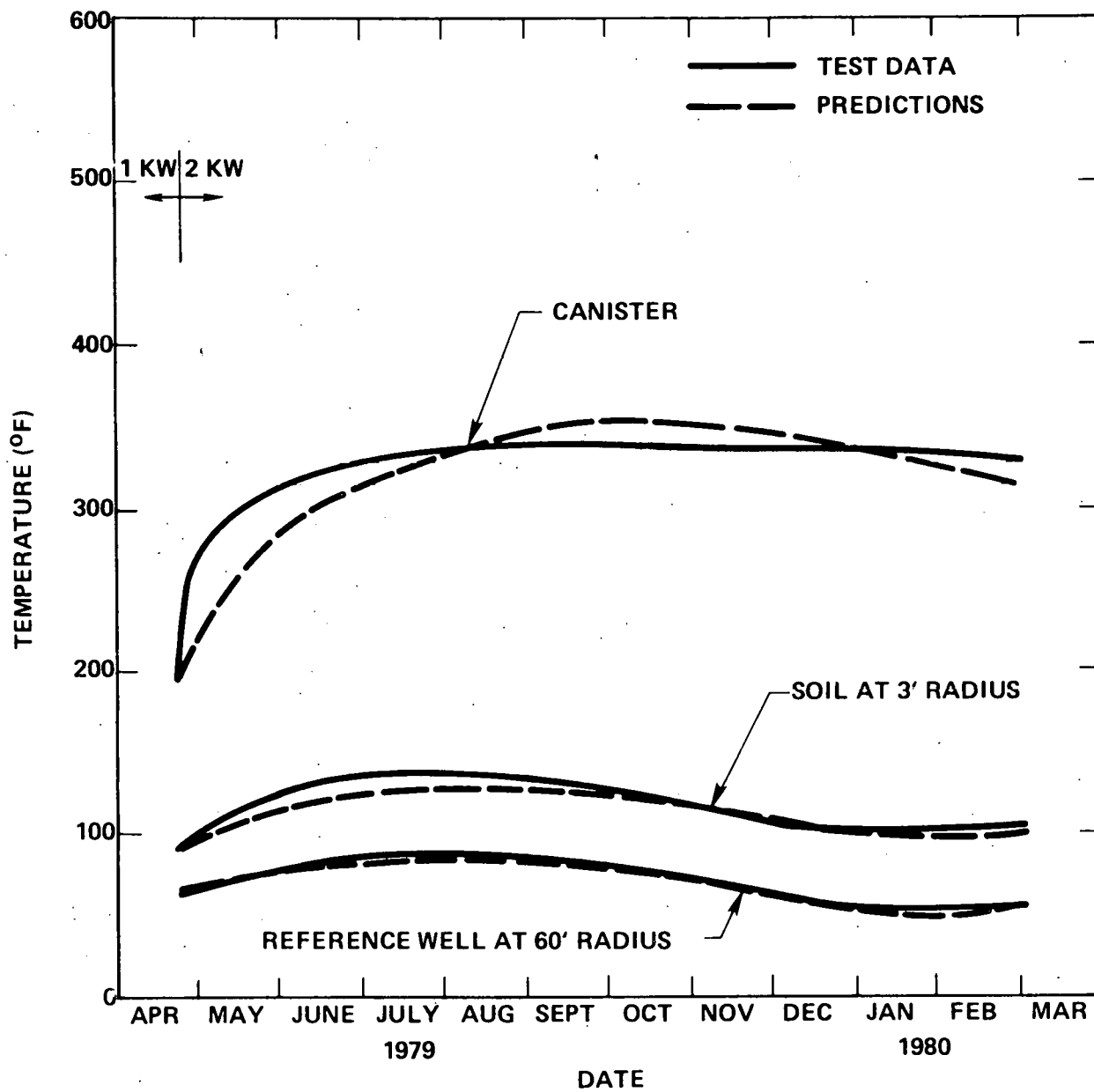


615671-18A

FIGURE 31. Soil Temperature Test Data and Predictions for the 11 Foot Depth During 1 kW Operation

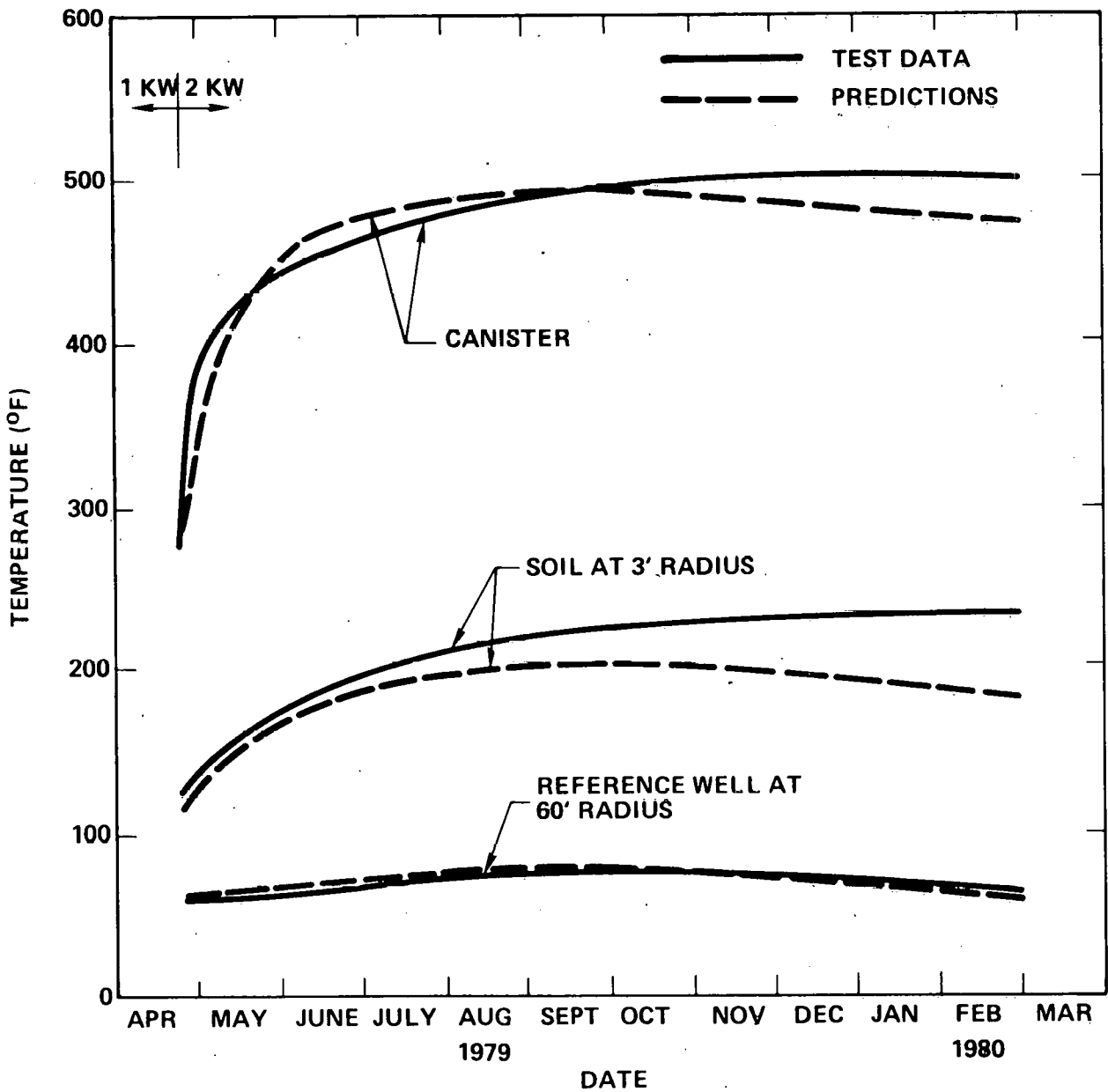
An effect of canister internal air circulation is that a temperature transient at one elevation on the canister can be a strong function of transients at other elevations. This is illustrated by a comparison of Figures 30 and 31. At the 3 foot depth, the measured canister temperature is in phase with the soil and reference well temperatures. However, at the 11 foot depth, the canister temperature actually appears to be phased ahead of the soil temperatures and is very nearly in phase with canister temperatures at the 3 foot depth. This strong link between canister temperatures at two different elevations is partly due to axial heat conduction which is included in the thermal model. However, as evidenced by the relatively slow response of the predicted canister temperatures during the last five months of the 1.0 kW period, modeling canister heat transfer by conduction alone is not sufficient to produce completely accurate results. Air circulation within the canister (and in the annular space between the canister and liner) should be taken into account.

Canister, soil and reference well temperatures for the 2.0 kW operating period are plotted in Figures 32 and 33. As with 1.0 kW operation, the soil and reference well predictions at the 3 foot depth are satisfactory, but the canister predictions lag the measurements during the 1.0 kW to 2.0 kW heatup period. Later in the 2.0 kW period, they respond more strongly than desired to seasonal effects. Again, both observed discrepancies are apparently related to canister air circulation effects. In the first case, the rapid canister temperature transient at the 3 foot depth is undoubtedly due to hot air currents rising from the electric heater assembly. These currents impinge directly on the underside of the canister closure lid while the thermocouple sensing canister temperature at the 3 foot depth is located on the lid's upper surface. It should be noted that the predicted canister temperature plots in Figures 32 and 33 have been normalized such that predicted temperatures and test data were in exact agreement at the beginning of the 2.0 kW test period. This facilitates comparing predictions and test data as well as explaining discrepancies between the April 1979 canister temperature predictions in Figures 30 and 32 and in Figures 31 and 33.



615671-17A

FIGURE 32. Soil Temperature Test Data and Predictions for the 3 Foot Depth During 2 kW Operation



615671-20A

FIGURE 33. Soil Temperature Test Data and Predictions for the 11 Foot Depth During 2 kW Operation

The second discrepancy (occurring at both the 3 and 11 foot depths) is also attributed to internal air circulation in the canister and is related again to the fact that seasonal temperature variations at a point on the canister are more strongly dependent upon soil and canister temperature variations at other depths than the present conduction-controlled thermal model allows. Therefore, while seasonal soil temperatures at a certain depth may be decreasing at a particular time, temperatures at another depth may still be rising. These competing effects are transmitted throughout the canister by the circulating air and they are factors in determining a local canister temperature and local soil temperature.

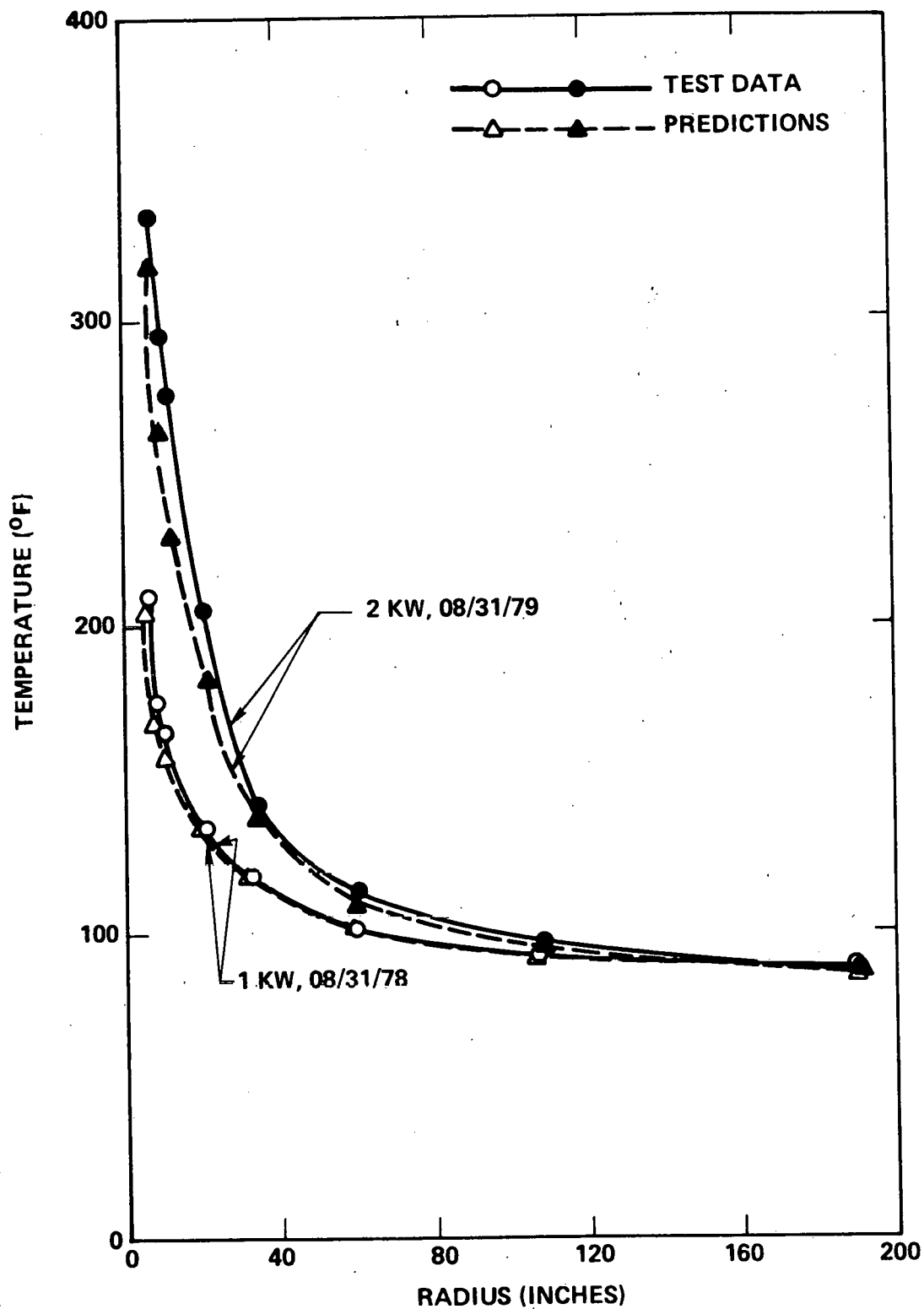
7.2.3 RADIAL TEMPERATURE PROFILES

Curves of temperature versus radius at three depths (3, 8, and 13 feet) are presented in Figures 34, 35, and 36 for 1.0 and 2.0 kW power operation and in Figures B-1, B-2, and B-3 for 3.0 kW accelerated heatup operation. At 1.0 kW and 2.0 kW, the plots apply to times when the effects of changing heater power level had for the most part disappeared, and any transient conditions would be due to seasonal variations. The 3.0 kW curves were taken from the last day of accelerated heatup when the power level transient effects were relatively strong.

The test data appearing in the curves were taken from canister, liner and grout thermocouples and from soil region thermocouples in instrumentation wells 2 through 6 (see Figures 7 and A-1). The thermal model predictions at nodes corresponding to the thermocouple locations are in close agreement with the test data. In addition, temperature differentials between canister and liner, liner and grout, grout and soil, etc., and are predicted accurately.

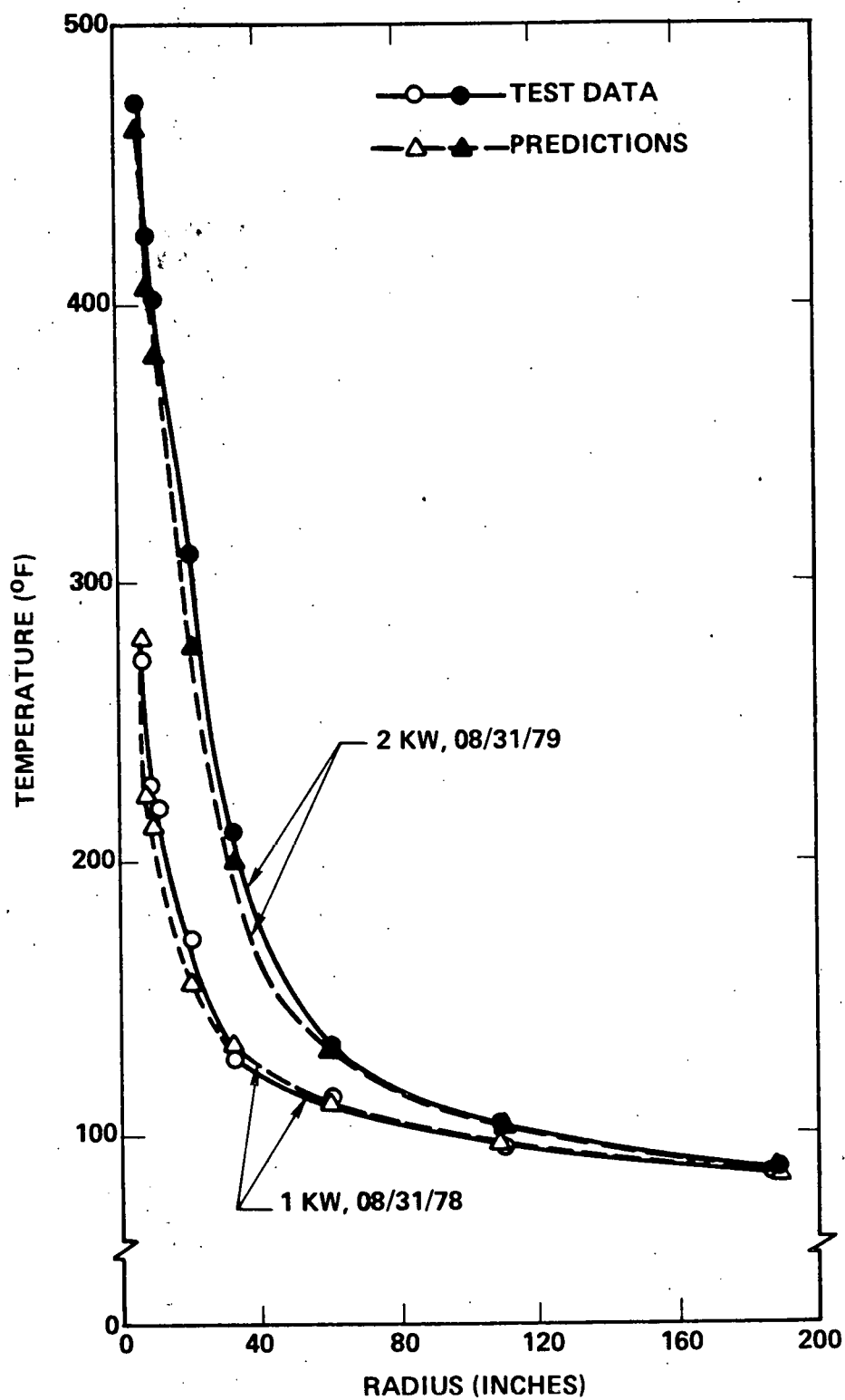
7.2.4 SOIL AXIAL TEMPERATURE PROFILES

Figures 37, 38, and 39 present comparisons of grout and soil temperature measurements and predictions. The grout thermocouples are supported off the liner at the 10.8 inch radius and soil thermocouples are located at the 21 and 60 inch radii. Data are included in the figures for the 1.0 kW and 2.0 kW



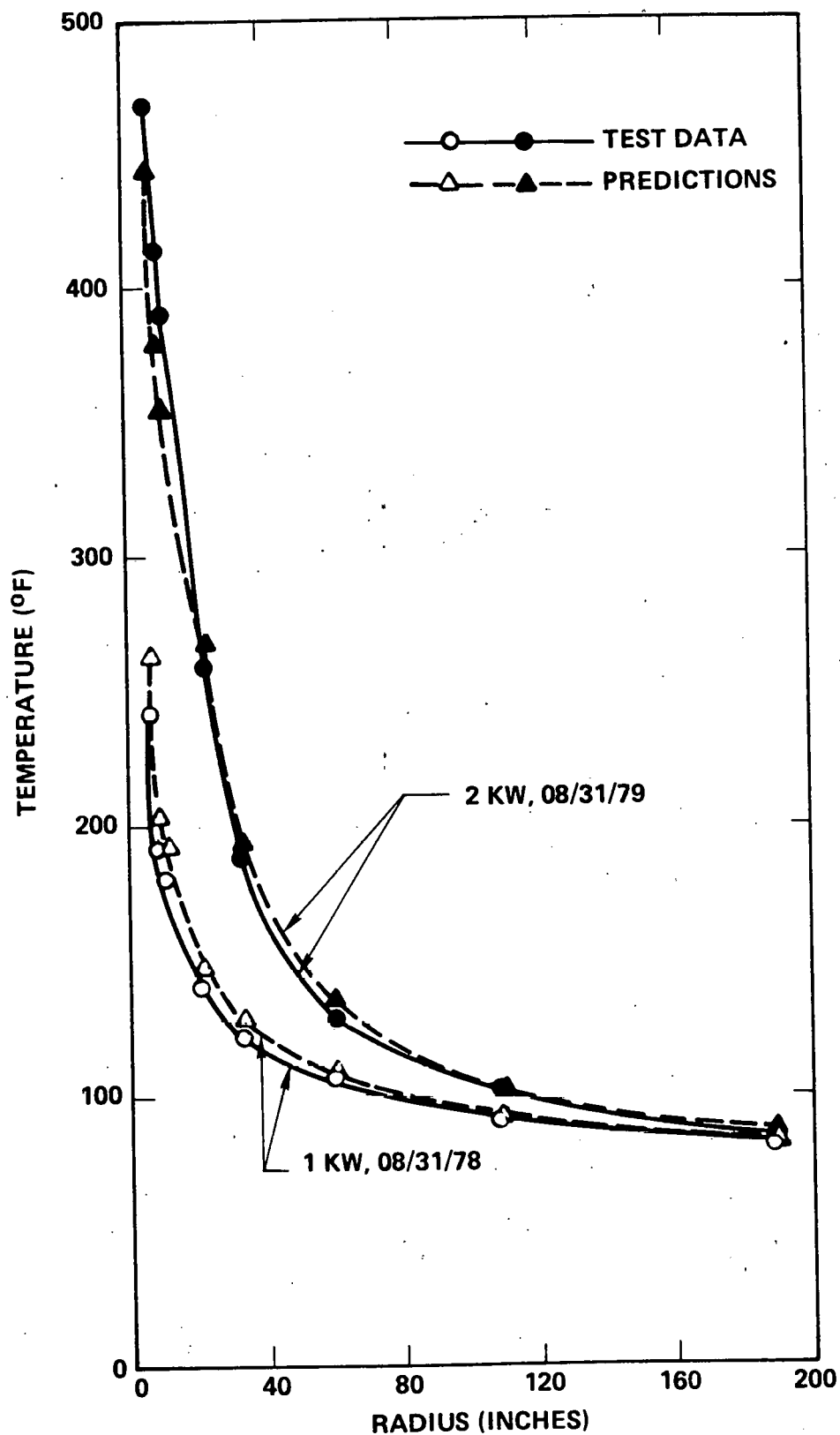
615671-12A

FIGURE 34. Radial Temperature Profile Comparison for the 3 Foot Depth During 1 kW and 2 kW Operation



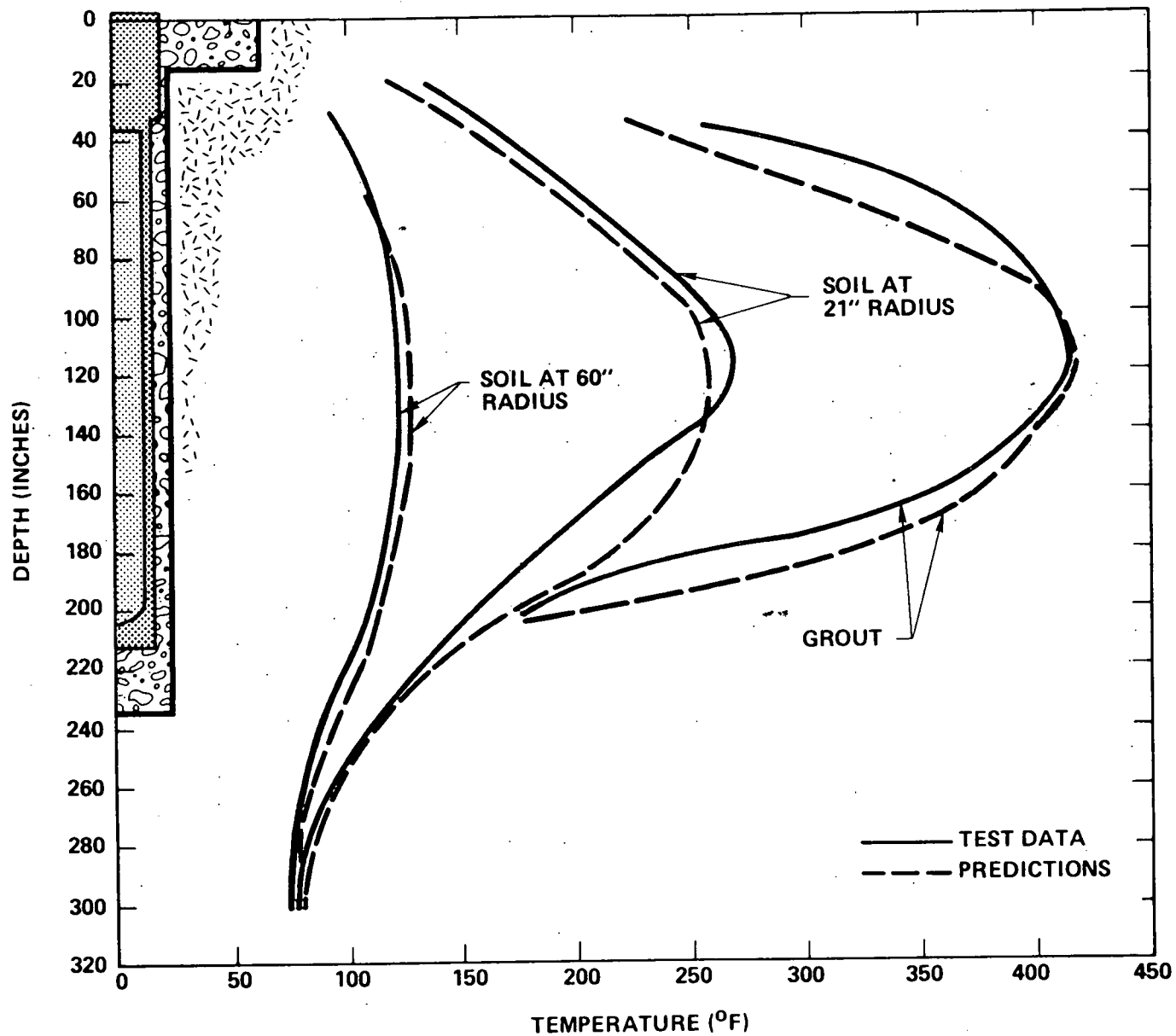
615671-9A

FIGURE 35. Radial Temperature Profile Comparison for the 8 Foot Depth During 1 kW and 2 kW Operation



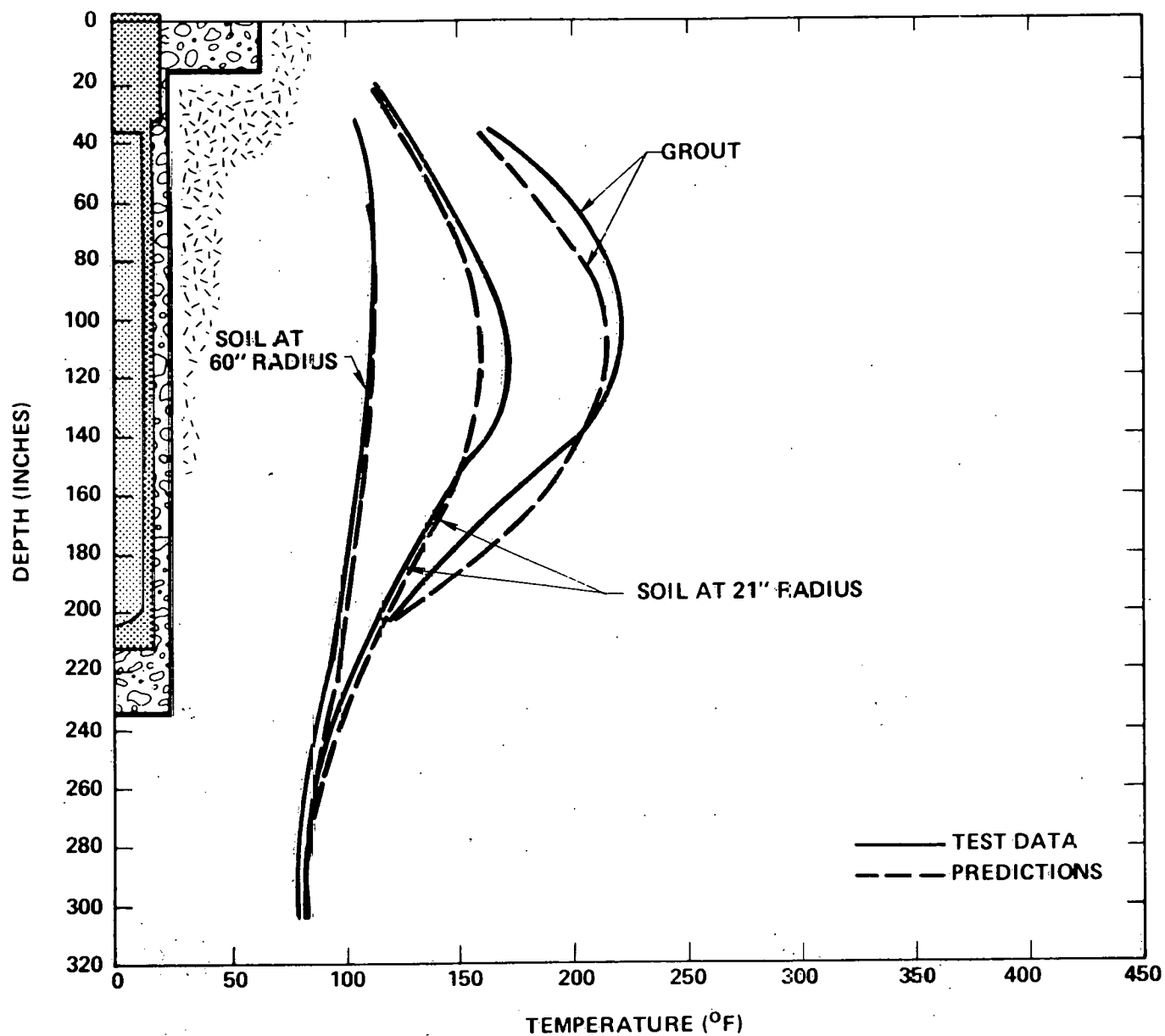
615671-11A

FIGURE 36. Radial Temperature Profile Comparison for the 13 Foot Depth During 1 kW and 2 kW Operation



E15671-15A

FIGURE 37. Axial Temperature Profile Comparison in Grout and Soil During 3 kW (Accelerated Heatup) Operation, April 30, 1978



615671-14A

FIGURE 38. Axial Temperature Profile Comparison in Grout and Soil During 1 kW Operation, August 31, 1978

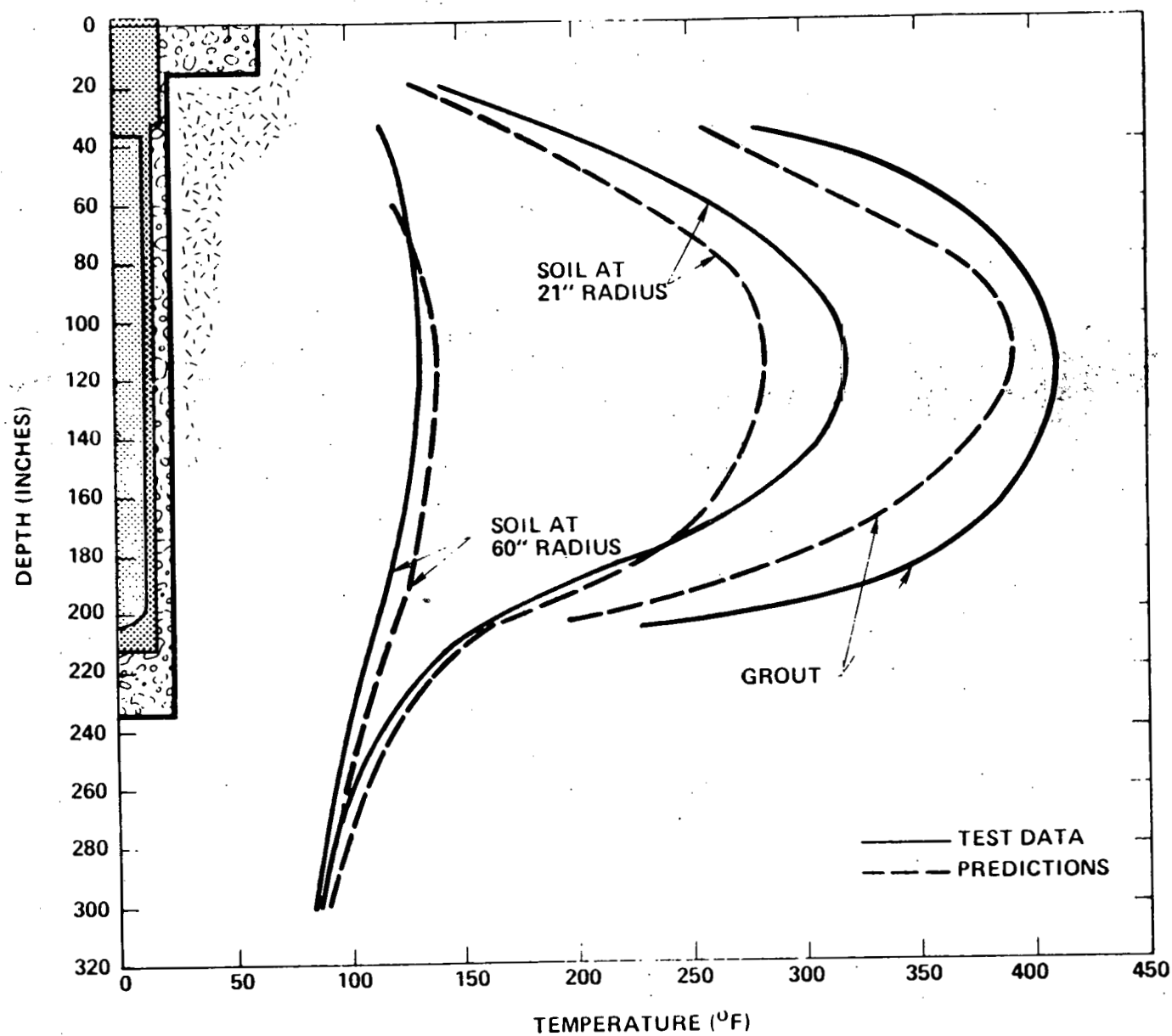


FIGURE 39. Axial Temperature Profile Comparison in Grout and Soil During 2 kW Operation, August 31, 1979

power levels as well as for the accelerated heatup period. Generally, the agreement between data and predictions is good, and it demonstrates the ability of the thermal model to predict both near-field and far-field temperature distributions.

7.2.4 CONCLUSIONS FROM MODEL/DATA COMPARISON

The Soil Temperature Test thermal model as described in this report does a fairly good job of predicting electrically heated drywell peak temperatures and transient temperature trends. However, the accuracy of canister and liner temperature predictions was found to be influenced by the modeling of heat transfer mechanisms inside the drywell and out in the soil. The two areas where additional verification and/or model refinement is needed are the effects of free convection and radiation inside the canister and between canister and liner, and the effects of in-situ soil thermal conductivity changes with temperature. Test data and prediction evaluations show that canister and liner temperature predictions both above and below the midplane level are sensitive to these effects.

Free convection effects of air inside the test canister and to a lesser extent between canister and liner were assumed to have caused a nonuniform axial heat flux profile which peaks near the canister's upper end. Due to computer code limitations, free convection effects were modeled by imposing a skewed axial heater assembly heat generation rate rather than by using mass flow dependent temperature calculations between heater, canister and liner. In addition, the tendency of radiation to be the dominant heat transfer mechanism between the heater and canister at higher temperatures was not included in the model. A more accurate method of modeling heat transfer inside the canister should be developed which includes both free convection and radiation effects over the entire range of heater power output and canister temperatures. In this way, model prediction agreement with test data for the entire drywell could be improved.

The relationship of soil conductivity to temperature utilized in the thermal model was found to have a significant effect on drywell and soil temperature

prediction agreement with test data. The soil conductivity values used in the model were based on correlations from literature for comparable soils and from an analytical evaluation of soil temperature data rather than the Soil Properties Test data conducted at E-MAD. Initial model analyses using the Soil Properties Test conductivity data overpredicted test canister temperatures. Moisture variations in the soil samples tested and in the soil itself are judged to cause the differences in soil thermal conductivity. A more accurate relationship of "in-situ" thermal conductivity for the range of moisture levels and soil temperatures around the drywell should improve overall drywell and soil temperature prediction agreement with test data for both transient and thermal stabilization conditions.

7.3 COMPARISON OF DRYWELL THERMAL RESPONSE

The thermal response of the Soil Temperature Test drywell at thermal stabilization was different for 2.0 kW heater power output from that for 1.0 kW. A comparison of canister and liner temperature distributions derived from the test data for the two power levels reveals a marked difference between axial profiles. These differences in axial profiles can be explained by the heat transfer mechanisms involved inside the canister and out in the soil.

Canister and liner axial temperature profiles for 1.0 kW and 2.0 kW power levels are shown in Figures 10 and 13, respectively with a comparison of canister profiles shown in Figure B-4. Above the canister midplane, the test data show that a doubling of the power level caused a corresponding factor of 2 increase in the differential between canister temperatures and ambient temperature (measured at thermocouple reference well - see Figures 16 and 19). Below the midplane, the differentials increased by factors greater than 2.0 and as high as 3.5 at the lower end of the canister. The location of the minimum canister temperature shifted from the bottom end (for 1.0 kW) to the top end of the canister (for 2.0 kW). The profile for 2.0 kW is much flatter over the canister's heated length (varying from the peak by about 10 percent) than that for 1.0 kW.

The differences in the canister profiles can be related to the temperatures of

the canister and soil surrounding the drywell. As discussed in Section 6.2.4, the free convection effects of air inside the canister were believed to cause the canister heat flux shape (and resultant temperature profile) to be skewed towards the top of the canister. The power increase from 1.0 kW to 2.0 kW raised the canister peak temperature to about 500°F and the liner peak temperature to about 400°F. At these higher temperatures, heat transfer by radiation becomes dominant over free convection and tends to flatten the heat flux shape. In addition to internal canister effects, the increase in heater power level caused more of the soil below the drywell to be heated above 200°F causing that soil to dry out (the extent of soil effected can be seen by comparing the soil isotherms shown in Figures 11 and 14). Once the soil was dry, its thermal conductivity decreased resulting in a rise in canister and liner temperatures. Figures B-5 and B-6 illustrate canister and liner axial temperature profile changes during 2.0 kW power operation. As shown in these figures, the temperatures of the canister and liner lower end increased at a faster rate than the canister midplane until the entire drywell area reached thermal stabilization.

8.0 REFERENCES

1. NVO-198, Safety Assessment Document for the Spent Fuel Handling and Packaging Program Demonstration at the Nevada Test Site, U. S. Department of Energy, December 1978.
2. WANL-TME-1872, Pierce, B. L., and Stumpf, H. J., "TAP-A Program for Computing Transient or Steady-State Temperature Distributions," Westinghouse Astronuclear Laboratory (now Advanced Energy Systems Division), December, 1969.
3. Duffie, J. A., and Beckman, W. A., "Solar Energy Thermal Processes," Wiley & Sons, Inc., 1974.
4. Kreith, F., and Kreider, J. F., "Principles of Solar Engineering," Hemisphere Publishing Co., 1978.
5. Eckert, E.R., and Drake, R. M., Jr., "Heat and Mass Transfer," Second Edition, McGraw-Hill Book Co., Inc., 1959.
6. Mark's Mechanical Engineers Handbook, McGraw-Hill Book Co., 6th Edition, 1958.
7. Kreith, F., "Principles of Heat Transfer," Scranton International Textbook Co., 1958.
8. ASHRAE Handbook and Product Directory, 1978 Applications Volume, p. 12.5, American Society of Heating, Refrigeration and Air Conditioning Engineers Inc.
9. Blackwell, J. H., "A Transient-Flow Method for Determination of Thermal Constants of Insulating Materials in Bulk," Journal of Applied Physics, Volume 25, No. 2, February, 1954, pp. 137-144.
10. Marovelli, R. L., and Veith, K. F., "Thermal Conductivity of Rock: Measurement by the Transient Line Source Method," U. S. Dept. of the Interior, Bureau of Mines, Report of Investigations 6604, 1964.
11. Gemant, A., "How to Compute Thermal Soil Conductivity," Heating, Piping and Air Conditioning, January 1952, pp. 122-123.
12. McAdams, W. H., "Heat Transmission," McGraw-Hill Book Co., Third Edition, 1954.
13. Rohsenow, W. M., and Hartnett, J. P., "Handbook of Heat Transfer," McGraw-Hill Book Co., 1972.
14. DOE/NV/00597-4, "Spent Fuel Dry Storage Technology Development: Fuel Temperature Measurements Under Imposed Dry Storage Conditions," Westinghouse Advanced Energy Systems Division, September 1980.

APPENDIX A

SOIL TEMPERATURE TEST HARDWARE AND INSTALLATION

This Appendix provides additional illustrations of the Soil Temperature Test hardware and installation. Table A-1 and Figures A-1 and A-19 provide detailed information on the location of canister, liner, grout, and soil thermocouples. Figures A-2 through A-18 show photographs taken during the construction, assembly, and installation of the Soil Temperature Test.

TABLE A-1
SOIL TEMPERATURE TEST THERMOCOUPLE LOCATIONS

<u>T/C No.</u>	<u>Radius (In.)</u>	<u>Orientation (Degrees)</u>	<u>Depth Below Ground Level (Inches)</u>	<u>Location</u>
001	0	-	-2.4	On Bottom of Drywell Cover Plate
002	0.7	180	0.0	On Top Plate of Plug
003	0.7	180	7.9	7.6" Below Top of Concrete, Inside Plug
004	0.7	180	20.0	19.7" Below Top of Concrete, Inside Plug
005	0.7	180	28.2	27.9" Below Top of Concrete, Inside Plug
006	9.7	135	0.0	On Plug Liner, At Top Plate
007	9.7	135	7.9	On Plug Liner, 7.6" Below Top of Concrete
008	9.7	135	20.0	On Plug Liner, 19.7" Below Top of Concrete
009	9.7	135	28.2	On Plug Liner, 27.9" Below Top of Concrete
010	8.0	135	34.3	On Outside of Plug, 36.4" Below Top of Plug
011	8.0	135	39.7	On Outside of Plug, 41.8" Below Top of Plug
012	0	-	36.6	Center of Canister Lid
013	6.8	135	36.6	Top Rim of Canister
014	7.0	0	66.1	Side of Canister, 29.5" Below Top of Canister
015	7.0	135	66.1	Side of Canister, 29.5" Below Top of Canister
016	7.0	0	96.6	Side of Canister, 60.0" Below Top of Canister
017	7.0	90	96.6	Side of Canister, 60.0" Below Top of Canister
018	7.0	180	96.6	Side of Canister, 60.0" Below Top of Canister
019	7.0	270	96.6	Side of Canister, 60.0" Below Top of Canister
020	7.0	0	127.0	Side of Canister, 90.4" Below Top of Canister
021	7.0	180	157.4	Side of Canister, 120.8" Below Top of Canister
022	7.0	180	187.8	Side of Canister, 151.2" Below Top of Canister
023	7.0	315	187.8	Side of Canister, 151.2" Below Top of Canister
024	0	-	203.1	Center of Canister Bottom Cap
025	10.4	45	-1.2	On Liner, 1.2" Below Top of Liner
026	10.4	0	6.4	On Liner, 8.8" Below Top of Liner
027	10.4	0	19.8	On Liner, 22.2" Below Top of Liner
028	10.4	0	28.2	On Liner, 30.6" Below Top of Liner
029	9.0	0	39.7	On Liner, 42.1" Below Top of Liner
030	9.0	0	65.8	On Liner, 68.2" Below Top of Liner
031	9.0	0	96.3	On Liner, 98.7" Below Top of Liner
032	9.0	90	96.3	On Liner, 98.7" Below Top of Liner
033	9.0	180	96.3	On Liner, 98.7" Below Top of Liner
034	9.0	270	96.3	On Liner, 98.7" Below Top of Liner
035	9.0	0	126.7	On Liner, 129.1" Below Top of Liner
036	9.0	0	157.1	On Liner, 159.5" Below Top of Liner
037	9.0	0	187.5	On Liner, 189.9" Below Top of Liner
038	9.0	0	207.2	On Liner, 209.6" Below Top of Liner
039	8.0	0	212.3	On Liner Bottom Plate
040	0	-	212.3	Center of Liner Bottom Plate

TABLE A-1 (CONTD.)

<u>T/C No.</u>	<u>Radius (In.)</u>	<u>Orientation (Degrees)</u>	<u>Depth Below Ground Level (Inches)</u>	<u>Location</u>
041	15.5	315	6.4	In Concrete Pad, 6.4" Below Top Surface
042	15.5	315	19.8	Below Pad, 19.8" Below Top Surface
043	15.5	315	30.2	Below Pad, 30.2" Below Top Surface
044	10.8	315	39.7	Supported Off Liner, 42.1" Below Top of Liner
045	10.8	315	65.8	Supported Off Liner, 68.2" Below Top of Liner
046	10.8	315	96.3	Supported Off Liner, 98.7" Below Top of Liner
047	10.8	315	126.7	Supported Off Liner, 129.1" Below Top of Liner
048	10.8	315	157.1	Supported Off Liner, 159.5" Below Top of Liner
049	10.8	315	187.5	Supported Off Liner, 189.9" Below Top of Liner
050	10.8	315	207.2	Supported Off Liner, 209.6" Below Top of Liner

INSTRUMENTATION WELLS

051	21	240	1.0" Below Ground Level*
052	21	240	7.6" Below Ground Level
053	21	240	19.8" Below Ground Level
054	21	240	40.9" Below Ground Level
055	21	240	68.2" Below Ground Level
056	21	240	98.6" Below Ground Level
057	21	240	129.0" Below Ground Level
058	21	240	159.4" Below Ground Level
059	21	240	189.8" Below Ground Level
060	21	240	213.2" Below Ground Level
061	21	240	229.7" Below Ground Level
062	21	240	253.7" Below Ground Level
063	21	240	301.7" Below Ground Level
064	33	210	1.0" Below Ground Level
065	33	210	7.6" Below Ground Level
066	33	210	30.2" Below Ground Level
067	33	210	40.9" Below Ground Level
068	33	210	68.2" Below Ground Level
069	33	210	98.6" Below Ground Level
070	33	210	129.0" Below Ground Level
071	33	210	159.4" Below Ground Level
072	33	210	189.8" Below Ground Level
073	33	210	219.2" Below Ground Level
074	60	180	1.5" Below Ground Level
075	60	180	12.1" Below Ground Level
076	60	180	34.9" Below Ground Level

*Reference ground level is 2.4" below top rim of liner.

TABLE A-1 (CONTD.)

<u>T/C No.</u>	<u>Radius (In.)</u>	<u>Orientation (Degrees)</u>	<u>Location</u>
077	60	180	60.7" Below Ground Level
078	60	180	91.1" Below Ground Level
079	60	180	121.5" Below Ground Level
080	60	180	151.9" Below Ground Level
081	60	180	182.3" Below Ground Level
082	60	180	219.2" Below Ground Level
083	60	180	253.7" Below Ground Level
084	60	180	301.7" Below Ground Level
085	108	155	1.5" Below Ground Level
086	108	155	12.1" Below Ground Level
087	108	155	34.9" Below Ground Level
088	108	155	60.7" Below Ground Level
089	108	155	91.1" Below Ground Level
090	108	155	121.5" Below Ground Level
091	108	155	151.9" Below Ground Level
092	108	155	200.1" Below Ground Level
093	189	130	1.5" Below Ground Level
094	189	130	12.1" Below Ground Level
095	189	130	34.9" Below Ground Level
096	189	130	60.7" Below Ground Level
097	189	130	91.1" Below Ground Level
098	189	130	121.5" Below Ground Level
099	189	130	151.9" Below Ground Level

REFERENCE WELL

101	720 (60 ft)	30	6.0" Below Ground Level
102	720 (60 ft)	30	18.0" Below Ground Level
103	720 (60 ft)	30	36.0" Below Ground Level
104	720 (60 ft)	30	60.0" Below Ground Level
105	720 (60 ft)	30	96.0" Below Ground Level
106	720 (60 ft)	30	132.0" Below Ground Level
107	720 (60 ft)	30	192.0" Below Ground Level
108	720 (60 ft)	30	252.0" Below Ground Level
109	720 (60 ft)	30	312.0" Below Ground Level

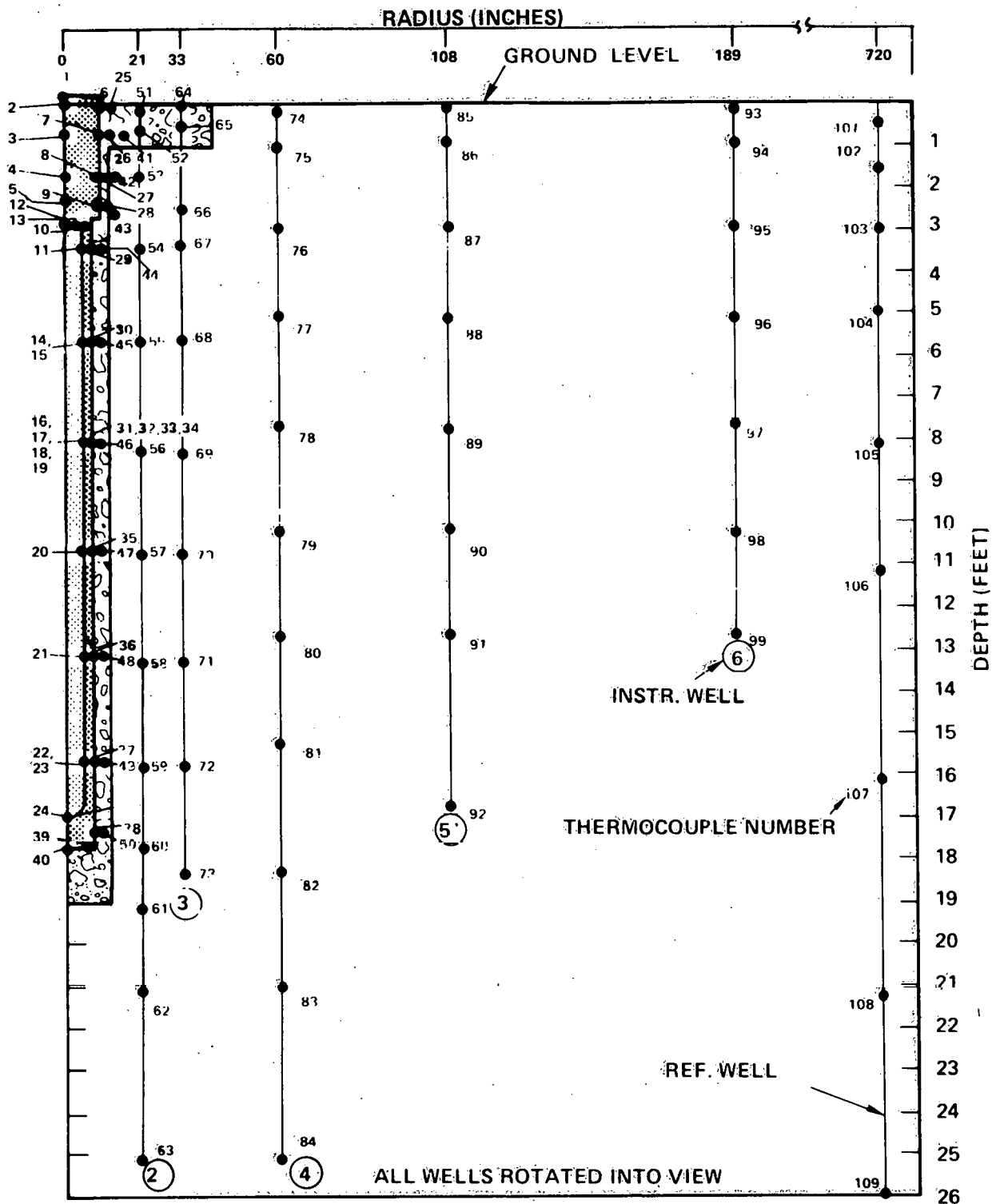


FIGURE A-1. Identification and Location of Thermocouples

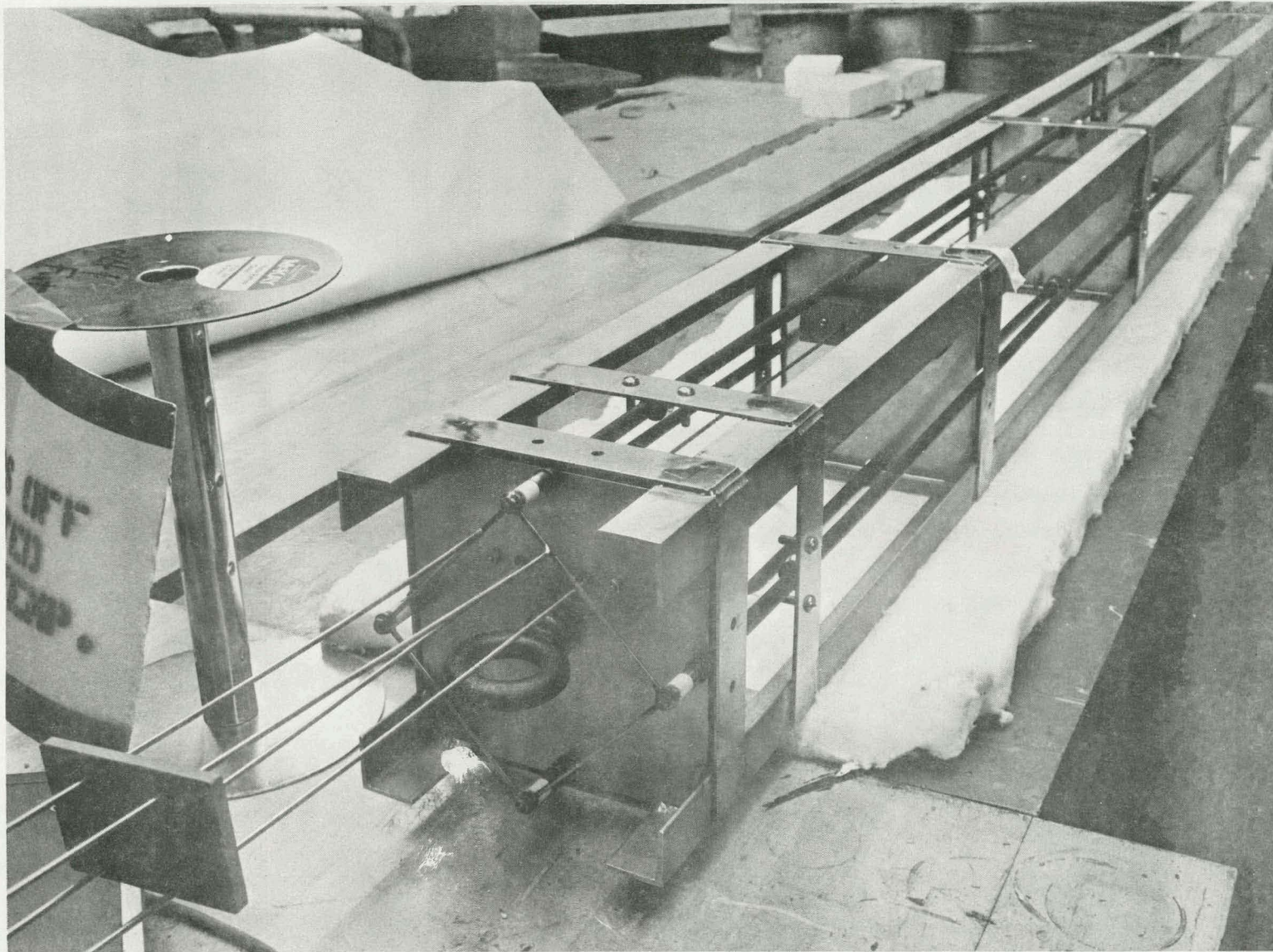


FIGURE A-2. Electric Heater Assembly

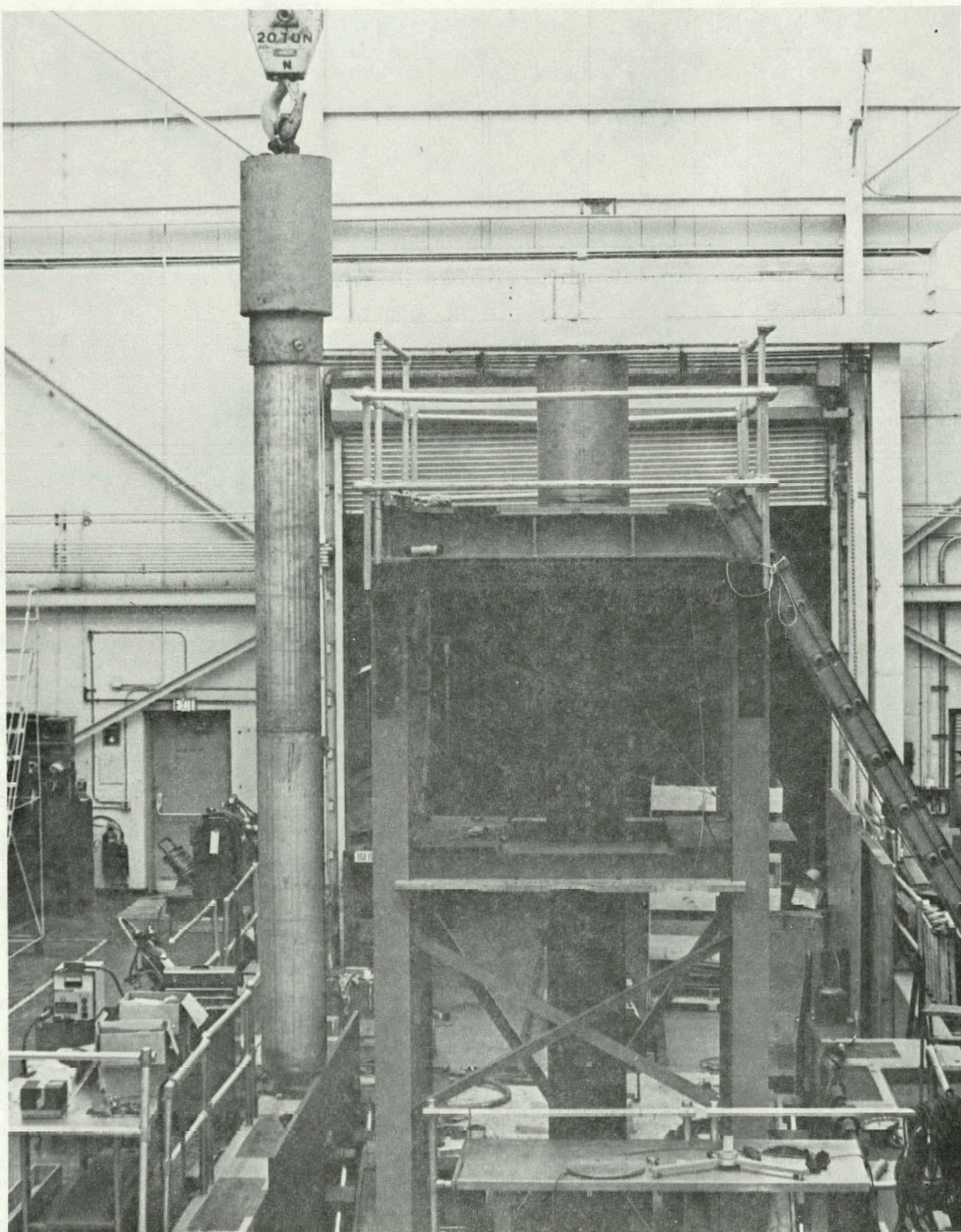


FIGURE A-3. Canister Assembly Prior to Fitup with Liner

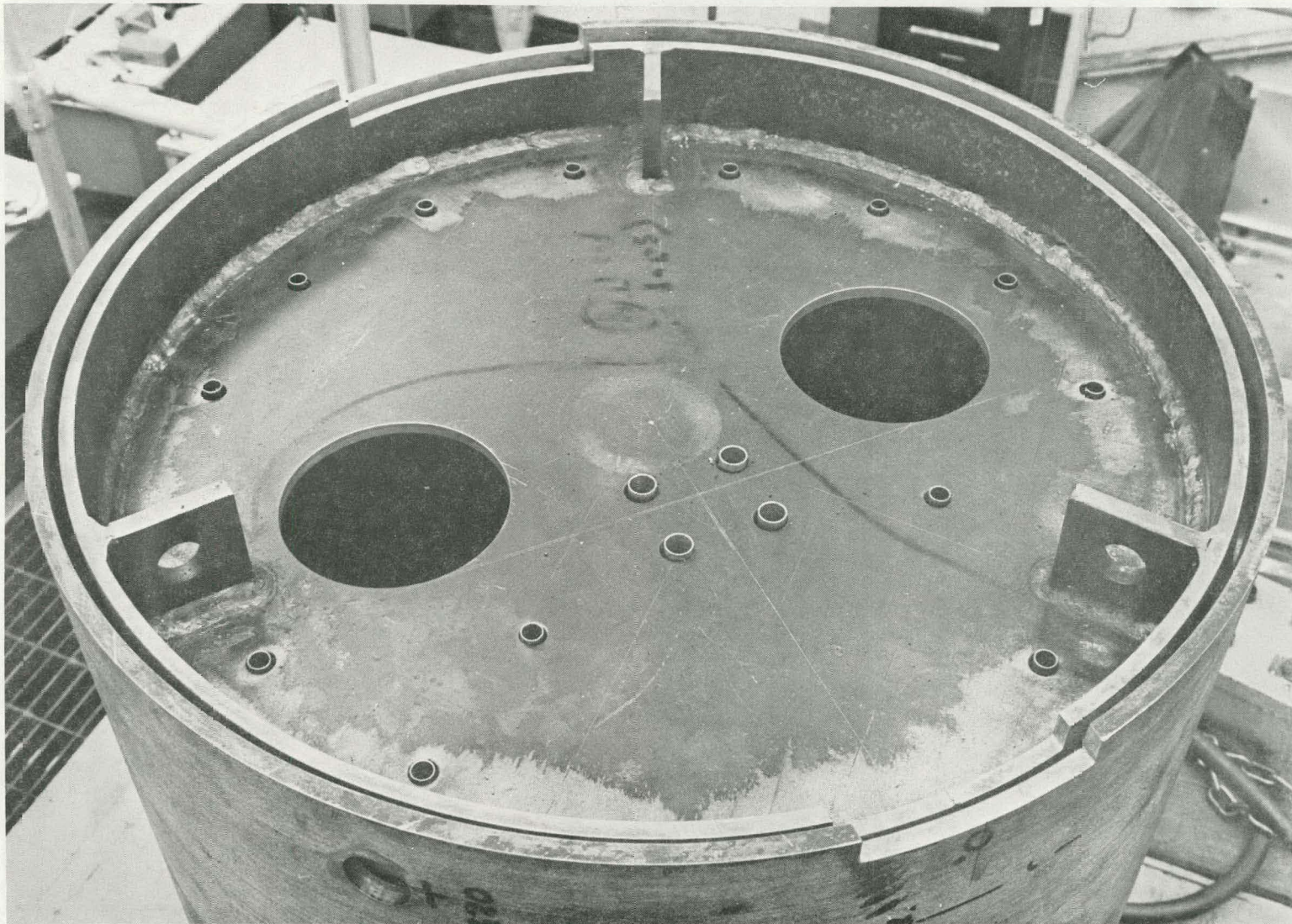


FIGURE A-4. Top View of Canister Assembly Shield Plug Fitup Inside Liner

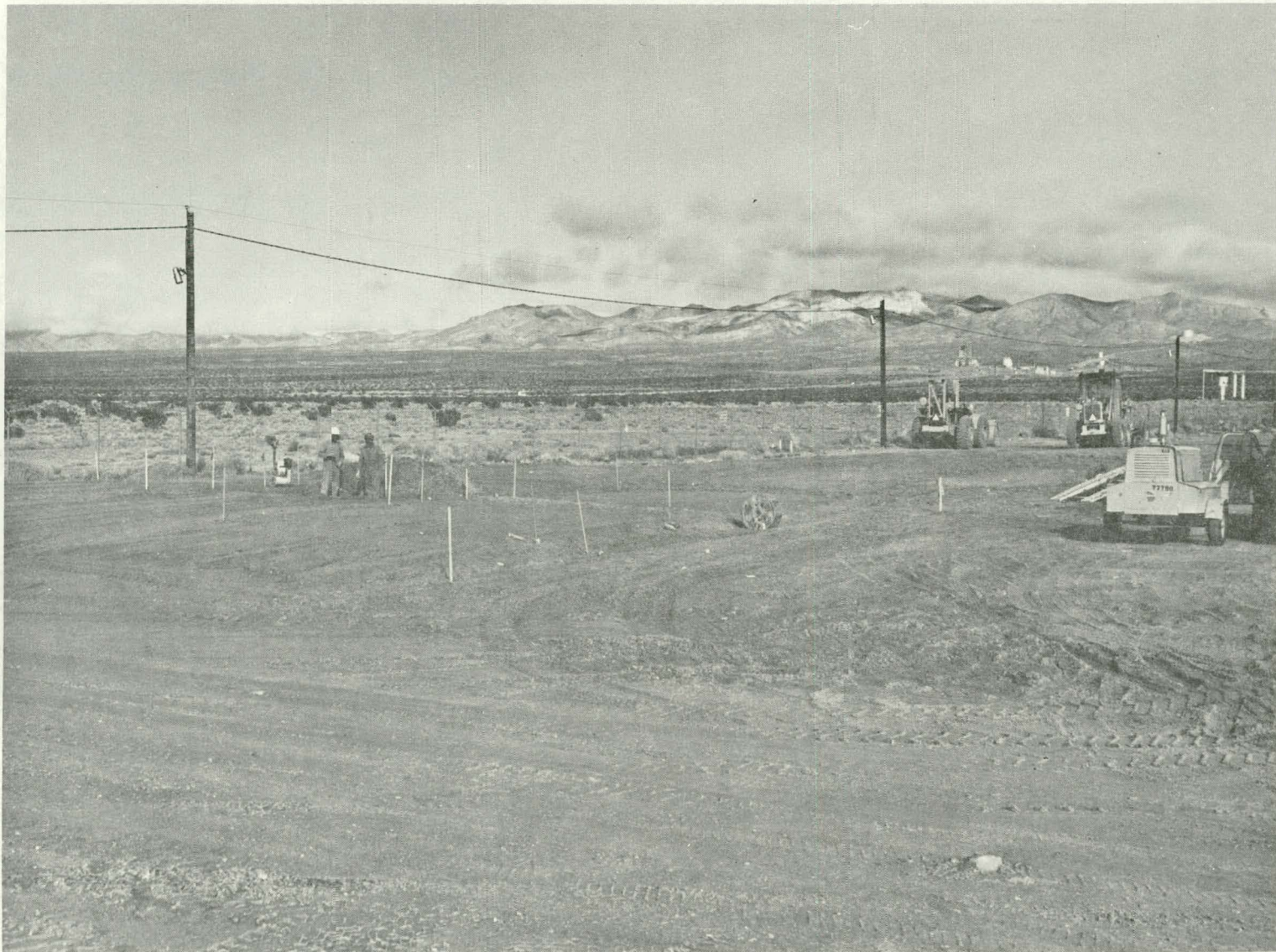


FIGURE A-5. Grading Completed and Pad Forming Started for Soil Temperature Test

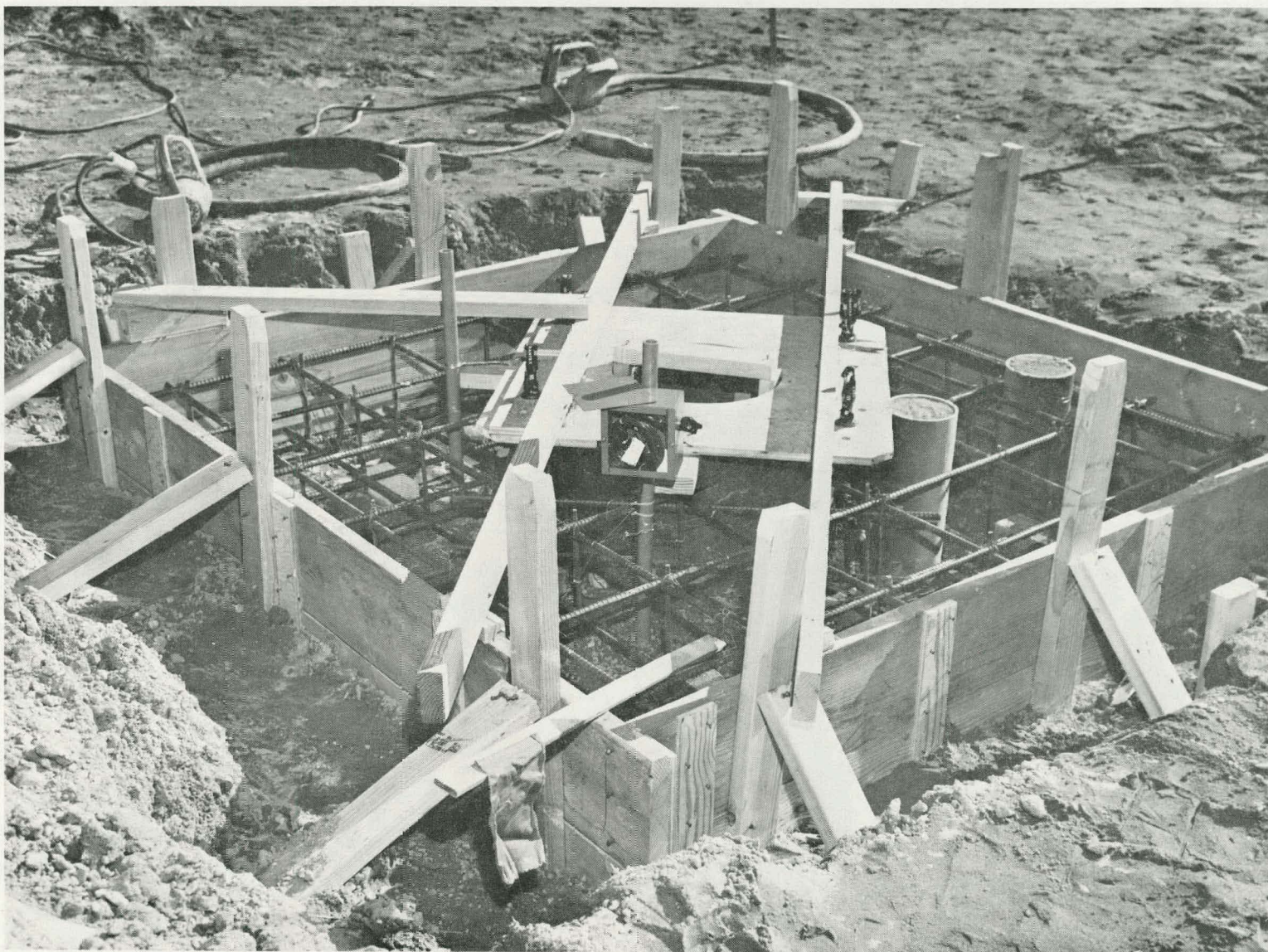


FIGURE A-6 . Pouring of Pad, Half Complete

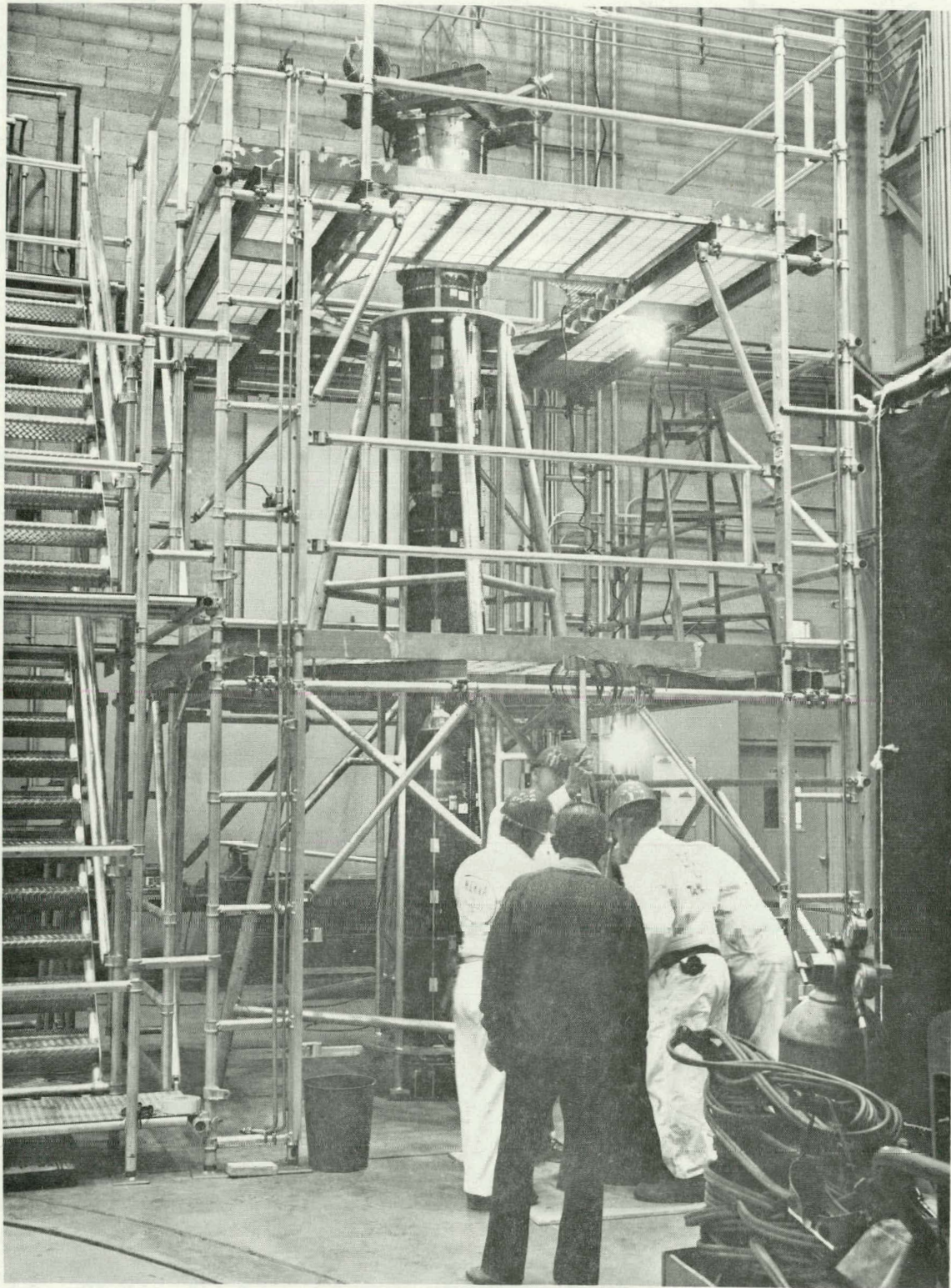


FIGURE A-7, Thermocouples Installed on Liner

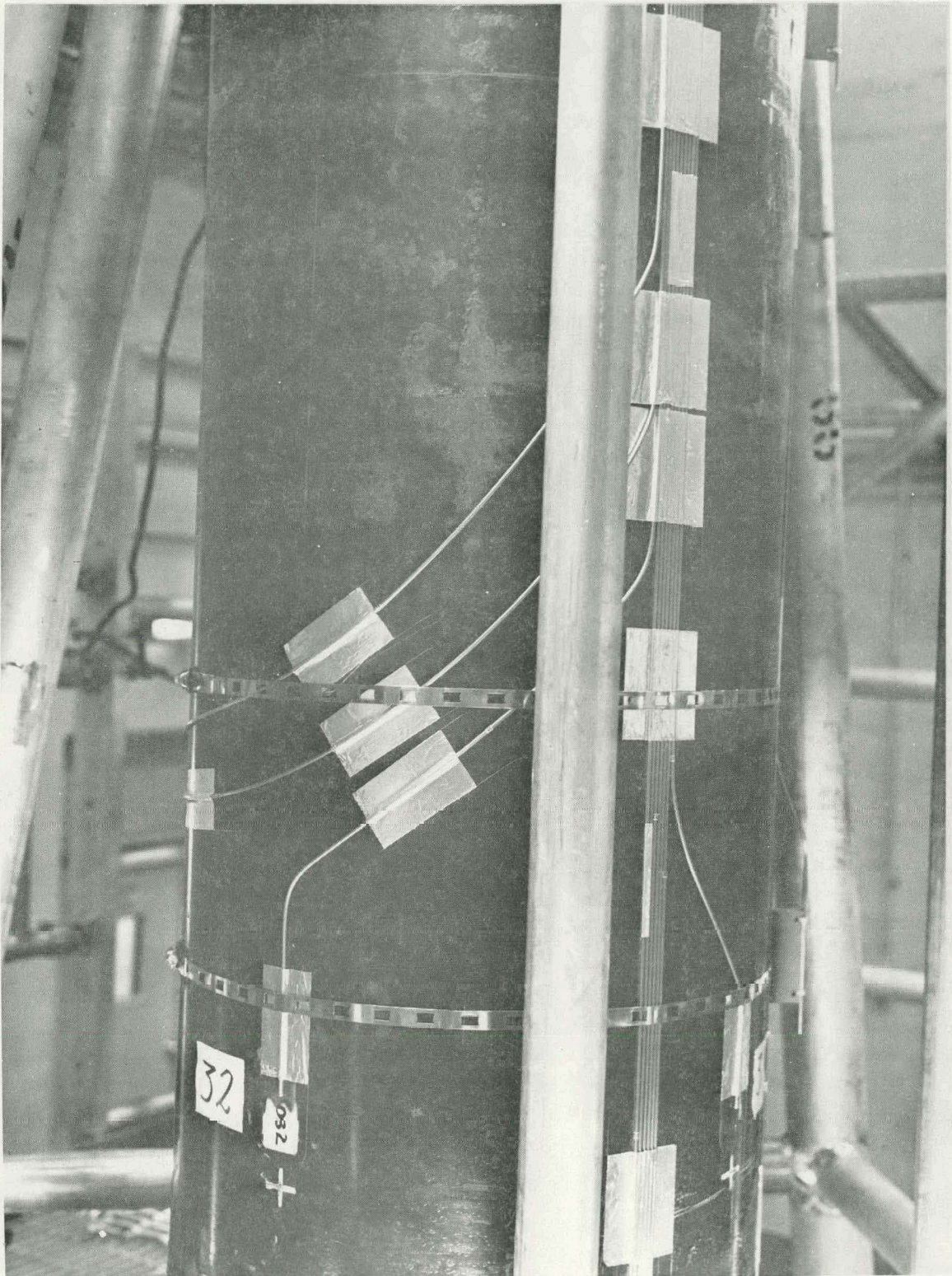


FIGURE A-8. Thermocouple Bead Routing on Liner

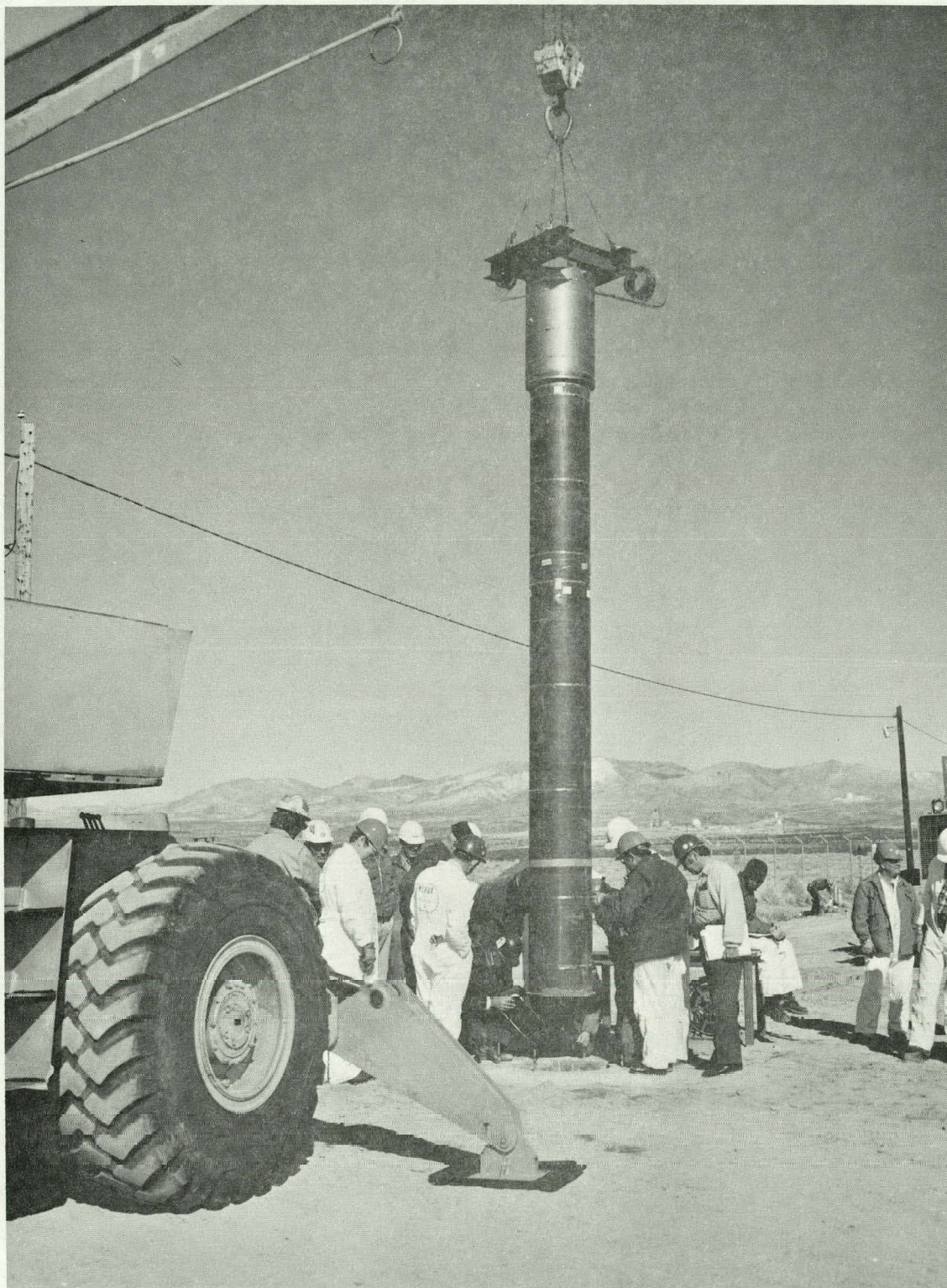


FIGURE A-9. Positioning Liner Over Hole



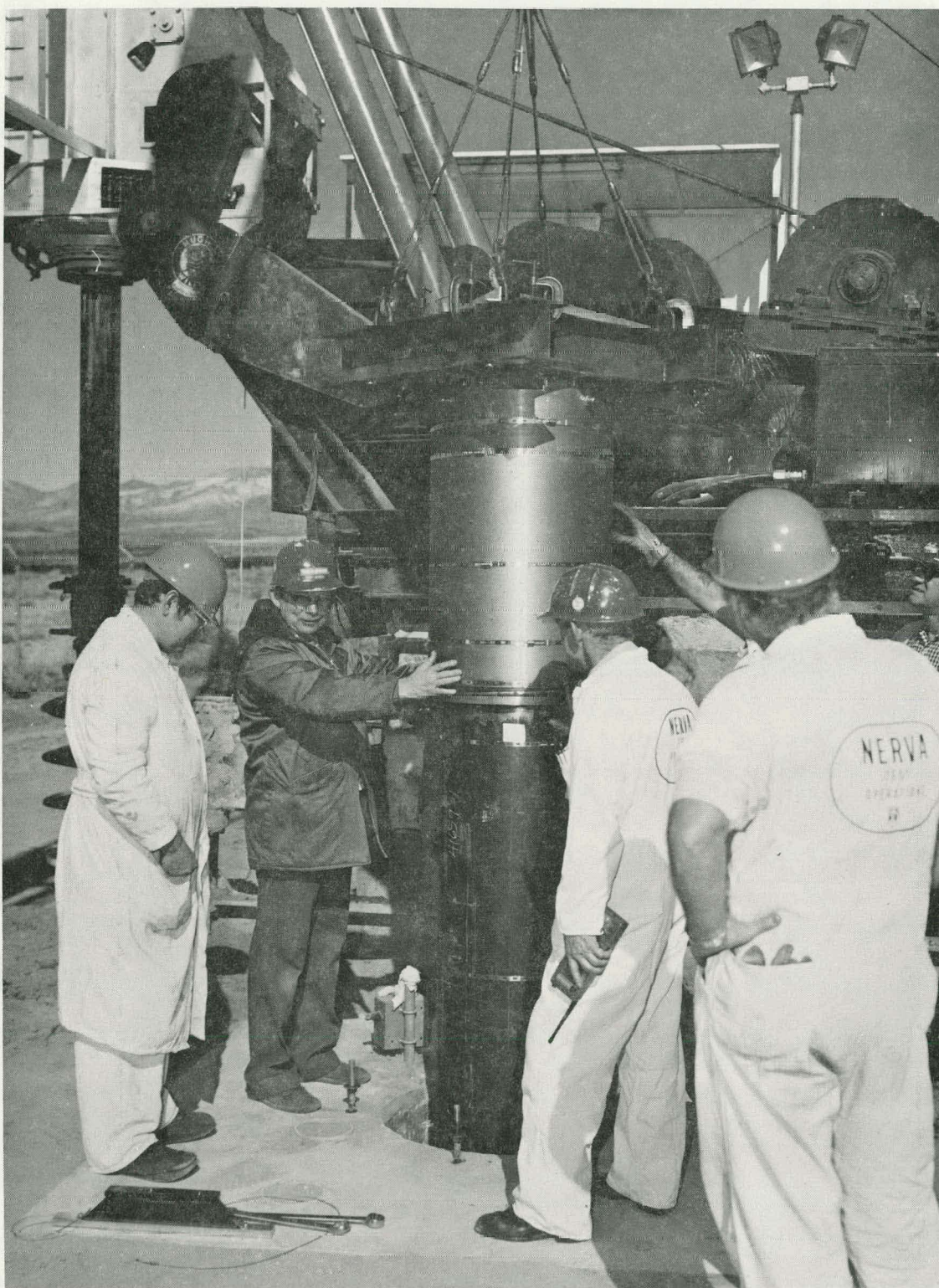


FIGURE A-10. . Liner Three-Quarters Installed

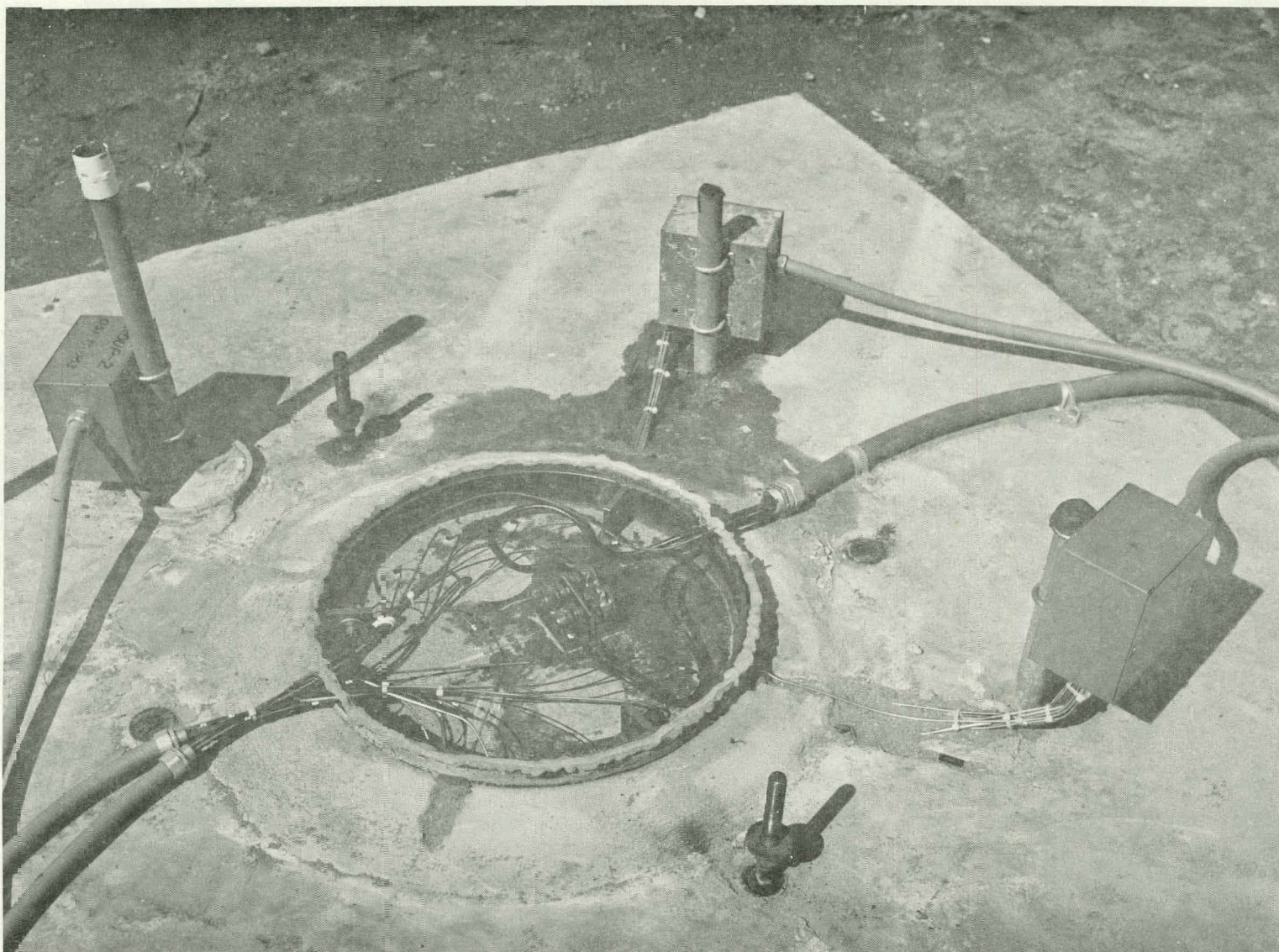


FIGURE A-11. Top of Soil Temperature Test Shield Plug, Liner & Three Thermocouple Wells

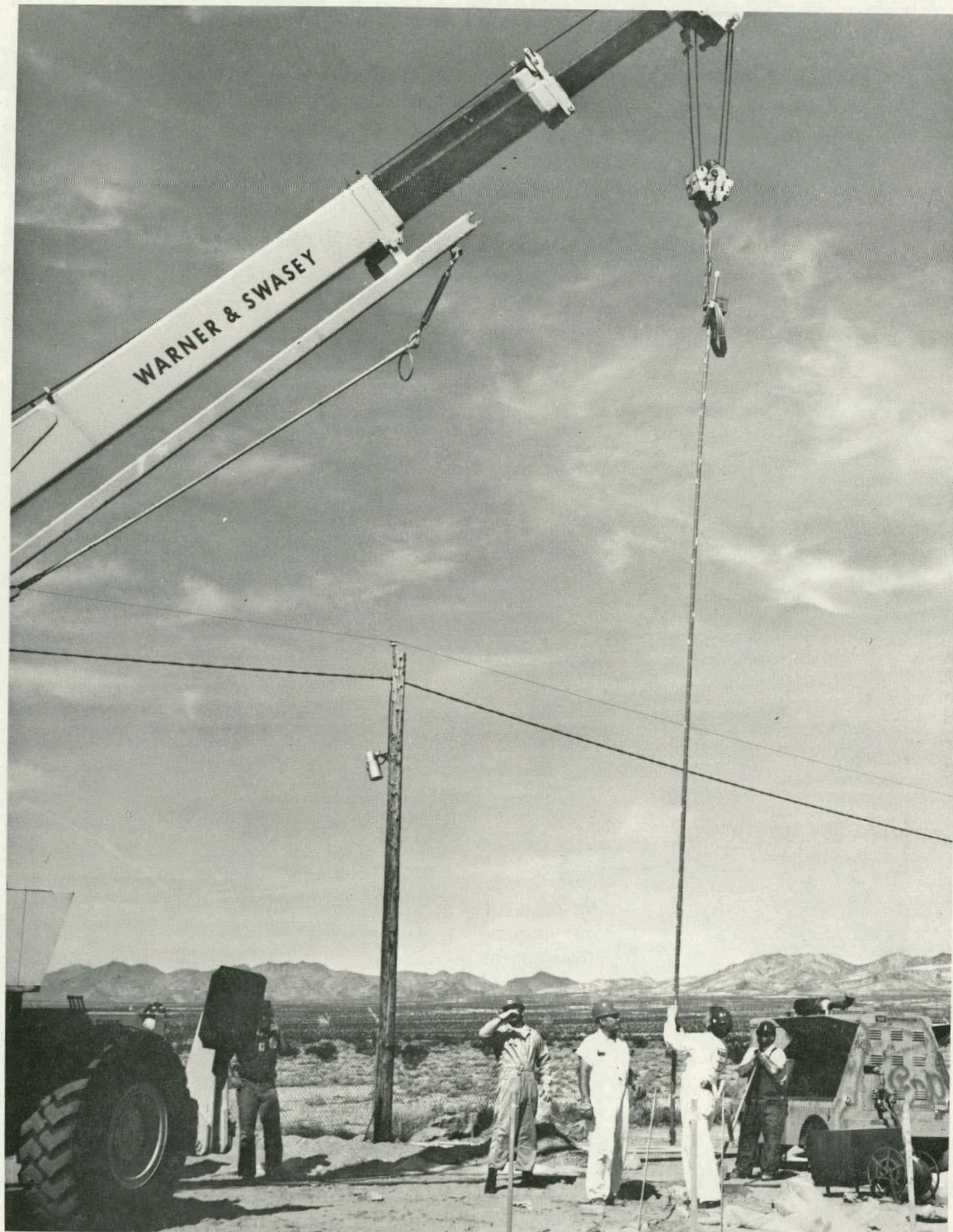


FIGURE A-12. Thermocouple Well Suspended Over Hole

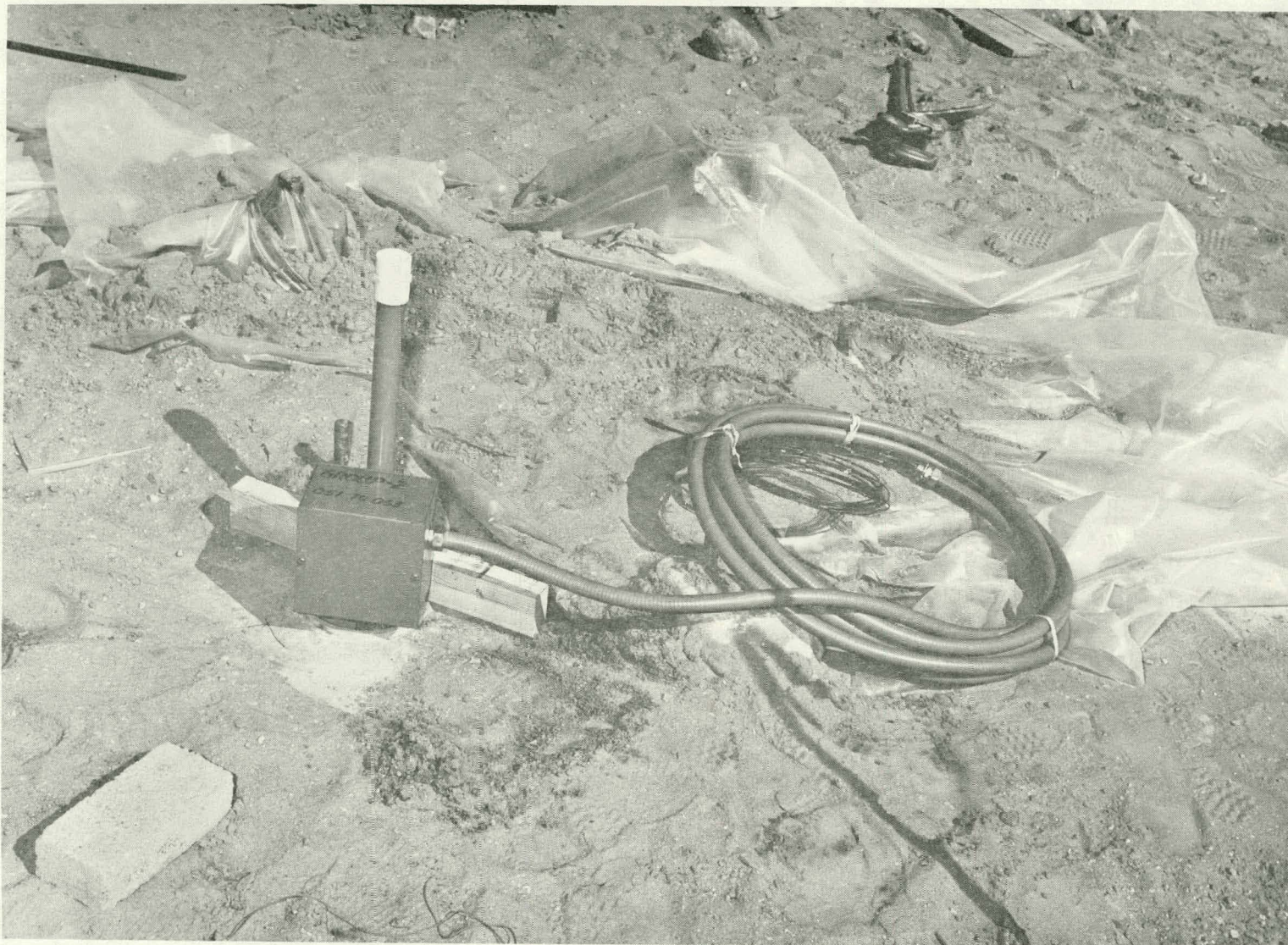


FIGURE A-13. Thermocouple Well Fully Installed in Hole

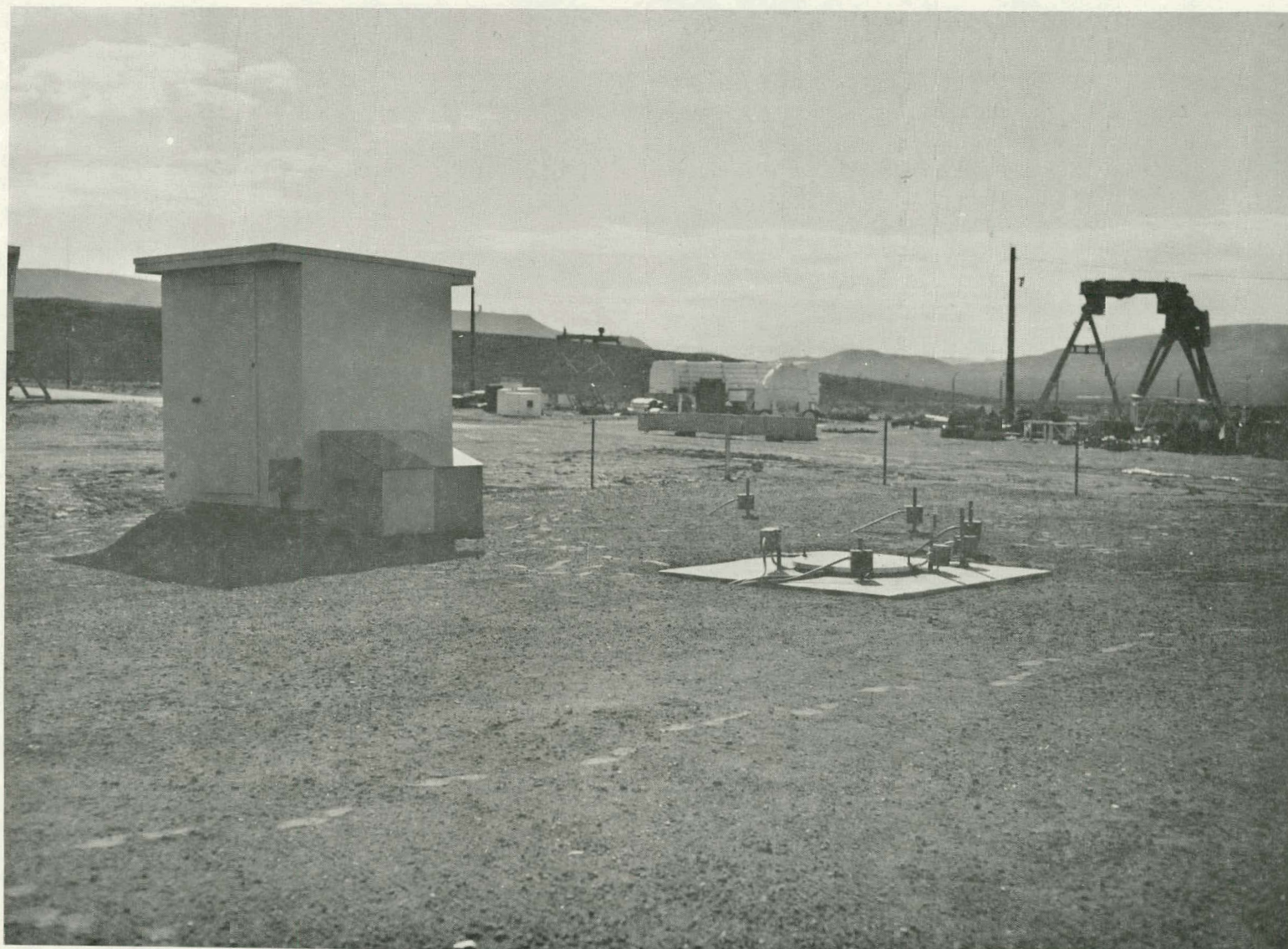


FIGURE A-14. View of Soil Temperature Test Area

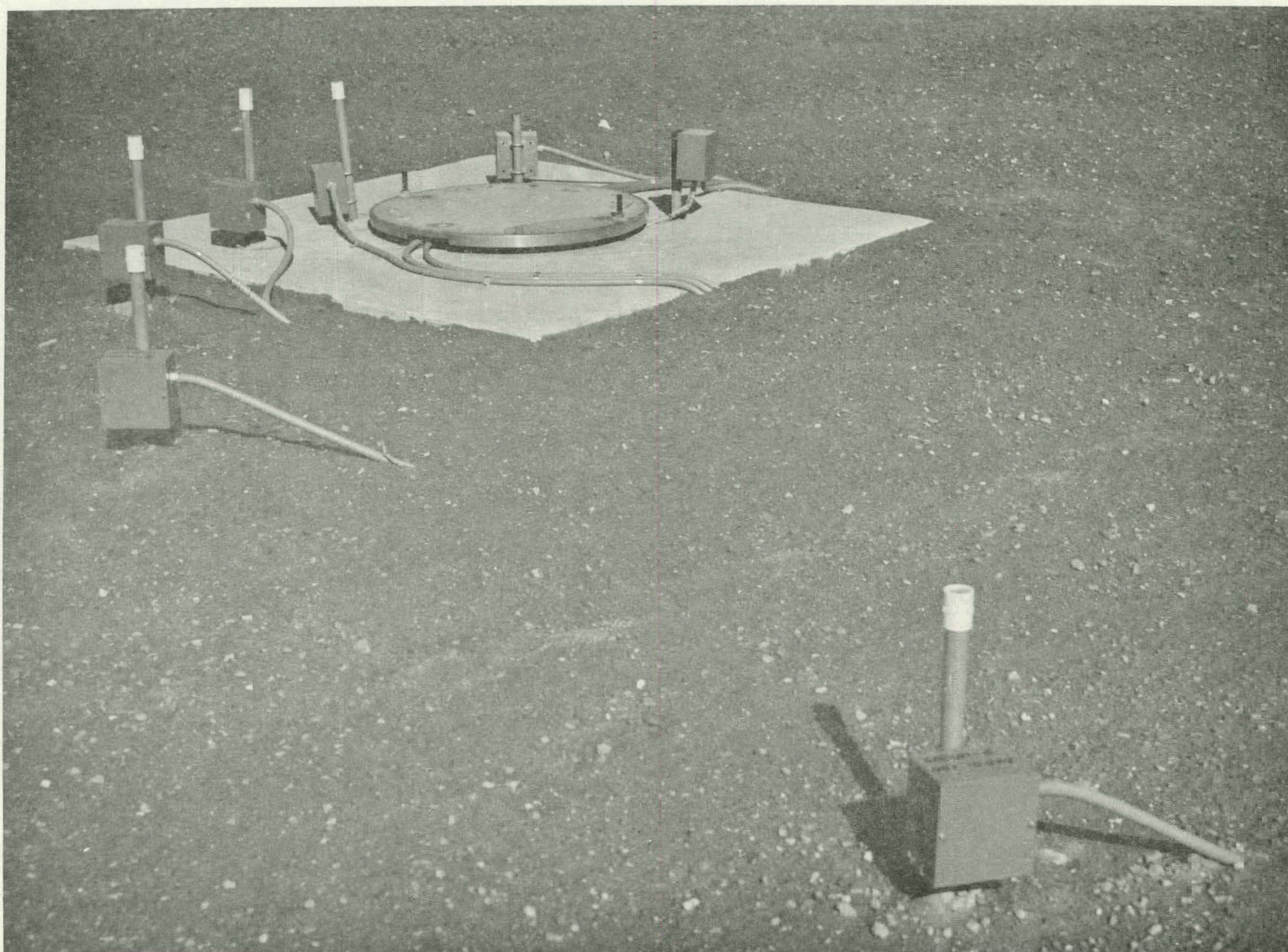


FIGURE A-15. Soil Temperature Test Installation With Drywell Cover In Place

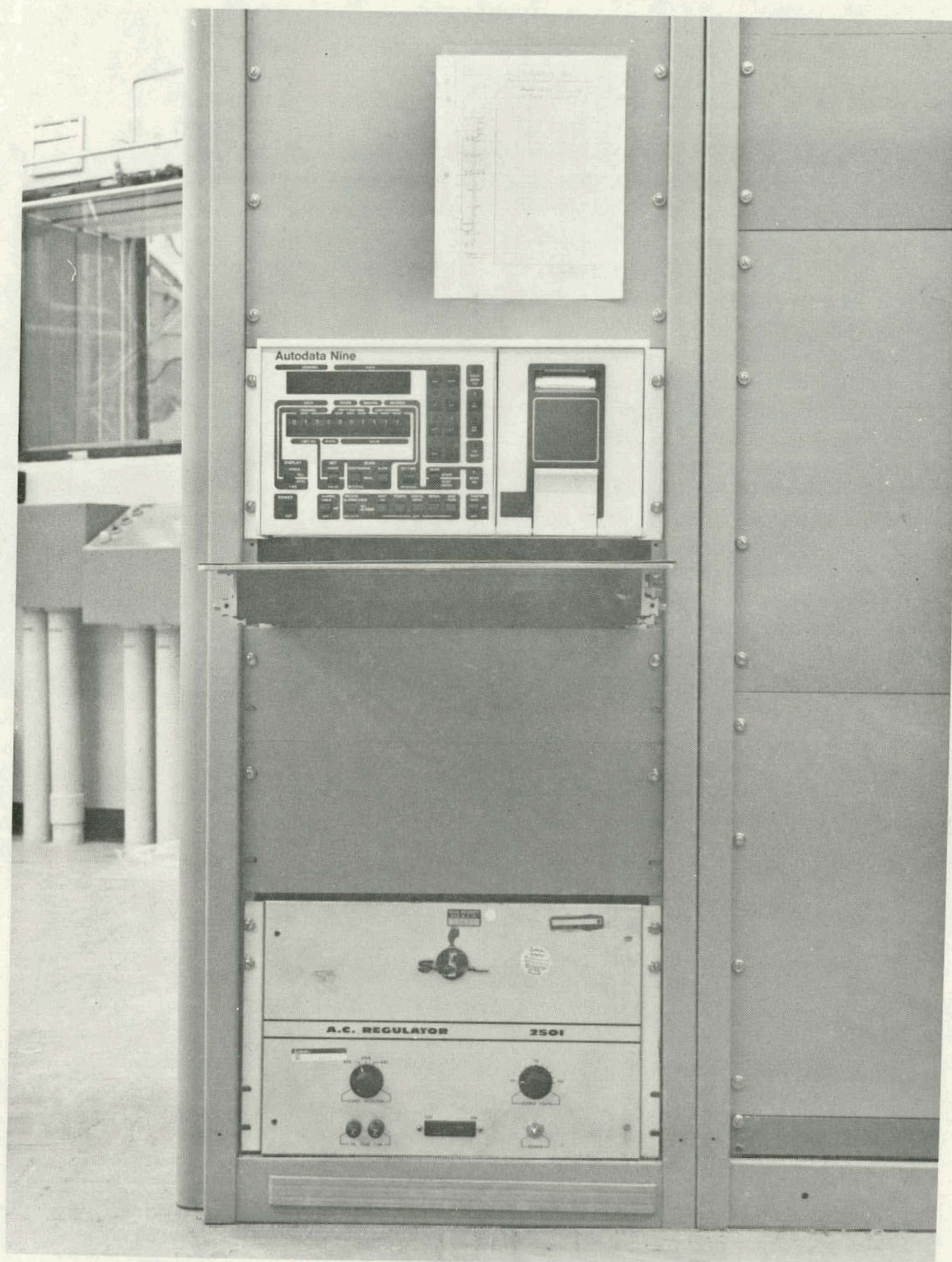


FIGURE A-16. Data Logger Installation in E-MAD West Gallery

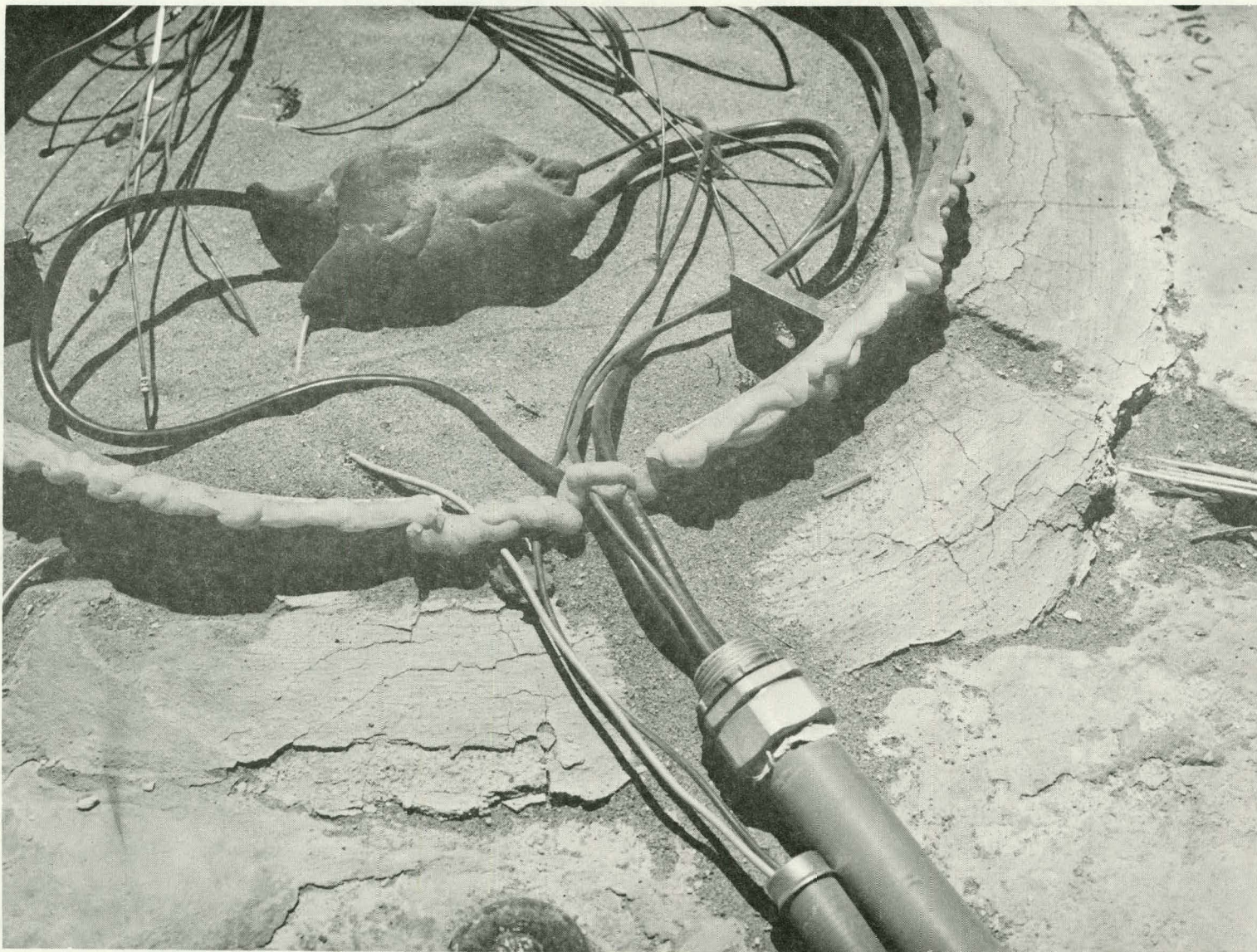


FIGURE A-17. Cracks in Grout Around Liner, Formed When Power Was Reduced From 3 kW to 1 kW

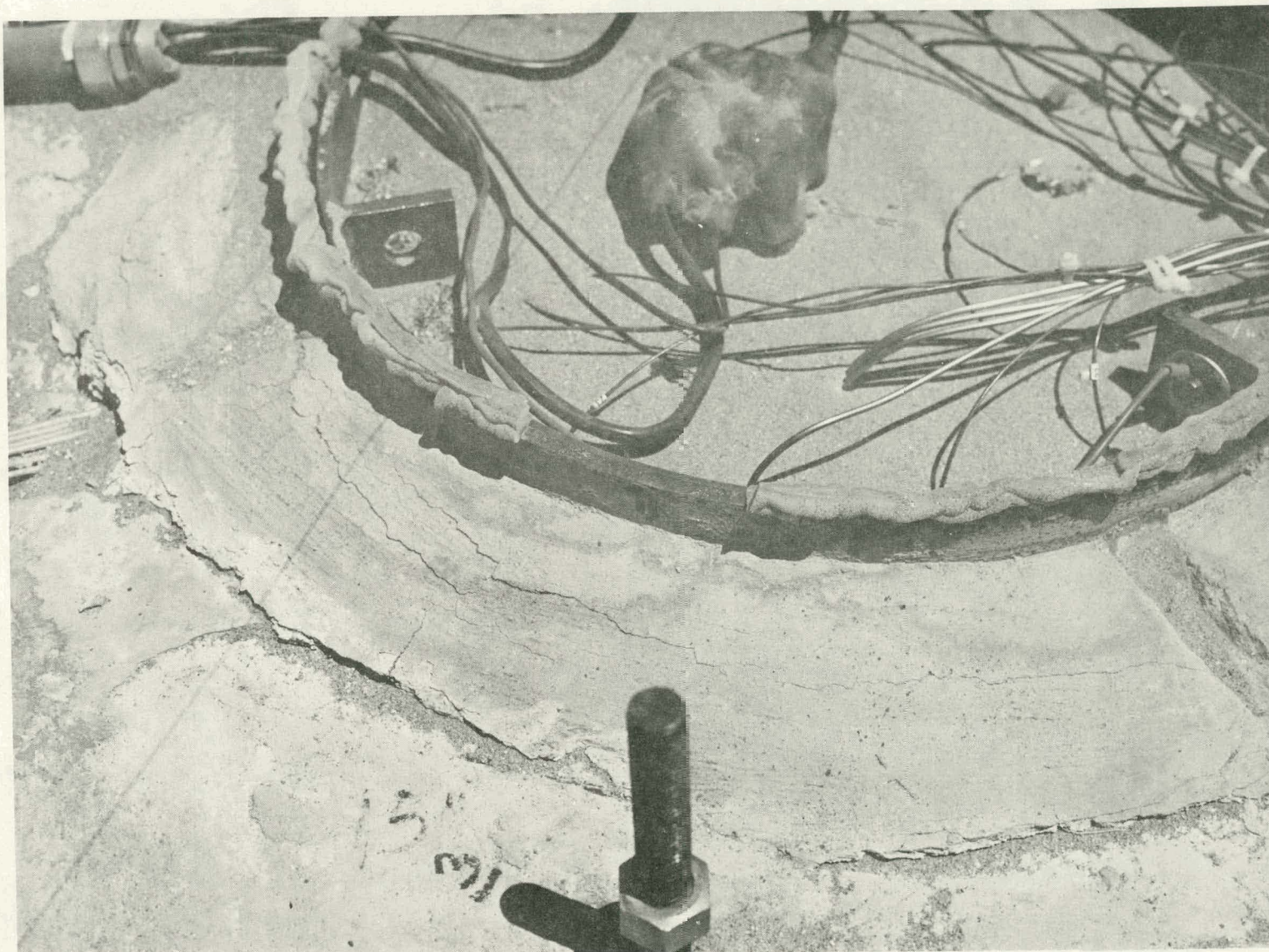


FIGURE A-18. Cracks in Grout Around Liner, Formed When Power Was Reduced From 3 kW to 1 kW

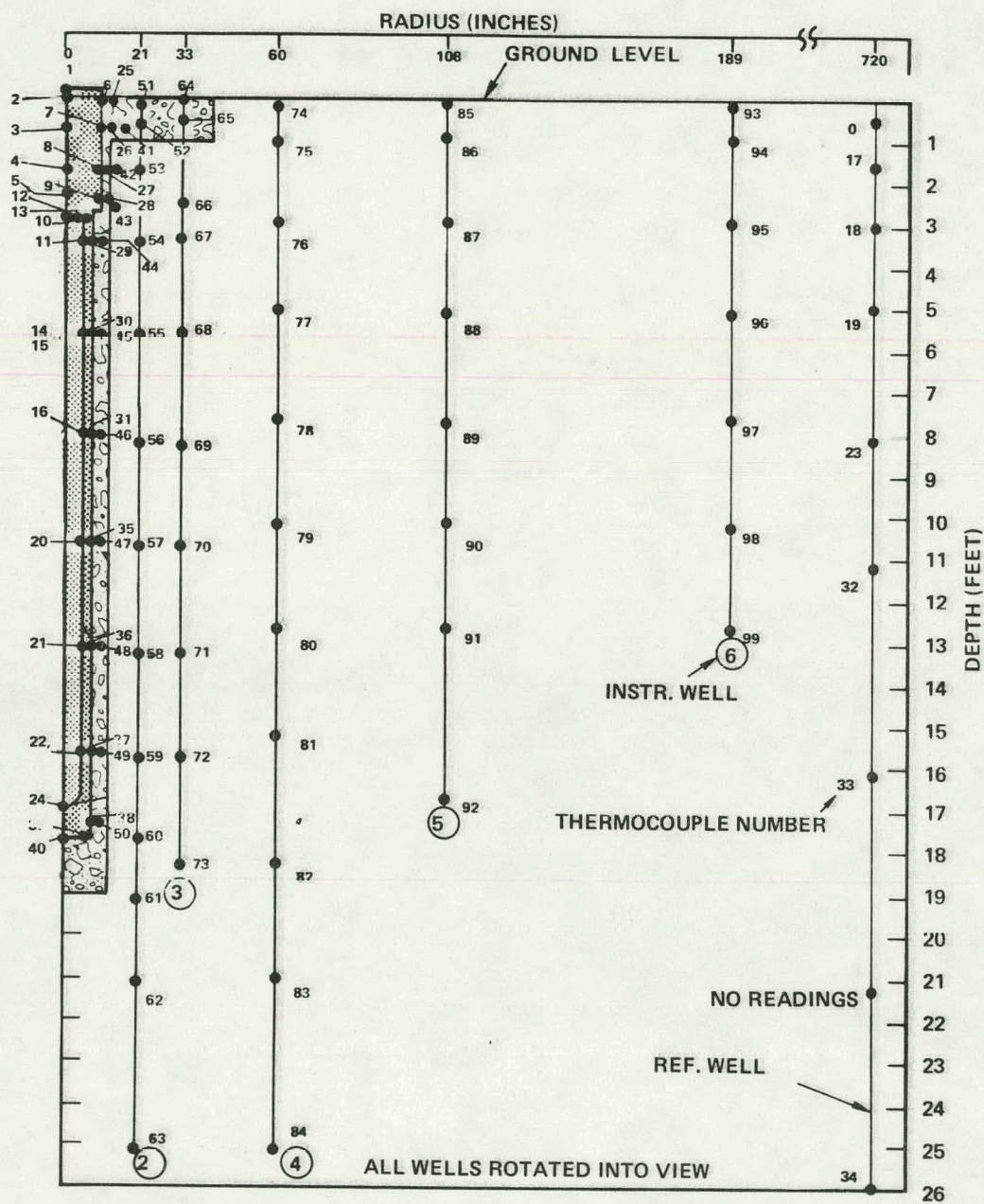
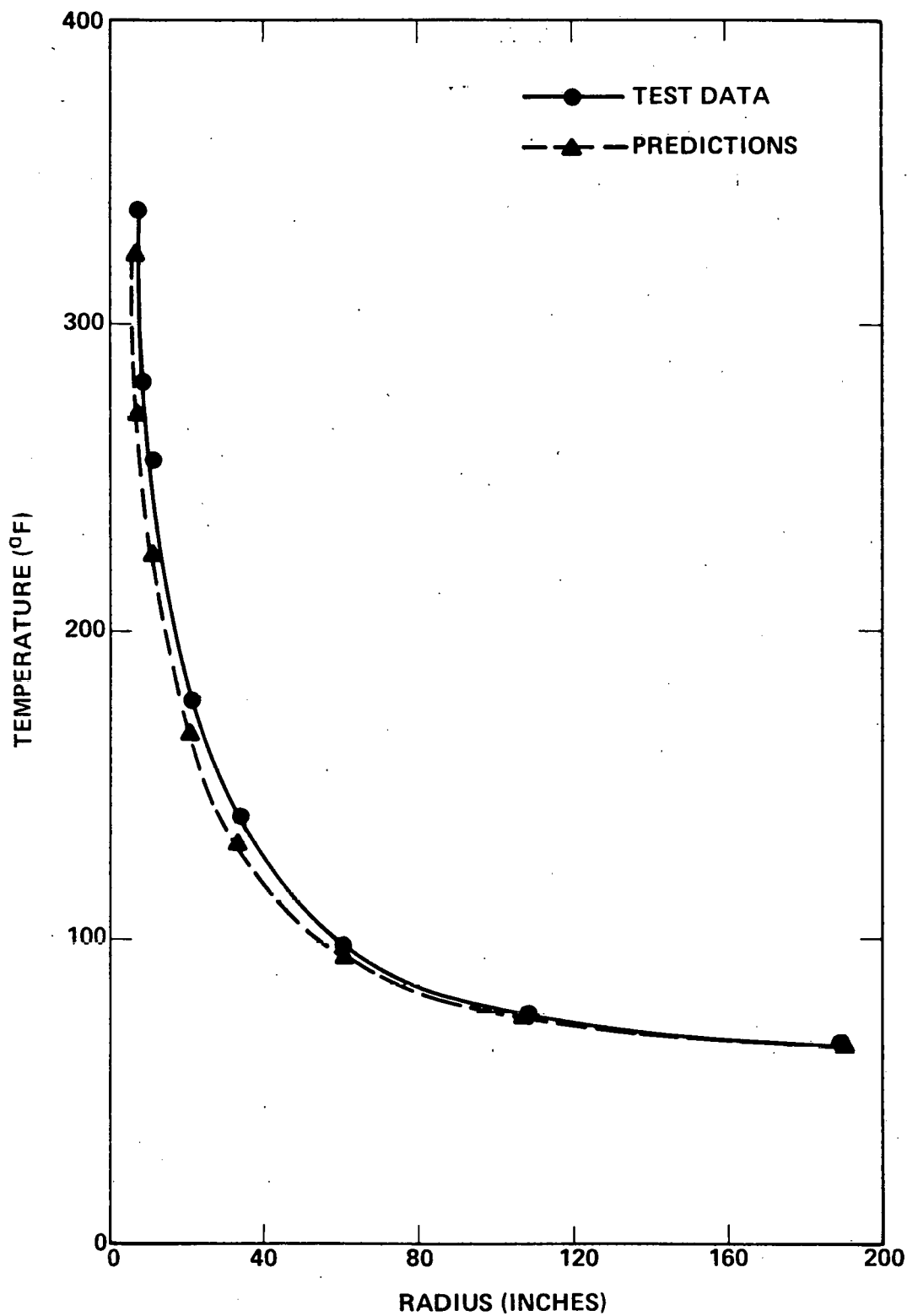


FIGURE A-19. Identification and Location of Thermocouples After February 6, 1979.

APPENDIX B

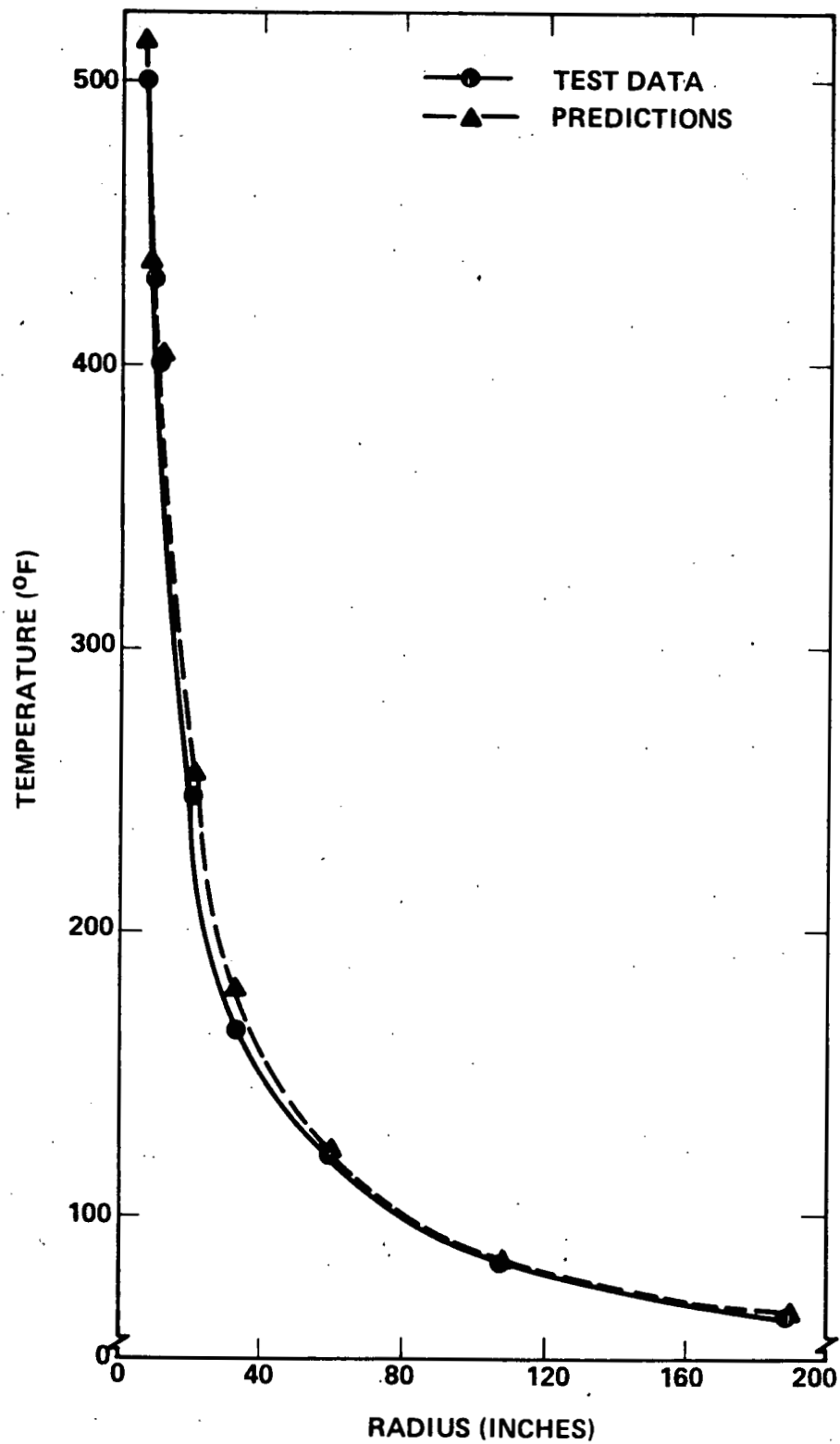
TEST DATA AND MODEL PREDICTIONS

This Appendix presents additional curves of test data and model comparisons with test data.



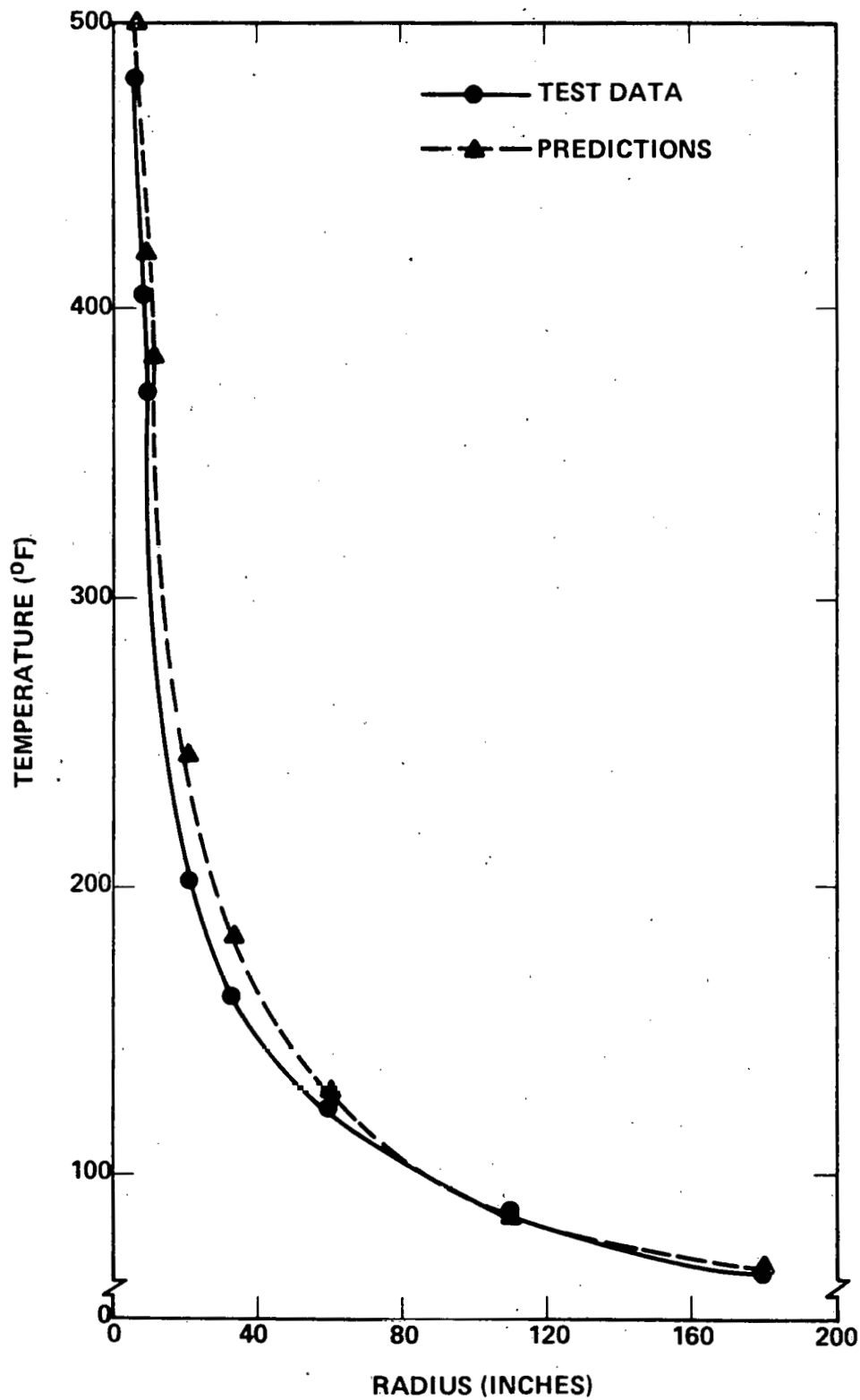
615671-13A

FIGURE B-1. Radial Temperature Profiles for the 3 Foot Depth During 3 kW (Accelerated Heatup) Operation, April 30, 1980



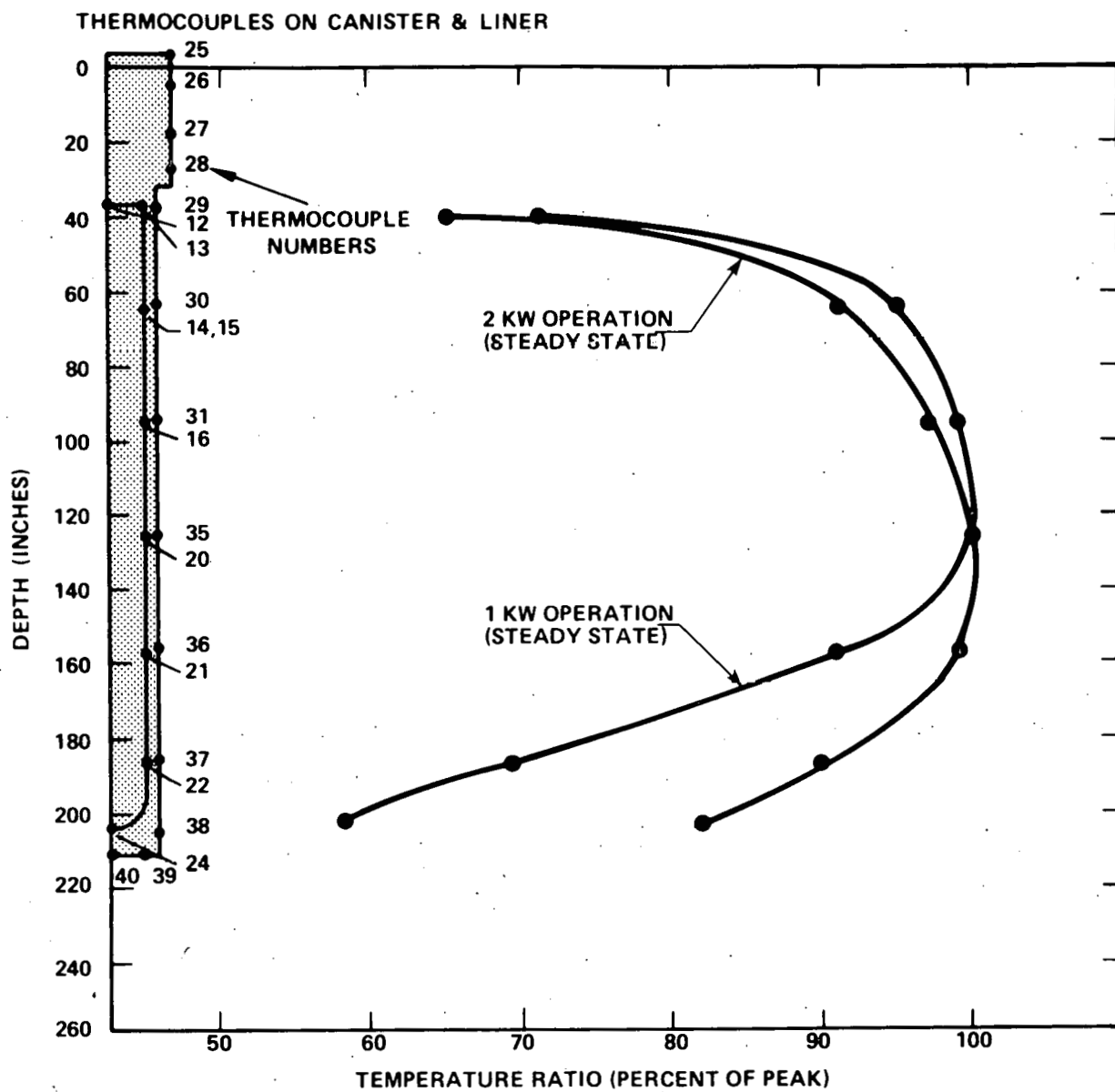
615671-10A

FIGURE B-2. Radial Temperature Profile for the 8 Foot Depth During 3 kW (Accelerated Heatup) Operation, April 30, 1980



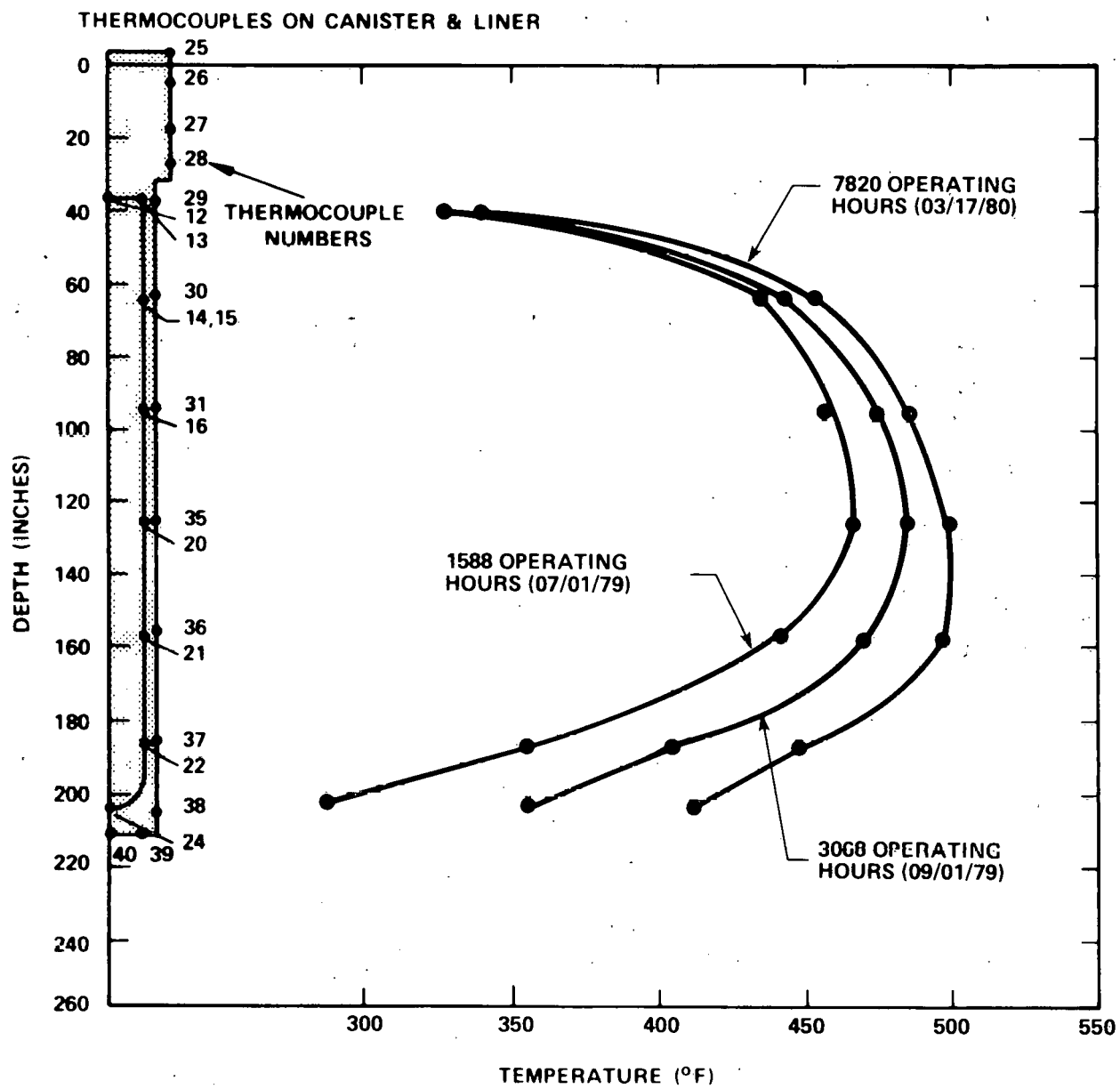
615671-8A

FIGURE B-3. Radial Temperature Profile for the 13 Foot Depth During 3 kW (Accelerated Heatup) Operation, April 30, 1980



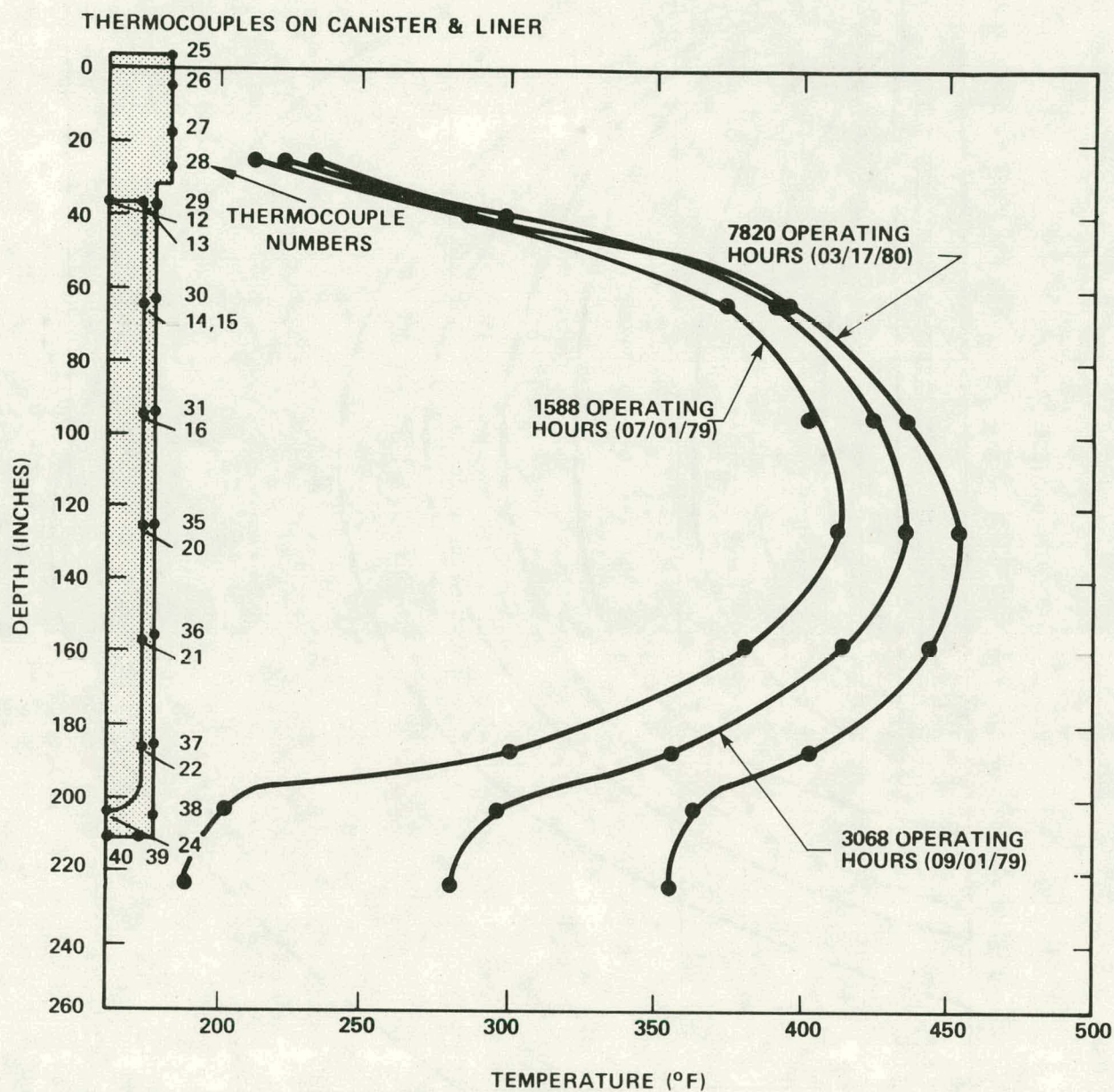
615576-5A

FIGURE B-4. Comparison of Canister Axial Temperature Profiles for 1 kW (April 1, 1979) and 2 kW (April 1, 1980) Operation



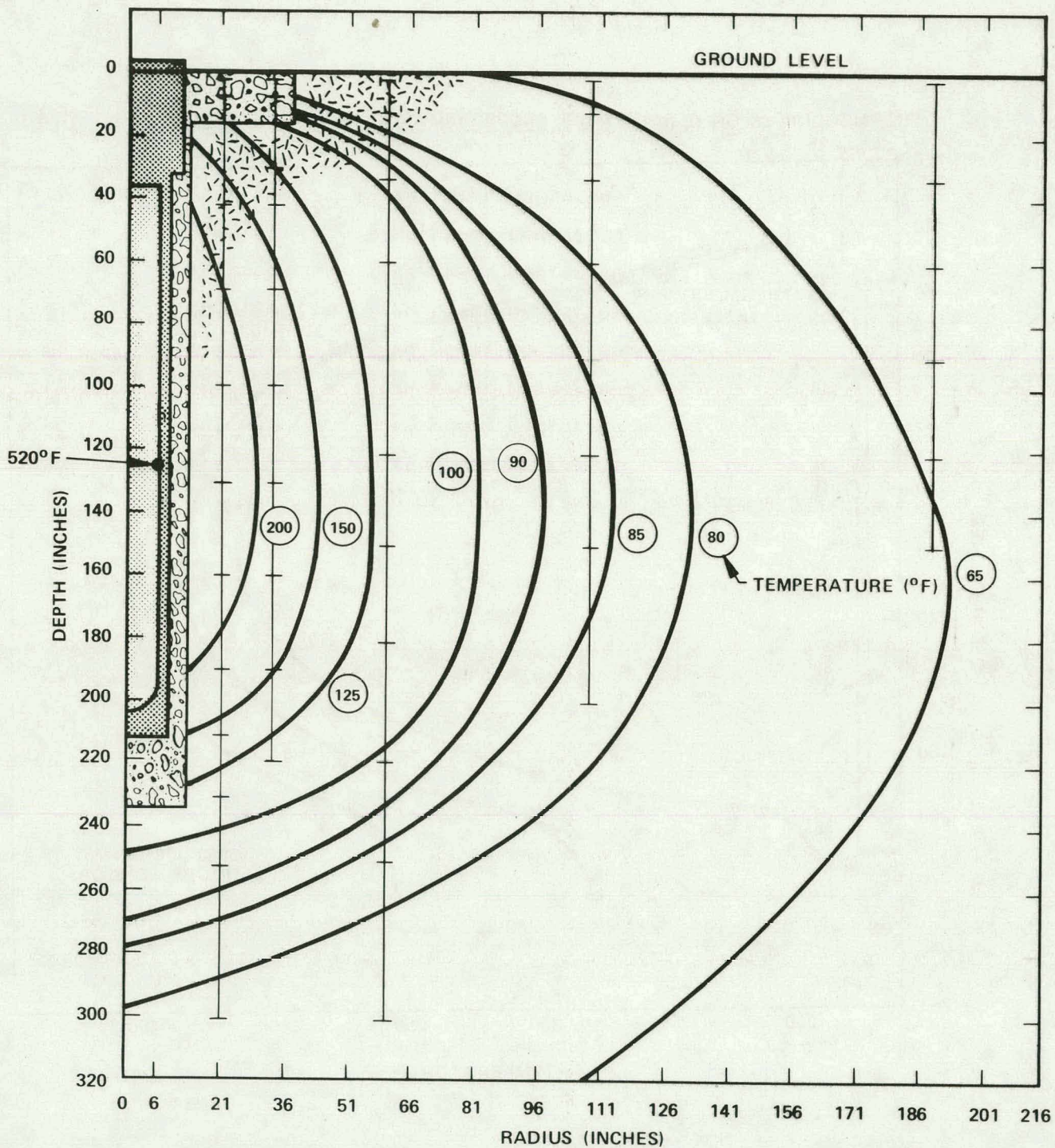
615576-3A

FIGURE B-5. Comparison of Canister Axial Temperature Profiles During 2 kW Operation



615576-4A

FIGURE B-6. Comparison of Liner Axial Temperature Profiles During 2 kW Operation



615576-2AA

FIGURE B-7. Soil Isotherms at End of Accelerated Heatup Period, May 1, 1978

APPENDIX C

SOIL TEMPERATURE TEST DATA

Test data are provided in this Appendix for the Soil Temperature Test. Table C-1 provides the laboratory measured thermal conductivity data from the Soil Properties Test conducted at E-MAD. The remainder of this Appendix provides data from the test thermocouples. See Table A-1 for the detailed identification and the location of the Soil Temperature Test thermocouples. Figures 8 and A-1 show these locations. Figure A-19 provides a revised thermocouple location identification for readings after February 6, 1979. Tables C-2 through C-26 provide thermocouple readings at the times and for the test operating conditions shown below:

<u>Table</u>	<u>Date</u>	<u>Test Operating Condition</u>
C-2	3/6/78	Start of Test - 0.5 kW Power Operation
C-3	3/7/78	Start of 3 kW Power Operation
C-4	3/8/78	3 kW Power Operation
C-5	3/9/78	3 kW Power Operation
C-6	3/10/78	3 kW Power Operation
C-7	3/11/78	3 kW Power Operation
C-8	3/12/78	3 kW Power Operation
C-9	5/1/78	End of 3 kW, Start of 1 kW Power Operation
C-10	5/2/78	1 kW Power Operation
C-11	5/3/78	1 kW Power Operation
C-12	5/4/78	1 kW Power Operation
C-13	5/5/78	1 kW Power Operation
C-14	5/6/78	1 kW Power Operation
C-15	10/2/78	1 kW Power Operation
C-16	4/1/79	1 kW Power Operation
C-17	4/26/79	End of 1 kW, Start of 2 kW Power Operation

<u>Table</u>	<u>Date</u>	<u>Test Operating Condition</u>
C-18	4/27/79	2 kW Power Operation
C-19	4/28/79	2 kW Power Operation
C-20	4/29/79	2 kW Power Operation
C-21	4/30/79	2 kW Power Operation
C-22	5/1/79	2 kW Power Operation
C-23	7/1/79	2 kW Power Operation
C-24	9/1/79	2 kW Power Operation
C-25	1/1/80	2 kW Power Operation
C-26	4/1/80	End of 2 kW, Start of 3 kW Power Operation

TABLE C-1

MEASURED THERMAL CONDUCTIVITY OF SOIL INSIDE E-MAD COMPOUND*

Temperature Conductivity Measured (°F)	Depth (Feet)			
	5	10	15	20
70	0.466	0.520	0.513	0.479
100	0.374	0.350	0.525	0.517
200	0.248	0.246	0.349	0.321
300	0.253	0.257	0.269	0.295
400	0.243	0.255	0.265	0.298
500	0.247	0.258	0.266	0.287
600	0.250	0.244	0.274	0.261
700	0.231	0.231	0.262	0.343**

*Thermal conductivity measured in Btu/hr-ft-°F

**Reading was judged erroneous due to problem with potentiometer.

TABLE C-2

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 3/6/78

TIME: 3:51 PM

OPERATING HOURS: 0 AT POWER LEVEL: 1/2 kW (Heatup Check)

TOTAL OPERATING HOURS: N/A

THERMOCOUPLE READINGS*

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
035	65.6	070	64.4	109	69.8
034	64.0	069	63.5	108	
033	64.3	068	60.0	107	66.7
032	64.3	067	56.5	106	61.8
031	63.9	066	54.2	105	57.8
030	61.9	065	55.3	104	54.2
029	57.1	064	69.8	103	52.1
028	54.4	063	70.9	102	48.9
027	53.0	062	72.0	101	64.5
026	55.0	061	71.5	100	
025	59.5	060	70.9	099	63.3
024	68.2	059	70.3	098	60.6
023	72.1	058	69.3	097	57.1
022	72.3	057	66.9	096	54.0
021	78.1	056	64.4	095	51.4
020	75.4	055	61.5	094	48.0
019	74.0	054	57.9	093	58.1
018	74.5	053	52.4	092	67.1
017	74.0	052	53.7	091	64.0
016	73.6	051	62.6	090	61.2
015	73.2	050	70.3	089	58.3
014	71.7	049	68.4	088	55.1
013	59.4	048	67.0	087	52.3
012	51.7	047	65.3	086	48.4
011	59.4	046	63.3	085	54.8
010	57.7	045	61.1	084	70.3
009	55.8	044	57.4	083	70.8
008	54.7	043	54.2	082	70.1
007	56.8	042	52.7	081	68.5
006	61.3	041	52.9	080	66.8
005	55.2	040	69.3	079	62.5
004	54.2	039	68.8	078	59.3
003	58.6	038	68.9	077	55.5
002	62.5	037	68.5	076	52.0
001	83.5	036	67.1	075	46.8
				074	54.9
				073	69.0
				072	67.9
				071	66.3

* See Figure A-1 for T/C location

TABLE C-3

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 3/7/78

TIME: 10:57 AM

OPERATING HOURS: 0

AT POWER LEVEL: 3 kW

TOTAL OPERATING HOURS: 0

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
001	97.8	036	80.4	071	66.2
002	67.2	037	76.4	072	67.9
003	60.0	038	71.9	073	69.1
004	60.5	039	71.3	074	46.0
005	67.0	040	71.5	075	47.6
006	64.0	041	51.6	076	51.8
007	59.4	042	55.4	077	55.5
008	63.5	043	57.8	078	59.1
009	73.5	044	68.7	079	62.5
010	85.1	045	75.0	080	68.7
011	91.9	046	76.3	081	68.6
012	114.3	047	77.4	082	70.1
013	101.6	048	77.2	083	70.8
014	117.6	049	74.1	084	70.3
015	117.7	050	71.8	085	47.5
016	116.3	051	56.4	086	48.9
017	116.4	052	51.6	087	52.2
018	116.4	053	55.0	088	55.0
019	115.2	054	59.7	089	58.5
020	114.0	055	63.5	090	61.4
021	109.2	056	66.1	091	64.2
022	94.3	057	68.5	092	67.1
023	93.9	058	70.2	093	48.3
024	85.3	059	70.7	094	48.4
025	61.3	060	70.5	095	51.3
026	55.9	061	71.3	096	53.9
027	58.8	062	71.6	097	57.2
028	64.1	063	70.8	098	60.6
029	71.5	064	58.6	099	63.3
030	79.2	065	50.5	100	
031	80.7	066	54.5	101	57.7
032	81.4	067	56.3	102	49.4
033	81.7	068	59.9	103	51.9
034	80.7	069	63.4	104	54.1
035	81.3	070	64.3	105	57.8
				106	61.6
				107	66.6
				108	69.8

* See Figure A-1 for T/C location

TABLE C-4

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 3/8/78

TIME: 11:07 AM

OPERATING HOURS: 24

AT POWER LEVEL: 3 kW

TOTAL OPERATING HOURS: 24

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
001	102.1	037	122.7	073	60.9
002	80.1	038	89.4	074	49.3
003	80.3	039	83.6	075	48.5
004	94.5	040	83.7	076	51.9
005	119.0	041	57.6	077	55.3
006	75.7	042	66.5	078	59.2
007	77.7	043	75.0	079	62.5
008	98.8	044	116.7	080	68.6
009	132.1	045	142.1	081	68.4
010	173.3	046	143.6	082	70.0
011	198.7	047	144.0	083	70.6
012	262.9	048	133.2	084	70.3
013	218.5	049	109.3	085	49.9
014	305.9	050	83.5	086	49.3
015	310.5	051	61.8	087	52.2
016	304.6	052	55.8	088	55.2
017	306.6	053	61.7	089	58.5
018	306.6	054	75.1	090	61.4
019	299.2	055	81.5	091	64.2
020	301.3	056	84.0	092	67.1
021	285.3	057	85.5	093	51.1
022	216.0	058	83.8	094	49.3
023	216.3	059	77.3	095	51.5
024	157.8	060	71.5	096	54.2
025	68.5	061	71.0	097	57.4
026	67.5	062	71.5	098	60.8
027	82.5	063	70.7	099	63.3
028	102.0	064	60.8	100	
029	130.0	065	52.1	101	60.3
030	160.8	066	58.3	102	51.0
031	165.5	067	57.9	103	52.2
032	167.7	068	61.6	104	54.1
033	168.4	069	64.8	105	57.8
034	165.5	070	65.7	106	61.4
035	164.7	071	67.3	107	66.4
036	151.2	072	68.4	108	69.6

* See Figure A-1 for T/C location

TABLE C-5

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 3/9/78

TIME: 11:07 AM

OPERATING HOURS: 48

AT POWER LEVEL: 3 kW

TOTAL OPERATING HOURS: 48

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
001	76.0	038	100.4	075	49.0
002	87.7	039	92.9	076	52.0
003	94.6	040	92.8	077	55.1
004	115.5	041	64.5	078	59.0
005	143.2	042	77.9	079	62.2
006	84.8	043	89.9	080	66.3
007	92.1	044	138.8	081	68.1
008	118.2	045	169.7	082	69.6
009	153.1	046	174.1	083	70.2
010	194.5	047	175.5	084	70.1
011	220.8	048	161.8	085	49.7
012	281.7	049	127.5	086	49.8
013	238.9	050	92.8	087	52.1
014	326.1	051	58.3	088	55.0
015	331.3	052	60.8	089	58.4
016	326.4	053	70.8	090	61.2
017	328.9	054	92.0	091	63.9
018	328.9	055	104.2	092	66.9
019	321.5	056	107.7	093	50.4
020	325.0	057	109.3	094	50.2
021	308.4	058	102.2	095	51.5
022	234.3	059	87.6	096	53.8
023	235.0	060	74.1	097	57.0
024	174.3	061	71.1	098	60.4
025	72.7	062	71.0	099	63.1
026	77.5	063	70.4	100	
027	96.3	064	57.0	101	53.7
028	120.7	065	54.2	102	51.9
029	151.1	066	60.3	103	52.6
030	187.1	067	83.2	104	54.0
031	194.8	068	68.2	105	57.7
032	197.5	069	71.7	106	61.3
033	198.1	070	72.6	107	66.3
034	194.8	071	72.4	108	69.5
035	194.6	072	70.7		
036	179.7	073	88.8		
037	141.8	074	48.5		

* See Figure A-1 for T/C location

TABLE C-6
SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 3/10/78 TIME: 11:10 AM
OPERATING HOURS: 72 AT POWER LEVEL: 3 kW
TOTAL OPERATING HOURS: 72

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
030	204.0	070	82.8	109	89.3
029	163.8	069	91.8	108	
028	131.5	068	77.5	107	66.8
027	107.2	067	69.9	106	61.2
026	83.7	066	65.6	105	57.5
025	82.8	065	55.1	104	54.0
024	184.9	064	60.0	103	52.8
023	240.3	063	70.4	102	51.8
022	245.5	062	71.1	101	62.6
021	319.6	061	72.0	100	
020	334.3	060	77.6	099	63.2
019	331.6	059	97.1	098	60.6
018	338.9	058	118.2	097	57.2
017	338.9	057	127.9	096	54.1
016	338.4	056	126.5	095	51.9
015	340.2	055	121.8	094	50.4
014	336.1	054	105.4	093	52.6
013	248.7	053	77.8	092	67.1
012	290.5	052	63.4	091	64.1
011	231.3	051	65.7	090	61.3
010	205.4	050	100.7	089	58.5
009	164.1	049	140.8	088	55.1
008	128.5	048	179.3	087	52.3
007	101.0	047	198.5	086	50.2
006	96.0	046	200.0	085	51.8
005	154.9	045	187.9	084	70.1
004	128.1	044	152.3	083	70.3
003	103.2	043	100.1	082	69.7
002	100.6	042	86.3	081	68.4
001	120.9	041	67.8	080	67.0
		040	100.2	079	62.9
		039	100.1	078	59.8
		038	109.1	077	55.8
		037	155.3	076	52.8
		036	190.3	075	48.9
		035	207.6	074	53.6
		034	208.7	073	69.9
		033	213.1	072	74.9
		032	209.9	071	80.2
		031	207.5		

*See Figure A-1 for T/C location

TABLE C-7

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 3/11/78

TIME: 11:10 AM

OPERATING HOURS: 96

AT POWER LEVEL: 3 kW

TOTAL OPERATING HOURS: 96

THERMOCOUPLE READINGS*

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
030	206.7	070	92.2	109	69.2
029	188.8	069	91.6	108	
028	143.4	068	85.9	107	65.8
027	115.4	067	75.9	106	61.1
026	88.3	066	70.2	105	57.4
025	79.5	065	57.0	104	54.1
024	192.3	064	52.8	103	53.1
023	255.0	063	70.0	102	52.4
022	253.9	062	70.7	101	49.9
021	328.3	061	72.7	100	
020	343.8	060	80.5	099	62.8
019	338.9	059	104.9	098	60.3
018	348.0	058	129.1	097	56.9
017	346.7	057	139.1	096	53.8
016	343.7	056	139.6	095	51.8
015	346.0	055	132.8	094	51.0
014	343.5	054	114.9	093	49.1
013	255.8	053	83.2	092	66.7
012	297.2	052	67.5	091	63.7
011	237.6	051	57.0	090	61.0
010	212.6	050	108.3	089	58.2
009	171.6	049	150.4	088	54.9
008	130.0	048	195.2	087	52.3
007	105.2	047	205.7	086	51.1
006	93.2	046	205.1	085	49.2
005	163.0	045	198.2	084	70.0
004	133.8	044	165.1	083	69.8
003	107.0	043	107.8	082	69.4
002	93.5	042	92.5	081	68.7
001	64.9	041	72.8	080	67.8
		040	105.8	079	64.2
		039	105.9	078	61.0
		038	115.4	077	56.8
		037	164.3	076	53.6
		036	205.7	075	49.8
		035	216.4	074	47.4
		034	214.9	073	70.6
		033	223.9	072	79.0
		032	218.6	071	87.3
		031	214.9		

* See Figure A-1 for T/C location

TABLE C-8

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 3/12/78

TIME: 11:10 AM

OPERATING HOURS: 120

AT POWER LEVEL: 3 kW

TOTAL OPERATING HOURS: 120

THERMOCOUPLE READINGS*

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
035	227.1	073	72.1	109	69.2
034	225.4	072	83.4	108	
033	234.1	071	94.3	107	65.9
032	227.7	070	100.4	106	61.2
031	225.0	069	101.4	105	57.4
030	207.5	068	94.3	104	54.2
029	193.2	067	81.6	103	52.4
028	149.7	066	73.6	102	44.3
027	118.6	065	52.3	101	45.2
026	85.0	064	47.3	100	
025	75.2	063	70.0	099	62.8
024	197.1	062	70.7	098	60.3
023	261.0	061	73.8	097	56.9
022	259.7	060	83.6	096	53.8
021	331.2	059	111.9	095	51.9
020	350.4	058	137.7	094	47.6
019	344.2	057	147.6	093	45.8
018	354.4	056	150.1	092	66.6
017	351.4	055	141.2	091	63.6
016	348.1	054	122.2	090	60.9
015	348.4	053	83.6	089	58.2
014	345.6	052	62.0	088	54.9
013	256.7	051	50.1	087	52.3
012	294.1	050	111.8	086	47.8
011	240.3	049	160.0	085	44.9
010	213.3	048	204.4	084	69.9
009	176.0	047	205.5	083	69.6
008	139.5	046	205.2	082	69.5
007	104.8	045	202.5	081	69.6
006	91.1	044	171.1	080	69.5
005	170.7	043	113.5	079	66.4
004	136.8	042	95.7	078	63.2
003	105.0	041	68.5	077	58.7
002	93.5	040	111.0	076	54.8
001	63.9	039	111.0	075	46.6
		038	121.0	074	44.5
		037	172.8		
		036	206.4		

* See Figure A-1 for T/C location

TABLE C-9

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 5/1/78

TIME: 11:00 AM

OPERATING HOURS: 1320

AT POWER LEVEL: 3 kW

TOTAL OPERATING HOURS: 1320

THERMOCOUPLE READINGS*

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
035	450.5	073	120.2	109	66.8
034	433.5	072	149.7	108	
033	439.5	071	161.4	107	63.1
032	440.5	070	162.6	106	60.8
031	433.1	069	165.0	105	60.5
030	395.0	068	158.9	104	61.6
029	280.9	067	138.1	103	63.4
028	208.3	066	124.0	102	61.2
027	171.6	065	79.4	101	55.2
026	130.1	064	61.0	100	
025	113.4	063	75.5	099	65.0
024	266.6	062	94.2	098	64.2
023	340.7	061	117.9	097	63.2
022	339.4	060	146.0	096	63.4
021	481.5	059	186.5	095	64.3
020	515.8	058	204.2	094	61.3
019	496.3	057	267.3	093	54.4
018	508.0	056	259.5	092	81.5
017	506.7	055	204.0	091	85.4
016	499.8	054	175.7	090	85.5
015	494.2	053	133.2	089	83.4
014	473.5	052	98.9	088	79.0
013	334.6	051	69.7	087	74.3
012	372.7	050	180.9	086	66.0
011	335.7	049	220.8	085	55.9
010	298.7	048	374.6	084	73.2
009	231.5	047	415.8	083	84.1
008	197.7	046	402.8	082	99.5
007	166.4	045	365.3	081	115.8
006	140.4	044	256.5	080	123.0
005	216.6	043	166.5	079	123.7
004	204.0	042	146.5	078	121.2
003	160.2	041	108.0	077	111.0
002	140.8	040	176.0	076	96.0
001	88.0	039	176.3	075	74.1
		038	187.6	074	56.4
		037	243.9		
		036	407.5		

* See Figure A-1 for T/C location.

TABLE C-10

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 5/2/78

TIME: 11:00 AM

OPERATING HOURS: 24

AT POWER LEVEL: 1 kW

TOTAL OPERATING HOURS: 1344

THERMOCOUPLE READINGS*

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
035	362.1	073	120.9	109	67.0
034	350.3	072	149.2	108	63.3
033	351.4	071	161.4	107	61.1
032	352.2	070	162.7	106	60.7
031	350.7	069	165.0	105	61.8
030	317.4	068	158.6	104	62.9
029	235.4	067	137.3	103	60.1
028	187.0	066	122.9	102	75.2
027	159.0	065	80.7	101	65.4
026	124.0	064	77.2	100	64.6
025	116.8	063	75.9	099	63.7
024	215.1	062	94.8	098	63.9
023	259.8	061	118.4	097	64.1
022	259.1	060	143.9	096	60.6
021	355.4	059	178.7	095	61.5
020	387.4	058	200.2	094	82.1
019	375.5	057	262.7	093	86.1
018	379.7	056	254.6	092	86.2
017	379.0	055	200.4	091	84.1
016	377.1	054	169.4	090	79.6
015	364.6	053	129.6	089	74.1
014	354.9	052	98.8	088	65.2
013	262.3	051	88.0	087	64.4
012	284.6	050	170.3	086	73.4
011	261.5	049	207.8	085	84.7
010	240.0	048	310.5	084	100.1
009	205.1	047	352.2	083	116.5
008	182.2	046	341.6	082	123.6
007	149.5	045	306.0	081	124.3
006	136.6	044	223.5	080	121.7
005	199.7	043	157.8	079	111.7
004	178.9	042	140.7	078	95.8
003	144.2	041	106.5	077	73.5
002	136.3	040	166.8	076	70.2
001	135.8	039	166.9	075	
		038	174.6	074	
		037	217.4		
		036	322.7		

* See Figure A-1 for T/C location

TABLE C-11

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 5/3/78

TIME: 11:00 AM

OPERATING HOURS: 48

AT POWER LEVEL: 1 kW

TOTAL OPERATING HOURS: 1368

THERMOCOUPLE READINGS*

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
035	328.4	073	120.2	109	67.1
034	317.9	072	146.2	108	
033	318.3	071	158.9	107	63.4
032	318.8	070	160.9	106	61.2
031	318.0	069	163.0	105	60.9
030	287.3	068	155.7	104	61.9
029	218.1	067	134.5	103	62.9
028	176.4	066	121.0	102	64.6
027	149.3	065	85.0	101	80.1
026	117.0	064	82.8	100	
025	108.8	063	76.4	099	65.8
024	205.0	062	95.4	098	65.0
023	245.6	061	118.3	097	64.2
022	245.2	060	140.1	096	64.2
021	326.8	059	171.2	095	64.1
020	356.4	058	192.5	094	64.7
019	344.9	057	248.6	093	67.8
018	349.4	056	240.9	092	82.6
017	349.4	055	191.0	091	86.7
016	346.8	054	161.6	090	86.8
015	337.0	053	126.3	089	84.7
014	327.5	052	99.2	088	80.0
013	246.5	051	91.1	087	74.3
012	267.5	050	163.3	086	69.5
011	244.6	049	199.1	085	71.1
010	225.2	048	280.0	084	73.7
009	194.4	047	320.0	083	85.4
008	167.8	046	309.8	082	100.8
007	136.2	045	276.7	081	117.0
006	125.9	044	207.5	080	124.1
005	185.9	043	150.6	079	124.9
004	160.8	042	135.3	078	122.2
003	130.5	041	104.4	077	112.2
002	126.0	040	160.8	076	95.9
001	133.1	039	160.9	075	78.1
		038	167.9	074	76.7
		037	206.8		
		036	291.7		

* See Figure A-1 for T/C location

TABLE C-12

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 5/4/78 TIME: 11:00 AM

OPERATING HOURS: 72 AT POWER LEVEL: 1 kW

TOTAL OPERATING HOURS: 1392

THERMOCOUPLE READINGS*

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
035	307.4	073	118.7	109	67.1
034	298.0	072	142.7	108	
033	298.3	071	155.3	107	63.3
032	298.5	070	157.8	106	61.2
031	298.0	069	159.7	105	61.0
030	270.0	068	151.8	104	61.9
029	207.8	067	131.3	103	63.6
028	169.8	066	119.2	102	67.1
027	144.2	065	86.8	101	77.6
026	113.6	064	82.2	100	
025	103.0	063	76.4	099	65.8
024	198.5	062	95.4	098	64.9
023	236.7	061	116.9	097	64.2
022	236.1	060	136.5	096	64.2
021	311.3	059	165.1	095	64.5
020	338.5	058	185.3	094	67.0
019	328.9	057	235.0	093	68.4
018	332.8	056	228.2	092	82.7
017	332.4	055	182.9	091	86.8
016	329.9	054	155.5	090	86.9
015	321.0	053	123.7	089	84.8
014	313.2	052	99.7	088	80.1
013	237.6	051	88.9	087	74.8
012	250.2	050	158.1	086	72.0
011	233.6	049	191.5	085	72.2
010	215.8	048	262.1	084	73.6
009	186.8	047	298.6	083	85.4
008	159.8	046	289.3	082	100.7
007	130.5	045	259.2	081	116.7
006	119.1	044	197.6	080	123.7
005	177.2	043	145.5	079	124.5
004	153.3	042	131.5	078	121.9
003	125.2	041	103.9	077	111.7
002	118.6	040	156.1	076	96.1
001	117.2	039	156.2	075	80.4
		038	162.6	074	76.8
		037	198.7		
		036	273.6		

* See Figure A-1 for T/C location

TABLE C-13

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 5/5/78

TIME: 11:00 AM

OPERATING HOURS: 96

AT POWER LEVEL: 1 kW

TOTAL OPERATING HOURS: 1416

THERMOCOUPLE READINGS*

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
035	292.6	073	117.2	109	67.1
034	284.1	072	139.7	108	
033	284.5	071	152.0	107	63.4
032	285.0	070	154.6	106	61.3
031	284.3	069	156.4	105	61.2
030	258.7	068	148.3	104	62.2
029	200.8	067	128.8	103	64.6
028	165.8	066	117.8	102	67.9
027	138.5	065	82.4	101	68.9
026	105.2	064	68.8	100	
025	88.3	063	78.5	099	65.9
024	193.8	062	95.6	098	65.2
023	230.2	061	115.8	097	64.3
022	230.1	060	133.3	096	64.3
021	300.9	059	160.5	095	65.2
020	326.7	058	179.7	094	67.7
019	317.4	057	224.1	093	61.6
018	320.9	056	218.2	092	82.9
017	321.0	055	176.7	091	87.0
016	318.8	054	151.3	090	87.2
015	310.2	053	126.6	089	85.2
014	303.7	052	94.8	088	80.5
013	231.9	051	77.2	087	75.8
012	252.5	050	154.6	086	72.9
011	227.1	049	185.7	085	65.1
010	210.4	048	250.2	084	74.0
009	180.8	047	283.2	083	85.6
008	151.6	046	275.2	082	100.7
007	120.8	045	247.8	081	116.2
006	105.9	044	191.1	080	123.3
005	169.2	043	141.5	079	124.0
004	144.7	042	128.0	078	121.4
003	114.6	041	97.8	077	111.0
002	105.1	040	152.9	076	96.6
001	94.8	039	152.6	075	80.6
		038	158.8	074	66.3
		037	192.5		
		036	261.3		

* See Figure A-1 for T/C location

TABLE C-14

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 5/6/78

TIME: 11:00 AM

OPERATING HOURS: 120

AT POWER LEVEL: 1 kW

TOTAL OPERATING HOURS: 1440

THERMOCOUPLE READINGS*

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
035	281.4	073	115.8	109	67.1
034	273.8	072	137.1	108	
033	274.2	071	148.9	107	63.4
032	274.6	070	151.7	106	61.5
031	273.8	069	153.3	105	61.2
030	250.1	068	145.3	104	62.4
029	194.4	067	126.3	103	65.0
028	159.6	066	114.8	102	64.0
027	131.3	065	76.0	101	67.2
026	97.7	064	68.8	100	
025	83.9	063	76.7	099	66.1
024	189.9	062	95.6	098	65.5
023	224.9	061	114.7	097	64.5
022	224.7	060	131.5	096	64.7
021	292.9	059	156.9	095	65.7
020	317.8	058	175.1	094	63.8
019	308.3	057	215.5	093	58.9
018	312.5	056	210.2	092	83.2
017	312.2	055	171.8	091	87.2
016	309.9	054	147.6	090	87.5
015	302.3	053	114.5	089	85.5
014	295.7	052	86.8	088	81.0
013	225.2	051	74.3	087	76.4
012	246.3	050	151.6	086	68.8
011	220.2	049	181.3	085	62.1
010	203.9	048	241.3	084	74.2
009	173.7	047	271.8	083	85.7
008	143.7	046	264.6	082	100.6
007	113.3	045	239.3	081	115.5
006	100.7	044	185.2	080	122.6
005	160.3	043	136.4	079	123.2
004	135.7	042	122.0	078	120.6
003	107.2	041	90.3	077	110.3
002	100.9	040	150.1	076	96.4
001	99.4	039	149.8	075	76.0
		038	155.7	074	65.4
		037	187.6		
		036	252.2		

* See Figure A-1 for T/C location

TABLE C-15

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 10/2/78

TIME: 4:00 PM

OPERATING HOURS: 3701

AT POWER LEVEL: 1 kW

TOTAL OPERATING HOURS: 5021

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
034	229.1	072	114.1	109	66.8
033	230.5	071	123.7	108	
032	230.0	070	127.5	107	70.5
031	229.0	069	125.2	106	73.9
030	214.7	068	121.0	105	75.9
029	173.9	067	112.1	104	77.6
028	149.0	066	106.4	103	79.5
027	128.3	065	94.8	102	79.6
026	110.8	064	105.4	101	100.8
025	110.7	063	79.1	100	
024	157.2	062	88.3	099	81.3
023	185.1	061	97.5	098	82.6
022	184.6	060	107.7	097	82.9
021	242.9	059	126.3	096	82.9
020	272.6	058	142.6	095	83.3
019	270.9	057	172.7	094	82.9
018	274.2	056	172.4	093	96.7
017	273.8	055	150.7	092	86.8
016	272.7	054	129.3	091	91.3
015	269.2	053	110.1	090	92.6
014	264.2	052	99.3	089	92.1
013	205.9	051	97.8	088	89.9
012	224.8	050	123.3	087	87.8
011	199.9	049	144.1	086	84.7
010	185.6	048	181.5	085	99.8
009	160.5	047	217.3	084	77.6
008	138.0	046	218.3	083	84.7
007	121.3	045	203.6	082	92.5
006	118.1	044	163.3	081	101.3
005	150.1	043	123.4	080	105.7
004	132.5	042	113.7	079	107.4
003	120.5	041	100.3	078	106.9
002	119.5	040	120.8	077	102.6
001	123.1	039	122.4	076	96.8
		038	125.9	075	89.1
		037	149.4	074	105.0
		036	193.8	073	100.0
		035	229.0		

* See Figure A-1 for T/C location

TABLE C-16

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 4/1/79

TIME: 4:00 PM

OPERATING HOURS: 8045

AT POWER LEVEL: 1 kW

TOTAL OPERATING HOURS: 9365

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
031	223.0	065	69.7	099	69.1
030	205.6	064	73.4	098	66.5
029	157.4	063	79.8	097	63.5
028	129.2	062	86.9	096	60.3
027	106.0	061	94.8	095	57.2
026	84.7	060	104.0	094	54.8
025	80.1	059	121.7	093	65.3
024	156.7	058	136.8	092	80.0
023	57.2	057	169.5	091	78.8
022	186.2	056	167.5	090	76.2
021	247.5	055	142.9	089	72.7
020	270.8	054	108.3	088	67.4
019	56.3	053	84.6	087	61.5
018	55.1	052	74.0	086	57.0
017	54.7	051	70.2	085	68.7
016	268.8	050	120.9	084	78.8
015	262.8	049	142.5	083	83.2
014	258.4	048	186.0	082	88.2
013	192.4	047	213.6	081	93.3
012	213.1	046	212.3	080	94.1
011	185.9	045	194.6	079	91.4
010	170.4	044	146.4	078	88.0
009	142.6	043	100.1	076	80.6
008	117.0	042	88.7	075	61.0
007	97.7	041	74.8	074	71.4
006	92.6	040	118.8	073	96.0
005	130.0	039	119.8	072	107.6
004	110.4	038	123.7	071	114.0
003	96.3	037	148.4	070	124.0
002	93.1	036	197.4	069	117.9
001	90.5	035	225.1	068	101.5
000	70.5	034	66.7	067	38.5
		033	62.6	066	80.8
		032	58.8		

* See Figure A-19 for T/C location

TABLE C-17

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 4/26/79

TIME: 12:00 P.M.

OPERATING HOURS: 0

AT POWER LEVEL: 2kW

TOTAL OPERATING HOURS: 9961

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
031	225.6	065	82.1	099	69.5
030	309.3	064	83.6	098	67.5
029	164.6	063	79.5	097	66.1
028	139.1	062	86.3	096	65.7
027	119.0	061	94.2	095	66.9
026	101.0	060	103.5	094	69.3
025	102.1	059	121.3	093	78.0
024	156.9	058	137.6	092	79.9
023	59.6	057	170.5	091	79.3
022	186.4	056	169.4	090	77.4
021	247.9	055	146.7	089	75.3
020	271.5	054	115.8	088	72.7
019	62.0	053	98.3	087	71.4
018	64.1	052	87.7	086	71.3
017	67.5	051	89.3	085	79.8
016	270.3	050	121.0	084	78.2
015	265.1	049	143.1	083	82.8
014	260.5	048	187.5	082	87.8
013	198.8	047	215.2	081	93.1
012	218.7	046	214.9	080	94.2
011	192.5	045	198.5	079	92.3
010	177.7	044	153.6	078	90.3
009	151.8	043	111.0	077	86.1
008	128.3	042	101.9	076	80.8
007	111.3	041	89.7	075	76.3
006	108.8	040	118.5	074	81.5
005	140.8	039	119.8	073	95.9
004	123.0	038	123.8	072	107.4
003	110.3	037	149.2	071	113.9
002	110.9	036	198.8	070	125.1
001	137.9	035	226.9	069	120.3
000	92.0	034	66.2	068	105.5
		033	62.2	067	97.2
		032	59.5	066	92.0

* See Figure A-19 for T/C location

TABLE C-18

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 4/27/79

TIME: 12:00

OPERATING HOURS: 24

AT POWER LEVEL: 2 kW

TOTAL OPERATING HOURS: 9985

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
31	273.0	65	81.7	99	69.6
30	255.3	64	83.4	98	67.8
29	194.1	63	79.6	97	66.4
28	158.4	62	86.4	96	66.1
27	129.9	61	94.4	95	67.8
26	105.6	60	104.1	94	70.6
25	105.9	59	125.0	93	77.8
24	188.7	58	141.7	92	80.0
23	59.7	57	175.4	91	79.5
22	236.2	56	174.7	90	77.6
21	324.0	55	152.0	89	75.5
20	349.4	54	120.1	88	73.0
19	62.2	53	101.7	87	72.3
18	64.9	52	88.3	86	72.4
17	68.4	51	89.3	85	79.5
16	346.7	50	126.8	84	78.3
15	344.6	49	160.3	83	82.9
14	335.9	48	221.7	82	87.9
13	248.8	47	251.4	81	93.2
12	278.1	46	250.9	80	94.3
11	240.7	45	234.4	79	92.5
10	217.5	44	176.5	78	90.6
9	176.8	43	117.8	77	86.5
8	142.1	42	107.0	76	81.7
7	117.8	41	91.6	75	77.5
6	114.4	40	125.5	74	81.4
5	159.9	39	126.6	73	96.0
4	135.2	38	132.4	72	107.7
3	117.6	37	170.7	71	114.2
2	117.8	36	243.1	70	125.3
1	143.3	35	275.3	69	120.6
0	92.9	34	66.5	68	106.0
		33	62.2	67	98.3
		32	59.9	66	93.7

*See Figure A-19 for T/C Location

TABLE C-19

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 4/28/79

TIME: 12:00

OPERATING HOURS: 48

AT POWER LEVEL: 2 kW

TOTAL OPERATING HOURS: 10,009

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
31	291.3	65	83.1	99	69.8
30	272.7	64	86.8	98	68.0
29	206.4	63	79.6	97	66.7
28	167.3	62	86.4	96	66.5
27	137.0	61	94.6	95	68.6
26	109.9	60	105.7	94	71.5
25	108.6	59	130.4	93	79.1
24	195.7	58	148.8	92	80.1
23	59.9	57	185.5	91	79.6
22	245.3	56	185.1	90	77.8
21	337.8	55	161.5	89	75.8
20	365.4	54	126.3	88	73.4
19	62.4	53	105.9	87	73.2
18	65.5	52	91.1	86	73.3
17	68.9	51	92.8	85	81.2
16	361.9	50	131.3	84	78.3
15	360.7	49	168.6	83	83.0
14	349.8	48	236.9	82	88.0
13	259.5	47	269.1	81	93.3
12	288.7	46	268.9	80	94.3
11	252.5	45	251.3	79	92.7
10	228.7	44	188.3	78	90.9
9	186.8	43	124.3	77	87.0
8	150.8	42	112.3	76	82.8
7	124.6	41	94.9	75	78.3
6	120.7	40	129.9	74	84.0
5	169.9	39	131.0	73	96.4
4	143.9	38	137.1	72	109.5
3	124.2	37	179.1	71	115.8
2	124.0	36	258.9	70	126.5
1	151.5	35	293.7	69	122.0
0	94.9	34	66.5	68	107.5
		33	62.2	67	100.7
		32	60.0	66	96.0

*See Figure A-19 for T/C Location

TABLE C-20

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 4/29/79

TIME: 12:00

OPERATING HOURS: 72

AT POWER LEVEL: 2 kW

TOTAL OPERATING HOURS: 10,033

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
31	303.2	65	85.2	99	69.6
30	283.6	64	88.3	98	67.9
29	214.2	63	79.4	97	66.7
28	173.0	62	86.3	96	66.7
27	141.9	61	95.0	95	69.2
26	114.3	60	107.4	94	72.4
25	112.2	59	134.3	93	80.8
24	200.1	58	154.2	92	79.9
23	60.1	57	194.4	91	79.4
22	250.9	56	194.1	90	77.7
21	346.0	55	169.0	89	75.7
20	375.5	54	130.8	88	73.6
19	62.8	53	109.3	87	73.7
18	66.1	52	94.2	86	74.3
17	69.9	51	94.1	85	83.5
16	371.7	50	134.4	84	78.2
15	369.8	49	173.7	83	82.8
14	359.0	48	246.3	82	87.8
13	266.4	47	281.5	81	93.3
12	295.0	46	281.1	80	94.3
11	260.0	45	262.1	79	92.6
10	236.0	44	195.5	78	91.0
9	192.8	43	128.5	77	87.3
8	156.2	42	116.1	76	83.4
7	129.2	41	98.2	75	79.4
6	124.5	40	133.1	74	86.0
5	175.7	39	134.0	73	96.7
4	149.5	38	140.4	72	111.3
3	128.9	37	184.2	71	117.9
2	127.6	36	268.7	70	128.6
1	130.8	35	305.7	69	124.3
0	91.7	34	66.5	68	109.7
		33	62.2	67	103.2
		32	60.0	66	98.2

*See Figure A-19 for T/C Location

TABLE C-21

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 4/30/79 TIME: 12:00
 OPERATING HOURS: 96 AT POWER LEVEL: 2 kW
 TOTAL OPERATING HOURS: 10,057

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
31	310.6	65	86.0	99	69.6
30	289.6	64	86.7	98	67.9
29	219.1	63	79.5	97	66.7
28	177.1	62	86.5	96	66.9
27	145.7	61	95.7	95	69.8
26	117.0	60	109.2	94	73.1
25	116.3	59	137.6	93	80.3
24	201.9	58	158.7	92	79.9
23	60.2	57	201.9	91	79.5
22	252.8	56	201.6	90	77.8
21	349.6	55	175.1	89	76.0
20	380.4	54	134.5	88	74.1
19	63.3	53	112.5	87	74.5
18	67.0	52	95.8	86	75.0
17	70.8	51	93.4	85	82.4
16	376.5	50	136.8	84	78.1
15	373.8	49	177.1	83	82.8
14	362.3	48	252.6	82	88.0
13	269.6	47	289.8	81	93.6
12	297.7	46	289.2	80	94.7
11	263.7	45	269.3	79	92.8
10	239.3	44	200.5	78	91.4
9	196.8	43	132.1	77	88.0
8	159.8	42	119.4	76	84.5
7	132.4	41	100.1	75	80.3
6	126.4	40	134.9	74	84.4
5	180.0	39	136.4	73	97.6
4	152.9	38	142.7	72	113.4
3	131.4	37	187.8	71	120.3
2	129.2	36	274.6	70	131.5
1	143.7	35	313.5	69	127.2
0	94.3	34	66.3	68	112.3
		33	62.3	67	105.8
		32	59.9	66	100.8

*See Figure A-19 for T/C Location

TABLE C-22

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 5/1/79 TIME: 12:00
 OPERATING HOURS: 120 AT POWER LEVEL: 2 kW
 TOTAL OPERATING HOURS: 10,081

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
31	318.6	65	83.8	99	69.5
30	296.7	64	80.2	98	67.9
29	224.2	63	79.3	97	66.7
28	180.6	62	86.4	96	67.1
27	148.3	61	96.3	95	70.2
26	117.4	60	110.5	94	73.3
25	114.7	59	140.1	93	73.5
24	205.4	58	162.0	92	79.7
23	60.3	57	208.0	91	79.3
22	257.2	56	207.6	90	77.7
21	355.9	55	179.8	89	76.0
20	387.5	54	137.3	88	74.3
19	63.8	53	114.7	87	75.0
18	67.6	52	95.3	86	75.0
17	71.1	51	89.7	85	75.4
16	383.3	50	138.9	84	78.1
15	380.0	49	180.5	83	82.6
14	369.0	48	259.5	82	88.0
13	275.1	47	298.1	81	94.0
12	303.0	46	297.4	80	95.0
11	268.6	45	276.7	79	93.0
10	244.2	44	205.5	78	91.7
9	200.8	43	134.5	77	88.7
8	162.6	42	121.6	76	85.3
7	132.9	41	100.2	75	80.5
6	124.7	40	136.7	74	78.4
5	183.3	39	138.2	73	98.2
4	155.7	38	144.7	72	114.9
3	130.9	37	191.5	71	122.2
2	127.0	36	282.0	70	134.0
1	135.2	35	322.0	69	129.8
0	86.1	34	66.1	68	114.5
		33	62.1	67	107.9
		32	59.8	66	102.6

*See Figure A-19 for T/C Location

TABLE C-23

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 7/1/79

TIME: 4:00 p.m.

OPERATING HOURS: 1588

AT POWER LEVEL: 2 kW

TOTAL OPERATING HOURS: 11,549

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
31	402.4	64	113.5	99	76.3
30	373.6	63	82.9	98	78.0
29	284.0	62	98.8	97	80.0
28	222.4	61	118.0	96	83.8
27	186.5	60	137.8	95	88.0
26	150.9	59	168.4	94	90.8
25	145.1	58	234.5	93	102.6
24	285.5	57	290.4	92	88.6
23	71.2	56	288.4	91	93.1
22	354.9	55	250.4	90	95.0
21	442.2	54	188.8	89	96.2
20	466.5	53	144.4	88	96.4
19	78.0	52	124.0	87	96.4
18	83.2	51	112.1	86	94.6
17	85.8	50	172.3	85	105.9
16	456.1	49	283.0	84	80.5
15	451.3	48	355.7	83	90.2
14	435.9	47	386.9	82	101.9
13	329.6	46	380.6	81	113.9
12	358.0	45	351.6	80	119.7
11	327.4	44	266.0	79	120.9
10	300.8	43	165.0	78	123.2
9	249.0	42	152.9	77	120.2
8	200.8	41	130.8	76	113.9
7	165.3	40	189.8	75	103.7
6	153.7	39	188.8	74	110.0
5	225.4	38	204.3	73	118.7
4	191.9	37	301.4	72	137.7
3	162.8	36	380.6	71	160.7
2	154.9	35	411.8	70	193.9
1	136.1	34	66.2	69	188.2
0	107.9	33	64.7	68	154.1
		32	67.6	67	141.1
				66	133.5
				65	111.9

*See Figure A-19 for T/C Location

TABLE C-24

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 9/1/79

TIME: 8:00 a.m.

OPERATING HOURS: 3068

AT POWER LEVEL: 2 kW

TOTAL OPERATING HOURS: 13,029

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
31	424.4	65	98.9	99	84.3
30	392.0	64	78.7	98	86.5
29	297.3	63	86.2	97	87.8
28	230.7	62	103.6	96	88.8
27	189.3	61	122.9	95	89.0
26	142.9	60	141.8	94	88.1
25	129.6	59	203.6	93	77.4
24	354.5	58	268.3	92	96.2
23	77.4	57	315.7	91	102.6
22	403.5	56	311.5	90	104.6
21	470.5	55	273.8	89	104.7
20	485.4	54	206.4	88	102.1
19	82.0	53	142.5	87	97.7
18	83.9	52	116.5	86	92.0
17	84.4	51	87.0	85	76.4
16	472.7	50	227.9	84	83.9
15	464.3	49	337.3	83	95.5
14	448.6	48	390.0	82	108.5
13	337.6	47	411.8	81	122.3
12	364.1	46	403.0	80	129.1
11	338.8	45	371.5	79	131.0
10	310.5	44	280.0	78	131.1
9	257.6	43	168.8	77	125.0
8	204.9	42	151.1	76	114.3
7	162.7	41	123.2	75	99.8
6	145.6	40	283.2	74	79.6
5	234.5	39	279.5	73	124.4
4	191.7	38	297.1	72	148.7
3	156.9	37	356.1	71	188.9
2	144.8	36	414.5	70	217.9
1	98.3	35	436.8	69	210.6
0	72.6	34	66.1	68	176.0
		33	69.0	67	141.8
		32	73.5	66	131.4

*See Figure A-19 for T/C Location

TABLE C-25

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 1/1/80

TIME: 4:00 p.m.

OPERATING HOURS: 6004

AT POWER LEVEL: 2 kW

TOTAL OPERATING HOURS: 15,965

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
31	442.1	65	70.3	99	82.5
30	403.8	64	72.4	98	79.7
29	296.7	63	90.3	97	74.5
28	219.9	62	107.5	96	66.3
27	166.4	61	126.1	95	57.8
26	119.8	60	148.7	94	50.2
25	112.7	59	234.1	93	61.5
24	405.3	58	293.7	92	98.8
23	63.5	57	332.8	91	100.8
22	444.2	56	324.7	90	97.8
21	498.5	55	281.9	89	91.2
20	504.5	54	199.8	88	79.5
19	57.8	53	113.0	87	65.9
18	52.4	52	86.4	86	54.2
17	47.8	51	74.1	85	64.2
16	489.1	50	300.0	84	87.9
15	472.8	49	377.2	83	99.6
14	460.4	48	419.1	82	111.7
13	336.0	47	432.2	81	124.3
12	364.1	46	419.5	80	131.9
11	337.6	45	382.7	79	138.2
10	307.7	44	278.8	78	122.2
9	248.2	43	154.4	77	103.7
8	188.3	42	123.5	76	83.8
7	142.0	41	93.5	75	62.8
6	127.8	40	347.7	74	70.2
5	221.8	39	345.1	73	127.4
4	170.4	38	357.0	72	171.0
3	137.9	37	398.4	71	212.4
2	129.2	36	445.2	70	234.3
1	94.9	35	458.6	69	223.6
0	60.3	34	67.5	68	182.3
		33	68.9	67	126.3
		32	66.8	66	102.4

*See Figure A-19 for T/C Location

TABLE C-26

SOIL TEMPERATURE TEST - TEMPERATURE DISTRIBUTION

DATE: 4/1/80

TIME: 11:45 a.m.

OPERATING HOURS: 8184

AT POWER LEVEL: 2 kW

TOTAL OPERATING HOURS: 18,145

THERMOCOUPLE READINGS *

<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>	<u>T/C No.</u>	<u>Temp(°F)</u>
31	427.5	65	72.6	99	76.6
30	385.2	64	61.4	98	73.2
29	278.9	63	90.1	97	68.6
28	208.0	62	105.7	96	63.6
27	160.8	61	124.8	95	60.6
26	117.5	60	152.3	94	57.1
25	107.5	59	237.6	93	55.1
24	400.8	58	293.0	92	94.9
23	58.0	57	327.8	91	95.4
22	441.6	56	315.2	90	91.6
21	489.6	55	258.4	89	85.6
20	490.8	54	163.4	88	76.9
19	56.9	53	119.1	87	69.3
18	56.4	52	89.9	86	61.2
17	55.6	51	69.5	85	56.8
16	473.4	50	307.6	84	87.9
15	453.3	49	376.6	83	97.9
14	442.8	48	414.0	82	109.0
13	320.9	47	422.4	81	122.5
12	348.9	46	406.1	80	132.9
11	320.8	45	362.9	79	136.8
10	292.1	44	257.8	78	121.3
9	236.3	43	144.8	77	102.7
8	182.4	42	127.5	76	88.7
7	139.3	41	96.6	75	70.4
6	125.3	40	354.3	74	60.7
5	214.9	39	352.1	73	125.4
4	170.3	38	361.7	72	174.9
3	134.5	37	397.7	71	214.8
2	125.5	36	438.7	70	233.5
1	104.1	35	446.9	69	217.6
0	61.5	34	66.7	68	156.9
		33	63.7	67	123.4
		32	60.1	66	110.4

*See Figure A-19 for T/C Location

APPENDIX D

TAP-A INPUT AND OUTPUT

This Appendix contains a copy of typical computer printout of the TAP-A input data and output data. Model temperatures for the end of April, 1978 (accelerated heatup period); the end of August, 1978 and April, 1979 (1.0 kW power operation); and the end of August, 1979 and February, 1980 (2.0 kW operation) are provided in the output printouts. The nodes are identified and their locations are shown in Figures 17 and 18. For an explanation of the input data and its format, see Reference 2.

TAP-A INPUT DATA

FIELD LENGTH(OCTAL) NEEDED FOR THIS TAP-A RUN = 00000000000000105254
 FIELD LENGTH SPECIFIED BY YOU = 0000000000000035500

MARCH 1978 3 KW		.207E+07	.216E+05	.500E-02	.300E+01	.500E+02	.300E+04		
0.	1.	30.	.6000E+02	0.	0.	0.	0.	0.	0.
1	31.	33.	.1140E+03	0.	0.	0.	0.	0.	0.
1	34.	35.	.1020E+03	0.	0.	0.	0.	0.	0.
1	36.	38.	.1160E+03	0.	0.	0.	0.	0.	0.
1	39.	40.	.1150E+03	0.	0.	0.	0.	0.	0.
1	41.	42.	.1130E+03	0.	0.	0.	0.	0.	0.
1	43.	44.	.1080E+03	0.	0.	0.	0.	0.	0.
1	45.	48.	.9400E+02	0.	0.	0.	0.	0.	0.
1	49.	50.	.8500E+02	0.	0.	0.	0.	0.	0.
1	51.	52.	.1000E+03	0.	0.	0.	0.	0.	0.
1	53.	58.	.9500E+02	0.	0.	0.	0.	0.	0.
1	59.	0.	.8500E+02	0.	0.	0.	0.	0.	0.
1	60.	0.	.9200E+02	0.	0.	0.	0.	0.	0.
1	61.	62.	.7900E+02	0.	0.	0.	0.	0.	0.
1	63.	68.	.8100E+02	0.	0.	0.	0.	0.	0.
1	69.	70.	.7600E+02	0.	0.	0.	0.	0.	0.
1	71.	72.	.7300E+02	0.	0.	0.	0.	0.	0.
1	73.	77.	.7100E+02	0.	0.	0.	0.	0.	0.
1	78.	110.	.6000E+02	0.	0.	0.	0.	0.	0.
1	111.	117.	.9700E+02	0.	0.	0.	0.	0.	0.
1	118.	122.	.5900E+02	0.	0.	0.	0.	0.	0.
1	122.	0.	.5180E+02	0.	0.	0.	0.	0.	0.
1	123.	0.	.5550E+02	0.	0.	0.	0.	0.	0.
1	124.	0.	.5790E+02	0.	0.	0.	0.	0.	0.
1	125.	0.	.5790E+02	0.	0.	0.	0.	0.	0.
1	126.	0.	.5870E+02	0.	0.	0.	0.	0.	0.
1	127.	0.	.6600E+02	0.	0.	0.	0.	0.	0.
1	128.	0.	.7510E+02	0.	0.	0.	0.	0.	0.
1	129.	0.	.7600E+02	0.	0.	0.	0.	0.	0.
1	130.	0.	.7630E+02	0.	0.	0.	0.	0.	0.
1	131.	0.	.7700E+02	0.	0.	0.	0.	0.	0.
1	132.	0.	.7740E+02	0.	0.	0.	0.	0.	0.
1	133.	0.	.7740E+02	0.	0.	0.	0.	0.	0.
1	134.	0.	.7730E+02	0.	0.	0.	0.	0.	0.
1	135.	0.	.7600E+02	0.	0.	0.	0.	0.	0.
1	136.	0.	.7420E+02	0.	0.	0.	0.	0.	0.
1	137.	0.	.7300E+02	0.	0.	0.	0.	0.	0.
1	138.	0.	.7200E+02	0.	0.	0.	0.	0.	0.
1	139.	0.	.7200E+02	0.	0.	0.	0.	0.	0.
1	140.	0.	.5180E+02	0.	0.	0.	0.	0.	0.
1	141.	0.	.5550E+02	0.	0.	0.	0.	0.	0.
1	142.	0.	.5790E+02	0.	0.	0.	0.	0.	0.
1	143.	0.	.5870E+02	0.	0.	0.	0.	0.	0.
1	144.	0.	.6600E+02	0.	0.	0.	0.	0.	0.
1	145.	0.	.7510E+02	0.	0.	0.	0.	0.	0.
1	146.	0.	.7600E+02	0.	0.	0.	0.	0.	0.
1	147.	0.	.7630E+02	0.	0.	0.	0.	0.	0.
1	148.	0.	.7700E+02	0.	0.	0.	0.	0.	0.
1	149.	0.	.7740E+02	0.	0.	0.	0.	0.	0.
1	150.	0.	.7740E+02	0.	0.	0.	0.	0.	0.
1	151.	0.	.7730E+02	0.	0.	0.	0.	0.	0.
1	152.	0.	.7600E+02	0.	0.	0.	0.	0.	0.
1	153.	0.	.7420E+02	0.	0.	0.	0.	0.	0.
1	154.	0.	.7300E+02	0.	0.	0.	0.	0.	0.
1	155.	0.	.7200E+02	0.	0.	0.	0.	0.	0.
1	156.	0.	.7000E+02	0.	0.	0.	0.	0.	0.
1	157.	0.	.7000E+02	0.	0.	0.	0.	0.	0.
1	158.	0.	.7000E+02	0.	0.	0.	0.	0.	0.
1	159.	0.	.7000E+02	0.	0.	0.	0.	0.	0.
1	160.	0.	.7000E+02	0.	0.	0.	0.	0.	0.
1	161.	0.	.7000E+02	0.	0.	0.	0.	0.	0.
1	162.	0.	.7000E+02	0.	0.	0.	0.	0.	0.
1	163.	0.	.5160E+02	0.	0.	0.	0.	0.	0.
1	164.	0.	.5500E+02	0.	0.	0.	0.	0.	0.
1	165.	0.	.5700E+02	0.	0.	0.	0.	0.	0.
1	166.	0.	.5990E+02	0.	0.	0.	0.	0.	0.
1	167.	0.	.6100E+02	0.	0.	0.	0.	0.	0.
1	168.	0.	.6340E+02	0.	0.	0.	0.	0.	0.
1	169.	0.	.6450E+02	0.	0.	0.	0.	0.	0.
1	170.	0.	.6630E+02	0.	0.	0.	0.	0.	0.
1	171.	0.	.6730E+02	0.	0.	0.	0.	0.	0.
1	172.	0.	.6860E+02	0.	0.	0.	0.	0.	0.
1	173.	0.	.6930E+02	0.	0.	0.	0.	0.	0.
1	174.	0.	.7040E+02	0.	0.	0.	0.	0.	0.

TAP-A INPUT DATA (Cont'd)

1	175.	0.	.7050E+02	0.	0.	0.	0.	0.
1	176.	0.	.7070E+02	0.	0.	0.	0.	0.
1	177.	0.	.7060E+02	0.	0.	0.	0.	0.
1	178.	0.	.7060E+02	0.	0.	0.	0.	0.
1	179.	0.	.7140E+02	0.	0.	0.	0.	0.
1	180.	0.	.7170E+02	0.	0.	0.	0.	0.
1	181.	0.	.7090E+02	0.	0.	0.	0.	0.
1	182.	0.	.5080E+02	0.	0.	0.	0.	0.
1	183.	0.	.5200E+02	0.	0.	0.	0.	0.
1	184.	0.	.5430E+02	0.	0.	0.	0.	0.
1	185.	0.	.5630E+02	0.	0.	0.	0.	0.
1	186.	0.	.5800E+02	0.	0.	0.	0.	0.
1	187.	0.	.6000E+02	0.	0.	0.	0.	0.
1	188.	0.	.6200E+02	0.	0.	0.	0.	0.
1	189.	0.	.6340E+02	0.	0.	0.	0.	0.
1	190.	0.	.6400E+02	0.	0.	0.	0.	0.
1	191.	0.	.6430E+02	0.	0.	0.	0.	0.
1	192.	0.	.6500E+02	0.	0.	0.	0.	0.
1	193.	0.	.6630E+02	0.	0.	0.	0.	0.
1	194.	0.	.6700E+02	0.	0.	0.	0.	0.
1	195.	0.	.6790E+02	0.	0.	0.	0.	0.
1	196.	0.	.6850E+02	0.	0.	0.	0.	0.
1	197.	0.	.6910E+02	0.	0.	0.	0.	0.
1	198.	0.	.7000E+02	0.	0.	0.	0.	0.
1	199.	0.	.7000E+02	0.	0.	0.	0.	0.
1	200.	0.	.7000E+02	0.	0.	0.	0.	0.
1	201.	0.	.7000E+02	0.	0.	0.	0.	0.
1	202.	0.	.4760E+02	0.	0.	0.	0.	0.
1	203.	0.	.5180E+02	0.	0.	0.	0.	0.
1	204.	0.	.5560E+02	0.	0.	0.	0.	0.
1	205.	0.	.5920E+02	0.	0.	0.	0.	0.
1	206.	0.	.6250E+02	0.	0.	0.	0.	0.
1	207.	0.	.6680E+02	0.	0.	0.	0.	0.
1	208.	0.	.6860E+02	0.	0.	0.	0.	0.
1	209.	0.	.6940E+02	0.	0.	0.	0.	0.
1	210.	0.	.7010E+02	0.	0.	0.	0.	0.
1	211.	0.	.7090E+02	0.	0.	0.	0.	0.
1	212.	0.	.7030E+02	0.	0.	0.	0.	0.
1	213.	0.	.7000E+02	0.	0.	0.	0.	0.
1	214.	0.	.4900E+02	0.	0.	0.	0.	0.
1	215.	0.	.5230E+02	0.	0.	0.	0.	0.
1	216.	0.	.5510E+02	0.	0.	0.	0.	0.
1	217.	0.	.5960E+02	0.	0.	0.	0.	0.
1	218.	0.	.6160E+02	0.	0.	0.	0.	0.
1	219.	0.	.6420E+02	0.	0.	0.	0.	0.
1	220.	0.	.6560E+02	0.	0.	0.	0.	0.
1	221.	0.	.6710E+02	0.	0.	0.	0.	0.
1	222.	0.	.7000E+02	0.	0.	0.	0.	0.
1	223.	0.	.7000E+02	0.	0.	0.	0.	0.
1	224.	0.	.7000E+02	0.	0.	0.	0.	0.
1	225.	0.	.7000E+02	0.	0.	0.	0.	0.
1	226.	0.	.4840E+02	0.	0.	0.	0.	0.
1	227.	0.	.5140E+02	0.	0.	0.	0.	0.
1	228.	0.	.5400E+02	0.	0.	0.	0.	0.
1	229.	0.	.5720E+02	0.	0.	0.	0.	0.
1	230.	0.	.6060E+02	0.	0.	0.	0.	0.
1	231.	0.	.6340E+02	0.	0.	0.	0.	0.
1	232.	0.	.6500E+02	0.	0.	0.	0.	0.
1	233.	0.	.6700E+02	0.	0.	0.	0.	0.
1	234.	0.	.7000E+02	0.	0.	0.	0.	0.
1	235.	0.	.7000E+02	0.	0.	0.	0.	0.
1	236.	0.	.7000E+02	0.	0.	0.	0.	0.
1	237.	0.	.7000E+02	0.	0.	0.	0.	0.
1	238.	0.	.7000E+02	0.	0.	0.	0.	0.
1	239.	0.	.7000E+02	0.	0.	0.	0.	0.
1	240.	0.	.7000E+02	0.	0.	0.	0.	0.
1	241.	0.	.7000E+02	0.	0.	0.	0.	0.
1	242.	0.	.7000E+02	0.	0.	0.	0.	0.
1	3001.	3042.	.6000E+02	0.	0.	0.	0.	0.
1	3043.	3056.	.5500E+02	0.	0.	0.	0.	0.
1	3057.	3077.	.7000E+02	0.	0.	0.	0.	0.
1	5001.	5042.	.6000E+02	0.	0.	0.	0.	0.
1	5043.	0.	.5500E+02	0.	0.	0.	0.	0.
1	5044.	0.	-.5000E+02	0.	0.	0.	0.	0.
1	5045.	0.	-.5500E+02	0.	0.	0.	0.	0.
1	5046.	0.	-.5000E+02	0.	0.	0.	0.	0.

TAP-A INPUT DATA (Cont'd)

1	5047.	0.	.5500E+02	0.	0.	0.	0.	0.
1	5048.	0.	-.5000E+02	0.	0.	0.	0.	0.
1	5078.	3081.	.5500E+02	0.	0.	0.	0.	0.
1	5049.	0.	.5860E+02	0.	0.	0.	0.	0.
1	5050.	0.	.4950E+02	0.	0.	0.	0.	0.
1	5051.	0.	.5200E+02	0.	0.	0.	0.	0.
1	5052.	0.	.5420E+02	0.	0.	0.	0.	0.
1	5053.	0.	.5780E+02	0.	0.	0.	0.	0.
1	5054.	0.	.6160E+02	0.	0.	0.	0.	0.
1	5055.	0.	.6660E+02	0.	0.	0.	0.	0.
1	5056.	0.	.6800E+02	0.	0.	0.	0.	0.
1	5057.	0.	.6980E+02	0.	0.	0.	0.	0.
1	5058.	0.	.7000E+02	0.	0.	0.	0.	0.
1	243.	0.	.5160E+02	0.	0.	0.	0.	0.
1	244.	0.	.5080E+02	0.	0.	0.	0.	0.
1	245.	0.	.4760E+02	0.	0.	0.	0.	0.
1	246.	0.	.4900E+02	0.	0.	0.	0.	0.
1	247.	0.	.4840E+02	0.	0.	0.	0.	0.
1	248.	0.	.4840E+02	0.	0.	0.	0.	0.
1	249.	0.	.4840E+02	0.	0.	0.	0.	0.
1	250.	0.	.4840E+02	0.	0.	0.	0.	0.
1	251.	0.	.4840E+02	0.	0.	0.	0.	0.
1	264.	0.	.4840E+02	0.	0.	0.	0.	0.
1	277.	0.	.4840E+02	0.	0.	0.	0.	0.
1	252.	0.	.5140E+02	0.	0.	0.	0.	0.
1	265.	0.	.5140E+02	0.	0.	0.	0.	0.
1	278.	0.	.5140E+02	0.	0.	0.	0.	0.
1	253.	0.	.5400E+02	0.	0.	0.	0.	0.
1	266.	0.	.5400E+02	0.	0.	0.	0.	0.
1	279.	0.	.5400E+02	0.	0.	0.	0.	0.
1	254.	0.	.5720E+02	0.	0.	0.	0.	0.
1	267.	0.	.5720E+02	0.	0.	0.	0.	0.
1	280.	0.	.5720E+02	0.	0.	0.	0.	0.
1	255.	0.	.6060E+02	0.	0.	0.	0.	0.
1	268.	0.	.6060E+02	0.	0.	0.	0.	0.
1	281.	0.	.6060E+02	0.	0.	0.	0.	0.
1	256.	0.	.6340E+02	0.	0.	0.	0.	0.
1	269.	0.	.6340E+02	0.	0.	0.	0.	0.
1	282.	0.	.6340E+02	0.	0.	0.	0.	0.
1	257.	0.	.6500E+02	0.	0.	0.	0.	0.
1	270.	0.	.6500E+02	0.	0.	0.	0.	0.
1	283.	0.	.6500E+02	0.	0.	0.	0.	0.
1	258.	0.	.6700E+02	0.	0.	0.	0.	0.
1	271.	0.	.6700E+02	0.	0.	0.	0.	0.
1	284.	0.	.6700E+02	0.	0.	0.	0.	0.
1	259.	0.	.7000E+02	0.	0.	0.	0.	0.
1	272.	0.	.7000E+02	0.	0.	0.	0.	0.
1	285.	0.	.7000E+02	0.	0.	0.	0.	0.
1	260.	263.	.7000E+02	0.	0.	0.	0.	0.
1	273.	276.	.7000E+02	0.	0.	0.	0.	0.
1	286.	289.	.7000E+02	0.	0.	0.	0.	0.
3	201.	0.	.1000E-01	0.	0.	0.	0.	0.
3	202.	0.	.4130E-01	0.	0.	0.	0.	0.
3	203.	0.	.5960E-01	0.	0.	0.	0.	0.
3	204.	0.	.3472E-04	0.	0.	0.	0.	0.
3	205.	0.	.6770E-01	0.	0.	0.	0.	0.
3	206.	0.	.5960E-01	0.	0.	0.	0.	0.
3	207.	0.	.2836E+00	0.	0.	0.	0.	0.
3	227.	0.	.2836E+00	0.	0.	0.	0.	0.
3	228.	0.	.8220E-01	0.	0.	0.	0.	0.
3	207.	0.	.6130E-01	0.	0.	0.	0.	0.
4	201.	1.	.1000E+00	.1620E-05	.1000E+03	.1000E+00	.1620E-05	.3450E+03
4	201.	3.	.1000E+00	.2360E-05	.5000E+03	.1000E+00	.3009E-05	.6000E+03
4	201.	5.	.1000E+00	.3704E-05	.7000E+03	.1000E+00	.4398E-05	.8000E+03
4	201.	7.	.1000E+00	.5092E-05	.9000E+03	.1000E+00	.6020E-05	.1000E+04
4	201.	9.	.1000E+00	.6020E-05	.1300E+04	0.	0.	0.
4	202.	1.	.2500E+00	.2026E-04	.4000E+02	.2500E+00	.2026E-04	.1900E+03
4	202.	3.	.2500E+00	.6944E-05	.2000E+03	.2500E+00	.6944E-05	.5000E+03
4	203.	1.	.2500E+00	.2026E-04	.4000E+02	.2500E+00	.2026E-04	.1900E+03
4	203.	3.	.2500E+00	.1042E-04	.2000E+03	.2500E+00	.1042E-04	.5000E+03
4	204.	1.	.2390E+00	.3078E-06	0.	.2400E+00	.3565E-06	.1000E+03
4	204.	3.	.2430E+00	.4467E-06	.3000E+03	.2470E+00	.5347E-06	.5000E+03
4	204.	5.	.2530E+00	.6204E-06	.7000E+03	.2590E+00	.7014E-06	.9000E+03
4	205.	1.	.2000E+00	.1538E-04	.6000E+02	.2000E+00	.1512E-04	.1000E+03

TAP-A INPUT DATA (Cont'd)

4	205.	3.	.2000E+00	.1538E-04	.2000E+03	.2000E+00	.1485E-04	.3000E+03
4	205.	5.	.2000E+00	.1458E-04	.4000E+03	.2000E+00	.9230E-05	.5000E+03
4	205.	7.	.2000E+00	.8290E-05	.6000E+03	.2000E+00	.8030E-05	.7000E+03
4	206.	1.	.2500E+00	.2026E-04	.4000E+02	.2500E+00	.2026E-04	.1900E+03
4	206.	3.	.2500E+00	.8565E-05	.2000E+03	.2500E+00	.8565E-05	.5000E+03
4	207.	1.	.2500E+00	.2026E-04	.4000E+02	.2500E+00	.2026E-04	.1900E+03
4	207.	3.	.2500E+00	.6944E-05	.2000E+03	.2500E+00	.6944E-05	.5000E+03
4	226.	0.	.1100E+00	.2315E-03	0.	0.	0.	0.
4	227.	0.	.1100E+00	.5324E-03	0.	0.	0.	0.
4	228.	0.	.2000E+00	.2431E-04	0.	0.	0.	0.
5	1.	10.	.2010E+03	.3142E+01	.4000E+01	.1520E+02	0.	0.
5	11.	20.	.2010E+03	.3142E+01	.1200E+02	.1520E+02	0.	0.
5	21.	30.	.2010E+03	.3142E+01	.2000E+02	.1520E+02	0.	0.
5	31.	0.	.2260E+03	.3142E+01	.4000E+01	.2500E+01	0.	0.
5	32.	0.	.2260E+03	.3142E+01	.1200E+02	.2500E+01	0.	0.
5	33.	0.	.2260E+03	.3142E+01	.2000E+02	.2500E+01	0.	0.
5	34.	0.	.2260E+03	.6200E+02	.1000E+01	.1000E+01	0.	0.
5	35.	0.	.2260E+03	.6800E+02	.1000E+01	.1000E+01	0.	0.
5	36.	45.	.2260E+03	.3142E+01	.5109E+01	.1520E+02	0.	0.
5	46.	0.	.2260E+03	.1214E+03	.1000E+01	.1000E+01	0.	0.
5	47.	0.	.2260E+03	.1231E+02	.1000E+01	.1000E+01	0.	0.
5	48.	0.	.2260E+03	.3142E+01	.2000E+02	.3750E+00	0.	0.
5	49.	0.	.2260E+03	.3142E+01	.1200E+02	.3750E+00	0.	0.
5	50.	0.	.2260E+03	.3142E+01	.4000E+01	.3750E+00	0.	0.
5	51.	0.	.2270E+03	.3142E+01	.1500E+02	.4000E+01	0.	0.
5	52.	0.	.2270E+03	.3142E+01	.1500E+02	.6750E+01	0.	0.
5	53.	0.	.2270E+03	.3142E+01	.4000E+01	.5000E+00	0.	0.
5	54.	0.	.2270E+03	.3142E+01	.1200E+02	.5000E+00	0.	0.
5	55.	0.	.2270E+03	.3142E+01	.2000E+02	.5000E+00	0.	0.
5	56.	0.	.2270E+03	.3142E+01	.2800E+02	.5000E+00	0.	0.
5	57.	0.	.2270E+03	.3142E+01	.3600E+02	.5000E+00	0.	0.
5	58.	0.	.2270E+03	.3142E+01	.2925E+02	.2500E+00	0.	0.
5	59.	0.	.2270E+03	.3142E+01	.4438E+01	.4000E+01	0.	0.
5	60.	0.	.2270E+03	.3142E+01	.4438E+01	.6750E+01	0.	0.
5	61.	70.	.2270E+03	.3142E+01	.4438E+01	.1520E+02	0.	0.
5	71.	0.	.2270E+03	.3142E+01	.4438E+01	.7750E+01	0.	0.
5	72.	0.	.2270E+03	.3142E+01	.4438E+01	.9000E+01	0.	0.
5	73.	0.	.2050E+03	.3142E+01	.3200E+02	.1200E+02	0.	0.
5	74.	0.	.2050E+03	.3142E+01	.1300E+02	.1200E+02	0.	0.
5	75.	0.	.2050E+03	.3142E+01	.2000E+02	.1200E+02	0.	0.
5	76.	0.	.2050E+03	.3142E+01	.1200E+02	.1200E+02	0.	0.
5	77.	0.	.2050E+03	.3142E+01	.4000E+01	.1200E+02	0.	0.
5	78.	0.	.2280E+03	.3142E+01	.4000E+01	.1500E+02	0.	0.
5	79.	0.	.2280E+03	.3142E+01	.4000E+01	.9000E+01	0.	0.
5	80.	0.	.2280E+03	.3142E+01	.4000E+01	.7500E+01	0.	0.
5	81.	0.	.2280E+03	.3142E+01	.1200E+02	.1500E+02	0.	0.
5	82.	0.	.2280E+03	.3142E+01	.1200E+02	.9000E+01	0.	0.
5	83.	0.	.2280E+03	.3142E+01	.1200E+02	.7500E+01	0.	0.
5	84.	0.	.2280E+03	.3142E+01	.2000E+02	.1500E+02	0.	0.
5	85.	0.	.2280E+03	.3142E+01	.2000E+02	.9000E+01	0.	0.
5	86.	0.	.2280E+03	.3142E+01	.2000E+02	.7500E+01	0.	0.
5	87.	0.	.2280E+03	.3142E+01	.2800E+02	.1500E+02	0.	0.
5	88.	0.	.2280E+03	.3142E+01	.2800E+02	.9000E+01	0.	0.
5	89.	0.	.2280E+03	.3142E+01	.2800E+02	.7500E+01	0.	0.
5	90.	0.	.2280E+03	.3142E+01	.3106E+02	.1500E+02	0.	0.
5	91.	0.	.2280E+03	.3142E+01	.3106E+02	.9000E+01	0.	0.
5	92.	0.	.2280E+03	.3142E+01	.3106E+02	.7500E+01	0.	0.
5	93.	0.	.2270E+03	.3142E+01	.4000E+01	.2500E+00	0.	0.
5	94.	0.	.2270E+03	.3142E+01	.1200E+02	.2500E+00	0.	0.
5	95.	0.	.2270E+03	.3142E+01	.2000E+02	.2500E+00	0.	0.
5	96.	0.	.2270E+03	.3142E+01	.2800E+02	.2500E+00	0.	0.
5	97.	0.	.2270E+03	.3142E+01	.3106E+02	.2500E+00	0.	0.
5	98.	0.	.2270E+03	.3142E+01	.4938E+01	.2375E+01	0.	0.
5	99.	0.	.2270E+03	.3142E+01	.4938E+01	.1500E+02	0.	0.
5	100.	0.	.2270E+03	.3142E+01	.4938E+01	.9000E+01	0.	0.
5	101.	0.	.2270E+03	.3142E+01	.4938E+01	.7500E+01	0.	0.
5	102.	0.	.2040E+03	.3142E+01	.4000E+01	.2375E+01	0.	0.
5	103.	0.	.2040E+03	.3142E+01	.1200E+02	.2375E+01	0.	0.
5	104.	0.	.2040E+03	.3142E+01	.2000E+02	.2375E+01	0.	0.
5	105.	0.	.2040E+03	.3142E+01	.2800E+02	.2375E+01	0.	0.
5	106.	0.	.2040E+03	.3142E+01	.3106E+02	.2375E+01	0.	0.
5	107.	0.	.2040E+03	.3142E+01	.5063E+01	.2625E+01	0.	0.
5	108.	0.	.2040E+03	.3142E+01	.5063E+01	.1500E+02	0.	0.
5	109.	0.	.2040E+03	.3142E+01	.5063E+01	.9000E+01	0.	0.
5	110.	0.	.2040E+03	.3142E+01	.5063E+01	.8000E+01	0.	0.
5	111.	0.	.2270E+03	.3142E+01	.4000E+01	.2500E+00	0.	0.
5	112.	0.	.2270E+03	.3142E+01	.1200E+02	.2500E+00	0.	0.
5	113.	0.	.2270E+03	.3142E+01	.2000E+02	.2500E+00	0.	0.

TAP-A INPUT DATA (Cont'd)

S	114.	0.	.2270E+03	.3142E+01	.2800E+02	.2500E+00	0.	0.
S	115.	0.	.2270E+03	.3142E+01	.3106E+02	.2500E+00	0.	0.
S	116.	0.	.2270E+03	.3142E+01	.1519E+02	.2500E+00	0.	0.
S	117.	0.	.2270E+03	.3142E+01	.2508E+03	.2500E+00	0.	0.
S	118.	0.	.2270E+03	.3142E+01	.5188E+01	.2625E+01	0.	0.
S	119.	0.	.2270E+03	.3142E+01	.5188E+01	.1500E+02	0.	0.
S	120.	0.	.2270E+03	.3142E+01	.5188E+01	.9000E+01	0.	0.
S	121.	0.	.2270E+03	.3142E+01	.5188E+01	.8000E+01	0.	0.
S	122.	0.	.2280E+03	.3142E+01	.5875E+02	.1763E+02	0.	0.
S	123.	0.	.2050E+03	.3142E+01	.5875E+02	.9000E+01	0.	0.
S	124.	0.	.2050E+03	.3142E+01	.5875E+02	.8000E+01	0.	0.
S	125.	0.	.2050E+03	.3142E+01	.8800E+02	.3750E+01	0.	0.
S	126.	0.	.2050E+03	.3142E+01	.8800E+02	.6750E+01	0.	0.
S	127.	136.	.2050E+03	.3142E+01	.8800E+02	.1520E+02	0.	0.
S	137.	0.	.2050E+03	.3142E+01	.8800E+02	.7750E+01	0.	0.
S	138.	0.	.2050E+03	.3142E+01	.8800E+02	.9000E+01	0.	0.
S	139.	0.	.2050E+03	.3142E+01	.8800E+02	.1200E+02	0.	0.
S	140.	0.	.2280E+03	.3142E+01	.1733E+03	.1763E+02	0.	0.
S	141.	0.	.2070E+03	.3142E+01	.1733E+03	.9000E+01	0.	0.
S	142.	0.	.2020E+03	.3142E+01	.1733E+03	.1200E+02	0.	0.
S	143.	0.	.2020E+03	.3142E+01	.1733E+03	.6750E+01	0.	0.
S	144.	145.	.2020E+03	.3142E+01	.1733E+03	.1520E+02	0.	0.
S	146.	149.	.2060E+03	.3142E+01	.1733E+03	.1520E+02	0.	0.
S	150.	153.	.2030E+03	.3142E+01	.1733E+03	.1520E+02	0.	0.
S	154.	0.	.2030E+03	.3142E+01	.1733E+03	.7750E+01	0.	0.
S	155.	0.	.2030E+03	.3142E+01	.1733E+03	.2100E+02	0.	0.
S	156.	0.	.2030E+03	.3142E+01	.2613E+03	.1200E+02	0.	0.
S	157.	0.	.2030E+03	.3142E+01	.4500E+02	.1200E+02	0.	0.
S	158.	0.	.2030E+03	.3142E+01	.3600E+02	.1200E+02	0.	0.
S	159.	0.	.2030E+03	.3142E+01	.2613E+03	.3600E+02	0.	0.
S	160.	0.	.2030E+03	.3142E+01	.8100E+02	.3600E+02	0.	0.
S	161.	0.	.2030E+03	.3142E+01	.2613E+03	.6000E+02	0.	0.
S	162.	0.	.2030E+03	.3142E+01	.8100E+02	.6000E+02	0.	0.
S	163.	0.	.2280E+03	.3142E+01	.2338E+03	.1425E+02	0.	0.
S	164.	0.	.2070E+03	.3142E+01	.2338E+03	.9000E+01	0.	0.
S	165.	0.	.2020E+03	.3142E+01	.2338E+03	.1200E+02	0.	0.
S	166.	0.	.2020E+03	.3142E+01	.2338E+03	.9250E+01	0.	0.
S	167.	168.	.2020E+03	.3142E+01	.2338E+03	.1520E+02	0.	0.
S	169.	172.	.2060E+03	.3142E+01	.2338E+03	.1520E+02	0.	0.
S	173.	176.	.2030E+03	.3142E+01	.2338E+03	.1520E+02	0.	0.
S	177.	0.	.2030E+03	.3142E+01	.2338E+03	.5400E+01	0.	0.
S	178.	0.	.2030E+03	.3142E+01	.2338E+03	.2100E+02	0.	0.
S	179.	0.	.2030E+03	.3142E+01	.2338E+03	.1200E+02	0.	0.
S	180.	0.	.2030E+03	.3142E+01	.2338E+03	.3600E+02	0.	0.
S	181.	0.	.2030E+03	.3142E+01	.2338E+03	.6000E+02	0.	0.
S	182.	0.	.2280E+03	.3142E+01	.1188E+04	.1425E+02	0.	0.
S	183.	0.	.2070E+03	.3142E+01	.1188E+04	.9000E+01	0.	0.
S	184.	0.	.2020E+03	.3142E+01	.1188E+04	.1200E+02	0.	0.
S	185.	0.	.2020E+03	.3142E+01	.1188E+04	.9250E+01	0.	0.
S	186.	187.	.2020E+03	.3142E+01	.1188E+04	.1520E+02	0.	0.
S	188.	191.	.2060E+03	.3142E+01	.1188E+04	.1520E+02	0.	0.
S	192.	195.	.2030E+03	.3142E+01	.1188E+04	.1520E+02	0.	0.
S	196.	0.	.2030E+03	.3142E+01	.1188E+04	.5400E+01	0.	0.
S	197.	0.	.2030E+03	.3142E+01	.1188E+04	.3300E+02	0.	0.
S	198.	0.	.2030E+03	.3142E+01	.1188E+04	.3600E+02	0.	0.
S	199.	0.	.2030E+03	.3142E+01	.1188E+04	.6000E+02	0.	0.
S	200.	0.	.2030E+03	.3142E+01	.1683E+04	.7625E+02	0.	0.
S	201.	0.	.2030E+03	.3142E+01	.8101E+02	.7625E+02	0.	0.
S	202.	0.	.2070E+03	.3142E+01	.4320E+04	.2325E+02	0.	0.
S	203.	0.	.2020E+03	.3142E+01	.4320E+04	.2125E+02	0.	0.
S	204.	0.	.2020E+03	.3142E+01	.4320E+04	.3040E+02	0.	0.
S	205.	206.	.2060E+03	.3142E+01	.4320E+04	.3040E+02	0.	0.
S	207.	208.	.2030E+03	.3142E+01	.4320E+04	.3040E+02	0.	0.
S	209.	0.	.2030E+03	.3142E+01	.4320E+04	.5400E+01	0.	0.
S	210.	0.	.2030E+03	.3142E+01	.4320E+04	.3300E+02	0.	0.
S	211.	0.	.2030E+03	.3142E+01	.4320E+04	.3600E+02	0.	0.
S	212.	0.	.2030E+03	.3142E+01	.4320E+04	.6000E+02	0.	0.
S	213.	0.	.2030E+03	.3142E+01	.4320E+04	.7625E+02	0.	0.
S	214.	0.	.2070E+03	.3142E+01	.1116E+05	.2325E+02	0.	0.
S	215.	0.	.2020E+03	.3142E+01	.1116E+05	.2125E+02	0.	0.
S	216.	0.	.2020E+03	.3142E+01	.1116E+05	.3040E+02	0.	0.
S	217.	218.	.2060E+03	.3142E+01	.1116E+05	.3040E+02	0.	0.
S	219.	220.	.2030E+03	.3142E+01	.1116E+05	.3040E+02	0.	0.
S	221.	0.	.2030E+03	.3142E+01	.1116E+05	.5400E+01	0.	0.
S	222.	0.	.2030E+03	.3142E+01	.1116E+05	.3300E+02	0.	0.
S	223.	0.	.2030E+03	.3142E+01	.1116E+05	.3600E+02	0.	0.

TAP-A INPUT DATA (Cont'd)

5	224.	0.	.2030E+03	.3142E+01	.1116E+05	.6000E+02	0.	0.
5	225.	0.	.2030E+03	.3142E+01	.1116E+05	.7625E+02	0.	0.
5	226.	0.	.2070E+03	.3142E+01	.7567E+04	.2325E+02	0.	0.
5	227.	0.	.2020E+03	.3142E+01	.7567E+04	.2125E+02	0.	0.
5	228.	0.	.2020E+03	.3142E+01	.7567E+04	.3040E+02	0.	0.
5	229.	230.	.2060E+03	.3142E+01	.7567E+04	.3040E+02	0.	0.
5	231.	232.	.2030E+03	.3142E+01	.7567E+04	.3040E+02	0.	0.
5	233.	0.	.2030E+03	.3142E+01	.7567E+04	.5400E+01	0.	0.
5	234.	0.	.2030E+03	.3142E+01	.7567E+04	.3300E+02	0.	0.
5	235.	0.	.2030E+03	.3142E+01	.7567E+04	.3600E+02	0.	0.
5	236.	0.	.2030E+03	.3142E+01	.7567E+04	.6000E+02	0.	0.
5	237.	0.	.2030E+03	.3142E+01	.7567E+04	.7625E+02	0.	0.
5	238.	0.	.2030E+03	.3142E+01	.7567E+04	.1159E+05	0.	0.
5	239.	0.	.2030E+03	.3142E+01	.1116E+05	.1159E+05	0.	0.
5	240.	0.	.2030E+03	.3142E+01	.4320E+04	.1159E+05	0.	0.
5	241.	0.	.2030E+03	.3142E+01	.1683E+04	.1159E+05	0.	0.
5	242.	0.	.2030E+03	.3142E+01	.8100E+02	.1159E+05	0.	0.
5	243.	0.	.2280E+03	.3142E+01	.2338E+03	.1000E+01	0.	0.
5	244.	0.	.2280E+03	.3142E+01	.1188E+04	.1000E+01	0.	0.
5	245.	0.	.2070E+03	.3142E+01	.4320E+04	.1000E+01	0.	0.
5	246.	0.	.2070E+03	.3142E+01	.1116E+05	.1000E+01	0.	0.
5	247.	0.	.2070E+03	.3142E+01	.7567E+04	.1000E+01	0.	0.
5	248.	0.	.2070E+03	.3142E+01	.2185E+05	.1000E+01	0.	0.
5	251.	0.	.2070E+03	.3142E+01	.2185E+05	.2375E+02	0.	0.
5	252.	0.	.2020E+03	.3142E+01	.2185E+05	.2125E+02	0.	0.
5	253.	0.	.2020E+03	.3142E+01	.2185E+05	.3025E+02	0.	0.
5	254.	0.	.2060E+03	.3142E+01	.2185E+05	.3040E+02	0.	0.
5	255.	0.	.2060E+03	.3142E+01	.2185E+05	.3040E+02	0.	0.
5	256.	0.	.2030E+03	.3142E+01	.2185E+05	.3040E+02	0.	0.
5	257.	0.	.2030E+03	.3142E+01	.2185E+05	.3040E+02	0.	0.
5	258.	0.	.2030E+03	.3142E+01	.2185E+05	.5400E+01	0.	0.
5	259.	0.	.2030E+03	.3142E+01	.2185E+05	.3300E+02	0.	0.
5	260.	0.	.2030E+03	.3142E+01	.2185E+05	.3600E+02	0.	0.
5	261.	0.	.2030E+03	.3142E+01	.2185E+05	.6000E+02	0.	0.
5	262.	0.	.2030E+03	.3142E+01	.2185E+05	.7625E+02	0.	0.
5	263.	0.	.2030E+03	.3142E+01	.2185E+05	.1159E+05	0.	0.
5	264.	0.	.2070E+03	.3142E+01	.4334E+05	.1000E+01	0.	0.
5	265.	0.	.2070E+03	.3142E+01	.4334E+05	.2375E+02	0.	0.
5	266.	0.	.2020E+03	.3142E+01	.4334E+05	.2125E+02	0.	0.
5	267.	0.	.2060E+03	.3142E+01	.4334E+05	.3025E+02	0.	0.
5	268.	0.	.2060E+03	.3142E+01	.4334E+05	.3040E+02	0.	0.
5	269.	0.	.2030E+03	.3142E+01	.4334E+05	.3040E+02	0.	0.
5	270.	0.	.2030E+03	.3142E+01	.4334E+05	.3040E+02	0.	0.
5	271.	0.	.2030E+03	.3142E+01	.4334E+05	.5400E+01	0.	0.
5	272.	0.	.2030E+03	.3142E+01	.4334E+05	.3300E+02	0.	0.
5	273.	0.	.2030E+03	.3142E+01	.4334E+05	.3600E+02	0.	0.
5	274.	0.	.2030E+03	.3142E+01	.4334E+05	.6000E+02	0.	0.
5	275.	0.	.2030E+03	.3142E+01	.4334E+05	.7625E+02	0.	0.
5	276.	0.	.2030E+03	.3142E+01	.4334E+05	.1159E+05	0.	0.
5	280.	0.	.2070E+03	.3142E+01	.4284E+06	.1000E+01	0.	0.
5	277.	0.	.2070E+03	.3142E+01	.4284E+06	.2375E+02	0.	0.
5	278.	0.	.2020E+03	.3142E+01	.4284E+06	.2125E+02	0.	0.
5	279.	0.	.2020E+03	.3142E+01	.4284E+06	.3025E+02	0.	0.
5	280.	0.	.2060E+03	.3142E+01	.4284E+06	.3040E+02	0.	0.
5	281.	0.	.2060E+03	.3142E+01	.4284E+06	.3040E+02	0.	0.
5	282.	0.	.2030E+03	.3142E+01	.4284E+06	.3040E+02	0.	0.
5	283.	0.	.2030E+03	.3142E+01	.4284E+06	.3040E+02	0.	0.
5	284.	0.	.2030E+03	.3142E+01	.4284E+06	.5400E+01	0.	0.
5	285.	0.	.2030E+03	.3142E+01	.4284E+06	.3300E+02	0.	0.
5	286.	0.	.2030E+03	.3142E+01	.4284E+06	.3600E+02	0.	0.
5	287.	0.	.2030E+03	.3142E+01	.4284E+06	.6000E+02	0.	0.
5	288.	0.	.2030E+03	.3142E+01	.4284E+06	.7625E+02	0.	0.
5	289.	0.	.2030E+03	.3142E+01	.4284E+06	.1159E+05	0.	0.
7	1.	0.	.1100E+02	.1386E+01	.8110E+00	.1520E+02	.1257E+02	0.
7	2.	0.	.1200E+02	.1386E+01	.8110E+00	.1520E+02	.1257E+02	0.
7	3.	0.	.1300E+02	.1386E+01	.8110E+00	.1520E+02	.1257E+02	0.
7	4.	0.	.1400E+02	.1386E+01	.8110E+00	.1520E+02	.1257E+02	0.
7	5.	0.	.1500E+02	.1386E+01	.8110E+00	.1520E+02	.1257E+02	0.
7	6.	0.	.1600E+02	.1386E+01	.8110E+00	.1520E+02	.1257E+02	0.
7	7.	0.	.1700E+02	.1386E+01	.8110E+00	.1520E+02	.1257E+02	0.
7	8.	0.	.1800E+02	.1386E+01	.8110E+00	.1520E+02	.1257E+02	0.
7	9.	0.	.1900E+02	.1386E+01	.8110E+00	.1520E+02	.1257E+02	0.
7	10.	0.	.2000E+02	.1386E+01	.8110E+00	.1520E+02	.1257E+02	0.
7	11.	0.	.2100E+02	.1151E+01	.8930E+00	.1520E+02	.2513E+02	0.
7	12.	0.	.2200E+02	.1151E+01	.8930E+00	.1520E+02	.2513E+02	0.
7	13.	0.	.2300E+02	.1151E+01	.8930E+00	.1520E+02	.2513E+02	0.
7	14.	0.	.2400E+02	.1151E+01	.8930E+00	.1520E+02	.2513E+02	0.
7	15.	0.	.2500E+02	.1151E+01	.8930E+00	.1520E+02	.2513E+02	0.
7	16.	0.	.2600E+02	.1151E+01	.8930E+00	.1520E+02	.2513E+02	0.
7	17.	0.	.2700E+02	.1151E+01	.8930E+00	.1520E+02	.2513E+02	0.

TAP-A INPUT DATA (Cont'd)

7	18.	0.	.2800E+02	.1151E+01	.8930E+00	.1520E+02	.2513E+02	0.
7	19.	0.	.2900E+02	.1151E+01	.8930E+00	.1520E+02	.2513E+02	0.
7	20.	0.	.3000E+02	.1151E+01	.8930E+00	.1520E+02	.2513E+02	0.
7	31.	0.	.3200E+02	.1386E+01	.8110E+00	.2500E+01	.1257E+02	0.
7	32.	0.	.3300E+02	.1151E+01	.8930E+00	.2500E+01	.2513E+02	0.
7	35.	0.	.3600E+02	.3375E+01	.7600E+01	.5109E+01	.3142E+01	0.
7	33.	0.	.3400E+02	.1094E+01	.4803E+00	.2500E+01	.3770E+02	0.
7	34.	0.	.3500E+02	.3225E+00	.2125E+01	.1161E+03	.1000E+01	0.
7	36.	0.	.3700E+02	.7600E+01	.7600E+01	.5109E+01	.3142E+01	0.
7	37.	0.	.3800E+02	.7600E+01	.7600E+01	.5109E+01	.3142E+01	0.
7	38.	0.	.3900E+02	.7600E+01	.7600E+01	.5109E+01	.3142E+01	0.
7	39.	0.	.4000E+02	.7600E+01	.7600E+01	.5109E+01	.3142E+01	0.
7	40.	0.	.4100E+02	.7600E+01	.7600E+01	.5109E+01	.3142E+01	0.
7	41.	0.	.4200E+02	.7600E+01	.7600E+01	.5109E+01	.3142E+01	0.
7	42.	0.	.4300E+02	.7600E+01	.7600E+01	.5109E+01	.3142E+01	0.
7	43.	0.	.4400E+02	.7600E+01	.7600E+01	.5109E+01	.3142E+01	0.
7	44.	0.	.4500E+02	.7600E+01	.7600E+01	.5109E+01	.3142E+01	0.
7	45.	0.	.4600E+02	.7600E+01	.3875E+01	.5109E+01	.3142E+01	0.
7	46.	0.	.4700E+02	.3688E+01	.3225E+00	.7308E+01	.3142E+01	0.
7	47.	0.	.4800E+02	.4803E+00	.1094E+01	.3750E+00	.3770E+02	0.
7	48.	0.	.4900E+02	.8930E+00	.1151E+01	.3750E+00	.2513E+02	0.
7	49.	0.	.5000E+02	.8110E+00	.1386E+01	.3750E+00	.1257E+02	0.
7	53.	0.	.8000E+02	.2500E+00	.3750E+01	.3142E+01	.4000E+01	0.
7	54.	0.	.8300E+02	.2500E+00	.3750E+01	.3142E+01	.1200E+02	0.
7	55.	0.	.8600E+02	.2500E+00	.3750E+01	.3142E+01	.2000E+02	0.
7	56.	0.	.8900E+02	.2500E+00	.3750E+01	.3142E+01	.2800E+02	0.
7	57.	0.	.9200E+02	.2500E+00	.3750E+01	.3142E+01	.3106E+02	0.
7	57.	0.	.1010E+03	.2500E+00	.3750E+01	.3142E+01	.4938E+01	0.
7	57.	0.	.5800E+02	.2500E+00	.2500E+00	.3142E+01	.1900E+02	0.
7	57.	0.	.5900E+02	.2500E+00	.2000E+01	.3142E+01	.4438E+01	0.
7	59.	0.	.6000E+02	.2000E+01	.3375E+01	.3142E+01	.4438E+01	0.
7	60.	0.	.6100E+02	.3375E+01	.7600E+01	.3142E+01	.4438E+01	0.
7	61.	0.	.6200E+02	.7600E+01	.7600E+01	.3142E+01	.4438E+01	0.
7	62.	0.	.6300E+02	.7600E+01	.7600E+01	.3142E+01	.4438E+01	0.
7	63.	0.	.6400E+02	.7600E+01	.7600E+01	.3142E+01	.4438E+01	0.
7	64.	0.	.6500E+02	.7600E+01	.7600E+01	.3142E+01	.4438E+01	0.
7	65.	0.	.6600E+02	.7600E+01	.7600E+01	.3142E+01	.4438E+01	0.
7	66.	0.	.6700E+02	.7600E+01	.7600E+01	.3142E+01	.4438E+01	0.
7	67.	0.	.6800E+02	.7600E+01	.7600E+01	.3142E+01	.4438E+01	0.
7	68.	0.	.6900E+02	.7600E+01	.7600E+01	.3142E+01	.4438E+01	0.
7	69.	0.	.7000E+02	.7600E+01	.7600E+01	.3142E+01	.4438E+01	0.
7	70.	0.	.7100E+02	.7600E+01	.3875E+01	.3142E+01	.4438E+01	0.
7	71.	0.	.7200E+02	.3875E+01	.4500E+01	.3142E+01	.4438E+01	0.
7	72.	0.	.7300E+02	.4500E+01	.6000E+01	.3142E+01	.4438E+01	0.
7	73.	0.	.1570E+03	.6000E+01	.6000E+01	.3142E+01	.3200E+02	0.
7	74.	0.	.1570E+03	.6000E+01	.6000E+01	.3142E+01	.1300E+02	0.
7	75.	0.	.1580E+03	.6000E+01	.6000E+01	.3142E+01	.2000E+02	0.
7	76.	0.	.1580E+03	.6000E+01	.6000E+01	.3142E+01	.1200E+02	0.
7	77.	0.	.1580E+03	.6000E+01	.6000E+01	.3142E+01	.4000E+01	0.
7	78.	0.	.9300E+02	.7500E+01	.1250E+00	.3142E+01	.4000E+01	0.
7	78.	0.	.7900E+02	.7500E+01	.4500E+01	.3142E+01	.4000E+01	0.
7	79.	0.	.8000E+02	.4500E+01	.3750E+01	.3142E+01	.4000E+01	0.
7	81.	0.	.9400E+02	.7500E+01	.1250E+00	.3142E+01	.1200E+02	0.
7	81.	0.	.8700E+02	.7500E+01	.4500E+01	.3142E+01	.1200E+02	0.
7	82.	0.	.8300E+02	.4500E+01	.3750E+01	.3142E+01	.1200E+02	0.
7	84.	0.	.9500E+02	.7500E+01	.1250E+00	.3142E+01	.2000E+02	0.
7	84.	0.	.8500E+02	.7500E+01	.4500E+01	.3142E+01	.2000E+02	0.
7	85.	0.	.8600E+02	.4500E+01	.3750E+01	.3142E+01	.2000E+02	0.
7	87.	0.	.9600E+02	.7500E+01	.1250E+00	.3142E+01	.2800E+02	0.
7	87.	0.	.8800E+02	.7500E+01	.4500E+01	.3142E+01	.2800E+02	0.
7	88.	0.	.8900E+02	.4500E+01	.3750E+01	.3142E+01	.2800E+02	0.
7	90.	0.	.9700E+02	.7500E+01	.1250E+00	.3142E+01	.3106E+02	0.
7	90.	0.	.9100E+02	.7500E+01	.4500E+01	.3142E+01	.3106E+02	0.
7	91.	0.	.9200E+02	.4500E+01	.3750E+01	.3142E+01	.3106E+02	0.
7	93.	0.	.1020E+03	.1250E+00	.1188E+01	.3142E+01	.4000E+01	0.
7	94.	0.	.1030E+03	.1250E+00	.1188E+01	.3142E+01	.1200E+02	0.
7	95.	0.	.1040E+03	.1250E+00	.1188E+01	.3142E+01	.2000E+02	0.
7	96.	0.	.1050E+03	.1250E+00	.1188E+01	.3142E+01	.2800E+02	0.
7	97.	0.	.1060E+03	.1250E+00	.1188E+01	.3142E+01	.3106E+02	0.
7	98.	0.	.1160E+03	.1313E+01	.1250E+00	.3142E+01	.4938E+01	0.
7	98.	0.	.9900E+02	.1313E+01	.7500E+01	.3142E+01	.4938E+01	0.
7	99.	0.	.1000E+03	.7500E+01	.4500E+01	.3142E+01	.4938E+01	0.
7	100.	0.	.1010E+03	.4500E+01	.3750E+01	.3142E+01	.4938E+01	0.
7	102.	0.	.1110E+03	.1188E+01	.1250E+00	.3142E+01	.4000E+01	0.
7	103.	0.	.1120E+03	.1188E+01	.1250E+00	.3142E+01	.1200E+02	0.
7	104.	0.	.1130E+03	.1188E+01	.1250E+00	.3142E+01	.2000E+02	0.
7	105.	0.	.1140E+03	.1188E+01	.1250E+00	.3142E+01	.2800E+02	0.
7	106.	0.	.1150E+03	.1188E+01	.1250E+00	.3142E+01	.3106E+02	0.
7	107.	0.	.1160E+03	.1313E+01	.1250E+00	.3142E+01	.5063E+01	0.
7	107.	0.	.1080E+03	.1313E+01	.7500E+01	.3142E+01	.5063E+01	0.
7	108.	0.	.1090E+03	.7500E+01	.4500E+01	.3142E+01	.5063E+01	0.

TAP-A INPUT DATA (Cont'd)

7	109.	0.	.1100E+03	.4500E+01	.3750E+01	.3142E+01	.5063E+01	0.
7	58.	0.	.1100E+03	.1250E+00	.3750E+01	.3142E+01	.5063E+01	0.
7	58.	0.	.1210E+03	.1250E+00	.3750E+01	.3142E+01	.5188E+01	0.
7	58.	0.	.1250E+03	.1250E+00	.1875E+01	.3142E+01	.2925E+02	0.
7	116.	0.	.1180E+03	.1250E+00	.1313E+01	.3142E+01	.5188E+01	0.
7	117.	0.	.1220E+03	.1250E+00	.8813E+01	.3142E+01	.5875E+02	0.
7	117.	0.	.1400E+03	.1250E+00	.8813E+01	.3142E+01	.1733E+03	0.
7	118.	0.	.1190E+03	.1313E+01	.7500E+01	.3142E+01	.5188E+01	0.
7	119.	0.	.1200E+03	.7500E+01	.4500E+01	.3142E+01	.5188E+01	0.
7	120.	0.	.1210E+03	.4500E+01	.4000E+01	.3142E+01	.5188E+01	0.
7	122.	0.	.1230E+03	.8813E+01	.4500E+01	.3142E+01	.5875E+02	0.
7	123.	0.	.1240E+03	.4500E+01	.4000E+01	.3142E+01	.5875E+02	0.
7	124.	0.	.1250E+03	.4000E+01	.1875E+01	.3142E+01	.5875E+02	0.
7	125.	0.	.1260E+03	.1875E+01	.3375E+01	.3142E+01	.8800E+02	0.
7	126.	0.	.1270E+03	.3375E+01	.7600E+01	.3142E+01	.8800E+02	0.
7	127.	0.	.1280E+03	.7600E+01	.7600E+01	.3142E+01	.8800E+02	0.
7	128.	0.	.1290E+03	.7600E+01	.7600E+01	.3142E+01	.8800E+02	0.
7	129.	0.	.1300E+03	.7600E+01	.7600E+01	.3142E+01	.8800E+02	0.
7	130.	0.	.1310E+03	.7600E+01	.7600E+01	.3142E+01	.8800E+02	0.
7	131.	0.	.1320E+03	.7600E+01	.7600E+01	.3142E+01	.8800E+02	0.
7	132.	0.	.1330E+03	.7600E+01	.7600E+01	.3142E+01	.8800E+02	0.
7	133.	0.	.1340E+03	.7600E+01	.7600E+01	.3142E+01	.8800E+02	0.
7	134.	0.	.1350E+03	.7600E+01	.7600E+01	.3142E+01	.8800E+02	0.
7	135.	0.	.1360E+03	.7600E+01	.7600E+01	.3142E+01	.8800E+02	0.
7	136.	0.	.1370E+03	.7600E+01	.3875E+01	.3142E+01	.8800E+02	0.
7	137.	0.	.1380E+03	.3875E+01	.4500E+01	.3142E+01	.8800E+02	0.
7	138.	0.	.1390E+03	.4500E+01	.6000E+01	.3142E+01	.8800E+02	0.
7	139.	0.	.1560E+03	.6000E+01	.6000E+01	.3142E+01	.8800E+02	0.
7	140.	0.	.1410E+03	.8813E+01	.4500E+01	.3142E+01	.1733E+03	0.
7	141.	0.	.1420E+03	.4500E+01	.6000E+01	.3142E+01	.1733E+03	0.
7	142.	0.	.1430E+03	.6000E+01	.3375E+01	.3142E+01	.1733E+03	0.
7	143.	0.	.1440E+03	.3375E+01	.7600E+01	.3142E+01	.1733E+03	0.
7	144.	0.	.1450E+03	.7600E+01	.7600E+01	.3142E+01	.1733E+03	0.
7	145.	0.	.1460E+03	.7600E+01	.7600E+01	.3142E+01	.1733E+03	0.
7	146.	0.	.1470E+03	.7600E+01	.7600E+01	.3142E+01	.1733E+03	0.
7	147.	0.	.1480E+03	.7600E+01	.7600E+01	.3142E+01	.1733E+03	0.
7	148.	0.	.1490E+03	.7600E+01	.7600E+01	.3142E+01	.1733E+03	0.
7	149.	0.	.1500E+03	.7600E+01	.7600E+01	.3142E+01	.1733E+03	0.
7	150.	0.	.1510E+03	.7600E+01	.7600E+01	.3142E+01	.1733E+03	0.
7	151.	0.	.1520E+03	.7600E+01	.7600E+01	.3142E+01	.1733E+03	0.
7	152.	0.	.1530E+03	.7600E+01	.7600E+01	.3142E+01	.1733E+03	0.
7	153.	0.	.1540E+03	.7600E+01	.3875E+01	.3142E+01	.1733E+03	0.
7	154.	0.	.1550E+03	.3875E+01	.1050E+02	.3142E+01	.1733E+03	0.
7	155.	0.	.1560E+03	.1050E+02	.6000E+01	.42E+01	.1733E+03	0.
7	156.	0.	.1590E+03	.6000E+01	.1800E+02	.42E+01	.2613E+03	0.
7	157.	0.	.1600E+03	.6000E+01	.1800E+02	.3142E+01	.4500E+02	0.
7	158.	0.	.1600E+03	.6000E+01	.1800E+02	.3142E+01	.3600E+02	0.
7	159.	0.	.1610E+03	.1800E+02	.3000E+02	.3142E+01	.2613E+03	0.
7	160.	0.	.1620E+03	.1800E+02	.3000E+02	.3142E+01	.8100E+02	0.
7	161.	0.	.2000E+03	.3000E+02	.3813E+02	.3142E+01	.2613E+03	0.
7	162.	0.	.2010E+03	.3000E+02	.4800E+02	.3142E+01	.8100E+02	0.
7	163.	0.	.1640E+03	.7125E+01	.4500E+01	.3142E+01	.2338E+03	0.
7	163.	0.	.2430E+03	.7125E+01	.5000E+00	.3142E+01	.2338E+03	0.
7	164.	0.	.1650E+03	.4500E+01	.6000E+01	.3142E+01	.2338E+03	0.
7	165.	0.	.1660E+03	.6000E+01	.4650E+01	.3142E+01	.2338E+03	0.
7	166.	0.	.1670E+03	.4650E+01	.7550E+01	.3142E+01	.2338E+03	0.
7	167.	0.	.1680E+03	.7550E+01	.7550E+01	.3142E+01	.2338E+03	0.
7	168.	0.	.1690E+03	.7550E+01	.7600E+01	.3142E+01	.2338E+03	0.
7	169.	0.	.1700E+03	.7600E+01	.7600E+01	.3142E+01	.2338E+03	0.
7	170.	0.	.1710E+03	.7600E+01	.7600E+01	.3142E+01	.2338E+03	0.
7	171.	0.	.1720E+03	.7600E+01	.7600E+01	.3142E+01	.2338E+03	0.
7	172.	0.	.1730E+03	.7600E+01	.7600E+01	.3142E+01	.2338E+03	0.
7	173.	0.	.1740E+03	.7600E+01	.7600E+01	.3142E+01	.2338E+03	0.
7	174.	0.	.1750E+03	.7600E+01	.7600E+01	.3142E+01	.2338E+03	0.
7	175.	0.	.1760E+03	.7600E+01	.7600E+01	.3142E+01	.2338E+03	0.
7	176.	0.	.1770E+03	.7600E+01	.2700E+01	.3142E+01	.2338E+03	0.
7	177.	0.	.1780E+03	.2700E+01	.1050E+02	.3142E+01	.2338E+03	0.
7	178.	0.	.1790E+03	.1050E+02	.6000E+01	.3142E+01	.2338E+03	0.
7	179.	0.	.1800E+03	.6000E+01	.1800E+02	.3142E+01	.2338E+03	0.
7	180.	0.	.1810E+03	.1800E+02	.3000E+02	.3142E+01	.2338E+03	0.
7	181.	0.	.2000E+03	.3000E+02	.3813E+02	.3142E+01	.2338E+03	0.
7	182.	0.	.1830E+03	.7125E+01	.4500E+01	.3142E+01	.1188E+04	0.
7	182.	0.	.2440E+03	.7125E+01	.5000E+00	.3142E+01	.1188E+04	0.
7	183.	0.	.1840E+03	.4500E+01	.6000E+01	.3142E+01	.1188E+04	0.
7	184.	0.	.1850E+03	.6000E+01	.4650E+01	.3142E+01	.1188E+04	0.
7	185.	0.	.1860E+03	.4650E+01	.7550E+01	.3142E+01	.1188E+04	0.
7	186.	0.	.1870E+03	.7550E+01	.7550E+01	.3142E+01	.1188E+04	0.
7	187.	0.	.1880E+03	.7550E+01	.7600E+01	.3142E+01	.1188E+04	0.
7	188.	0.	.1890E+03	.7600E+01	.7600E+01	.3142E+01	.1188E+04	0.

TAP-A INPUT DATA (Cont'd)

7	189.	0.	.1900E+03	.7600E+01	.7600E+01	.3142E+01	.1188E+04	0.
7	190.	0.	.1910E+03	.7600E+01	.7600E+01	.3142E+01	.1188E+04	0.
7	191.	0.	.1920E+03	.7600E+01	.7600E+01	.3142E+01	.1188E+04	0.
7	192.	0.	.1930E+03	.7600E+01	.7600E+01	.3142E+01	.1188E+04	0.
7	193.	0.	.1940E+03	.7600E+01	.7600E+01	.3142E+01	.1188E+04	0.
7	194.	0.	.1950E+03	.7600E+01	.7600E+01	.3142E+01	.1188E+04	0.
7	195.	0.	.1960E+03	.7600E+01	.2700E+01	.3142E+01	.1188E+04	0.
7	196.	0.	.1970E+03	.2700E+01	.1650E+02	.3142E+01	.1188E+04	0.
7	197.	0.	.1980E+03	.1650E+02	.1800E+02	.3142E+01	.1188E+04	0.
7	198.	0.	.1990E+03	.1800E+02	.3000E+02	.3142E+01	.1188E+04	0.
7	199.	0.	.2000E+03	.3000E+02	.3813E+02	.3142E+01	.1188E+04	0.
7	200.	0.	.2410E+03	.3813E+02	.5796E+04	.3142E+01	.1188E+04	0.
7	201.	0.	.2420E+03	.3813E+02	.5796E+04	.3142E+01	.1188E+04	0.
7	202.	0.	.2030E+03	.1163E+02	.1065E+02	.3142E+01	.1188E+04	0.
7	202.	0.	.2450E+03	.1163E+02	.5000E+00	.3142E+01	.1188E+04	0.
7	203.	0.	.2040E+03	.1065E+02	.1510E+02	.3142E+01	.1188E+04	0.
7	204.	0.	.2050E+03	.1510E+02	.1520E+02	.3142E+01	.1188E+04	0.
7	205.	0.	.2060E+03	.1520E+02	.1520E+02	.3142E+01	.1188E+04	0.
7	206.	0.	.2070E+03	.1520E+02	.1520E+02	.3142E+01	.1188E+04	0.
7	207.	0.	.2080E+03	.1520E+02	.1520E+02	.3142E+01	.1188E+04	0.
7	208.	0.	.2090E+03	.1520E+02	.2700E+01	.3142E+01	.1188E+04	0.
7	209.	0.	.2100E+03	.2700E+01	.1650E+02	.3142E+01	.1188E+04	0.
7	210.	0.	.2110E+03	.1650E+02	.1800E+02	.3142E+01	.1188E+04	0.
7	211.	0.	.2120E+03	.1800E+02	.3000E+02	.3142E+01	.1188E+04	0.
7	212.	0.	.2130E+03	.3000E+02	.3813E+02	.3142E+01	.1188E+04	0.
7	213.	0.	.2400E+03	.3813E+02	.5796E+04	.3142E+01	.1188E+04	0.
7	214.	0.	.2150E+03	.1163E+02	.1065E+02	.3142E+01	.1188E+04	0.
7	214.	0.	.2460E+03	.1163E+02	.5000E+00	.3142E+01	.1188E+04	0.
7	215.	0.	.2160E+03	.1065E+02	.1510E+02	.3142E+01	.1188E+04	0.
7	216.	0.	.2170E+03	.1510E+02	.1520E+02	.3142E+01	.1188E+04	0.
7	217.	0.	.2180E+03	.1520E+02	.1520E+02	.3142E+01	.1188E+04	0.
7	218.	0.	.2190E+03	.1520E+02	.1520E+02	.3142E+01	.1188E+04	0.
7	219.	0.	.2200E+03	.1520E+02	.1520E+02	.3142E+01	.1188E+04	0.
7	220.	0.	.2210E+03	.1520E+02	.2700E+01	.3142E+01	.1188E+04	0.
7	221.	0.	.2220E+03	.2700E+01	.1650E+02	.3142E+01	.1188E+04	0.
7	222.	0.	.2230E+03	.1650E+02	.1800E+02	.3142E+01	.1188E+04	0.
7	223.	0.	.2240E+03	.1800E+02	.3000E+02	.3142E+01	.1188E+04	0.
7	224.	0.	.2250E+03	.3000E+02	.3813E+02	.3142E+01	.1188E+04	0.
7	225.	0.	.2260E+03	.3813E+02	.5796E+04	.3142E+01	.1188E+04	0.
7	226.	0.	.2270E+03	.1163E+02	.1065E+02	.3142E+01	.1188E+04	0.
7	226.	0.	.2470E+03	.1163E+02	.5000E+00	.3142E+01	.1188E+04	0.
7	227.	0.	.2280E+03	.1065E+02	.1510E+02	.3142E+01	.1188E+04	0.
7	228.	0.	.2290E+03	.1510E+02	.1520E+02	.3142E+01	.1188E+04	0.
7	229.	0.	.2300E+03	.1520E+02	.1520E+02	.3142E+01	.1188E+04	0.
7	230.	0.	.2310E+03	.1520E+02	.1520E+02	.3142E+01	.1188E+04	0.
7	231.	0.	.2320E+03	.1520E+02	.1520E+02	.3142E+01	.1188E+04	0.
7	232.	0.	.2330E+03	.1520E+02	.2700E+01	.3142E+01	.1188E+04	0.
7	233.	0.	.2340E+03	.2700E+01	.1650E+02	.3142E+01	.1188E+04	0.
7	234.	0.	.2350E+03	.1650E+02	.1800E+02	.3142E+01	.1188E+04	0.
7	235.	0.	.2360E+03	.1800E+02	.3000E+02	.3142E+01	.1188E+04	0.
7	236.	0.	.2370E+03	.3000E+02	.3813E+02	.3142E+01	.1188E+04	0.
7	237.	0.	.2380E+03	.3813E+02	.5796E+04	.3142E+01	.1188E+04	0.
7	1.	0.	.3100E+02	.2800E+00	.1250E+01	.3142E+01	.1188E+04	0.
7	11.	0.	.3200E+02	.2800E+00	.1250E+01	.3142E+01	.1188E+04	0.
7	21.	0.	.3300E+02	.2800E+00	.1250E+01	.3142E+01	.1188E+04	0.
7	21.	0.	.3600E+02	.1094E+01	.1849E+00	.3770E+02	.1520E+02	0.
7	22.	0.	.3700E+02	.1094E+01	.1849E+00	.3770E+02	.1520E+02	0.
7	23.	0.	.3800E+02	.1094E+01	.1849E+00	.3770E+02	.1520E+02	0.
7	24.	0.	.3900E+02	.1094E+01	.1849E+00	.3770E+02	.1520E+02	0.
7	25.	0.	.4000E+02	.1094E+01	.1849E+00	.3770E+02	.1520E+02	0.
7	26.	0.	.4100E+02	.1094E+01	.1849E+00	.3770E+02	.1520E+02	0.
7	27.	0.	.4200E+02	.1094E+01	.1849E+00	.3770E+02	.1520E+02	0.
7	28.	0.	.4300E+02	.1094E+01	.1849E+00	.3770E+02	.1520E+02	0.
7	29.	0.	.4400E+02	.1094E+01	.1849E+00	.3770E+02	.1520E+02	0.
7	30.	0.	.4500E+02	.1094E+01	.1849E+00	.3770E+02	.1520E+02	0.
7	30.	0.	.4800E+02	.3200E+01	.1250E+01	.3142E+01	.1188E+04	0.
7	20.	0.	.4900E+02	.3200E+01	.1250E+01	.3142E+01	.1188E+04	0.
7	10.	0.	.5000E+02	.3200E+01	.1250E+01	.3142E+01	.1188E+04	0.
7	35.	0.	.5200E+02	.1900E+00	.4830E+00	.4398E+02	.1500E+02	0.
7	51.	0.	.5200E+02	.2000E+01	.1250E+01	.3142E+01	.1500E+02	0.
7	51.	0.	.5600E+02	.2000E+01	.2500E+00	.3142E+01	.1500E+02	0.
7	31.	0.	.5300E+02	.1250E+01	.2500E+00	.3142E+01	.1500E+02	0.
7	32.	0.	.5400E+02	.1250E+01	.2500E+00	.3142E+01	.1500E+02	0.
7	33.	0.	.5500E+02	.1250E+01	.2500E+00	.3142E+01	.1500E+02	0.
7	34.	0.	.5600E+02	.1250E+01	.2500E+00	.3142E+01	.1500E+02	0.

TAP-A INPUT DATA (Cont'd)

7	36.	0.	.6100E+02	.1900E+00	.1241E+00	.4948E+02	.1520E+02	.3000E+01
7	37.	0.	.6200E+02	.1900E+00	.1241E+00	.4948E+02	.1520E+02	.3000E+01
7	38.	0.	.6300E+02	.1900E+00	.1241E+00	.4948E+02	.1520E+02	.3000E+01
7	39.	0.	.6400E+02	.1900E+00	.1241E+00	.4948E+02	.1520E+02	.3000E+01
7	40.	0.	.6500E+02	.1900E+00	.1241E+00	.4948E+02	.1520E+02	.3000E+01
7	41.	0.	.6600E+02	.1900E+00	.1241E+00	.4948E+02	.1520E+02	.3000E+01
7	42.	0.	.6700E+02	.1900E+00	.1241E+00	.4948E+02	.1520E+02	.3000E+01
7	43.	0.	.6800E+02	.1900E+00	.1241E+00	.4948E+02	.1520E+02	.3000E+01
7	44.	0.	.6900E+02	.1900E+00	.1241E+00	.4948E+02	.1520E+02	.3000E+01
7	45.	0.	.7000E+02	.1900E+00	.1241E+00	.4948E+02	.1520E+02	.3000E+01
7	46.	0.	.7100E+02	.1900E+00	.1241E+00	.4948E+02	.6475E+01	.3000E+01
7	47.	0.	.7400E+02	.1875E+00	.6000E+01	.3142E+01	.1300E+02	.4000E+01
7	48.	0.	.7500E+02	.1875E+00	.6000E+01	.3142E+01	.4000E+01	.4000E+01
7	49.	0.	.7600E+02	.1875E+00	.6000E+01	.3142E+01	.1200E+02	.4000E+01
7	50.	0.	.7700E+02	.1875E+00	.6000E+01	.3142E+01	.2000E+02	.4000E+01
7	51.	0.	.5900E+02	.5163E+00	.1241E+00	.5262E+02	.4000E+01	.2000E+01
7	52.	0.	.6000E+02	.5163E+00	.1241E+00	.5262E+02	.6750E+01	.2000E+01
7	53.	0.	.5400E+02	.1386E+01	.8109E+00	.1257E+02	.5000E+00	0.
7	54.	0.	.5500E+02	.1151E+01	.8926E+00	.2513E+02	.5000E+00	0.
7	55.	0.	.5600E+02	.1094E+01	.9249E+00	.3770E+02	.5000E+00	0.
7	56.	0.	.5700E+02	.1068E+01	.9423E+00	.5027E+02	.5000E+00	0.
7	57.	0.	.1100E+03	.1054E+01	.1242E+00	.6283E+02	.5000E+00	0.
7	58.	0.	.1240E+03	.7781E+00	.1181E+01	.6597E+02	.2500E+00	0.
7	58.	0.	.5900E+02	.7204E+00	.1241E+00	.5655E+02	.2500E+00	0.
7	59.	0.	.1250E+03	.1241E+00	.1806E+01	.5655E+02	.3750E+01	0.
7	60.	0.	.1260E+03	.1241E+00	.1806E+01	.5655E+02	.6750E+01	0.
7	61.	0.	.1270E+03	.1241E+00	.1806E+01	.5655E+02	.1520E+02	0.
7	62.	0.	.1280E+03	.1241E+00	.1806E+01	.5655E+02	.1520E+02	0.
7	63.	0.	.1290E+03	.1241E+00	.1806E+01	.5655E+02	.1520E+02	0.
7	64.	0.	.1300E+03	.1241E+00	.1806E+01	.5655E+02	.1520E+02	0.
7	65.	0.	.1310E+03	.1241E+00	.1806E+01	.5655E+02	.1520E+02	0.
7	66.	0.	.1320E+03	.1241E+00	.1806E+01	.5655E+02	.1520E+02	0.
7	67.	0.	.1330E+03	.1241E+00	.1806E+01	.5655E+02	.1520E+02	0.
7	68.	0.	.1340E+03	.1241E+00	.1806E+01	.5655E+02	.1520E+02	0.
7	69.	0.	.1350E+03	.1241E+00	.1806E+01	.5655E+02	.1520E+02	0.
7	70.	0.	.1360E+03	.1241E+00	.1806E+01	.5655E+02	.1520E+02	0.
7	71.	0.	.1370E+03	.1241E+00	.1806E+01	.5655E+02	.8250E+01	0.
7	72.	0.	.1380E+03	.1241E+00	.1806E+01	.5655E+02	.9000E+01	0.
7	73.	0.	.1390E+03	.1060E+01	.1806E+01	.5655E+02	.1200E+02	0.
7	73.	0.	.7400E+02	.9347E+00	.5188E+00	.4398E+02	.1200E+02	0.
7	74.	0.	.7500E+02	.4803E+00	.1094E+01	.3770E+02	.1200E+02	0.
7	75.	0.	.7600E+02	.8926E+00	.1151E+01	.2513E+02	.1200E+02	0.
7	76.	0.	.7700E+02	.8109E+00	.1387E+01	.1257E+02	.1200E+02	0.
7	78.	0.	.8100E+02	.1386E+01	.8109E+00	.1257E+02	.1500E+02	0.
7	79.	0.	.8200E+02	.1386E+01	.8109E+00	.1257E+02	.9000E+01	0.
7	80.	0.	.8300E+02	.1386E+01	.8109E+00	.1257E+02	.7500E+01	0.
7	81.	0.	.8400E+02	.1151E+01	.8926E+00	.2513E+02	.1500E+02	0.
7	82.	0.	.8500E+02	.1151E+01	.8926E+00	.2513E+02	.9000E+01	0.
7	83.	0.	.8600E+02	.1151E+01	.8926E+00	.2513E+02	.7500E+01	0.
7	84.	0.	.8700E+02	.1094E+01	.9249E+00	.3770E+02	.1500E+02	0.
7	85.	0.	.8800E+02	.1094E+01	.9249E+00	.3770E+02	.9000E+01	0.
7	86.	0.	.8900E+02	.1094E+01	.9249E+00	.3770E+02	.7500E+01	0.
7	87.	0.	.9000E+02	.1068E+01	.8304E+00	.5027E+02	.1500E+02	0.
7	88.	0.	.9100E+02	.1068E+01	.8304E+00	.5027E+02	.9000E+01	0.
7	89.	0.	.9200E+02	.1068E+01	.8304E+00	.5027E+02	.7500E+01	0.
7	90.	0.	.9900E+02	.9168E+00	.1242E+00	.6126E+02	.1500E+02	0.
7	91.	0.	.1000E+03	.9168E+00	.1242E+00	.6126E+02	.9000E+01	0.
7	92.	0.	.1010E+03	.9168E+00	.1242E+00	.6126E+02	.7500E+01	0.
7	93.	0.	.9400E+02	.1386E+01	.8109E+00	.1257E+02	.2500E+00	0.
7	94.	0.	.9500E+02	.1151E+01	.8926E+00	.2513E+02	.2500E+00	0.
7	95.	0.	.9600E+02	.1094E+01	.9249E+00	.3770E+02	.2500E+00	0.
7	96.	0.	.9700E+02	.1068E+01	.8304E+00	.5027E+02	.2500E+00	0.
7	97.	0.	.9800E+02	.9168E+00	.1242E+00	.6126E+02	.2500E+00	0.
7	98.	0.	.1070E+03	.1258E+00	.1242E+00	.6283E+02	.2625E+01	0.
7	99.	0.	.1080E+03	.1258E+00	.1242E+00	.6283E+02	.1500E+02	0.
7	100.	0.	.1090E+03	.1258E+00	.1242E+00	.6283E+02	.9000E+01	0.
7	101.	0.	.1100E+03	.1258E+00	.1242E+00	.6283E+02	.7500E+01	0.
7	102.	0.	.1030E+03	.1386E+01	.8109E+00	.1257E+02	.2375E+01	0.
7	103.	0.	.1040E+03	.1151E+01	.8926E+00	.2513E+02	.2375E+01	0.
7	104.	0.	.1050E+03	.1094E+01	.9249E+00	.3770E+02	.2375E+01	0.
7	105.	0.	.1060E+03	.1068E+01	.8304E+00	.5027E+02	.2375E+01	0.
7	106.	0.	.9800E+02	.9168E+00	.1242E+00	.6126E+02	.2375E+01	0.
7	107.	0.	.1180E+03	.1258E+00	.1242E+00	.6440E+02	.2625E+01	0.
7	108.	0.	.1190E+03	.1258E+00	.1242E+00	.6440E+02	.1500E+02	0.
7	109.	0.	.1200E+03	.1258E+00	.1242E+00	.6440E+02	.9000E+01	0.
7	110.	0.	.1210E+03	.1258E+00	.1242E+00	.6440E+02	.7500E+01	0.
7	111.	0.	.1120E+03	.1386E+01	.8109E+00	.1257E+02	.2500E+00	0.
7	112.	0.	.1130E+03	.1151E+01	.8926E+00	.2513E+02	.2500E+00	0.
7	113.	0.	.1140E+03	.1094E+01	.9249E+00	.3770E+02	.2500E+00	0.
7	114.	0.	.1150E+03	.1068E+01	.8304E+00	.5027E+02	.2500E+00	0.
7	115.	0.	.1160E+03	.9168E+00	.3797E+00	.6126E+02	.2500E+00	0.

1

7	116.	0.	.1170E+03	.3819E+00	.3569E+01	.6597E+02	.2500E+00	0.
7	118.	0.	.1220E+03	.1258E+00	.1181E+01	.6597E+02	.2625E+01	0.
7	119.	0.	.1220E+03	.1258E+00	.1181E+01	.6597E+02	.1500E+02	0.
7	120.	0.	.1230E+03	.1258E+00	.1181E+01	.6597E+02	.9000E+01	0.
7	121.	0.	.1240E+03	.1258E+00	.1181E+01	.6597E+02	.7500E+01	0.
7	122.	0.	.1400E+03	.1314E+01	.2495E+01	.8168E+02	.1763E+02	0.
7	123.	0.	.1410E+03	.1314E+01	.2495E+01	.8168E+02	.9000E+01	0.
7	124.	0.	.1420E+03	.1314E+01	.2495E+01	.8168E+02	.8250E+01	0.
7	125.	0.	.1420E+03	.2172E+01	.2495E+01	.8168E+02	.3750E+01	0.
7	126.	0.	.1430E+03	.2172E+01	.2495E+01	.8168E+02	.6750E+01	0.
7	127.	0.	.1440E+03	.2172E+01	.2495E+01	.8168E+02	.1520E+02	0.
7	128.	0.	.1450E+03	.2172E+01	.2495E+01	.8168E+02	.1520E+02	0.
7	129.	0.	.1460E+03	.2172E+01	.2495E+01	.8168E+02	.1520E+02	0.
7	130.	0.	.1470E+03	.2172E+01	.2495E+01	.8168E+02	.1520E+02	0.
7	131.	0.	.1480E+03	.2172E+01	.2495E+01	.8168E+02	.1520E+02	0.
7	132.	0.	.1490E+03	.2172E+01	.2495E+01	.8168E+02	.1520E+02	0.
7	133.	0.	.1500E+03	.2172E+01	.2495E+01	.8168E+02	.1520E+02	0.
7	134.	0.	.1510E+03	.2172E+01	.2495E+01	.8168E+02	.1520E+02	0.
7	135.	0.	.1520E+03	.2172E+01	.2495E+01	.8168E+02	.1520E+02	0.
7	136.	0.	.1530E+03	.2172E+01	.2495E+01	.8168E+02	.1520E+02	0.
7	137.	0.	.1540E+03	.2172E+01	.2495E+01	.8168E+02	.1520E+02	0.
7	138.	0.	.1550E+03	.2172E+01	.2495E+01	.8168E+02	.1520E+02	0.
7	139.	0.	.1550E+03	.2172E+01	.2495E+01	.8168E+02	.1520E+02	0.
7	140.	0.	.2430E+03	.2977E+01	.2345E+01	.1162E+03	.1000E+01	0.
7	140.	0.	.1630E+03	.2977E+01	.2345E+01	.1162E+03	.1423E+02	0.
7	141.	0.	.1640E+03	.2977E+01	.2345E+01	.1162E+03	.9000E+01	0.
7	142.	0.	.1650E+03	.2977E+01	.2345E+01	.1162E+03	.1200E+02	0.
7	143.	0.	.1660E+03	.2977E+01	.2345E+01	.1162E+03	.6750E+01	0.
7	144.	0.	.1660E+03	.2977E+01	.2345E+01	.1162E+03	.2350E+01	0.
7	145.	0.	.1670E+03	.2977E+01	.2345E+01	.1162E+03	.2350E+01	0.
7	146.	0.	.1680E+03	.2977E+01	.2345E+01	.1162E+03	.2350E+01	0.
7	147.	0.	.1690E+03	.2977E+01	.2345E+01	.1162E+03	.2350E+01	0.
7	148.	0.	.1700E+03	.2977E+01	.2345E+01	.1162E+03	.2350E+01	0.
7	149.	0.	.1710E+03	.2977E+01	.2345E+01	.1162E+03	.2350E+01	0.
7	150.	0.	.1720E+03	.2977E+01	.2345E+01	.1162E+03	.2350E+01	0.
7	151.	0.	.1730E+03	.2977E+01	.2345E+01	.1162E+03	.2350E+01	0.
7	152.	0.	.1740E+03	.2977E+01	.2345E+01	.1162E+03	.2350E+01	0.
7	153.	0.	.1750E+03	.2977E+01	.2345E+01	.1162E+03	.2350E+01	0.
7	154.	0.	.1760E+03	.2977E+01	.2345E+01	.1162E+03	.2350E+01	0.
7	155.	0.	.1770E+03	.2977E+01	.2345E+01	.1162E+03	.1265E+02	0.
7	156.	0.	.1780E+03	.2977E+01	.2345E+01	.1162E+03	.1265E+02	0.
7	157.	0.	.1790E+03	.2977E+01	.2345E+01	.1162E+03	.1285E+02	0.
7	158.	0.	.1700E+03	.2977E+01	.2345E+01	.1162E+03	.1285E+02	0.
7	159.	0.	.1710E+03	.2977E+01	.2345E+01	.1162E+03	.1285E+02	0.
7	160.	0.	.1720E+03	.2977E+01	.2345E+01	.1162E+03	.1285E+02	0.
7	161.	0.	.1730E+03	.2977E+01	.2345E+01	.1162E+03	.1285E+02	0.
7	162.	0.	.1740E+03	.2977E+01	.2345E+01	.1162E+03	.1285E+02	0.
7	163.	0.	.1750E+03	.2977E+01	.2345E+01	.1162E+03	.1285E+02	0.
7	164.	0.	.1760E+03	.2977E+01	.2345E+01	.1162E+03	.1285E+02	0.
7	165.	0.	.1840E+03	.3205E+01	.7643E+01	.1508E+03	.1200E+02	0.
7	166.	0.	.1850E+03	.3205E+01	.7643E+01	.1508E+03	.6750E+01	0.
7	167.	0.	.1860E+03	.3205E+01	.7643E+01	.1508E+03	.1520E+02	0.
7	168.	0.	.1870E+03	.3205E+01	.7643E+01	.1508E+03	.1520E+02	0.
7	169.	0.	.1880E+03	.3205E+01	.7643E+01	.1508E+03	.1520E+02	0.
7	170.	0.	.1890E+03	.3205E+01	.7643E+01	.1508E+03	.1520E+02	0.
7	171.	0.	.1900E+03	.3205E+01	.7643E+01	.1508E+03	.1520E+02	0.
7	172.	0.	.1910E+03	.3205E+01	.7643E+01	.1508E+03	.1520E+02	0.
7	173.	0.	.1920E+03	.3205E+01	.7643E+01	.1508E+03	.1520E+02	0.
7	174.	0.	.1930E+03	.3205E+01	.7643E+01	.1508E+03	.1520E+02	0.
7	175.	0.	.1940E+03	.3205E+01	.7643E+01	.1508E+03	.1520E+02	0.
7	176.	0.	.1950E+03	.3205E+01	.7643E+01	.1508E+03	.1520E+02	0.
7	177.	0.	.1960E+03	.3205E+01	.7643E+01	.1508E+03	.7750E+01	0.
7	178.	0.	.1970E+03	.3205E+01	.7643E+01	.1508E+03	.2100E+02	0.
7	179.	0.	.1970E+03	.3205E+01	.7643E+01	.1508E+03	.1200E+02	0.
7	180.	0.	.1980E+03	.3205E+01	.7643E+01	.1508E+03	.3600E+02	0.
7	181.	0.	.1990E+03	.3205E+01	.7643E+01	.1508E+03	.6000E+02	0.
7	182.	0.	.2020E+03	.1013E+02	.1498E+02	.2639E+03	.1425E+02	0.
7	183.	0.	.2020E+03	.1013E+02	.1498E+02	.2639E+03	.9000E+01	0.
7	184.	0.	.2030E+03	.1013E+02	.1498E+02	.2639E+03	.1200E+02	0.

TAP-A INPUT DATA (Cont'd)

7	185.	0.	.2030E+03	.1013E+02	.1498E+02	.2639E+03	.6750E+01	0.
7	186.	0.	.2040E+03	.1013E+02	.1498E+02	.2639E+03	.1520E+02	0.
7	187.	0.	.2040E+03	.1013E+02	.1498E+02	.2639E+03	.1520E+02	0.
7	188.	0.	.2050E+03	.1013E+02	.1498E+02	.2639E+03	.1520E+02	0.
7	189.	0.	.2050E+03	.1013E+02	.1498E+02	.2639E+03	.1520E+02	0.
7	190.	0.	.2060E+03	.1013E+02	.1498E+02	.2639E+03	.1520E+02	0.
7	191.	0.	.2060E+03	.1013E+02	.1498E+02	.2639E+03	.1520E+02	0.
7	192.	0.	.2070E+03	.1013E+02	.1498E+02	.2639E+03	.1520E+02	0.
7	193.	0.	.2070E+03	.1013E+02	.1498E+02	.2639E+03	.1520E+02	0.
7	194.	0.	.2080E+03	.1013E+02	.1498E+02	.2639E+03	.1520E+02	0.
7	195.	0.	.2080E+03	.1013E+02	.1498E+02	.2639E+03	.1520E+02	0.
7	196.	0.	.2090E+03	.1013E+02	.1498E+02	.2639E+03	.1520E+02	0.
7	197.	0.	.2100E+03	.1013E+02	.1498E+02	.2639E+03	.1520E+02	0.
7	198.	0.	.2110E+03	.1013E+02	.1498E+02	.2639E+03	.1520E+02	0.
7	199.	0.	.2120E+03	.1013E+02	.1498E+02	.2639E+03	.1520E+02	0.
7	200.	0.	.2130E+03	.1413E+02	.1498E+02	.2639E+03	.1520E+02	0.
7	200.	0.	.2010E+03	.1084E+02	.6238E+01	.5655E+02	.7625E+02	0.
7	202.	0.	.2140E+03	.2046E+02	.2538E+02	.4901E+03	.2325E+02	0.
7	203.	0.	.2150E+03	.2046E+02	.2538E+02	.4901E+03	.2125E+02	0.
7	204.	0.	.2160E+03	.2046E+02	.2538E+02	.4901E+03	.3040E+02	0.
7	205.	0.	.2170E+03	.2046E+02	.2538E+02	.4901E+03	.3040E+02	0.
7	206.	0.	.2180E+03	.2046E+02	.2538E+02	.4901E+03	.3040E+02	0.
7	207.	0.	.2190E+03	.2046E+02	.2538E+02	.4901E+03	.3040E+02	0.
7	208.	0.	.2200E+03	.2046E+02	.2538E+02	.4901E+03	.3040E+02	0.
7	209.	0.	.2210E+03	.2046E+02	.2538E+02	.4901E+03	.7750E+01	0.
7	210.	0.	.2220E+03	.2046E+02	.2538E+02	.4901E+03	.3000E+01	0.
7	211.	0.	.2230E+03	.2046E+02	.2538E+02	.4901E+03	.3600E+02	0.
7	212.	0.	.2240E+03	.2046E+02	.2538E+02	.4901E+03	.6000E+02	0.
7	213.	0.	.2250E+03	.2046E+02	.2538E+02	.4901E+03	.7625E+02	0.
7	239.	0.	.2400E+03	.2538E+02	.2046E+02	.4901E+03	.1159E+05	0.
7	240.	0.	.2410E+03	.1498E+02	.1413E+02	.2639E+03	.1159E+05	0.
7	241.	0.	.2420E+03	.1084E+02	.6238E+01	.5655E+02	.1159E+05	0.
7	243.	0.	.2440E+03	.3203E+01	.7643E+01	.1508E+03	.1000E+01	0.
7	244.	0.	.2450E+03	.1013E+02	.1498E+02	.2639E+03	.1000E+01	0.
7	248.	0.	.3078E+04	.5000E+00	0.	.3142E+01	.2185E+05	0.
7	263.	0.	.3077E+04	.5796E+04	0.	.3142E+01	.2185E+05	0.
7	248.	0.	.2510E+03	.5000E+00	.1163E+02	.3142E+01	.2185E+05	0.
7	251.	0.	.2520E+03	.1163E+02	.1063E+02	.3142E+01	.2185E+05	0.
7	252.	0.	.2530E+03	.1063E+02	.1513E+02	.3142E+01	.2185E+05	0.
7	253.	0.	.2540E+03	.1513E+02	.1520E+02	.3142E+01	.2185E+05	0.
7	254.	0.	.2550E+03	.1520E+02	.1520E+02	.3142E+01	.2185E+05	0.
7	255.	0.	.2560E+03	.1520E+02	.1520E+02	.3142E+01	.2185E+05	0.
7	256.	0.	.2570E+03	.1520E+02	.1520E+02	.3142E+01	.2185E+05	0.
7	257.	0.	.2580E+03	.1520E+02	.2700E+01	.3142E+01	.2185E+05	0.
7	258.	0.	.2590E+03	.2700E+01	.1650E+02	.3142E+01	.2185E+05	0.
7	259.	0.	.2600E+03	.1650E+02	.1800E+02	.3142E+01	.2185E+05	0.
7	260.	0.	.2610E+03	.1800E+02	.3000E+02	.3142E+01	.2185E+05	0.
7	261.	0.	.2620E+03	.3000E+02	.3813E+02	.3142E+01	.2185E+05	0.
7	262.	0.	.2630E+03	.3813E+02	.5796E+04	.3142E+01	.2185E+05	0.
7	249.	0.	.3079E+04	.5000E+00	0.	.3142E+01	.4334E+05	0.
7	276.	0.	.3076E+04	.5796E+04	0.	.3142E+01	.4334E+05	0.
7	249.	0.	.2640E+03	.5000E+00	.1163E+02	.3142E+01	.4334E+05	0.
7	264.	0.	.2650E+03	.1163E+02	.1063E+02	.3142E+01	.4334E+05	0.
7	265.	0.	.2660E+03	.1063E+02	.1513E+02	.3142E+01	.4334E+05	0.
7	266.	0.	.2670E+03	.1513E+02	.1520E+02	.3142E+01	.4334E+05	0.
7	267.	0.	.2680E+03	.1520E+02	.1520E+02	.3142E+01	.4334E+05	0.
7	268.	0.	.2690E+03	.1520E+02	.1520E+02	.3142E+01	.4334E+05	0.
7	269.	0.	.2700E+03	.1520E+02	.1520E+02	.3142E+01	.4334E+05	0.
7	270.	0.	.2710E+03	.1520E+02	.2700E+01	.3142E+01	.4334E+05	0.
7	271.	0.	.2720E+03	.2700E+01	.1650E+02	.3142E+01	.4334E+05	0.
7	272.	0.	.2730E+03	.1650E+02	.1800E+02	.3142E+01	.4334E+05	0.
7	273.	0.	.2740E+03	.1800E+02	.3000E+02	.3142E+01	.4334E+05	0.
7	274.	0.	.2750E+03	.3000E+02	.3813E+02	.3142E+01	.4334E+05	0.
7	275.	0.	.2760E+03	.3813E+02	.5796E+04	.3142E+01	.4334E+05	0.
7	250.	0.	.3080E+04	.5000E+00	0.	.3142E+01	.4284E+06	0.
7	289.	0.	.3075E+04	.5796E+04	0.	.3142E+01	.4284E+06	0.
7	250.	0.	.2770E+03	.5000E+00	.1163E+02	.3142E+01	.4284E+06	0.
7	277.	0.	.2780E+03	.1163E+02	.1063E+02	.3142E+01	.4284E+06	0.
7	278.	0.	.2790E+03	.1063E+02	.1513E+02	.3142E+01	.4284E+06	0.
7	279.	0.	.2800E+03	.1513E+02	.1520E+02	.3142E+01	.4284E+06	0.
7	280.	0.	.2810E+03	.1520E+02	.1520E+02	.3142E+01	.4284E+06	0.
7	281.	0.	.2820E+03	.1520E+02	.1520E+02	.3142E+01	.4284E+06	0.
7	282.	0.	.2830E+03	.1520E+02	.1520E+02	.3142E+01	.4284E+06	0.
7	283.	0.	.2840E+03	.1520E+02	.2700E+01	.3142E+01	.4284E+06	0.

TAP-A INPUT DATA (Cont'd)

7	284.	0.	.2850E+03	.2700E+01	.1650E+02	.3142E+01	.4284E+06	0.
7	285.	0.	.2860E+03	.1650E+02	.1800E+02	.3142E+01	.4284E+06	0.
7	286.	0.	.2870E+03	.1800E+02	.3000E+02	.3142E+01	.4284E+06	0.
7	287.	0.	.2880E+03	.3000E+02	.3813E+02	.3142E+01	.4284E+06	0.
7	288.	0.	.2890E+03	.3813E+02	.5796E+04	.3142E+01	.4284E+06	0.
7	248.	0.	.2470E+03	.2565E+02	.1303E+02	.8250E+03	.1000E+01	0.
7	214.	0.	.2260E+03	.2565E+02	.1303E+02	.8250E+03	.2325E+02	0.
7	215.	0.	.2270E+03	.2565E+02	.1303E+02	.8250E+03	.2125E+02	0.
7	216.	0.	.2280E+03	.2565E+02	.1303E+02	.8250E+03	.3040E+02	0.
7	217.	0.	.2290E+03	.2565E+02	.1303E+02	.8250E+03	.3040E+02	0.
7	218.	0.	.2300E+03	.2565E+02	.1303E+02	.8250E+03	.3040E+02	0.
7	219.	0.	.2310E+03	.2565E+02	.1303E+02	.8250E+03	.3040E+02	0.
7	220.	0.	.2320E+03	.2565E+02	.1303E+02	.8250E+03	.3040E+02	0.
7	221.	0.	.2330E+03	.2565E+02	.1303E+02	.8250E+03	.5400E+01	0.
7	222.	0.	.2340E+03	.2565E+02	.1303E+02	.8250E+03	.3300E+02	0.
7	223.	0.	.2350E+03	.2565E+02	.1303E+02	.8250E+03	.3600E+02	0.
7	224.	0.	.2360E+03	.2565E+02	.1303E+02	.8250E+03	.6000E+02	0.
7	225.	0.	.2370E+03	.2565E+02	.1303E+02	.8250E+03	.7625E+02	0.
7	238.	0.	.2390E+03	.2565E+02	.1303E+02	.8250E+03	.1159E+05	0.
7	247.	0.	.2480E+03	.1302E+02	.2872E+02	.9896E+03	.1000E+01	0.
7	226.	0.	.2510E+03	.1302E+02	.2872E+02	.9896E+03	.2325E+02	0.
7	227.	0.	.2520E+03	.1302E+02	.2872E+02	.9896E+03	.2125E+02	0.
7	228.	0.	.2530E+03	.1302E+02	.2872E+02	.9896E+03	.3040E+02	0.
7	229.	0.	.2540E+03	.1302E+02	.2872E+02	.9896E+03	.3040E+02	0.
7	230.	0.	.2550E+03	.1302E+02	.2872E+02	.9896E+03	.3040E+02	0.
7	231.	0.	.2560E+03	.1302E+02	.2872E+02	.9896E+03	.3040E+02	0.
7	232.	0.	.2570E+03	.1302E+02	.2872E+02	.9896E+03	.3040E+02	0.
7	233.	0.	.2580E+03	.1302E+02	.2872E+02	.9896E+03	.5400E+01	0.
7	234.	0.	.2590E+03	.1302E+02	.2872E+02	.9896E+03	.3300E+02	0.
7	235.	0.	.2600E+03	.1302E+02	.2872E+02	.9896E+03	.3600E+02	0.
7	236.	0.	.2610E+03	.1302E+02	.2872E+02	.9896E+03	.6000E+02	0.
7	237.	0.	.2620E+03	.1302E+02	.2872E+02	.9896E+03	.7625E+02	0.
7	238.	0.	.2630E+03	.1302E+02	.2872E+02	.9896E+03	.1159E+05	0.
7	248.	0.	.2490E+03	.2884E+02	.4121E+02	.1357E+04	.1000E+01	0.
7	251.	0.	.2640E+03	.2884E+02	.4121E+02	.1357E+04	.2325E+02	0.
7	252.	0.	.2650E+03	.2884E+02	.4121E+02	.1357E+04	.2125E+02	0.
7	253.	0.	.2660E+03	.2884E+02	.4121E+02	.1357E+04	.3040E+02	0.
7	254.	0.	.2670E+03	.2884E+02	.4121E+02	.1357E+04	.3040E+02	0.
7	255.	0.	.2680E+03	.2884E+02	.4121E+02	.1357E+04	.3040E+02	0.
7	256.	0.	.2690E+03	.2884E+02	.4121E+02	.1357E+04	.3040E+02	0.
7	257.	0.	.2700E+03	.2884E+02	.4121E+02	.1357E+04	.3040E+02	0.
7	258.	0.	.2710E+03	.2884E+02	.4121E+02	.1357E+04	.5400E+01	0.
7	259.	0.	.2720E+03	.2884E+02	.4121E+02	.1357E+04	.3300E+02	0.
7	260.	0.	.2730E+03	.2884E+02	.4121E+02	.1357E+04	.3600E+02	0.
7	261.	0.	.2740E+03	.2884E+02	.4121E+02	.1357E+04	.6000E+02	0.
7	262.	0.	.2750E+03	.2884E+02	.4121E+02	.1357E+04	.7625E+02	0.
7	263.	0.	.2760E+03	.2884E+02	.4121E+02	.1357E+04	.1159E+05	0.
7	249.	0.	.2500E+03	.4132E+02	.1827E+03	.1885E+04	.1000E+01	0.
7	264.	0.	.2770E+03	.4132E+02	.1827E+03	.1885E+04	.2325E+02	0.
7	265.	0.	.2780E+03	.4132E+02	.1827E+03	.1885E+04	.2125E+02	0.
7	266.	0.	.2790E+03	.4132E+02	.1827E+03	.1885E+04	.3040E+02	0.
7	267.	0.	.2800E+03	.4132E+02	.1827E+03	.1885E+04	.3040E+02	0.
7	268.	0.	.2810E+03	.4132E+02	.1827E+03	.1885E+04	.3040E+02	0.
7	269.	0.	.2820E+03	.4132E+02	.1827E+03	.1885E+04	.3040E+02	0.
7	270.	0.	.2830E+03	.4132E+02	.1827E+03	.1885E+04	.3040E+02	0.
7	271.	0.	.2840E+03	.4132E+02	.1827E+03	.1885E+04	.5400E+01	0.
7	272.	0.	.2850E+03	.4132E+02	.1827E+03	.1885E+04	.3300E+02	0.
7	273.	0.	.2860E+03	.4132E+02	.1827E+03	.1885E+04	.3600E+02	0.
7	274.	0.	.2870E+03	.4132E+02	.1827E+03	.1885E+04	.6000E+02	0.
7	275.	0.	.2880E+03	.4132E+02	.1827E+03	.1885E+04	.7625E+02	0.
7	276.	0.	.2890E+03	.4132E+02	.1827E+03	.1885E+04	.1159E+05	0.
7	250.	0.	.3081E+04	.1920E+03	0.	.1000E+19	.1000E+01	0.
7	277.	0.	.3057E+04	.1920E+03	0.	.1000E+19	.2325E+02	0.
7	278.	0.	.3058E+04	.1920E+03	0.	.1000E+19	.2125E+02	0.
7	279.	0.	.3059E+04	.1920E+03	0.	.1000E+19	.3040E+02	0.
7	280.	0.	.3060E+04	.1920E+03	0.	.1000E+19	.3040E+02	0.
7	281.	0.	.3061E+04	.1920E+03	0.	.1000E+19	.3040E+02	0.
7	282.	0.	.3062E+04	.1920E+03	0.	.1000E+19	.3040E+02	0.
7	283.	0.	.3063E+04	.1920E+03	0.	.1000E+19	.3040E+02	0.
7	284.	0.	.3064E+04	.1920E+03	0.	.1000E+19	.5400E+01	0.
7	285.	0.	.3065E+04	.1920E+03	0.	.1000E+19	.3300E+02	0.
7	286.	0.	.3066E+04	.1920E+03	0.	.1000E+19	.3600E+02	0.
7	287.	0.	.3067E+04	.1920E+03	0.	.1000E+19	.6000E+02	0.
7	288.	0.	.3068E+04	.1920E+03	0.	.1000E+19	.7625E+02	0.
7	289.	0.	.3069E+04	.1920E+03	0.	.1000E+19	.7920E+03	0.
7	245.	0.	.2460E+03	.2046E+02	.2538E+02	.4901E+03	.1000E+01	0.
7	31.	0.	.3001E+04	.1250E+01	0.	.3142E+01	.4000E+01	0.
7	32.	0.	.3002E+04	.1250E+01	0.	.3142E+01	.1200E+02	0.
7	33.	0.	.3003E+04	.1250E+01	0.	.3142E+01	.2000E+02	0.
7	34.	0.	.3004E+04	.1250E+01	0.	.3142E+01	.1300E+02	0.
7	36.	0.	.3007E+04	.1901E+00	0.	.4398E+02	.1520E+02	0.

TAP-A INPUT DATA (Cont'd)

7	37.	0.	.3008E+04	.1901E+00	0.	.4398E+02	.1520E+02	0.
7	38.	0.	.3009E+04	.1901E+00	0.	.4398E+02	.1520E+02	0.
7	39.	0.	.3010E+04	.1901E+00	0.	.4398E+02	.1520E+02	0.
7	40.	0.	.3011E+04	.1901E+00	0.	.4398E+02	.1520E+02	0.
7	41.	0.	.3012E+04	.1901E+00	0.	.4398E+02	.1520E+02	0.
7	42.	0.	.3013E+04	.1901E+00	0.	.4398E+02	.1520E+02	0.
7	43.	0.	.3014E+04	.1901E+00	0.	.4398E+02	.1520E+02	0.
7	44.	0.	.3015E+04	.1901E+00	0.	.4398E+02	.1520E+02	0.
7	45.	0.	.3016E+04	.1901E+00	0.	.4398E+02	.1520E+02	0.
7	46.	0.	.3017E+04	.1901E+00	0.	.4398E+02	.7750E+01	0.
7	47.	0.	.3018E+04	.1875E+00	0.	.3142E+01	.1300E+02	0.
7	48.	0.	.3019E+04	.1875E+00	0.	.3142E+01	.2000E+02	0.
7	49.	0.	.3020E+04	.1875E+00	0.	.3142E+01	.1200E+02	0.
7	50.	0.	.3021E+04	.1875E+00	0.	.3142E+01	.4000E+01	0.
7	51.	0.	.3003E+04	.4830E+00	0.	.3027E+02	.4000E+01	0.
7	52.	0.	.3006E+04	.4630E+00	0.	.3027E+02	.6750E+01	0.
7	53.	0.	.3022E+04	.2500E+00	0.	.3142E+01	.4000E+01	0.
7	54.	0.	.3023E+04	.2500E+00	0.	.3142E+01	.1200E+02	0.
7	55.	0.	.3024E+04	.2500E+00	0.	.3142E+01	.2000E+02	0.
7	56.	0.	.3025E+04	.2500E+00	0.	.3142E+01	.1300E+02	0.
7	59.	0.	.3026E+04	.1241E+00	0.	.5498E+02	.1520E+02	0.
7	60.	0.	.3027E+04	.1241E+00	0.	.5498E+02	.1520E+02	0.
7	61.	0.	.3028E+04	.1241E+00	0.	.5498E+02	.4000E+01	0.
7	62.	0.	.3029E+04	.1241E+00	0.	.5498E+02	.6750E+01	0.
7	63.	0.	.3030E+04	.1241E+00	0.	.5498E+02	.1520E+02	0.
7	64.	0.	.3031E+04	.1241E+00	0.	.5498E+02	.1520E+02	0.
7	65.	0.	.3032E+04	.1241E+00	0.	.5498E+02	.1520E+02	0.
7	66.	0.	.3033E+04	.1241E+00	0.	.5498E+02	.1520E+02	0.
7	67.	0.	.3034E+04	.1241E+00	0.	.5498E+02	.1520E+02	0.
7	68.	0.	.3035E+04	.1241E+00	0.	.5498E+02	.1520E+02	0.
7	69.	0.	.3036E+04	.1241E+00	0.	.5498E+02	.1520E+02	0.
7	70.	0.	.3037E+04	.1241E+00	0.	.5498E+02	.1520E+02	0.
7	71.	0.	.3038E+04	.1241E+00	0.	.5498E+02	.7750E+01	0.
7	74.	0.	.3039E+04	.6000E+01	0.	.3142E+01	.1300E+02	0.
7	75.	0.	.3040E+04	.6000E+01	0.	.3142E+01	.2000E+02	0.
7	76.	0.	.3041E+04	.6000E+01	0.	.3142E+01	.1200E+02	0.
7	77.	0.	.3042E+04	.6000E+01	0.	.3142E+01	.4000E+01	0.
7	111.	0.	.3043E+04	.2500E+00	0.	.3142E+01	.4000E+01	0.
7	112.	0.	.3044E+04	.2500E+00	0.	.3142E+01	.1200E+02	0.
7	113.	0.	.3045E+04	.2500E+00	0.	.3142E+01	.2000E+02	0.
7	114.	0.	.3046E+04	.2500E+00	0.	.3142E+01	.2800E+02	0.
7	115.	0.	.3047E+04	.2500E+00	0.	.3142E+01	.3106E+02	0.
7	116.	0.	.3048E+04	.2500E+00	0.	.3142E+01	.1519E+02	0.
7	117.	0.	.3049E+04	.2500E+00	0.	.3142E+01	.2508E+03	0.
7	117.	0.	.3050E+04	.4811E+01	0.	.1194E+03	.2500E+00	0.
7	140.	0.	.3051E+04	.4807E+01	0.	.1162E+03	.2375E+01	0.
7	243.	0.	.3052E+04	.5000E+00	0.	.3142E+01	.2338E+03	0.
7	244.	0.	.3053E+04	.5000E+00	0.	.3142E+01	.1188E+04	0.
7	245.	0.	.3054E+04	.5000E+00	0.	.3142E+01	.4320E+04	0.
7	246.	0.	.3055E+04	.5000E+00	0.	.3142E+01	.1116E+05	0.
7	247.	0.	.3056E+04	.5000E+00	0.	.3142E+01	.7567E+04	0.
7	238.	0.	.3070E+04	.5796E+04	0.	.3142E+01	.7567E+04	0.
7	239.	0.	.3071E+04	.5796E+04	0.	.3142E+01	.1116E+05	0.
7	240.	0.	.3072E+04	.5796E+04	0.	.3142E+01	.4320E+04	0.
7	241.	0.	.3073E+04	.5796E+04	0.	.3142E+01	.1683E+04	0.
7	242.	0.	.3074E+04	.5796E+04	0.	.3142E+01	.8100E+02	0.
8	1.	1.	.1000E+03	.8910E-07	.3000E+03	.1116E-06	.5000E+03	.1336E-06
8	1.	4.	.7000E+03	.1550E-06	.9000E+03	.1753E-06	0.	0.
8	2.	1.	.1000E+03	.4753E-06	.3000E+03	.5956E-06	.5000E+03	.7129E-06
8	2.	4.	.7000E+03	.8271E-06	.9000E+03	.9351E-06	0.	0.
8	3.	1.	.1000E+03	.4916E-06	.3000E+03	.6162E-06	.5000E+03	.7375E-06
8	3.	4.	.7000E+03	.8556E-06	.9000E+03	.9874E-06	0.	0.
8	4.	1.	.1000E+03	.3960E-07	.3000E+03	.4947E-07	.5000E+03	.5938E-07
8	4.	4.	.7000E+03	.6889E-07	.9000E+03	.7791E-07	0.	0.
9	3001.	0.	.5001E+04	-.2000E+01	0.	0.	0.	0.
9	3002.	0.	.5002E+04	-.2000E+01	0.	0.	0.	0.
9	3003.	0.	.5003E+04	-.2000E+01	0.	0.	0.	0.
9	3004.	0.	.5004E+04	-.2000E+01	0.	0.	0.	0.
9	3005.	0.	.5005E+04	-.2000E+01	0.	0.	0.	0.
9	3006.	0.	.5006E+04	-.2000E+01	0.	0.	0.	0.
9	3007.	0.	.5007E+04	-.2000E+01	0.	0.	0.	0.
9	3008.	0.	.5008E+04	-.2000E+01	0.	0.	0.	0.
9	3009.	0.	.5009E+04	-.2000E+01	0.	0.	0.	0.
9	3010.	0.	.5010E+04	-.2000E+01	0.	0.	0.	0.
9	3011.	0.	.5011E+04	-.2000E+01	0.	0.	0.	0.
9	3012.	0.	.5012E+04	-.2000E+01	0.	0.	0.	0.
9	3013.	0.	.5013E+04	-.2000E+01	0.	0.	0.	0.
9	3014.	0.	.5014E+04	-.2000E+01	0.	0.	0.	0.
9	3015.	0.	.5015E+04	-.2000E+01	0.	0.	0.	0.

TAP-A INPUT DATA (Cont'd)

9	3016.	0.	.5016E+04	-.2000E+01	0.	0.	0.	0.
9	3017.	0.	.5017E+04	-.2000E+01	0.	0.	0.	0.
9	3018.	0.	.5018E+04	-.2000E+01	0.	0.	0.	0.
9	3019.	0.	.5019E+04	-.2000E+01	0.	0.	0.	0.
9	3020.	0.	.5020E+04	-.2000E+01	0.	0.	0.	0.
9	3021.	0.	.5021E+04	-.2000E+01	0.	0.	0.	0.
9	3022.	0.	.5022E+04	-.2000E+01	0.	0.	0.	0.
9	3023.	0.	.5023E+04	-.2000E+01	0.	0.	0.	0.
9	3024.	0.	.5024E+04	-.2000E+01	0.	0.	0.	0.
9	3025.	0.	.5025E+04	-.2000E+01	0.	0.	0.	0.
9	3026.	0.	.5026E+04	-.2000E+01	0.	0.	0.	0.
9	3027.	0.	.5027E+04	-.2000E+01	0.	0.	0.	0.
9	3028.	0.	.5028E+04	-.2000E+01	0.	0.	0.	0.
9	3029.	0.	.5029E+04	-.2000E+01	0.	0.	0.	0.
9	3030.	0.	.5030E+04	-.2000E+01	0.	0.	0.	0.
9	3031.	0.	.5031E+04	-.2000E+01	0.	0.	0.	0.
9	3032.	0.	.5032E+04	-.2000E+01	0.	0.	0.	0.
9	3033.	0.	.5033E+04	-.2000E+01	0.	0.	0.	0.
9	3034.	0.	.5034E+04	-.2000E+01	0.	0.	0.	0.
9	3035.	0.	.5035E+04	-.2000E+01	0.	0.	0.	0.
9	3036.	0.	.5036E+04	-.2000E+01	0.	0.	0.	0.
9	3037.	0.	.5037E+04	-.2000E+01	0.	0.	0.	0.
9	3038.	0.	.5038E+04	-.2000E+01	0.	0.	0.	0.
9	3039.	0.	.5039E+04	-.2000E+01	0.	0.	0.	0.
9	3040.	0.	.5040E+04	-.2000E+01	0.	0.	0.	0.
9	3041.	0.	.5041E+04	-.2000E+01	0.	0.	0.	0.
9	3042.	0.	.5042E+04	-.2000E+01	0.	0.	0.	0.
9	3001.	0.	.5022E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3002.	0.	.5023E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3003.	0.	.5024E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3004.	0.	.5025E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3005.	0.	.5026E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3006.	0.	.5027E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3007.	0.	.5028E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3008.	0.	.5029E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3009.	0.	.5030E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3010.	0.	.5031E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3011.	0.	.5032E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3012.	0.	.5033E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3013.	0.	.5034E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3014.	0.	.5035E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3015.	0.	.5036E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3016.	0.	.5037E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3017.	0.	.5038E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3018.	0.	.5039E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3019.	0.	.5040E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3020.	0.	.5041E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3021.	0.	.5042E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3022.	0.	.5001E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3023.	0.	.5002E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3024.	0.	.5003E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3025.	0.	.5004E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3026.	0.	.5005E+04	-.1000E+01	0.	.3165E+00	0.	0.
9	3027.	0.	.5006E+04	-.1000E+01	0.	.3165E+00	0.	0.
9	3028.	0.	.5007E+04	-.1000E+01	0.	.2769E+00	0.	0.
9	3029.	0.	.5008E+04	-.1000E+01	0.	.2769E+00	0.	0.
9	3030.	0.	.5009E+04	-.1000E+01	0.	.2769E+00	0.	0.
9	3031.	0.	.5010E+04	-.1000E+01	0.	.2769E+00	0.	0.
9	3032.	0.	.5011E+04	-.1000E+01	0.	.2769E+00	0.	0.
9	3033.	0.	.5012E+04	-.1000E+01	0.	.2769E+00	0.	0.
9	3034.	0.	.5013E+04	-.1000E+01	0.	.2769E+00	0.	0.
9	3035.	0.	.5014E+04	-.1000E+01	0.	.2769E+00	0.	0.
9	3036.	0.	.5015E+04	-.1000E+01	0.	.2769E+00	0.	0.
9	3037.	0.	.5016E+04	-.1000E+01	0.	.2769E+00	0.	0.
9	3038.	0.	.5017E+04	-.1000E+01	0.	.2769E+00	0.	0.
9	3039.	0.	.5018E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3040.	0.	.5019E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3041.	0.	.5020E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3042.	0.	.5021E+04	-.1000E+01	0.	.3462E+00	0.	0.
9	3043.	3050.	.5043E+04	0.	0.	.5000E-05	0.	0.
9	3043.	3050.	.5744E+04	-.1000E+01	0.	.9500E+00	0.	0.
9	3051.	3053.	.5045E+04	0.	0.	.5000E-05	0.	0.
9	3051.	3053.	.5046E+04	-.1000E+01	0.	.9000E+00	0.	0.
9	3054.	3056.	.5047E+04	0.	0.	.5000E-05	0.	0.
9	3054.	3056.	.5048E+04	-.1000E+01	0.	.9000E+00	0.	0.

TAP-A INPUT DATA (Cont'd)

9	3078.	3080.	.5047E+04	0.	0.	.5000E-05	0.	0.
9	3078.	3080.	.5048E+04	-.1000E+01	0.	.9000E+00	0.	0.
9	3081.	0.	.5049E+04	-.5000E+01	0.	0.	0.	0.
9	3057.	0.	.5049E+04	-.5000E+01	0.	0.	0.	0.
9	3058.	0.	.5050E+04	-.5000E+01	0.	0.	0.	0.
9	3059.	0.	.5051E+04	-.5000E+01	0.	0.	0.	0.
9	3060.	0.	.5052E+04	-.5000E+01	0.	0.	0.	0.
9	3061.	0.	.5053E+04	-.5000E+01	0.	0.	0.	0.
9	3062.	0.	.5054E+04	-.5000E+01	0.	0.	0.	0.
9	3063.	0.	.5055E+04	-.5000E+01	0.	0.	0.	0.
9	3064.	0.	.5056E+04	-.5000E+01	0.	0.	0.	0.
9	3065.	0.	.5057E+04	-.5000E+01	0.	0.	0.	0.
9	3066.	3077.	.5058E+04	-.5000E+01	0.	0.	0.	0.
12	1.	0.	.3087E-03	0.	0.	0.	0.	0.
12	11.	0.	.3087E-03	0.	0.	0.	0.	0.
12	21.	0.	.3087E-03	0.	0.	0.	0.	0.
12	2.	0.	.1642E-03	0.	0.	0.	0.	0.
12	12.	0.	.1642E-03	0.	0.	0.	0.	0.
12	22.	0.	.1642E-03	0.	0.	0.	0.	0.
12	3.	0.	.1474E-03	0.	0.	0.	0.	0.
12	13.	0.	.1474E-03	0.	0.	0.	0.	0.
12	23.	0.	.1474E-03	0.	0.	0.	0.	0.
12	4.	0.	.1411E-03	0.	0.	0.	0.	0.
12	14.	0.	.1411E-03	0.	0.	0.	0.	0.
12	24.	0.	.1411E-03	0.	0.	0.	0.	0.
12	5.	0.	.1389E-03	0.	0.	0.	0.	0.
12	15.	0.	.1389E-03	0.	0.	0.	0.	0.
12	25.	0.	.1389E-03	0.	0.	0.	0.	0.
12	6.	0.	.1432E-03	0.	0.	0.	0.	0.
12	16.	0.	.1432E-03	0.	0.	0.	0.	0.
12	26.	0.	.1432E-03	0.	0.	0.	0.	0.
12	7.	0.	.1453E-03	0.	0.	0.	0.	0.
12	17.	0.	.1453E-03	0.	0.	0.	0.	0.
12	27.	0.	.1453E-03	0.	0.	0.	0.	0.
12	8.	0.	.1432E-03	0.	0.	0.	0.	0.
12	18.	0.	.1432E-03	0.	0.	0.	0.	0.
12	28.	0.	.1432E-03	0.	0.	0.	0.	0.
12	9.	0.	.1368E-03	0.	0.	0.	0.	0.
12	19.	0.	.1368E-03	0.	0.	0.	0.	0.
12	29.	0.	.1368E-03	0.	0.	0.	0.	0.
12	10.	0.	.1859E-03	0.	0.	0.	0.	0.
12	20.	0.	.1859E-03	0.	0.	0.	0.	0.
12	30.	0.	.1859E-03	0.	0.	0.	0.	0.
12	111.	117.	.5299E-03	0.	0.	0.	0.	0.
12	243.	250.	.1255E-03	0.	0.	0.	0.	0.
25	0.	0.	.1000E+01	0.	0.	0.	0.	0.

TAP-A OUTPUT

TAP--TRANSIENT ANALYSIS PROGRAM

MARCH 1978 3 KW

SPECIFICATIONS

INITIAL TIME		FINAL TIME		TIME INCREMENT		CONVERGE CRITERIA		PROBLEM TYPE		STEPS BEFORE ACCELERATE		MAXIMUM NO. ITERATION	
0.0000		2073600.0000		21600.0000		.0050		3.0000		50		3000	
BOUNDARY TEMPERATURE TABLES													
TABLE	TIME	TEMP	TIME	TEMP	TIME	TEMP	TIME	TEMP	TIME	TEMP	TIME	TEMP	TEMP
MATERIALS													
NO.	DENSITY	HEAT CAP.	CONDUCTIVITY	TEMP.	HEAT CAP.	CONDUCTIVITY	TEMP.	HEAT CAP.	CONDUCTIVITY	TEMP.	HEAT CAP.	CONDUCTIVITY	TEMP.
201	.0100	.1000	.1620E-05	100.00	.1000	.1620E-05	345.00	.1000	.2360E-05	500.00	.1000	.2360E-05	500.00
		.1000	.3009E-05	600.00	.1000	.3704E-05	700.00	.1000	.4398E-05	800.00	.1000	.4398E-05	800.00
		.1000	.5092E-05	900.00	.1000	.6020E-05	1000.00	.1000	.6020E-05	1300.00	.1000	.6020E-05	1300.00
202	.0613	.2500	.2026E-04	40.00	.2500	.2026E-04	190.00	.2500	.6944E-05	200.00	.2500	.6944E-05	200.00
		.2500	.6944E-05	500.00									
		.2500	.2026E-04	40.00	.2500	.2026E-04	190.00	.2500	.1042E-04	200.00	.2500	.1042E-04	200.00
203	.0596	.2500	.1042E-04	500.00									
		.2390	.3078E-06	0.00	.2400	.3565E-06	100.00	.2430	.4467E-06	300.00	.2590	.7014E-06	900.00
		.2470	.5347E-06	500.00	.2530	.6204E-06	700.00	.2590	.7014E-06	900.00	.2590	.7014E-06	900.00
205	.0677	.2000	.1538E-04	60.00	.2000	.1512E-04	100.00	.2000	.1538E-04	200.00	.2000	.1538E-04	200.00
		.2000	.1485E-04	300.00	.2000	.1458E-04	400.00	.2000	.9230E-05	500.00	.2000	.9230E-05	500.00
		.2000	.8290E-05	600.00	.2000	.8030E-05	700.00						
206	.0596	.2500	.2026E-04	40.00	.2500	.2026E-04	190.00	.2500	.8565E-05	200.00	.2500	.8565E-05	200.00
		.2500	.8565E-05	500.00									
		.2500	.2026E-04	40.00	.2500	.2026E-04	190.00	.2500	.6944E-05	200.00	.2500	.6944E-05	200.00
207	.0613	.2500	.6944E-05	500.00									
		.2500	.2315E-03										
		.2500	.5324E-03										
226	.2836	.1100	.2431E-04										
227	.2836	.1100											
228	.0822	.2000											

INTERNAL NODES

NODE	MATERIAL	VOLUME	BASE GEN.1	BASE GEN.2	TEMPERATURE
1	201	.1910E+03	.5896E-01	0.	60.00
2	201	.1910E+03	.3136E-01	0.	60.00
3	201	.1910E+03	.2815E-01	0.	60.00
4	201	.1910E+03	.2694E-01	0.	60.00
5	201	.1910E+03	.2654E-01	0.	60.00
6	201	.1910E+03	.2734E-01	0.	60.00
7	201	.1910E+03	.2775E-01	0.	60.00
8	201	.1910E+03	.2734E-01	0.	60.00
9	201	.1910E+03	.2614E-01	0.	60.00
10	201	.1910E+03	.3550E-01	0.	60.00
11	201	.5730E+03	.1769E+00	0.	60.00
12	201	.5730E+03	.9409E-01	0.	60.00
13	201	.5730E+03	.8444E-01	0.	60.00
14	201	.5730E+03	.8083E-01	0.	60.00
15	201	.5730E+03	.7962E-01	0.	60.00
16	201	.5730E+03	.8203E-01	0.	60.00
17	201	.5730E+03	.8324E-01	0.	60.00
18	201	.5730E+03	.8203E-01	0.	60.00
19	201	.5730E+03	.7841E-01	0.	60.00
20	201	.5730E+03	.1065E+00	0.	60.00
21	201	.9550E+03	.2948E+00	0.	60.00
22	201	.9550E+03	.1568E+00	0.	60.00
23	201	.9550E+03	.1407E+00	0.	60.00
24	201	.9550E+03	.1347E+00	0.	60.00
25	201	.9550E+03	.1327E+00	0.	60.00
26	201	.9550E+03	.1367E+00	0.	60.00
27	201	.9550E+03	.1387E+00	0.	60.00
28	201	.9550E+03	.1367E+00	0.	60.00
29	201	.9550E+03	.1307E+00	0.	60.00
30	201	.9550E+03	.1775E+00	0.	60.00
31	226	.3142E+02	0.	0.	114.00
32	226	.9425E+02	0.	0.	114.00
33	226	.1571E+03	0.	0.	114.00
34	226	.6200E+02	0.	0.	102.00
35	226	.6800E+02	0.	0.	102.00
36	226	.2440E+03	0.	0.	116.00
37	226	.2440E+03	0.	0.	116.00
38	226	.2440E+03	0.	0.	116.00
39	226	.2440E+03	0.	0.	115.00

TAP-A OUTPUT (Cont'd)

40	226	.2440E+03	0.	0.	115.00
41	226	.2440E+03	0.	0.	113.00
42	226	.2440E+03	0.	0.	113.00
43	226	.2440E+03	0.	0.	108.00
44	226	.2440E+03	0.	0.	108.00
45	226	.2440E+03	0.	0.	94.00
46	226	.1214E+03	0.	0.	94.00
47	226	.1231E+02	0.	0.	94.00
48	226	.2356E+02	0.	0.	94.00
49	226	.1414E+02	0.	0.	85.00
50	226	.4712E+01	0.	0.	85.00
51	227	.1885E+03	0.	0.	100.00
52	227	.3181E+03	0.	0.	100.00
53	227	.6283E+01	0.	0.	95.00
54	227	.1885E+02	0.	0.	95.00
55	227	.3142E+02	0.	0.	95.00
56	227	.4398E+02	0.	0.	95.00
57	227	.5655E+02	0.	0.	95.00
58	227	.2297E+02	0.	0.	95.00
59	227	.5576E+02	0.	0.	85.00
60	227	.9410E+02	0.	0.	92.00
61	227	.2119E+03	0.	0.	79.00
62	227	.2119E+03	0.	0.	79.00
63	227	.2119E+03	0.	0.	81.00
64	227	.2119E+03	0.	0.	81.00
65	227	.2119E+03	0.	0.	81.00
66	227	.2119E+03	0.	0.	81.00
67	227	.2119E+03	0.	0.	81.00
68	227	.2119E+03	0.	0.	81.00
69	227	.2119E+03	0.	0.	76.00
70	227	.2119E+03	0.	0.	76.00
71	227	.1080E+03	0.	0.	73.00
72	227	.1255E+03	0.	0.	73.00
73	205	.1206E+04	0.	0.	71.00
74	205	.4901E+03	0.	0.	71.00
75	205	.7540E+03	0.	0.	71.00
76	205	.4524E+03	0.	0.	71.00
77	205	.1508E+03	0.	0.	71.00
78	228	.1885E+03	0.	0.	60.00
79	228	.1131E+03	0.	0.	60.00
80	228	.9425E+02	0.	0.	60.00
81	228	.5655E+03	0.	0.	60.00
82	228	.3393E+03	0.	0.	60.00
83	228	.2827E+03	0.	0.	60.00
84	228	.9425E+03	0.	0.	60.00
85	228	.5655E+03	0.	0.	60.00
86	228	.4712E+03	0.	0.	60.00
87	228	.1319E+04	0.	0.	60.00
88	228	.7917E+03	0.	0.	60.00
89	228	.6597E+03	0.	0.	60.00
90	228	.1464E+04	0.	0.	60.00
91	228	.8783E+03	0.	0.	60.00
92	228	.7319E+03	0.	0.	60.00
93	227	.3142E+01	0.	0.	60.00
94	227	.9425E+01	0.	0.	60.00
95	227	.1571E+02	0.	0.	60.00
96	227	.2199E+02	0.	0.	60.00
97	227	.2440E+02	0.	0.	60.00
98	227	.3684E+02	0.	0.	60.00
99	227	.2327E+03	0.	0.	60.00
100	227	.1396E+03	0.	0.	60.00
101	227	.1163E+03	0.	0.	60.00
102	204	.2985E+02	0.	0.	60.00
103	204	.8954E+02	0.	0.	60.00
104	204	.1492E+03	0.	0.	60.00
105	204	.2089E+03	0.	0.	60.00
106	204	.2318E+03	0.	0.	60.00
107	204	.4175E+02	0.	0.	60.00
108	204	.2386E+03	0.	0.	60.00
109	204	.1431E+03	0.	0.	60.00
110	204	.1272E+03	0.	0.	60.00
111	227	.3142E+01	.1665E-02	0.	97.00
112	227	.9425E+01	.4994E-02	0.	97.00
113	227	.1571E+02	.8324E-02	0.	97.00
114	227	.2199E+02	.1165E-01	0.	97.00
115	227	.2440E+02	.1293E-01	0.	97.00
116	227	.1193E+02	.6321E-02	0.	97.00

TAP-A OUTPUT (Cont'd)

117	227	.1969E+03	.1044E+00	0.	97.00
118	227	.4278E+02	0.	0.	59.00
119	227	.2445E+03	0.	0.	59.00
120	227	.1467E+03	0.	0.	59.00
121	227	.1304E+03	0.	0.	59.00
122	228	.3253E+04	0.	0.	51.80
123	205	.1661E+04	0.	0.	55.50
124	205	.1477E+04	0.	0.	57.90
125	205	.1037E+04	0.	0.	57.90
126	205	.1866E+04	0.	0.	58.70
127	205	.4202E+04	0.	0.	66.00
128	205	.4202E+04	0.	0.	75.10
129	205	.4202E+04	0.	0.	76.00
130	205	.4202E+04	0.	0.	76.30
131	205	.4202E+04	0.	0.	77.00
132	205	.4202E+04	0.	0.	77.40
133	205	.4202E+04	0.	0.	77.40
134	205	.4202E+04	0.	0.	77.30
135	205	.4202E+04	0.	0.	76.00
136	205	.4202E+04	0.	0.	74.20
137	205	.2143E+04	0.	0.	73.00
138	205	.2488E+04	0.	0.	72.00
139	205	.3318E+04	0.	0.	72.00
140	228	.9593E+04	0.	0.	51.80
141	207	.4899E+04	0.	0.	55.50
142	202	.6531E+04	0.	0.	57.90
143	202	.3674E+04	0.	0.	58.70
144	202	.8273E+04	0.	0.	66.00
145	202	.8273E+04	0.	0.	75.10
146	206	.8273E+04	0.	0.	76.00
147	206	.8273E+04	0.	0.	76.30
148	206	.8273E+04	0.	0.	77.00
149	206	.8273E+04	0.	0.	77.40
150	203	.8273E+04	0.	0.	77.40

151	203	.8273E+04	0.	0.	77.30
152	203	.8273E+04	0.	0.	76.00
153	203	.8273E+04	0.	0.	74.20
154	203	.4218E+04	0.	0.	73.00
155	203	.1143E+05	0.	0.	72.00
156	203	.9849E+04	0.	0.	70.00
157	203	.1696E+04	0.	0.	70.00
158	203	.1357E+04	0.	0.	70.00
159	203	.2955E+05	0.	0.	70.00
160	203	.9161E+04	0.	0.	70.00
161	203	.4924E+05	0.	0.	70.00
162	203	.1527E+05	0.	0.	70.00
163	228	.1046E+05	0.	0.	51.80
164	207	.6609E+04	0.	0.	55.00
165	202	.8812E+04	0.	0.	57.00
166	202	.6793E+04	0.	0.	59.90
167	202	.1116E+05	0.	0.	61.00
168	202	.1116E+05	0.	0.	63.60
169	206	.1116E+05	0.	0.	64.50
170	206	.1116E+05	0.	0.	66.30
171	206	.1116E+05	0.	0.	67.30
172	206	.1116E+05	0.	0.	68.60
173	203	.1116E+05	0.	0.	69.30
174	203	.1116E+05	0.	0.	70.40
175	203	.1116E+05	0.	0.	70.50
176	203	.1116E+05	0.	0.	70.70
177	203	.3965E+04	0.	0.	70.60
178	203	.1542E+05	0.	0.	70.60
179	203	.8812E+04	0.	0.	71.40
180	203	.2644E+05	0.	0.	71.70
181	203	.4406E+05	0.	0.	70.90
182	228	.5318E+05	0.	0.	50.80
183	207	.3359E+05	0.	0.	52.00
184	202	.4479E+05	0.	0.	54.50
185	202	.3452E+05	0.	0.	56.30
186	202	.5673E+05	0.	0.	58.00
187	202	.5673E+05	0.	0.	60.00
188	206	.5673E+05	0.	0.	62.00
189	206	.5673E+05	0.	0.	63.40
190	206	.5673E+05	0.	0.	64.00
191	206	.5673E+05	0.	0.	64.30
192	203	.5673E+05	0.	0.	65.00
193	203	.5673E+05	0.	0.	66.30
194	203	.5673E+05	0.	0.	67.00
195	203	.5673E+05	0.	0.	67.90
196	203	.2015E+05	0.	0.	68.50
197	203	.1232E+06	0.	0.	69.10

TAP-A OUTPUT (Cont'd)

198	203	.1344E+06	0.	0.	70.00
199	203	.2239E+06	0.	0.	70.00
200	203	.4032E+06	0.	0.	70.00
201	203	.1941E+05	0.	0.	70.00
202	207	.3155E+06	0.	0.	47.60
203	202	.2884E+06	0.	0.	51.80
204	202	.4126E+06	0.	0.	55.60
205	206	.4126E+06	0.	0.	59.20
206	206	.4126E+06	0.	0.	62.50
207	203	.4126E+06	0.	0.	66.80
208	203	.4126E+06	0.	0.	68.60
209	203	.7329E+05	0.	0.	69.40
210	203	.4479E+06	0.	0.	70.10
211	203	.4886E+06	0.	0.	70.90
212	203	.8143E+06	0.	0.	70.30
213	203	.1035E+07	0.	0.	70.00
214	207	.8148E+06	0.	0.	49.00
215	202	.7447E+06	0.	0.	52.30
216	202	.1065E+07	0.	0.	55.10
217	206	.1065E+07	0.	0.	58.60
218	206	.1065E+07	0.	0.	61.40
219	203	.1065E+07	0.	0.	64.20
220	203	.1065E+07	0.	0.	65.60
221	203	.1893E+06	0.	0.	67.10
222	203	.1157E+07	0.	0.	70.00
223	203	.1262E+07	0.	0.	70.00
224	203	.2103E+07	0.	0.	70.00
225	203	.2672E+07	0.	0.	70.00
226	207	.5527E+06	0.	0.	48.40
227	202	.5051E+06	0.	0.	51.40
228	202	.7226E+06	0.	0.	56.00
229	206	.7226E+06	0.	0.	57.20
230	206	.7226E+06	0.	0.	60.60
231	203	.7226E+06	0.	0.	63.40
232	203	.7226E+06	0.	0.	65.00
233	203	.1284E+06	0.	0.	67.00
234	203	.7844E+06	0.	0.	70.00
235	203	.8558E+06	0.	0.	70.00
236	203	.1426E+07	0.	0.	70.00
237	203	.1813E+07	0.	0.	70.00
238	203	.2756E+09	0.	0.	70.00
239	203	.4063E+09	0.	0.	70.00
240	203	.1573E+09	0.	0.	70.00
241	203	.6129E+08	0.	0.	70.00
242	203	.2950E+07	0.	0.	70.00
243	228	.7343E+03	.9216E-01	0.	51.60
244	228	.3732E+04	.4684E+00	0.	50.80
245	207	.1357E+05	.1703E+01	0.	47.60
246	207	.3505E+05	.4398E+01	0.	49.00
247	207	.2377E+05	.2983E+01	0.	48.40
248	207	.6864E+05	.8615E+01	0.	48.40
249	207	.1362E+06	.1709E+02	0.	48.40
250	207	.1346E+07	.1689E+03	0.	48.40
251	207	.1630E+07	0.	0.	48.40
252	202	.1459E+07	0.	0.	51.40
253	202	.2076E+07	0.	0.	54.00
254	206	.2087E+07	0.	0.	57.20
255	206	.2087E+07	0.	0.	60.60
256	203	.2087E+07	0.	0.	63.40
257	203	.2087E+07	0.	0.	65.00
258	203	.3707E+06	0.	0.	67.00
259	203	.2263E+07	0.	0.	70.00
260	203	.2471E+07	0.	0.	70.00
261	203	.4119E+07	0.	0.	70.00
262	203	.5234E+07	0.	0.	70.00
263	203	.7957E+09	0.	0.	70.00
264	207	.3234E+07	0.	0.	48.40
265	202	.2894E+07	0.	0.	51.40
266	202	.4119E+07	0.	0.	54.00
267	206	.4140E+07	0.	0.	57.20
268	206	.4140E+07	0.	0.	60.60
269	203	.4140E+07	0.	0.	63.40
270	203	.4140E+07	0.	0.	65.00
271	203	.7353E+06	0.	0.	67.00
272	203	.4494E+07	0.	0.	70.00
273	203	.4902E+07	0.	0.	70.00
274	203	.8170E+07	0.	0.	70.00

TAP-A OUTPUT (Cont'd)

275	203	.1038E+08	0.	0.	70.00
276	203	.1578E+10	0.	0.	70.00
277	207	.3196E+08	0.	0.	48.40
278	202	.2860E+08	0.	0.	51.40
279	202	.4071E+08	0.	0.	54.00
280	204	.4091E+08	0.	0.	57.20
281	204	.4091E+08	0.	0.	60.60
282	203	.4091E+08	0.	0.	63.40
283	203	.4091E+08	0.	0.	65.00
284	203	.7268E+07	0.	0.	67.00
285	203	.4441E+08	0.	0.	70.00
286	203	.4845E+08	0.	0.	70.00
287	203	.8075E+08	0.	0.	70.00
288	203	.1026E+09	0.	0.	70.00
289	203	.1360E+11	0.	0.	70.00

INTERNAL ADMITTANCES

INTERNAL NODE	SELF ADMIT	BORDER NODE	BORDER ADMIT	BORDER NODE	BORDER ADMIT	BORDER NODE	BORDER ADMIT	BORDER NODE	BORDER ADMIT	BORDER NODE	BORDER ADMIT
1	-.211E-03	11	.141E-03	31	.705E-04						
2	-.141E-03	12	.141E-03								
3	-.141E-03	13	.141E-03								
4	-.141E-03	14	.141E-03								
5	-.141E-03	15	.141E-03								
6	-.141E-03	16	.141E-03								
7	-.141E-03	17	.141E-03								
8	-.141E-03	18	.141E-03								
9	-.141E-03	19	.141E-03								
10	-.147E-03	20	.141E-03	50	.634E-05						
11	-.655E-03	1	.141E-03	21	.303E-03	32	.212E-03				
12	-.444E-03	2	.141E-03	22	.303E-03						
13	-.444E-03	3	.141E-03	23	.303E-03						
14	-.444E-03	4	.141E-03	24	.303E-03						
15	-.444E-03	5	.141E-03	25	.303E-03						
16	-.444E-03	6	.141E-03	26	.303E-03						
17	-.444E-03	7	.141E-03	27	.303E-03						
18	-.444E-03	8	.141E-03	28	.303E-03						
19	-.444E-03	9	.141E-03	29	.303E-03						
20	-.463E-03	10	.141E-03	30	.303E-03	49	.190E-04				
21	-.150E-02	11	.303E-03	33	.353E-03	36	.848E-03				
22	-.115E-02	12	.303E-03	37	.848E-03						
23	-.115E-02	13	.303E-03	38	.848E-03						
24	-.115E-02	14	.303E-03	39	.848E-03						
25	-.115E-02	15	.303E-03	40	.848E-03						
26	-.115E-02	16	.303E-03	41	.848E-03						
27	-.115E-02	17	.303E-03	42	.848E-03						
28	-.115E-02	18	.303E-03	43	.848E-03						
29	-.115E-02	19	.303E-03	44	.848E-03						
30	-.118E-02	20	.303E-03	45	.848E-03	48	.317E-04				
31	-.571E-02	32	.331E-02	1	.705E-04	53	.113E-05	3001	.233E-02		
32	-.176E-01	31	.331E-02	33	.712E-02	11	.212E-03	54	.338E-05	3002	.698E-02
33	-.330E-01	32	.712E-02	34	.139E-01	21	.353E-03	55	.563E-05	3003	.116E-01
34	-.324E-01	33	.139E-01	35	.110E-01	56	.363E-05	3004	.756E-02		
35	-.183E+00	36	.339E-03	34	.110E-01	52	.172E+00				
36	-.816E+00	35	.339E-03	37	.244E-03	21	.848E-03	61	.368E-03	3007	.814E+00
37	-.816E+00	36	.244E-03	38	.244E-03	22	.848E-03	62	.368E-03	3008	.814E+00
38	-.816E+00	37	.244E-03	39	.244E-03	23	.848E-03	63	.369E-03	3009	.814E+00
39	-.816E+00	38	.244E-03	40	.244E-03	24	.848E-03	64	.369E-03	3010	.814E+00
40	-.816E+00	39	.244E-03	41	.244E-03	25	.848E-03	65	.369E-03	3011	.814E+00
41	-.816E+00	40	.244E-03	42	.244E-03	26	.848E-03	66	.368E-03	3012	.814E+00
42	-.816E+00	41	.244E-03	43	.244E-03	27	.848E-03	67	.368E-03	3013	.814E+00
43	-.816E+00	42	.244E-03	44	.244E-03	28	.848E-03	68	.367E-03	3014	.814E+00
44	-.816E+00	43	.244E-03	45	.244E-03	29	.848E-03	69	.366E-03	3015	.814E+00
45	-.816E+00	44	.244E-03	46	.324E-03	30	.848E-03	70	.363E-03	3016	.814E+00

TAP-A OUTPUT (Cont'd)

46	-.417E+00	45	.324E-03	47	.133E-02	71	.154E-03	3017	.415E+00	
47	-.538E-01	46	.133E-02	48	.208E-02	74	.156E-05	3018	.504E-01	
48	-.808E-01	47	.208E-02	49	.107E-02	30	.317E-04	75	.479E-06	3019 .776E-01
49	-.481E-01	48	.107E-02	50	.497E-03	20	.190E-04	76	.143E-05	3020 .445E-01
50	-.160E-01	49	.497E-03	10	.634E-05	77	.238E-05	3021	.155E-01	
51	-.241E+00	52	.772E-02	56	.112E-01	59	.990E-04	3005	.222E+00	
52	-.554E+00	35	.172E+00	51	.772E-02	60	.168E-03	3006	.374E+00	
53	-.284E-01	80	.812E-04	31	.113E-05	54	.152E-02	3022	.268E-01	
54	-.853E-01	83	.244E-03	32	.338E-05	53	.152E-02	55	.327E-02	3023 .803E-01
55	-.142E+00	86	.406E-03	33	.563E-05	54	.327E-02	56	.497E-02	3024 .134E+00
56	-.110E+00	89	.569E-03	51	.112E-01	34	.363E-05	55	.497E-02	57 .666E-02
57	-.763E-01	3025	.870E-01	101	.206E-02	58	.636E-01	59	.330E-02	56 .666E-02
58	-.757E-01	92	.631E-03	110	.143E-05	121	.224E-02	125	.753E-03	124 .211E-03
59	-.360E+01	110	.848E-04	60	.138E-02	51	.990E-04	58	.891E-02	125 .180E-02
60	-.359E+01	57	.636E-01	61	.676E-03	52	.168E-03	126	.325E-02	3027 .359E+01
61	-.952E+00	59	.891E-02	62	.488E-03	36	.368E-03	127	.729E-02	3028 .943E+00
62	-.160E+01	3026	.330E-02	63	.488E-03	37	.368E-03	128	.726E-02	3029 .159E+01
63	-.359E+01	59	.359E+01	64	.488E-03	38	.369E-03	129	.726E-02	3030 .359E+01
64	-.359E+01	60	.138E-02	65	.488E-03	39	.369E-03	130	.726E-02	3031 .359E+01
65	-.359E+01	61	.488E-03	66	.488E-03	40	.369E-03	131	.725E-02	3032 .359E+01
66	-.359E+01	62	.488E-03	67	.488E-03	41	.368E-03	132	.725E-02	3033 .359E+01
67	-.359E+01	63	.488E-03	68	.488E-03	42	.368E-03	133	.725E-02	3034 .359E+01
68	-.359E+01	64	.488E-03	69	.488E-03	43	.367E-03	134	.725E-02	3035 .359E+01
69	-.359E+01	65	.488E-03	70	.488E-03	44	.366E-03	135	.726E-02	3036 .359E+01
70	-.359E+01	66	.488E-03	71	.647E-03	45	.363E-03	136	.726E-02	3037 .359E+01
71	-.183E+01	67	.488E-03	72	.886E-03	46	.154E-03	137	.394E-02	3038 .183E+01
72	-.522E-02	68	.488E-03	73	.348E-04	138	.430E-02			
73	-.936E-02	69	.488E-03	74	.146E-03	139	.362E-02	74	.556E-02	
74	-.101E-01	70	.488E-03	75	.156E-05	73	.556E-02	75	.440E-02	3039 .104E-03
75	-.691E-02	71	.488E-03	76	.479E-06	74	.440E-02	76	.226E-02	3040 .160E-03
76	-.346E-02	72	.488E-03	77	.143E-05	75	.226E-02	77	.105E-02	3041 .962E-04
77	-.110E-02	73	.488E-03	78	.238E-05	76	.105E-02	3042	.321E-04	
78	-.215E-02	74	.488E-03	79	.255E-04	81	.209E-02			
79	-.131E-02	75	.488E-03	80	.370E-04	82	.125E-02			
80	-.116E-02	76	.488E-03	81	.370E-04	83	.104E-02			
81	-.677E-02	77	.488E-03	82	.764E-04	78	.209E-02	84	.449E-02	
82	-.413E-02	78	.488E-03	83	.111E-03	79	.125E-02	85	.269E-02	
83	-.364E-02	79	.488E-03	84	.111E-03	80	.104E-02	86	.224E-02	
84	-.116E-01	80	.488E-03	85	.127E-03	81	.449E-02	87	.681E-02	
85	-.709E-02	81	.488E-03	86	.185E-03	82	.269E-02	88	.409E-02	
86	-.624E-02	82	.488E-03	87	.185E-03	83	.224E-02	89	.340E-02	
87	-.169E-01	83	.488E-03	88	.178E-03	84	.681E-02	90	.965E-02	
88	-.103E-01	84	.488E-03	89	.259E-03	85	.409E-02	91	.579E-02	
89	-.906E-02	85	.488E-03	90	.259E-03	86	.340E-02	92	.483E-02	
90	-.344E-01	86	.488E-03	91	.198E-03	87	.965E-02	99	.242E-01	
91	-.208E-01	87	.488E-03	92	.288E-03	88	.579E-02	100	.145E-01	
92	-.179E-01	88	.488E-03	93	.288E-03	89	.483E-02	101	.121E-01	
93	-.805E-03	89	.488E-03	94	.357E-05	94	.761E-03			
94	-.253E-02	90	.488E-03	95	.107E-04	93	.761E-03	95	.164E-02	
95	-.434E-02	91	.488E-03	96	.178E-04	94	.164E-02	96	.249E-02	
96	-.632E-02	92	.488E-03	97	.250E-04	95	.249E-02	97	.352E-02	
97	-.117E-01	93	.488E-03	98	.277E-04	96	.352E-02	98	.783E-02	
98	-.150E-01	94	.488E-03	99	.937E-03	97	.783E-02	107	.447E-03	106 .535E-04
99	-.284E-01	95	.488E-03	100	.688E-03	90	.242E-01	108	.256E-02	
100	-.178E-01	96	.488E-03	101	.100E-02	91	.145E-01	109	.153E-02	

TAP-A OUTPUT (Cont'd)

101	-.165E-01	57	.206E-02	100	.100E-02	92	.121E-01	110	.128E-02		
102	-.117E-04	93	.357E-05	111	.357E-05	103	.458E-05				
103	-.358E-04	94	.107E-04	112	.107E-04	102	.458E-05	104	.985E-05		
104	-.605E-04	95	.178E-04	113	.178E-04	103	.985E-05	105	.149E-04		
105	-.861E-04	96	.250E-04	114	.250E-04	104	.149E-04	106	.212E-04		
106	-.130E-03	97	.277E-04	115	.277E-04	105	.212E-04	98	.535E-04		
107	-.905E-03	116	.408E-05	108	.608E-06	98	.447E-03	118	.453E-03		
108	-.514E-02	107	.608E-06	109	.447E-06	99	.256E-02	119	.259E-02		
109	-.309E-02	108	.447E-06	110	.650E-06	100	.153E-02	120	.155E-02		
110	-.266E-02	109	.650E-06	58	.143E-03	57	.848E-04	101	.128E-02	121	.129E-02
111	-.275E-01	102	.357E-05	112	.761E-03	3043	.268E-01				
112	-.827E-01	103	.107E-04	111	.761E-03	113	.164E-02	3044	.803E-01		
113	-.138E+00	104	.178E-04	112	.164E-02	114	.249E-02	3045	.134E+00		
114	-.193E+00	105	.250E-04	113	.249E-02	115	.352E-02	3046	.187E+00		
115	-.218E+00	106	.277E-04	114	.352E-02	116	.629E-02	3047	.208E+00		
116	-.122E+00	98	.574E-02	107	.408E-05	118	.604E-02	115	.629E-02	117	.222E-02
		3048	.102E+00								
117	-.169E+01	122	.509E-03	140	.150E-02	116	.222E-02	3049	.168E+01	3050	.330E-02
118	-.110E-01	116	.604E-02	119	.985E-03	107	.453E-03	122	.355E-02		
119	-.246E-01	118	.985E-03	120	.723E-03	108	.259E-02	122	.203E-01		
120	-.110E-01	119	.723E-03	121	.102E-02	109	.155E-02	123	.772E-02		
121	-.110E-01	58	.224E-02	120	.102E-02	110	.129E-02	124	.643E-02		
122	-.338E-01	117	.509E-03	123	.282E-03	118	.355E-02	119	.203E-01	140	.919E-02
123	-.119E-01	122	.282E-03	124	.334E-03	120	.772E-02	141	.353E-02		
124	-.107E-01	123	.334E-03	125	.484E-03	58	.211E-03	121	.643E-02	142	.323E-02
125	-.501E-02	58	.753E-03	124	.484E-03	126	.810E-03	59	.180E-02	142	.116E-02
126	-.653E-02	125	.810E-03	127	.387E-03	60	.325E-02	143	.209E-02		
127	-.126E-01	126	.387E-03	128	.278E-03	61	.729E-02	144	.469E-02		
128	-.125E-01	127	.278E-03	129	.278E-03	62	.726E-02	145	.468E-02		
129	-.125E-01	128	.278E-03	130	.278E-03	63	.726E-02	146	.468E-02		
130	-.125E-01	129	.278E-03	131	.278E-03	64	.726E-02	147	.468E-02		
131	-.125E-01	130	.278E-03	132	.278E-03	65	.725E-02	148	.468E-02		
132	-.125E-01	131	.278E-03	133	.278E-03	66	.725E-02	149	.468E-02		
133	-.125E-01	132	.278E-03	134	.278E-03	67	.725E-02	150	.468E-02		
134	-.125E-01	133	.278E-03	135	.278E-03	68	.725E-02	151	.468E-02		
135	-.125E-01	134	.278E-03	136	.278E-03	69	.726E-02	152	.468E-02		
136	-.126E-01	135	.278E-03	137	.368E-03	70	.726E-02	153	.468E-02		
137	-.720E-02	136	.368E-03	138	.505E-03	71	.394E-02	154	.239E-02		
138	-.798E-02	137	.505E-03	139	.403E-03	72	.430E-02	155	.277E-02		
139	-.813E-02	138	.403E-03	156	.402E-03	73	.362E-02	155	.370E-02		
140	-.209E-01	117	.150E-02	141	.931E-03	122	.919E-02	243	.531E-03	163	.727E-02
		3051	.149E-02								
141	-.949E-02	140	.931E-03	142	.105E-02	123	.353E-02	164	.398E-02		
142	-.119E-01	141	.105E-02	143	.118E-02	124	.323E-02	125	.116E-02	165	.531E-02
143	-.725E-02	142	.118E-02	144	.100E-02	126	.209E-02	166	.299E-02		
144	-.131E-01	143	.100E-02	145	.725E-03	127	.469E-02	166	.113E-02	167	.560E-02
145	-.128E-01	144	.725E-03	146	.725E-03	128	.468E-02	167	.104E-02	168	.560E-02
146	-.129E-01	145	.725E-03	147	.725E-03	129	.468E-02	168	.104E-02	169	.568E-02
147	-.129E-01	146	.725E-03	148	.725E-03	130	.468E-02	169	.104E-02	170	.568E-02
148	-.129E-01	147	.725E-03	149	.725E-03	131	.468E-02	170	.104E-02	171	.568E-02
149	-.129E-01	148	.725E-03	150	.725E-03	132	.468E-02	171	.104E-02	172	.568E-02
150	-.129E-01	149	.725E-03	151	.725E-03	133	.468E-02	172	.104E-02	173	.568E-02
151	-.129E-01	150	.725E-03	152	.725E-03	134	.468E-02	173	.104E-02	174	.568E-02
152	-.129E-01	151	.725E-03	153	.725E-03	135	.468E-02	174	.104E-02	175	.568E-02
153	-.131E-01	152	.725E-03	154	.961E-03	136	.468E-02	175	.104E-02	176	.568E-02
154	-.754E-02	153	.961E-03	155	.767E-03	137	.239E-02	176	.104E-02	177	.239E-02
155	-.172E-01	154	.767E-03	156	.668E-03	138	.277E-02	159	.370E-02	178	.929E-02

TAP-A OUTPUT (Cont'd)

156	-.789E-02	139	.402E-03	155	.668E-03	159	.693E-03	179	.361E-02	157	.252E-02
157	-.451E-02	73	.146E-03	74	.593E-04	160	.119E-03	156	.252E-02	158	.167E-02
158	-.193E-02	75	.913E-04	76	.548E-04	77	.183E-04	160	.954E-04	157	.167E-02
159	-.160E-01	156	.693E-03	161	.346E-03	180	.108E-01	160	.410E-02		
160	-.442E-02	157	.119E-03	158	.954E-04	162	.107E-03	159	.410E-02		
161	-.255E-01	159	.346E-03	200	.244E-03	181	.180E-01	162	.684E-02		
162	-.701E-02	160	.107E-03	201	.661E-04	161	.684E-02				
163	-.158E-01	164	.143E-02	243	.234E-02	140	.727E-02	182	.482E-02		
164	-.936E-02	163	.143E-02	165	.142E-02	141	.398E-02	183	.253E-02		
165	-.115E-01	164	.142E-02	166	.140E-02	142	.531E-02	184	.338E-02		
166	-.863E-02	165	.140E-02	167	.122E-02	143	.299E-02	144	.113E-02	185	.190E-02
167	-.131E-01	166	.122E-02	168	.985E-03	145	.104E-02	144	.560E-02	186	.428E-02
168	-.129E-01	167	.985E-03	169	.982E-03	146	.104E-02	145	.560E-02	187	.428E-02
169	-.130E-01	168	.982E-03	170	.979E-03	147	.104E-02	146	.568E-02	188	.428E-02
170	-.130E-01	169	.979E-03	171	.979E-03	148	.104E-02	147	.568E-02	189	.428E-02
171	-.130E-01	170	.979E-03	172	.979E-03	149	.104E-02	148	.568E-02	190	.428E-02
172	-.130E-01	171	.979E-03	173	.979E-03	150	.104E-02	149	.568E-02	191	.428E-02
173	-.130E-01	172	.979E-03	174	.979E-03	151	.104E-02	150	.568E-02	192	.428E-02
174	-.130E-01	173	.979E-03	175	.979E-03	152	.104E-02	151	.568E-02	193	.428E-02
175	-.130E-01	174	.979E-03	176	.979E-03	153	.104E-02	152	.568E-02	194	.428E-02
176	-.134E-01	175	.979E-03	177	.144E-02	154	.104E-02	153	.568E-02	195	.428E-02
177	-.714E-02	176	.144E-02	178	.113E-02	154	.239E-02	196	.218E-02		
178	-.172E-01	177	.113E-02	179	.901E-03	155	.929E-02	197	.591E-02		
179	-.851E-02	178	.901E-03	180	.620E-03	156	.361E-02	197	.338E-02		
180	-.219E-01	179	.620E-03	181	.310E-03	159	.108E-01	198	.101E-01		
181	-.355E-01	180	.310E-03	200	.218E-03	161	.180E-01	199	.169E-01		
182	-.272E-01	183	.724E-02	244	.119E-01	163	.482E-02	202	.325E-02		
183	-.189E-01	182	.724E-02	184	.720E-02	164	.253E-02	202	.192E-02		
184	-.202E-01	183	.720E-02	185	.710E-02	165	.338E-02	203	.255E-02		
185	-.166E-01	184	.710E-02	186	.620E-02	166	.190E-02	203	.144E-02		
186	-.187E-01	185	.620E-02	187	.501E-02	167	.428E-02	204	.324E-02		
187	-.175E-01	186	.501E-02	188	.499E-02	168	.428E-02	204	.324E-02		
188	-.175E-01	187	.499E-02	189	.497E-02	169	.428E-02	205	.324E-02		
189	-.175E-01	188	.497E-02	190	.497E-02	170	.428E-02	205	.324E-02		
190	-.175E-01	189	.497E-02	191	.497E-02	171	.428E-02	206	.324E-02		
191	-.175E-01	190	.497E-02	192	.497E-02	172	.428E-02	206	.324E-02		
192	-.175E-01	191	.497E-02	193	.497E-02	173	.428E-02	207	.324E-02		
193	-.175E-01	192	.497E-02	194	.497E-02	174	.428E-02	207	.324E-02		
194	-.175E-01	193	.497E-02	195	.497E-02	175	.428E-02	208	.324E-02		
195	-.198E-01	194	.497E-02	196	.734E-02	176	.428E-02	208	.324E-02		
196	-.151E-01	195	.734E-02	197	.394E-02	177	.218E-02	209	.165E-02		
197	-.224E-01	196	.394E-02	198	.219E-02	178	.591E-02	179	.338E-02	210	.702E-02
198	-.216E-01	197	.219E-02	199	.157E-02	180	.101E-01	211	.766E-02		
199	-.324E-01	198	.157E-02	200	.111E-02	181	.169E-01	212	.128E-01		
200	-.207E-01	161	.244E-03	181	.218E-03	199	.111E-02	241	.184E-04	213	.140E-01
201	-.518E-02	201	.512E-02								
202	-.452E-01	162	.661E-04	242	.883E-06	200	.512E-02				
203		203	.123E-01	245	.227E-01	182	.325E-02	183	.192E-02	214	.503E-02
204	-.316E-01	202	.123E-01	204	.107E-01	184	.255E-02	185	.144E-02	215	.660E-02
205	-.328E-01	203	.107E-01	205	.907E-02	186	.324E-02	187	.324E-02	216	.658E-02
206	-.312E-01	204	.907E-02	206	.904E-02	188	.324E-02	189	.324E-02	217	.658E-02
207											
208	-.311E-01	205	.904E-02	207	.904E-02	190	.324E-02	191	.324E-02	218	.658E-02
209											
210											
211											
212											
213											
214											
215											
216											
217											
218											
219											
220											
221											
222											
223											
224											
225											
226											
227											
228											
229											
230											
231											
232											
233											
234											
235											
236											
237											
238											
239											
240											
241											
242											
243											
244											
245											
246											
247											
248											
249											
250											
251											
252											
253											
254											
255											
256											
257											
258											
259											
260											
261											
262											
263											
264											
265											
266											
267											
268											
269											
270											
271											
272											
273											
274											
275											
276											
277											
278											
279											
280											
281											
282											
283											
284											
285											
286											
287											
288											
289											
290											
291											
292											
293											
294											
295											
296											
297											
298											
299											
300											

TAP-A OUTPUT (Cont'd)

209	-.330E-01	208	.154E-01	210	.143E-01	196	.165E-02	221	.168E-02
210	-.300E-01	209	.143E-01	211	.797E-02	197	.702E-02	222	.650E-03
211	-.292E-01	210	.797E-02	212	.573E-02	198	.766E-02	223	.779E-02
212	-.355E-01	211	.573E-02	213	.404E-02	199	.128E-01	224	.130E-01
213	-.346E-01	212	.404E-02	214	.471E-04	200	.140E-01	225	.165E-01
214	-.105E+00	213	.319E-01	215	.585E-01	202	.503E-02	226	.100E-01
215	-.732E-01	214	.319E-01	216	.276E-01	203	.460E-02	227	.918E-02
216	-.707E-01	215	.276E-01	217	.234E-01	204	.658E-02	228	.131E-01
217	-.665E-01	216	.234E-01	218	.234E-01	205	.658E-02	229	.131E-01
218	-.664E-01	217	.234E-01	219	.234E-01	206	.658E-02	230	.131E-01
219	-.664E-01	218	.234E-01	220	.234E-01	207	.658E-02	231	.131E-01
220	-.827E-01	219	.234E-01	221	.397E-01	208	.658E-02	232	.131E-01
221	-.806E-01	220	.397E-01	222	.370E-01	209	.168E-02	233	.233E-02
222	-.725E-01	221	.370E-01	223	.206E-01	210	.650E-03	234	.143E-01
223	-.587E-01	222	.206E-01	224	.148E-01	211	.779E-02	235	.156E-01
224	-.641E-01	223	.148E-01	225	.104E-01	212	.130E-01	236	.259E-01
225	-.600E-01	224	.104E-01	226	.122E-03	213	.165E-01	237	.329E-01
226	-.825E-01	225	.216E-01	227	.397E-01	214	.100E-01	238	.112E-01
227	-.597E-01	226	.216E-01	228	.187E-01	215	.918E-02	239	.102E-01
228	-.623E-01	227	.187E-01	229	.159E-01	216	.131E-01	240	.146E-01
229	-.595E-01	228	.159E-01	230	.158E-01	217	.131E-01	241	.146E-01
230	-.594E-01	229	.158E-01	231	.158E-01	218	.131E-01	242	.146E-01
231	-.594E-01	230	.158E-01	232	.158E-01	219	.131E-01	243	.146E-01
232	-.705E-01	231	.158E-01	233	.269E-01	220	.131E-01	244	.146E-01
233	-.569E-01	232	.269E-01	234	.251E-01	221	.233E-02	245	.259E-02
234	-.691E-01	233	.251E-01	235	.140E-01	222	.143E-01	246	.158E-01
235	-.568E-01	234	.140E-01	236	.100E-01	223	.156E-01	247	.173E-01
236	-.718E-01	235	.100E-01	237	.707E-02	224	.259E-01	248	.288E-01
237	-.767E-01	236	.707E-02	238	.825E-04	225	.329E-01	249	.366E-01
238	-.106E+02	237	.825E-04	239	.501E+01	226	.557E+01	250	.831E-04
239	-.752E+01	238	.122E-03	240	.251E+01	227	.501E+01	251	.122E-03
240	-.464E+01	239	.471E-04	241	.251E+01	228	.213E+01	252	.474E-04
241	-.291E+01	240	.184E-04	242	.213E+01	229	.778E+00	253	.185E-04
242	-.778E+00	241	.883E-06	243	.778E+00	230	.889E-06	254	.357E-01
243	-.389E-01	242	.234E-02	244	.331E-03	231	.338E-03	255	.181E+00
244	-.194E+00	243	.119E-01	245	.338E-03	232	.228E-03	256	.550E+00
245	-.573E+00	244	.227E-01	246	.228E-03	233	.217E-03	257	.142E+01
246	-.148E+01	245	.585E-01	247	.432E-03	234	.217E-03	258	.963E+00
247	-.100E+01	246	.397E-01	248	.432E-03	235	.480E-03	259	.392E-03
248	-.290E+01	247	.278E+01	249	.115E+00	236	.480E-03	260	

249	-.574E+01	3079	.552E+01	264	.227E+00	248	.392E-03	250	.170E-03
250	-.568E+02	3080	.565E+02	277	.225E+01	249	.170E-03	3081	.106E+26
251	-.197E+00	248	.115E+00	252	.625E-01	226	.912E-01	264	.912E-02
252	-.135E+00	251	.625E-01	253	.540E-01	227	.102E-01	265	.834E-02
253	-.126E+00	252	.540E-01	254	.458E-01	228	.146E-01	266	.119E-01
254	-.118E+00	253	.458E-01	255	.457E-01	229	.146E-01	267	.119E-01
255	-.118E+00	254	.457E-01	256	.457E-01	230	.146E-01	268	.119E-01
256	-.118E+00	255	.457E-01	257	.457E-01	231	.146E-01	269	.119E-01
257	-.150E+00	256	.457E-01	258	.777E-01	232	.146E-01	270	.119E-01
258	-.155E+00	257	.777E-01	259	.724E-01	233	.259E-02	271	.212E-02
259	-.142E+00	258	.724E-01	260	.403E-01	234	.158E-01	272	.130E-01
260	-.101E+00	259	.403E-01	261	.290E-01	235	.175E-01	273	.141E-01
261	-.102E+00	260	.290E-01	262	.204E-01	236	.288E-01	274	.235E-01
262	-.872E-01	261	.204E-01	263	.238E-03	237	.366E-01	275	.299E-01
263	-.101E+02	3077	.240E-03	262	.238E-03	238	.557E+01	276	.455E+01
264	-.365E+00	249	.227E+00	265	.124E+00	251	.912E-02	277	.396E-02
265	-.243E+00	264	.124E+00	266	.107E+00	252	.834E-02	278	.362E-02
266	-.215E+00	265	.107E+00	267	.910E-01	253	.119E-01	279	.518E-02
267	-.199E+00	266	.910E-01	268	.907E-01	254	.119E-01	280	.518E-02
268	-.199E+00	267	.907E-01	269	.907E-01	255	.119E-01	281	.518E-02
269	-.199E+00	268	.907E-01	270	.907E-01	256	.119E-01	282	.518E-02
270	-.262E+00	269	.907E-01	271	.154E+00	257	.119E-01	283	.518E-02
271	-.301E+00	270	.154E+00	272	.144E+00	258	.212E-02	284	.920E-03
272	-.242E+00	271	.144E+00	273	.799E-01	259	.130E-01	285	.563E-02
273	-.158E+00	272	.799E-01	274	.575E-01	260	.141E-01	286	.614E-02
274	-.132E+00	273	.575E-01	275	.405E-01	261	.235E-01	287	.102E-01
275	-.839E-01	274	.405E-01	276	.473E-03	262	.299E-01	288	.130E-01
276	-.653E+01	3076	.476E-03	275	.473E-03	263	.455E-01	289	.198E+01
277	-.348E+01	250	.225E+01	278	.123E+01	264	.396E-02	3057	.245E-25
278	-.229E+01	277	.123E+01	279	.106E+01	265	.362E-02	3058	.224E-25
279	-.196E+01	278	.106E+01	280	.899E+00	266	.518E-02	3059	.321E-25
280	-.180E+01	279	.899E+00	281	.897E+00	267	.518E-02	3060	.321E-25
281	-.180E+01	280	.897E+00	282	.897E+00	268	.518E-02	3061	.321E-25
282	-.180E+01	281	.897E+00	283	.897E+00	269	.518E-02	3062	.321E-25
283	-.242E+01	282	.897E+00	284	.152E+01	270	.518E-02	3063	.321E-25
284	-.294E+01	283	.152E+01	285	.142E+01	271	.920E-03	3064	.570E-26
285	-.222E+01	284	.142E+01	286	.790E+00	272	.563E-02	3065	.348E-25

TAP-A OUTPUT (Cont'd)

286	-.136E+01	285	.790E+00	287	.568E+00	273	.614E-02	3066	.380E-25
287	-.978E+00	286	.568E+00	288	.400E+00	274	.102E-01	3067	.633E-25
288	-.418E+00	287	.400E+00	289	.467E-02	275	.130E-01	3068	.805E-25
289	-.199E+01	3075	.470E-02	288	.467E-02	276	.198E+01	3069	.836E-24

INTERNAL CONTACT CONDUCTANCES

NODE	TO	NODE-TABLE	NODE-TABLE	NODE-TABLE	NODE-TABLE	NODE-TABLE	NODE-TABLE	NODE-TABLE
31	33	1.						
32	34	1.						
33	35	1.						

34	36	1.
36	61	3.
37	62	3.
38	63	3.
39	64	3.
40	65	3.
41	66	3.
42	67	3.
43	68	3.
44	69	3.
45	70	3.
46	71	3.
47	74	4.
48	75	4.
49	76	4.
50	77	4.
51	59	2.
52	60	2.
53	31	1.
54	32	1.
55	33	1.
56	34	1.
59	51	2.
60	52	2.
61	36	3.
62	37	3.
63	38	3.
64	39	3.
65	40	3.
66	41	3.
67	42	3.
68	43	3.
69	44	3.
70	45	3.
71	46	3.
74	47	4.
75	48	4.
76	49	4.
77	50	4.

FORCED CONVECTION, GAS CONDUCTIVITY OR CONTACT CONDUCTANCE TABLES

TABLE	TIME (TEMP)	COEFF.	TIME (TEMP)	COEFF.	TIME (TEMP)	COEFF.	TIME (TEMP)	COEFF.	TIME (TEMP)	COEFF.
1	100.000	.891E-07	300.000	.112E-06	500.000	.134E-06	700.000	.155E-06	900.000	.175E-06
2	100.000	.475E-06	300.000	.596E-06	500.000	.713E-06	700.000	.827E-06	900.000	.935E-06
3	100.000	.492E-06	300.000	.616E-06	500.000	.738E-06	700.000	.856E-06	900.000	.987E-06
4	100.000	.396E-07	300.000	.496E-07	500.000	.594E-07	700.000	.689E-07	900.000	.779E-07

SURFACE TO BOUNDARY CONNECTORS

NODE	TEMP	NODE	TEMP	MECHANISM	AREA	FILM COEF	ADMIT	GAP
3001	60.00	5022	60.00	RADIATION CONNECT	12.5664	.6497E-06	.8164E-05	
3002	60.00	5023	60.00	RADIATION CONNECT	37.6991	.6497E-06	.2449E-04	
3003	60.00	5024	60.00	RADIATION CONNECT	62.8318	.6497E-06	.4082E-04	
3004	60.00	5025	60.00	RADIATION CONNECT	40.8407	.6497E-06	.2633E-04	
3005	60.00	5026	60.00	RADIATION CONNECT	201.0620	.6497E-06	.1306E-03	
3006	60.00	5027	60.00	RADIATION CONNECT	339.2921	.6497E-06	.2204E-03	
3007	60.00	5028	60.00	RADIATION CONNECT	668.5308	.6497E-06	.4343E-03	
3008	60.00	5029	60.00	RADIATION CONNECT	668.5308	.6497E-06	.4343E-03	
3009	60.00	5030	60.00	RADIATION CONNECT	668.5308	.6497E-06	.4343E-03	
3010	60.00	5031	60.00	RADIATION CONNECT	668.5308	.6497E-06	.4343E-03	
3011	60.00	5032	60.00	RADIATION CONNECT	668.5308	.6497E-06	.4343E-03	

TAP-A OUTPUT (Cont'd)

3012	60.00	3033	60.00	RADIATION CONNECT	668.5308	.6497E-06	.4343E-03
3013	60.00	3034	60.00	RADIATION CONNECT	668.5308	.6497E-06	.4343E-03
3014	60.00	3035	60.00	RADIATION CONNECT	668.5308	.6497E-06	.4343E-03
3015	60.00	3036	60.00	RADIATION CONNECT	668.5308	.6497E-06	.4343E-03
3016	60.00	3037	60.00	RADIATION CONNECT	668.5308	.6497E-06	.4343E-03
3017	60.00	3038	60.00	RADIATION CONNECT	340.8627	.6497E-06	.2214E-03
3018	60.00	3039	60.00	RADIATION CONNECT	40.8407	.6497E-06	.2653E-04
3019	60.00	3040	60.00	RADIATION CONNECT	62.8318	.6497E-06	.4082E-04
3020	60.00	3041	60.00	RADIATION CONNECT	37.6991	.6497E-06	.2449E-04
3021	60.00	3042	60.00	RADIATION CONNECT	12.5664	.6497E-06	.8164E-05
3022	60.00	3001	60.00	RADIATION CONNECT	12.5664	.6497E-06	.8164E-05
3023	60.00	3002	60.00	RADIATION CONNECT	37.6991	.6497E-06	.2449E-04
3024	60.00	3003	60.00	RADIATION CONNECT	62.8318	.6497E-06	.4082E-04
3025	60.00	3004	60.00	RADIATION CONNECT	40.8407	.6497E-06	.2653E-04
3026	60.00	3005	60.00	RADIATION CONNECT	835.6636	.5940E-06	.4964E-03
3027	60.00	3006	60.00	RADIATION CONNECT	835.6636	.5940E-06	.4964E-03
3028	60.00	3007	60.00	RADIATION CONNECT	219.9115	.5197E-06	.1143E-03
3029	60.00	3008	60.00	RADIATION CONNECT	371.1006	.5197E-06	.1929E-03
3030	60.00	3009	60.00	RADIATION CONNECT	835.6636	.5197E-06	.4343E-03
3031	60.00	3010	60.00	RADIATION CONNECT	835.6636	.5197E-06	.4343E-03
3032	60.00	3011	60.00	RADIATION CONNECT	835.6636	.5197E-06	.4343E-03
3033	60.00	3012	60.00	RADIATION CONNECT	835.6636	.5197E-06	.4343E-03
3034	60.00	3013	60.00	RADIATION CONNECT	835.6636	.5197E-06	.4343E-03
3035	60.00	3014	60.00	RADIATION CONNECT	835.6636	.5197E-06	.4343E-03
3036	60.00	3015	60.00	RADIATION CONNECT	835.6636	.5197E-06	.4343E-03
3037	60.00	3016	60.00	RADIATION CONNECT	835.6636	.5197E-06	.4343E-03
3038	60.00	3017	60.00	RADIATION CONNECT	426.0785	.5197E-06	.4343E-03
3039	60.00	3018	60.00	RADIATION CONNECT	40.8407	.6497E-06	.2214E-03
3040	60.00	3019	60.00	RADIATION CONNECT	62.8318	.6497E-06	.2653E-04

3041	60.00	3020	60.00	RADIATION CONNECT	37.6991	.6497E-06	.2449E-04
3042	60.00	3021	60.00	RADIATION CONNECT	12.5664	.6497E-06	.8164E-05
3043	55.00	3043	55.00	CONSTANT FILM COEF	12.5664	.5000E-05	.6283E-04
3043	55.00	3044	-50.00	RADIATION CONNECT	12.5664	.1757E-05	.2208E-04
3044	55.00	3043	55.00	CONSTANT FILM COEF	37.6991	.5000E-05	.1885E-03
3044	55.00	3044	-50.00	RADIATION CONNECT	37.6991	.1757E-05	.6625E-04
3045	55.00	3043	55.00	CONSTANT FILM COEF	62.8318	.5000E-05	.3142E-03
3045	55.00	3044	-50.00	RADIATION CONNECT	62.8318	.1757E-05	.1104E-03
3046	55.00	3043	55.00	CONSTANT FILM COEF	87.9643	.5000E-05	.4398E-03
3046	55.00	3044	-50.00	RADIATION CONNECT	87.9643	.1757E-05	.1546E-03
3047	55.00	3043	55.00	CONSTANT FILM COEF	97.5856	.5000E-05	.4879E-03
3047	55.00	3044	-50.00	RADIATION CONNECT	97.5856	.1757E-05	.1713E-03
3048	55.00	3043	55.00	CONSTANT FILM COEF	47.7129	.5000E-05	.2386E-03
3048	55.00	3044	-50.00	RADIATION CONNECT	47.7129	.1757E-05	.8385E-04
3049	55.00	3043	55.00	CONSTANT FILM COEF	787.7537	.5000E-05	.3939E-02
3049	55.00	3044	-50.00	RADIATION CONNECT	787.7537	.1757E-05	.1384E-02
3050	55.00	3043	55.00	CONSTANT FILM COEF	29.8450	.5000E-05	.1492E-03
3050	55.00	3044	-50.00	RADIATION CONNECT	29.8450	.1757E-05	.5243E-04
3051	55.00	3045	55.00	CONSTANT FILM COEF	276.0676	.5000E-05	.1380E-02
3051	55.00	3046	-50.00	RADIATION CONNECT	276.0676	.1665E-05	.4596E-03
3052	55.00	3045	55.00	CONSTANT FILM COEF	734.3467	.5000E-05	.3677E-02
3052	55.00	3046	-50.00	RADIATION CONNECT	734.3467	.1665E-05	.1223E-02
3053	55.00	3045	55.00	CONSTANT FILM COEF	3732.2089	.5000E-05	.1866E-01
3053	55.00	3046	-50.00	RADIATION CONNECT	3732.2089	.1665E-05	.6214E-02
3054	55.00	3047	55.00	CONSTANT FILM COEF	13571.6688	.5000E-05	.6786E-01
3054	55.00	3048	-50.00	RADIATION CONNECT	13571.6688	.1665E-05	.2260E-01
3055	55.00	3047	55.00	CONSTANT FILM COEF	35046.6356	.5000E-05	.1752E-00
3055	55.00	3048	-50.00	RADIATION CONNECT	35046.6356	.1665E-05	.5835E-01
3056	55.00	3047	55.00	CONSTANT FILM COEF	23771.1549	.5000E-05	.1189E-00
3056	55.00	3048	-50.00	RADIATION CONNECT	23771.1549	.1665E-05	.3958E-01
3057	70.00	277	48.40	SPECIFIED TEMP	.0000		
3058	70.00	278	51.40	SPECIFIED TEMP	.0000		
3059	70.00	279	54.00	SPECIFIED TEMP	.0000		
3060	70.00	280	57.20	SPECIFIED TEMP	.0000		
3061	70.00	281	60.60	SPECIFIED TEMP	.0000		
3062	70.00	282	63.40	SPECIFIED TEMP	.0000		
3063	70.00	283	65.00	SPECIFIED TEMP	.0000		
3064	70.00	284	67.00	SPECIFIED TEMP	.0000		
3065	70.00	285	70.00	SPECIFIED TEMP	.0000		
3066	70.00	286	70.00	SPECIFIED TEMP	.0000		
3067	70.00	287	70.00	SPECIFIED TEMP	.0000		
3068	70.00	288	70.00	SPECIFIED TEMP	.0000		
3069	70.00	289	70.00	SPECIFIED TEMP	.0000		
3070	70.00	238	70.00	SPECIFIED TEMP	23771.1549		
3071	70.00	239	70.00	SPECIFIED TEMP	35046.6356		
3072	70.00	240	70.00	SPECIFIED TEMP	13571.6688		
3073	70.00	241	70.00	SPECIFIED TEMP	5287.2960		

TAP-A OUTPUT (Cont'd)

3074	70.00	242	70.00	SPECIFIED TEMP	254.4688		
3075	70.00	289	70.00	SPECIFIED TEMP	*****		
3076	70.00	276	70.00	SPECIFIED TEMP	*****		
3077	70.00	263	70.00	SPECIFIED TEMP	68643.1132		
3078	55.00	5047	55.00	CONSTANT FILM COEF	68643.1132	.5000E-05	.3432E+00
3078	55.00	5048	-50.00	RADIATION CONNECT	68643.1132	.1665E-05	.1143E+00
3079	55.00	5047	55.00	CONSTANT FILM COEF	*****	.5000E-05	.6808E+00
3079	55.00	5048	-50.00	RADIATION CONNECT	*****	.1665E-05	.2267E+00
3080	55.00	5047	55.00	CONSTANT FILM COEF	*****	.5000E-05	.6729E+01
3080	55.00	5048	-50.00	RADIATION CONNECT	*****	.1665E-05	.2241E+01
3081	55.00	250	48.40	SPECIFIED TEMP	.0000		
3001	60.00	5001	60.00	TEMP CONNECTED	12.5664		
3002	60.00	5002	60.00	TEMP CONNECTED	37.6991		
3003	60.00	5003	60.00	TEMP CONNECTED	62.8318		
3004	60.00	5004	60.00	TEMP CONNECTED	40.8407		
3005	60.00	5005	60.00	TEMP CONNECTED	201.0620		
3006	60.00	5006	60.00	TEMP CONNECTED	339.2921		
3007	60.00	5007	60.00	TEMP CONNECTED	668.5308		
3008	60.00	5008	60.00	TEMP CONNECTED	668.5308		
3009	60.00	5009	60.00	TEMP CONNECTED	668.5308		
3010	60.00	5010	60.00	TEMP CONNECTED	668.5308		
3011	60.00	5011	60.00	TEMP CONNECTED	668.5308		
3012	60.00	5012	60.00	TEMP CONNECTED	668.5308		
3013	60.00	5013	60.00	TEMP CONNECTED	668.5308		
3014	60.00	5014	60.00	TEMP CONNECTED	668.5308		
3015	60.00	5015	60.00	TEMP CONNECTED	668.5308		
3016	60.00	5016	60.00	TEMP CONNECTED	668.5308		
3017	60.00	5017	60.00	TEMP CONNECTED	340.8627		
3018	60.00	5018	60.00	TEMP CONNECTED	40.8407		
3019	60.00	5019	60.00	TEMP CONNECTED	62.8318		
3020	60.00	5020	60.00	TEMP CONNECTED	37.6991		
3021	60.00	5021	60.00	TEMP CONNECTED	12.5664		
3022	60.00	5022	60.00	TEMP CONNECTED	12.5664		
3023	60.00	5023	60.00	TEMP CONNECTED	37.6991		
3024	60.00	5024	60.00	TEMP CONNECTED	62.8318		
3025	60.00	5025	60.00	TEMP CONNECTED	40.8407		
3026	60.00	5026	60.00	TEMP CONNECTED	835.6636		
3027	60.00	5027	60.00	TEMP CONNECTED	835.6636		
3028	60.00	5028	60.00	TEMP CONNECTED	219.9115		
3029	60.00	5029	60.00	TEMP CONNECTED	371.1006		
3030	60.00	5030	60.00	TEMP CONNECTED	835.6636		
3031	60.00	5031	60.00	TEMP CONNECTED	835.6636		
3032	60.00	5032	60.00	TEMP CONNECTED	835.6636		
3033	60.00	5033	60.00	TEMP CONNECTED	835.6636		
3034	60.00	5034	60.00	TEMP CONNECTED	835.6636		
3035	60.00	5035	60.00	TEMP CONNECTED	835.6636		
3036	60.00	5036	60.00	TEMP CONNECTED	835.6636		
3037	60.00	5037	60.00	TEMP CONNECTED	835.6636		
3038	60.00	5038	60.00	TEMP CONNECTED	426.0785		
3039	60.00	5039	60.00	TEMP CONNECTED	40.8407		
3040	60.00	5040	60.00	TEMP CONNECTED	62.8318		
3041	60.00	5041	60.00	TEMP CONNECTED	37.6991		
3042	60.00	5042	60.00	TEMP CONNECTED	12.5664		

VOLUME WEIGHTED INTERNAL OR AREA WEIGHTED SURFACE AVERAGES
 FROM TO FROM TO FROM TO FROM TO FROM TO FROM TO
 CALCULATED SPREAD BETWEEN INTERNAL NODES = 103

TAP-A OUTPUT DATA

TEMPERATURE PREDICTIONS FOR END OF APRIL, 1978 ACCELERATED HEATUP (3 KW OPERATION)

APRIL 1978 3 KW ACCELERATED HEAT-UP									
	.207E+07	.467E+07	.216E+05	.500E-02	-.300E+01	.500E+02	.300E+04		
1	5043.	0.	.6000E+02	0.	0.	0.	0.	0.	0.
1	5045.	0.	.6000E+02	0.	0.	0.	0.	0.	0.
1	5047.	0.	.6000E+02	0.	0.	0.	0.	0.	0.
12	111.	117.	.6400E-03	0.	0.	0.	0.	0.	0.
12	243.	250.	.1516E-03	0.	0.	0.	0.	0.	0.
25	0.	0.	.1000E+01	0.	0.	0.	0.	0.	0.

APRIL 1978 3 KW ACCELERATED HEAT-UP

RNAL TEMPERATURES AT .467E+07 SECONDS									
MODE	TEMP	MODE	TEMP	MODE	TEMP	MODE	TEMP	MODE	TEMP
1	692.54	2	876.11	3	866.43	4	865.41	5	867.15
6	877.09	7	875.35	8	862.89	9	837.07	10	842.05
11	857.88	12	799.80	13	797.29	14	799.20	15	802.13
16	811.02	17	808.07	18	795.33	19	769.92	20	773.85
21	550.79	22	621.23	23	640.10	24	650.55	25	656.96
26	663.43	27	656.94	28	642.64	29	616.68	30	607.92
31	377.93	32	364.65	33	342.22	34	323.13	35	299.76
36	383.02	37	450.55	38	493.08	39	512.78	40	522.97
41	527.14	42	516.79	43	500.36	44	472.86	45	437.37
46	312.98	47	324.19	48	335.06	49	352.02	50	362.98
51	271.63	52	298.32	53	254.33	54	254.13	55	254.15
56	255.10	57	230.97	58	229.53	59	232.44	60	246.46
61	270.23	62	337.82	63	407.04	64	434.57	65	448.06
66	451.32	67	436.40	68	417.56	69	386.69	70	336.20
71	247.38	72	189.15	73	161.07	74	164.84	75	168.54
76	172.18	77	174.59	78	114.02	79	166.34	80	218.80
81	113.77	82	165.99	83	218.07	84	113.27	85	165.30
86	216.59	87	112.55	88	164.29	89	214.10	90	111.71
91	163.07	92	210.37	93	98.55	94	97.84	95	96.47
96	94.32	97	91.43	98	89.37	99	111.28	100	162.48
101	209.10	102	84.38	103	84.46	104	84.67	105	85.28
106	86.97	107	87.99	108	102.19	109	151.07	110	200.20
111	70.16	112	70.95	113	72.53	114	75.21	115	79.18
116	83.16	117	71.95	118	86.68	119	93.23	120	139.88
121	189.52	122	90.72	123	135.21	124	181.02	125	208.91
126	222.22	127	254.48	128	316.44	129	375.24	130	401.42
131	413.35	132	416.00	133	401.14	134	383.79	135	355.15
136	307.20	137	232.50	138	177.59	139	156.54	140	86.46
141	124.38	142	161.70	143	184.18	144	207.43	145	256.47
146	300.79	147	322.10	148	332.11	149	334.56	150	325.50
151	311.79	152	288.54	153	248.86	154	199.59	155	152.94
156	129.36	157	131.43	158	133.16	159	99.47	160	100.45
161	78.71	162	78.91	163	85.52	164	114.03	165	142.30
166	163.50	167	173.15	168	202.96	169	232.96	170	247.76
171	239.48	172	237.64	173	233.48	174	243.08	175	226.27
176	197.87	177	168.73	178	142.89	179	126.64	180	98.12
181	78.47	182	81.59	183	98.21	184	115.19	185	128.30
186	141.37	187	153.32	188	169.07	189	178.63	190	185.04
191	187.35	192	187.13	193	181.69	194	170.79	195	157.41
196	145.66	197	124.92	198	95.76	199	78.05	200	71.91
201	71.95	202	77.12	203	91.82	204	107.26	205	120.55
206	127.22	207	126.67	208	119.12	209	113.34	210	107.73
211	88.95	212	76.40	213	71.53	214	69.40	215	73.75
216	78.42	217	83.71	218	85.18	219	85.40	220	83.22
221	80.62	222	77.11	223	75.40	224	72.40	225	70.66
226	67.28	227	68.77	228	70.49	229	72.33	230	73.66
231	74.18	232	73.75	233	73.03	234	72.24	235	71.57
236	70.70	237	70.17	238	70.00	239	70.00	240	70.00
241	70.00	242	70.00	243	73.50	244	71.23	245	68.70
246	66.97	247	66.49	248	66.20	249	66.07	250	66.04
251	66.00	252	65.75	253	65.68	254	66.02	255	66.65
256	67.36	257	67.96	258	68.23	259	68.52	260	68.98
261	69.45	262	69.77	263	70.00	264	65.43	265	64.39
266	63.51	267	63.16	268	63.46	269	64.23	270	65.24
271	65.86	272	66.53	273	67.59	274	68.73	275	69.51
276	70.00	277	65.29	278	64.07	279	62.99	280	62.47
281	62.68	282	63.46	283	64.55	284	65.24	285	65.99
286	67.20	287	68.52	288	69.42	289	70.00		

TAP-A OUTPUT DATA (Cont'd)

TEMPERATURE PREDICTIONS FOR END OF AUGUST, 1978 1 KW OPERATION

AUGUST 1978 1 KW									
	.126E+08	.153E+08	.216E+08	.500E-02	-.300E+01	.500E+02	.300E+04		
1	5043.	0.	.8800E+02	0.	0.	0.	0.	0.	0.
1	5045.	0.	.8800E+02	0.	0.	0.	0.	0.	0.
1	5047.	0.	.8800E+02	0.	0.	0.	0.	0.	0.
12	111.	117.	.6764E-03	0.	0.	0.	0.	0.	0.
12	243.	250.	.1602E-03	0.	0.	0.	0.	0.	0.
25	0.	0.	.1000E+01	0.	0.	0.	0.	0.	0.

AUGUST 1978 1 KW									
ANAL TEMPERATURES AT .153E+08 SECONDS									
MODE	TEMP	MODE	TEMP	MODE	TEMP	MODE	TEMP	MODE	TEMP
1	419.10	2	535.75	3	526.83	4	519.63	5	517.12
6	522.28	7	524.61	8	515.24	9	477.59	10	452.98
11	396.04	12	484.41	13	478.91	14	473.61	15	471.74
16	476.12	17	477.36	18	467.79	19	432.29	20	409.34
21	326.88	22	366.46	23	370.83	24	370.85	25	370.76
26	372.98	27	371.14	28	360.97	29	332.47	30	310.89
31	223.08	32	218.26	33	210.26	34	203.37	35	194.79
36	227.20	37	256.37	38	271.14	39	276.59	40	278.30
41	278.39	42	273.37	43	262.26	44	241.81	45	218.07
46	173.24	47	176.00	48	178.71	49	182.92	50	185.72
51	181.95	52	194.14	53	172.59	54	172.74	55	173.15
56	174.06	57	162.77	58	161.99	59	162.36	60	163.86
61	164.48	62	188.47	63	212.14	64	221.34	65	224.22
66	223.18	67	215.52	68	203.84	69	186.26	70	162.64
71	139.44	72	122.60	73	113.91	74	114.87	75	115.78
76	116.65	77	117.24	78	109.99	79	134.77	80	158.10
81	109.83	82	134.55	83	157.76	84	109.53	85	134.17
86	157.09	87	109.11	88	133.62	89	155.95	90	108.62
91	132.96	92	154.18	93	102.21	94	101.82	95	101.07
96	99.93	97	98.40	98	97.31	99	108.34	100	132.58
101	153.50	102	95.01	103	95.03	104	95.09	105	95.34
106	96.12	107	96.49	108	103.53	109	126.74	110	148.99
111	87.79	112	88.17	113	88.94	114	90.23	115	92.15
116	94.08	117	88.27	118	95.69	119	98.77	120	120.96
121	143.61	122	97.48	123	118.72	124	139.52	125	151.32
126	153.93	127	157.32	128	180.42	129	200.96	130	210.07
131	212.95	132	211.87	133	203.77	134	192.56	135	176.22
136	153.48	137	134.79	138	119.17	139	112.78	140	95.16
141	113.57	142	130.33	143	138.89	144	143.44	145	157.06
146	173.61	147	182.08	148	184.75	149	183.87	150	177.76
151	167.76	152	154.36	153	139.40	154	127.56	155	111.99
156	103.54	157	104.06	158	104.49	159	91.63	160	91.99
161	81.14	162	81.25	163	95.54	164	108.91	165	121.60
166	130.49	167	133.95	168	139.93	169	150.02	170	155.29
171	156.96	172	156.16	173	152.95	174	146.15	175	137.21
176	128.94	177	120.01	178	108.87	179	102.89	180	91.09
181	80.99	182	94.52	183	102.00	184	109.48	185	114.98
186	120.17	187	124.47	188	128.00	189	130.42	190	131.53
191	131.24	192	129.68	193	126.89	194	122.01	195	116.52
196	111.61	197	102.79	198	90.12	199	80.72	200	75.89
201	75.94	202	92.93	203	99.17	204	105.17	205	108.99
206	109.76	207	107.58	208	102.91	209	99.77	210	96.71
211	87.24	212	79.71	213	75.44	214	89.56	215	91.25
216	92.76	217	93.41	218	92.80	219	90.98	220	88.08
221	85.85	222	83.15	223	80.56	224	77.01	225	74.27
226	88.46	227	88.67	228	88.68	229	88.11	230	86.91
231	85.13	232	82.89	233	81.43	234	79.88	235	77.70
236	75.18	237	73.19	238	70.00	239	70.00	240	70.00
241	70.00	242	70.00	243	90.64	244	89.98	245	89.28
246	88.54	247	88.30	248	88.12	249	88.00	250	87.89
251	87.68	252	86.83	253	85.75	254	84.28	255	82.59
256	80.78	257	78.93	258	77.90	259	76.83	260	75.21
261	73.43	262	72.06	263	70.00	264	67.11	265	65.47
266	83.58	267	81.37	268	79.24	269	77.27	270	75.55
271	74.70	272	73.83	273	72.62	274	71.41	275	70.59
276	70.00	277	66.60	278	64.27	279	61.63	280	78.69
281	76.04	282	73.76	283	71.93	284	71.12	285	70.31
286	69.33	287	68.53	288	68.18	289	70.00		

TAP-A OUTPUT DATA (Cont'd)

TEMPERATURE PREDICTIONS FOR END OF APRIL, 1979
1 KW OPERATION

APRIL 1979 1 KW								
	.336E+08	.358E+08	.216E+05	.500E-02	-.300E+01	.500E+02	.300E+04	
1	5043.	0.	.6500E+02	0.	0.	0.	0.	0.
1	5045.	0.	.6500E+02	0.	0.	0.	0.	0.
1	5047.	0.	.6500E+02	0.	0.	0.	0.	0.
12	111.	117.	.6401E-03	0.	0.	0.	0.	0.
12	243.	250.	.1516E-03	0.	0.	0.	0.	0.
25	0.	0.	.1000E+01	0.	0.	0.	0.	0.

APRIL 1979 1 KW

RNAL TEMPERATURES AT		.358E+08 SECONDS							
NODE	TEMP	NODE	TEMP	NODE	TEMP	NODE	TEMP	NODE	TEMP
1	387.77	2	509.21	3	497.01	4	487.56	5	486.65
6	496.42	7	502.27	8	492.80	9	454.35	10	436.78
11	363.16	12	456.02	13	446.93	14	439.33	15	439.32
16	448.69	17	453.78	18	444.16	19	407.94	20	392.42
21	290.34	22	334.33	23	334.26	24	331.89	25	333.98
26	341.41	27	344.02	28	335.23	29	308.06	30	293.99
31	183.19	32	178.56	33	170.94	34	164.22	35	155.89
36	193.34	37	220.77	38	230.18	39	233.51	40	237.53
41	242.13	42	241.86	43	234.92	44	220.04	45	203.56
46	161.51	47	164.34	48	167.01	49	171.04	50	173.75
51	144.47	52	155.33	53	135.74	54	135.97	55	136.46
56	137.50	57	127.74	58	127.12	59	127.45	60	129.25
61	131.50	62	145.90	63	163.00	64	169.94	65	176.34
66	181.14	67	179.12	68	172.05	69	161.30	70	147.60
71	127.76	72	112.95	73	105.59	74	106.50	75	107.36
76	108.19	77	108.74	78	84.80	79	104.36	80	123.54
81	84.71	82	104.24	83	123.31	84	84.53	85	103.99
86	122.83	87	84.27	88	103.63	89	121.95	90	83.97
91	103.20	92	120.53	93	79.07	94	78.81	95	78.31
96	77.52	97	76.46	98	75.70	99	83.82	100	102.99
101	120.05	102	74.00	103	74.02	104	74.08	105	74.27
106	74.85	107	75.15	108	80.35	109	98.74	110	116.70
111	68.93	112	69.20	113	69.75	114	70.67	115	72.05
116	73.42	117	69.21	118	74.63	119	76.95	120	94.57
121	112.71	122	76.00	123	92.94	124	109.69	125	119.08
126	121.88	127	125.50	128	137.75	129	151.77	130	158.55
131	165.30	132	170.33	133	167.85	134	160.89	135	151.27
136	139.18	137	123.41	138	109.92	139	104.46	140	74.33
141	89.23	142	102.99	143	110.98	144	115.87	145	125.08
146	134.87	147	140.67	148	145.11	149	147.87	150	146.79
151	142.62	152	135.89	153	126.67	154	116.65	155	103.60
156	96.69	157	97.24	158	97.67	159	87.57	160	87.89
161	80.69	162	80.78	163	75.07	164	85.88	165	96.47
166	104.99	167	109.80	168	117.36	169	124.78	170	129.15
171	131.24	172	131.90	173	131.97	174	129.79	175	124.75
176	117.78	177	109.81	178	100.79	179	95.92	180	87.07
181	80.54	182	74.74	183	80.86	184	87.25	185	92.47
186	97.90	187	103.16	188	108.40	189	111.63	190	113.88
191	114.69	192	114.66	193	113.23	194	110.07	195	105.77
196	102.05	197	95.41	198	86.18	199	80.28	200	77.85
201	77.91	202	73.67	203	79.01	204	84.97	205	90.34
206	93.44	207	94.12	208	92.47	209	91.05	210	89.78
211	83.52	212	79.33	213	77.43	214	70.76	215	72.00
216	73.60	217	75.60	218	77.33	219	78.41	220	78.59
221	78.10	222	77.25	223	77.39	224	76.85	225	76.35
226	69.77	227	69.67	228	69.87	229	70.71	230	71.87
231	73.00	232	73.81	233	74.05	234	74.27	235	74.78
236	75.17	237	75.31	238	70.00	239	70.00	240	70.00
241	70.00	242	70.00	243	71.55	244	71.23	245	70.80
246	70.15	247	69.93	248	69.77	249	69.66	250	69.54
251	69.08	252	68.02	253	67.24	254	67.22	255	67.93
256	69.02	257	70.20	258	70.83	259	71.49	260	72.50
261	73.53	262	74.20	263	70.00	264	68.57	265	66.81
266	65.30	267	64.61	268	64.89	269	65.82	270	67.07
271	67.84	272	68.67	273	70.00	274	71.48	275	72.57
276	70.00	277	68.05	278	65.59	279	63.29	280	61.82
281	61.47	282	61.97	283	62.97	284	63.68	285	64.46
286	65.83	287	67.46	288	68.80	289	70.00		

TAP-A OUTPUT DATA (Cont'd)

TEMPERATURE PREDICTIONS FOR END OF AUGUST, 1979 2 KW OPERATION

AUGUST 1979 2 KW									
	.442E+08	.468E+08	.216E+05	.500E-02	-.300E+01	.500E+02	.300E+04		
1	5043.	0.	.8800E+02	0.	0.	0.	0.	0.	0.
1	5045.	0.	.8800E+02	0.	0.	0.	0.	0.	0.
1	5047.	0.	.8800E+02	0.	0.	0.	0.	0.	0.
12	111.	117.	.6764E-03	0.	0.	0.	0.	0.	0.
12	243.	250.	.1602E-03	0.	0.	0.	0.	0.	0.
25	0.	0.	.1000E+01	0.	0.	0.	0.	0.	0.

AUGUST 1979 2 KW

INITIAL TEMPERATURES AT .468E+08 SECONDS

MODE	TEMP	MODE	TEMP	MODE	TEMP	MODE	TEMP	MODE	TEMP
1	608.48	2	755.44	3	751.57	4	746.03	5	746.18
6	754.65	7	754.07	8	740.42	9	715.78	10	741.26
11	580.32	12	693.44	13	694.86	14	692.14	15	693.08
16	700.31	17	698.39	18	684.61	19	660.59	20	682.74
21	494.10	22	550.31	23	567.13	24	572.07	25	575.22
26	579.39	27	573.71	28	558.93	29	535.36	30	540.72
31	351.13	32	341.86	33	326.24	34	312.87	35	296.47
36	361.25	37	414.95	38	448.51	39	461.47	40	466.95
41	468.08	42	458.40	43	442.23	44	418.54	45	395.23
46	297.04	47	303.91	48	311.19	49	323.03	50	330.74
51	274.84	52	295.38	53	260.27	54	260.33	55	260.72
56	261.97	57	243.21	58	242.79	59	246.13	60	262.35
61	282.78	62	334.21	63	383.54	64	401.83	65	408.92
66	408.46	67	394.95	68	377.17	69	351.64	70	314.98
71	246.57	72	198.65	73	167.84	74	170.66	75	173.39
76	176.05	77	177.81	78	132.72	79	182.34	80	230.45
81	132.44	82	181.98	83	229.92	84	131.90	85	181.30
86	228.83	87	131.14	88	180.30	89	226.97	90	130.24
91	179.08	92	224.12	93	117.85	94	117.14	95	115.77
96	113.65	97	110.82	98	108.79	99	129.76	100	178.42
101	223.11	102	104.37	103	104.41	104	104.56	105	105.04
106	106.55	107	107.27	108	120.64	109	166.68	110	216.57
111	90.87	112	91.58	113	93.03	114	95.47	115	99.11
116	102.77	117	92.20	118	105.79	119	111.63	120	155.10
121	208.40	122	109.13	123	149.45	124	202.96	125	231.69
126	248.33	127	271.78	128	319.56	129	361.68	130	379.46
131	386.48	132	385.75	133	371.00	134	354.11	135	329.94
136	294.26	137	235.77	138	189.12	139	164.58	140	104.63
141	135.34	142	177.16	143	211.74	144	238.47	145	278.40
146	310.18	147	325.52	148	332.11	149	331.32	150	319.20
151	304.59	152	283.64	153	252.47	154	211.83	155	160.86
156	134.97	157	137.38	158	139.19	159	109.07	160	109.96
161	88.86	162	89.08	163	103.39	164	124.85	165	147.16
166	177.44	167	207.88	168	239.73	169	263.15	170	274.84
171	279.86	172	278.58	173	269.85	174	257.59	175	239.00
176	211.97	177	179.83	178	147.10	179	132.08	180	107.80
181	88.57	182	99.85	183	112.17	184	124.26	185	133.81
186	152.40	187	171.71	188	187.90	189	195.39	190	199.63
191	199.69	192	197.06	193	190.48	194	178.59	195	163.14
196	148.10	197	130.52	198	105.62	199	88.07	200	79.89
201	79.97	202	96.69	203	107.90	204	119.19	205	130.50
206	135.04	207	133.98	208	126.48	209	121.39	210	116.76
211	99.52	212	86.19	213	79.16	214	91.17	215	95.09
216	99.04	217	102.21	218	103.15	219	101.71	220	97.93
221	94.55	222	90.32	223	86.73	224	81.38	225	77.34
226	89.39	227	90.90	228	92.32	229	93.13	230	92.80
231	91.28	232	88.70	233	86.78	234	84.71	235	81.86
236	78.43	237	75.73	238	70.00	239	70.00	240	70.00
241	70.00	242	70.00	243	93.76	244	91.81	245	90.11
246	88.89	247	88.50	248	88.23	249	88.04	250	87.89
251	88.15	252	87.95	253	87.58	254	86.77	255	85.54
256	83.92	257	82.04	258	80.90	259	79.70	260	77.83
261	75.72	262	74.08	263	70.00	264	67.30	265	65.93
266	84.31	267	82.36	268	80.42	269	78.57	270	76.89
271	76.05	272	75.19	273	73.97	274	72.73	275	71.89
276	70.00	277	86.61	278	84.27	279	81.61	280	78.63
281	75.89	282	73.53	283	71.60	284	70.74	285	69.87
286	68.81	287	67.92	288	67.52	289	70.00		

TAP-A OUTPUT DATA (Cont'd)

TEMPERATURE PREDICTIONS FOR END OF FEBRUARY, 1979 2 KW OPERATION

FEBRUARY 1980 2 KW									
	.600E+08	.626E+08	.216E+05	.500E-02	-.300E+01	.500E+02	.300E+04		
1	5043.	0.	.5000E+02	0.	0.	0.	0.	0.	0.
1	5045.	0.	.5000E+02	0.	0.	0.	0.	0.	0.
1	5047.	0.	.5000E+02	0.	0.	0.	0.	0.	0.
12	111.	117.	.4210E-03	0.	0.	0.	0.	0.	0.
12	243.	250.	.9970E-04	0.	0.	0.	0.	0.	0.
25	0.	0.	.1000E+01	0.	0.	0.	0.	0.	0.

FEBRUARY 1980 2 KW

NAL TEMPERATURES AT .626E+08 SECONDS

NODE	TEMP	NODE	TEMP	NODE	TEMP	NODE	TEMP	NODE	TEMP
1	579.60	2	728.94	3	725.39	4	722.76	5	726.07
6	737.27	7	739.17	8	727.61	9	704.98	10	731.74
11	550.72	12	665.68	13	667.56	14	668.10	15	672.54
16	682.81	17	683.62	18	672.13	19	650.25	20	673.86
21	460.66	22	516.59	23	535.14	24	544.79	25	552.64
26	560.81	27	558.63	28	546.73	29	525.83	30	533.27
31	313.20	32	304.00	33	288.60	34	275.43	35	259.14
36	321.02	37	373.48	38	410.70	39	430.20	40	441.77
41	447.96	42	442.62	43	430.01	44	409.56	45	389.15
46	294.61	47	301.53	48	308.64	49	320.19	50	327.69
51	235.88	52	257.97	53	219.88	54	219.98	55	220.66
56	221.79	57	201.58	58	200.25	59	202.48	60	215.90
61	231.85	62	282.51	63	339.17	64	346.37	65	360.95
66	386.46	67	378.02	68	364.42	69	342.76	70	309.77
71	245.01	72	199.41	73	170.46	74	173.29	75	175.99
76	178.60	77	180.31	78	97.41	79	145.26	80	191.02
81	97.12	82	144.89	83	190.40	84	96.61	85	144.20
86	189.15	87	95.87	88	143.20	89	187.04	90	95.00
91	142.00	92	183.82	93	82.58	94	81.86	95	80.49
96	78.35	97	75.50	98	73.45	99	94.54	100	141.33
101	182.60	102	68.67	103	68.74	104	68.93	105	69.51
106	71.13	107	72.03	108	85.60	109	130.22	110	174.09
111	54.69	112	55.46	113	57.02	114	59.64	115	63.51
116	67.36	117	56.49	118	70.66	119	76.78	120	119.24
121	163.88	122	74.40	123	114.83	124	155.86	125	182.22
126	200.24	127	220.38	128	267.48	129	317.90	130	344.84
131	359.33	132	364.52	133	354.82	134	342.01	135	321.64
136	289.57	137	234.43	138	190.25	139	167.00	140	70.37
141	104.63	142	137.38	143	160.34	144	184.70	145	223.70
146	267.44	147	292.81	148	306.84	149	311.79	150	304.52
151	293.74	152	276.43	153	248.66	154	210.76	155	163.03
156	137.49	157	140.01	158	141.95	159	113.18	160	114.09
161	94.97	162	95.19	163	69.03	164	95.04	165	119.88
166	135.12	167	152.09	168	179.63	169	224.30	170	245.55
171	257.47	172	261.34	173	257.07	174	248.25	175	233.16
176	209.18	177	179.32	178	148.79	179	134.10	180	111.84
181	94.64	182	65.09	183	80.75	184	96.53	185	108.07
186	119.96	187	133.26	188	154.72	189	170.06	190	180.54
191	184.61	192	186.21	193	182.35	194	173.86	195	160.75
196	147.59	197	131.89	198	109.54	199	94.06	200	86.65
201	86.76	202	61.91	203	78.25	204	95.24	205	109.62
206	120.30	207	125.24	208	122.90	209	120.18	210	117.87
211	103.19	212	91.97	213	85.79	214	55.61	215	63.86
216	72.83	217	81.80	218	88.71	219	92.88	220	93.88
221	92.67	222	90.60	223	89.78	224	86.69	225	83.60
226	53.62	227	59.22	228	65.51	229	72.27	230	77.93
231	81.97	232	84.13	233	84.38	234	84.50	235	84.39
236	83.26	237	81.58	238	70.00	239	70.00	240	70.00
241	70.00	242	70.00	243	57.18	244	54.86	245	52.43
246	51.00	247	50.54	248	50.22	249	49.99	250	49.78
251	52.22	252	55.94	253	60.31	254	65.41	255	70.11
256	74.01	257	76.84	258	77.88	259	78.89	260	79.77
261	80.01	262	79.45	263	70.00	264	51.22	265	53.57
266	56.50	267	60.29	268	64.16	269	67.74	270	70.73
271	72.06	272	73.40	273	74.97	274	76.14	275	76.45
276	70.00	277	50.26	278	51.31	279	52.82	280	55.18
281	57.95	282	60.77	283	63.35	284	64.61	285	65.90
286	67.60	287	69.15	288	70.02	289	70.00		