CorSTAR

A TEKNEKRON INDUSTRIES AFFILIATE

November 22, 1985

NRC FIN B6985

WM-RES
WM Record File
B6985
CorStar

WM Project 10, 11, 16
Docket No.
PDR ✓
LPDR (B, H, S)

Distribution:
Brooks
x Stin
(Return to WM, 623-SS)

x
Joan-ticket

of

Pauline Brooks, Project Officer
Division of Waste Management
MS 623 SS
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Contract No. NRC-02-81-026
Benchmarking of Computer Codes and Licensing Assistance
Monthly Letter Progress Report for August 1985

Dear Pauline:

This letter contains a management level summary of progress during the month of October. Also enclosed is a Technical Status Summary further describing work performed during this period.

Task 3 - Benchmark Problem Report - Waste Package Codes

There was no significant activity on this code area during the month. We are still waiting for formal reciept of NRC's comments on this report. The report has been revised using preliminary comments received from the NRC in the spring.

Tasks 4 & 5 - Siting Codes

There was no significant activity on this code area during the month.

Tasks 4 & 5 - Radiological Assessment Codes

There was no significant activity on this code area during the month.

Tasks 4 & 5 - Repository Design Codes

During the month, Problem 2.10 was attempted with ADINAT. As with the previous COYOTE attempt, this problem was not run successfully. The difficulties seem to occur as a result of the inability of ADINAT (and COYOTE) to correctly model radiation conditions to multiple surfaces. Instead, the code seems only to be able to model the radiation from a surface to a sink or source at a uniform fixed temperature.

CORPORATE SYSTEMS, TECHNOLOGIES, AND RESOURCES
2121 ALLSTON WAY • BERKELEY, CALIFORNIA 94704 • (415) 548-4100

BERKELEY WASHINGTON, D.C. INCLINE VILLAGE

2607

Problem 3.5 was set-up and attempted with the ADINA code. This problem, however, has not run successfully. Similar to the VISCOT code, ADINA does not seem to properly model the Von Mises yield criteria. In addition, the use of the Drucker-Prager yield criteria also produces questionable results. Uncertainty associated with the analytical solution, as discussed in previous reports, also hinders our progress.

The ADINAT code was used to run Problem 6.3 (BWIP). A comparison of the field measured temperature results with those from ADINAT for various locations and times are in the Technical Status Summary.

Problem 6.3 (BWIP) was set-up for use with ADINA. As previously feared, this problem would not run due to the small core memory restrictions required for the compilation of the ADINA code. We are considering available alternatives including making the finite element mesh coarser, and thus reducing the number of nodes and elements used; breaking the elements up into multiple groups in order to reduce the storage space required per group, attempting revisions to the ADINA code to increase the available memory storage, or using the ADINA code on a larger machine mentioned in earlier conversations. The first two options listed above will be attempted first.

On October 5, CorSTAR met with Dr. Krishan Wahi (SAI-Albuquerque), Dr. Mike Gross (SAI-San Leandro), and Mr. Barry Dial (SAI-San Leandro) in SAI's San Leandro Office to discuss STEALTH benchmarking. Arrangements were made to obtain a STEALTH source tape containing the version of the code that SAI is using for DOE-funded work.

Two benchmark problem substitutions were proposed for STEALTH. It was recommended that problem 2.9 replace problem 2.10 as extensive modifications would be required to run problem 2.10. It was recommended that problem 2.4 replace problem 2.6. Problem 2.6 requires analysis of a bar with anisotropic thermal conductivity. While STEALTH can be used to analyze this problem, the code's developers felt that in general STEALTH should not be used for analysis of materials with anisotropic thermal conductivity.

General

On October 3, 1985 CorSTAR and Acres met in Buffalo to review the status of work on Tasks 4 & 5 of the Repository Design Codes. During the meeting, Acres advised us that due to the lengthy delay in obtaining the codes ADINA and ADINAT they were considerably behind schedule and will require additional funds to complete the benchmarking of the repository design codes.

The codes ADINA and ADINAT were to be obtained by the NRC. When we prepared our proposal for this work, we anticipated that these codes would be available by September 1984 to allow us time to benchmark the codes and document the results in a report to be submitted to the NRC in November 1984. Work on these tasks was scheduled to be completed in March 1985. The potential problem with the availability of the ADINA codes was identified in the progress

report dated July 15, 1984. It was not until June 10, 1985 that a useable version of ADINAT was made available (see monthly progress report for June 1985 dated July 15, 1985). During September 1985, a potentially useable version of ADINA was available (see monthly progress report for September dated October 10, 1985).

Our estimate of costs through the end of October (through October 12, 1985 for CorSTAR) is:

Actual costs this month:	29K
Actual costs this fiscal year:	29K
Actual costs to date:	3,224K
Planned costs this fiscal year:	30K
Planned costs this month:	30K

These costs include labor, labor additive, overhead, subcontractor costs, other direct costs, G&A and fee. These costs have not been confirmed by our accounting department. Attached to this progress report is an estimate of the costs by month for work during the next Fiscal year.

Sincerely,

Douglas K. Vogt
Project Manager

DKV:kg

Enclosures

TECHNICAL STATUS SUMMARY

TECHNICAL STATUS REPORT ATTACHMENT
TO PROGRESS REPORT FOR OCTOBER 1985

Repository Design Codes

Task 4 - Code Procurement

All applicable codes have been procured.

Code Installation

The ADINAT code has been successfully compiled and used to run sample problems supplied by ADINA Engineering and most of our analytical problems. In addition, the ADINA-PLOT code has also been compiled successfully. This code, however, has not yet been tested. Compilation of the ADINA-IN code was attempted. However, due to FORTRAN errors, which seem to be the result of the type of computer systems used at Brcokhaven and not necessarily due to computer code errors, further debugging is required. Finally, the ADINA code was successfully compiled and run. The compilation difficulties previously encountered were corrected last month with the help of Mr. Lee Ho of ADINA Engineering. The correction entailed decreasing the amount of memory storage space called out internally within the ADINA code. The memory storage variable, MTOT was reduced from 25000 to 20000. This solution, however, may result in storage problems in the running of the large hypothetical and field validation problems.

The lengthy installation delay of these codes has caused us to fall considerably behind schedule in meeting the proposed deadline date of March 15, 1985.

General Information

Our meeting with you in our Buffalo office on October 3, 1985, was very beneficial. The minutes of this meeting which included the problems discussed along with the comments and recommendations suggested were sent to you previously in a letter dated October 8, 1985. A copy of the letter along with the meeting minutes are included later in the report.

In a phone conversation on November 1, 1985, Pauline Brooks of the NRC, called to review some general information of which she assumed we were knowledgeable. The topics she discussed that we were unaware of, are as follows:

We were informed that Brookhaven will be replacing the final CDC 6600 machine with a CYBER machine some time at the end of this year. No specific date of transfer has been given. It is felt that since the

new CYBER machine is still a CDC machine, no extensive training time is warranted. Some changes in job control and terminal commands are possible. However, information about these changes are not yet available.

We were also informed that the thermal analytical Problem 2.9 is being substituted for Problem 2.10 for the STEALTH and HEATING codes. Since we are having difficulties that have not been resolved in running Problem 2.10 with the COYOTE and ADINAT codes, we should look into substituting Problem 2.9 for Problem 2.10 also. There may be some cost changes resulting from this substitution due to the amount of time already spent in setting up Problem 2.10. In addition, Krishan Wahi has reported some difficulties with the analytical solution for Problem 2.9. This problem will be studied soon.

Pauline Brooks also stated that a general progress meeting that was previously scheduled for November 19, 1985 is now subject to change. We informed her that we were unaware of any plans for a progress meeting. No further information was available.

Run Benchmark Problems

During the month, Problem 2.10 was attempted with ADINAT. Similar to a previous COYOTE attempt, this problem was not run successfully. The difficulties seem to occur as a result of the inability of ADINAT (and COYOTE) to correctly model radiation conditions to multiple surfaces. Instead, the code seems only to be able to model the radiation of a surface to or from a radiation sink or source and not other surfaces. As discussed previously, Problem 2.9 may be substituted for Problem 2.10, if approved.

Problem 3.5 was set-up and attempted with the ADINA code. This problem, however, has not run successfully. Similar to the VISCOT code attempt, ADINA does not seem to properly model the Von Mises yield criteria. In addition, the use of the Drucker-Prager yield criteria also produces questionable results. The additional uncertainty of the analytical results, as discussed in previous progress reports, also hinders our progress. We are still attempting to find a viable solution for this problem.

The ADINAT code was used to run Problem 6.3 (BWIP). A comparison of ADINAT results with field measured results are included at the end of the report. The temperature history results at a point offset 0.40m from the mid-heater, vertical temperature profiles at day 259, and the radial temperature profiles at days 260 and 350 all show the ADINAT temperature results to be larger than the field measured results. This trend was also exhibited in the previous COYOTE and DOT result comparisons. The modification of the convection heat transfer properties, to account for possible errors resulting from the axisymmetric model assumption, resulted in only a small difference in the ADINAT temperature results.

Finally this month, Problem 6.3 (BWIP) was set-up for use with ADINA. As previously feared, this problem would not run due to the small core memory restrictions required for the successful compilation of the ADINA code. Possible corrective measures include breaking the single element grouping up into smaller element groups in order to reduce the storage space required per group, making the finite element mesh coarser and thus reducing the number of nodes and elements used, attempting revisions to the ADINA code to increase the available memory storage, or using an ADINA code located on a larger machine as had been mentioned in earlier conversations. The first two options listed above will be attempted before the remaining options are considered.

PROJECT STATUS

C O

TABLE 3

MATRIX OF CODE/PROBLEM COMBINATIONS*
(Revised 2/21/85)

Legend:

x Benchmark Problems by Acres.
0 Benchmark Problems by Teknekron.
(1) Requires 2 runs, one for MATLOC and one for VISCOT.
(2) Two-Dimensional Analysis.
(3) Requires 3 runs, one for MATLOC and two for VISCOT.
(4) Requires 2 runs, one for Salt and one for Basalt.
S - Problems run for Salt.
B - Problems run for Basalt.

	ADINA - 3D	ADINAT - 3D	DOT	HEATING	MATLOC	SPECTROM 11	SPECTROM 41	VISCOT	COYOTE	SALT 4	STEALTH
2.0 THERMAL ANALYSIS CASE PROBLEMS											
2.6 Transient Temperature Analysis of an Infinite Rectangular Bar With Anisotropic Conductivity (Schneider, 1955, pp. 261)		(2)	x	0					x		0
2.8 Transient Temperature Response to the Quench of an Infinite Slab With a Temperature-Dependent Convection Coefficient (Kreith, 1958, pp. 161)		(2)		0					x		0
2.10 Steady Radiation Analysis of a Infinite Rectangular Opening (Rohsenow and Hartnett, 1973, pp. 15-32)		x		0					x		0
3.0 GEOMECHANICAL ANALYTICAL PROBLEMS											
3.2 Circular Tunnel (Long Cylindrical Hole in An Infinite Medium) a) Unlined in elastic medium - biaxial stress field					x						
b) Unlined in plastic medium (Tresca) von Mises	(2)							x			0
3.3 Thick-Walled Cylinder Subjected to Internal and/or External Pressure c) Plane strain - creep	(2)							x			
3.5 Plane Strain Compression of an Elastic-Plastic Material von Mises; Drucker, Prager	(2)							x			0
5.0 HYPOTHETICAL REPOSITORY DESIGN PROBLEMS											
5.1 Hypothetical Very Near Field Problem	x	x	S,B	0	B			S,B	S	S	
5.2 Hypothetical Near Field Problem			(3)		x			(4)	x	x	0
5.3 Hypothetical Far Field Problem	(2)	(2)								x	0
6.0 FIELD VALIDATION PROBLEMS											
6.1 Project Salt Vault-Thermomechanical Response Simulation Problem	(2)	(2)	x					x		x	0
6.3 In Situ Heater Test-Basalt Waste Isolation Project	(2)	(2)	(1)		x			x	x		0

* From NUREG/CR-3636, Benchmark Problems for Repository Design Models, February 1984.

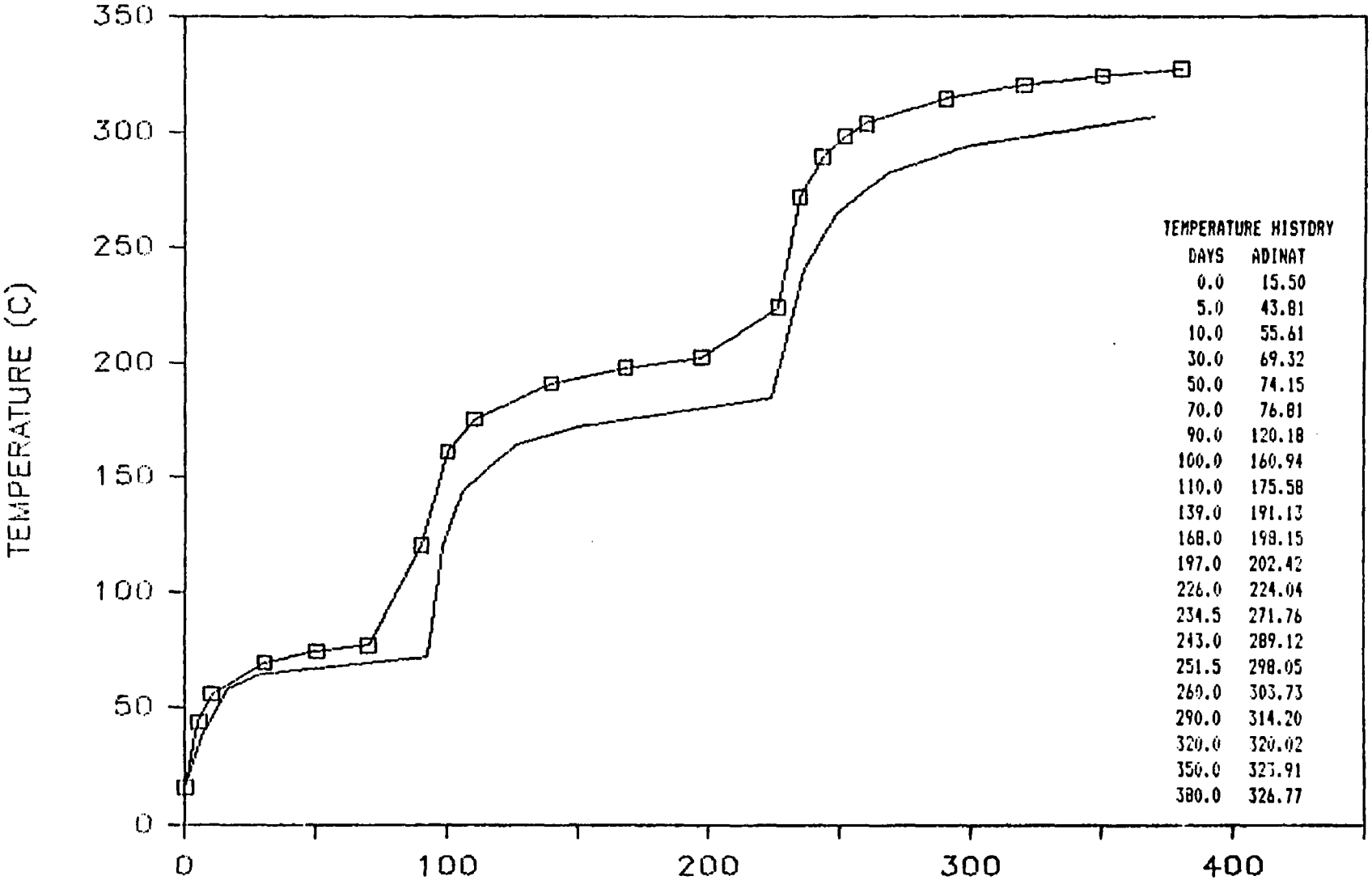
Problems completed

Problems attempted, results not analyzed

Problems attempted, difficulties encountered

ADINAT PROBLEM 6.3 — BWIP

TEMPERATURE HISTORY



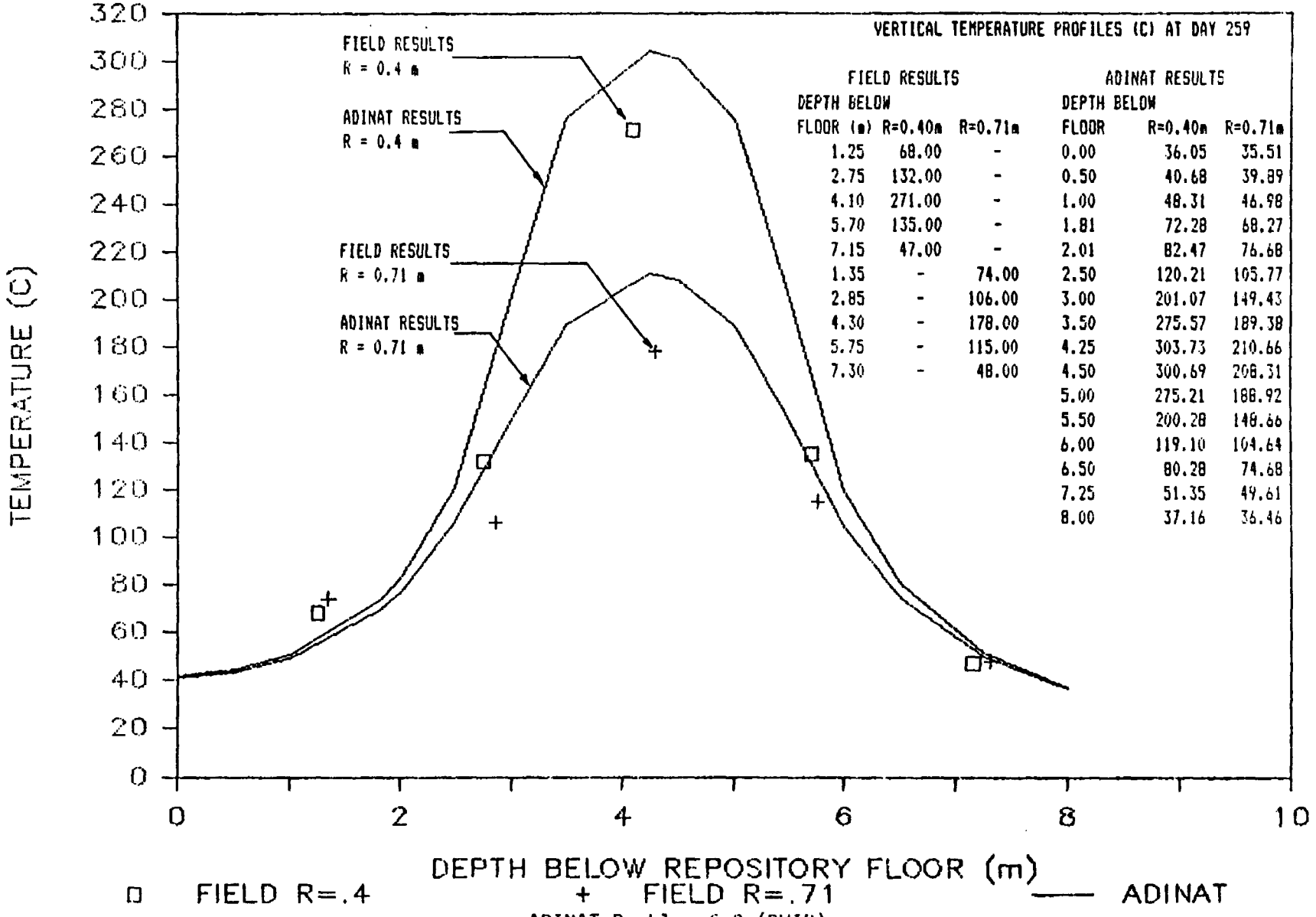
TEMPERATURE HISTORY

DAYS	ADINAT
0.0	15.50
5.0	43.81
10.0	55.61
30.0	69.32
50.0	74.15
70.0	76.81
90.0	120.18
100.0	160.94
110.0	175.58
139.0	191.13
168.0	198.15
197.0	202.42
226.0	224.04
234.5	271.76
243.0	289.12
251.5	298.05
260.0	303.73
290.0	314.20
320.0	320.02
350.0	323.91
380.0	326.77

ADINAT Problem 6.3 (BWIP)
Temperature History

ADINAT PROBLEM 6.3 — BWIP

VERTICAL TEMPERATURE PROFILES @ DAY 259



VERTICAL TEMPERATURE PROFILES (C) AT DAY 259

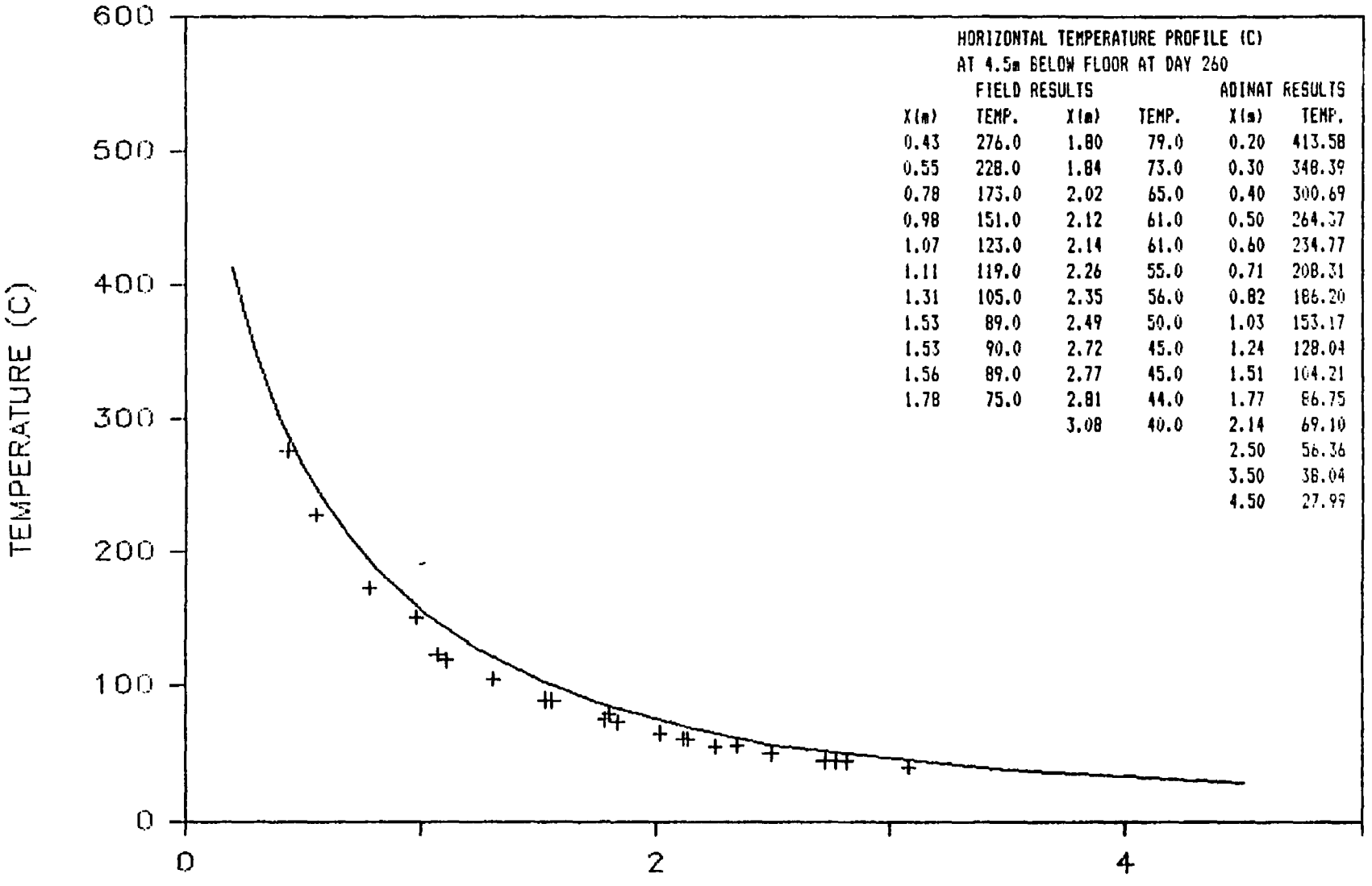
FIELD RESULTS DEPTH BELOW FLOOR (m)	R=0.40m	R=0.71m
1.25	68.00	-
2.75	132.00	-
4.10	271.00	-
5.70	135.00	-
7.15	47.00	-
1.35	-	74.00
2.85	-	106.00
4.30	-	178.00
5.75	-	115.00
7.30	-	48.00

ADINAT RESULTS DEPTH BELOW FLOOR	R=0.40m	R=0.71m
0.00	36.05	35.51
0.50	40.68	39.89
1.00	48.31	46.98
1.81	72.28	68.27
2.01	82.47	76.68
2.50	120.21	105.77
3.00	201.07	149.43
3.50	275.57	189.38
4.25	303.73	210.66
4.50	300.69	208.31
5.00	275.21	188.92
5.50	200.28	148.66
6.00	119.10	104.64
6.50	80.28	74.68
7.25	51.35	49.61
8.00	37.16	36.46

ADINAT Problem 6.3 (BWIP)
Vertical Temperature Profiles
on Day 259

ADINAT PROBLEM 6.3 — BWIP

RADIAL TEMPERATURES ON DAY 260



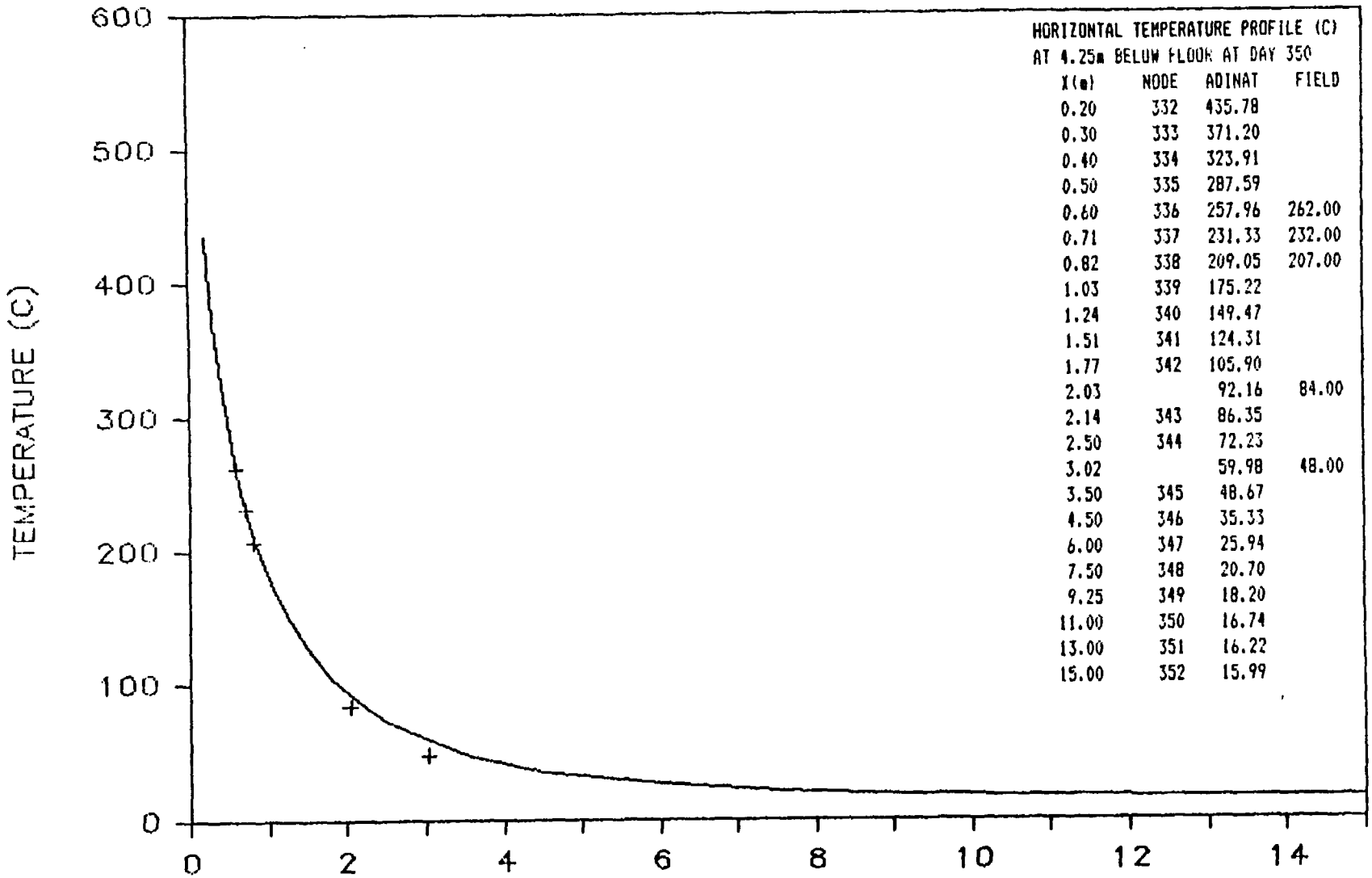
HORIZONTAL TEMPERATURE PROFILE (C)
AT 4.5m BELOW FLOOR AT DAY 260

FIELD RESULTS				ADINAT RESULTS	
X(m)	TEMP.	X(m)	TEMP.	X(m)	TEMP.
0.43	276.0	1.80	79.0	0.20	413.58
0.55	228.0	1.84	73.0	0.30	348.39
0.78	173.0	2.02	65.0	0.40	300.69
0.98	151.0	2.12	61.0	0.50	264.37
1.07	123.0	2.14	61.0	0.60	234.77
1.11	119.0	2.26	55.0	0.71	208.31
1.31	105.0	2.35	56.0	0.82	186.20
1.53	89.0	2.49	50.0	1.03	153.17
1.53	90.0	2.72	45.0	1.24	128.04
1.56	89.0	2.77	45.0	1.51	104.21
1.78	75.0	2.81	44.0	1.77	86.75
		3.08	40.0	2.14	69.10
				2.50	56.36
				3.50	38.04
				4.50	27.99

ADINAT Problem 6.3 (BWIP)
Radial Temperature Profile on
Day 260 at 4.5m Depth Below
Repository Floor

ADINAT PROBLEM 6.3 — BWIP

RADIAL TEMPERATURE PROFILE ON DAY 350



HORIZONTAL TEMPERATURE PROFILE (C)
AT 4.25m BELOW FLOOR AT DAY 350

X(m)	NODE	ADINAT	FIELD
0.20	332	435.78	
0.30	333	371.20	
0.40	334	323.91	
0.50	335	287.59	
0.60	336	257.96	262.00
0.71	337	231.33	232.00
0.82	338	209.05	207.00
1.03	339	175.22	
1.24	340	149.47	
1.51	341	124.31	
1.77	342	105.90	
2.03		92.16	84.00
2.14	343	86.35	
2.50	344	72.23	
3.02		59.98	48.00
3.50	345	48.67	
4.50	346	35.33	
6.00	347	25.94	
7.50	348	20.70	
9.25	349	18.20	
11.00	350	16.74	
13.00	351	16.22	
15.00	352	15.99	

ADINAT Problem 6.3 (BWIP)
Radial Temperature Profile on
Day 350 at 4.25m Depth Below
Repository Floor

Estimated Costs by Month for Fiscal Year 1986

Month	Monthly Costs	Commulative Costs
10/85	30K	30K
11/85	40K	70K
12/85	40K	110K
1/86	50K	160K
2/86	50K	210K
3/86	50K	260K
4/86	50K	310K
5/86	50K	360K
6/86	40K	400K
7/86	35K	435K
8/86	30K	465K
9/86	30K	495K