Aerojet Nuclear Company

Interoffice Correspondence

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J. F. Kunze
UPD

RESERVOIR ENGINEERING SEMINAR - SALT LAKE CITY - 5/21/76 - WCK-4-76

Because of time limitations at the SLC Reservoir Engineering Seminar, the ANC Thermal Analysis Branch reservoir engineering effort was not discussed. This effort has resulted in the development of a computer code to predict the long term pressure response of the Raft River Geothermal Reservoir and the long term temperature response of each of the wells. This computer code uses a modified heat-transfer code (SINDA-3G) which employs a finite-difference solution scheme.

Currently the code is able to match, with reasonable success, the test data taken at Raft River wells 1 & 2 using aquifer properties that are virtually unchanged from those determined by Dr. Paul Witherspoon. However, aquifer size and boundary locations are not known at this time thus making input boundary conditions to the computer code somewhat of a guessing game. Since the computer code now uses a very large aquifer model (8 miles X 10 miles), the boundary conditions have not as yet caused problems in matching the test data since test data is not of long enough duration to show significant effects from boundaries. Computer code predictions for times greater than 2 months will need accurate definition of aquifer boundaries.

Figures 1A-1E show the test data taken during the long term flow test of 9/75 to 10/75 and the corresponding computer predictions. Figure 1A is the actual flow rate for the flow test while a constant 415 gpm flow rate (not shown) was used for the computer predictions. The test data shown in Figure 1D was corrected to remove the sinusoidal tidal effects by taking only those data points approximately mid-way between the peaks and troughs. Figures 2A-2C show the test data for the pump test conducted during the early part of 1976 along with the computer predictions of this test. For this test prediction a constant 900 gpm flow rate was used in the computer model. Instrumentation on this test was not accurate enough to detect noticeable tidal effects and therefore no alteration of the test data was needed. Figure 3 shows a typical computer predicted well head temperature response curve resulting from flow initiation in an initially undisturbed well. This type of curve has no real test data counterpart since undisturbed wells are hard to come by at Raft River. Continuous flow from the wells to supply the various ongoing experiments at Raft River keep the wells relatively hot all the time.

The nature and location of the Raft River Geothermal Reservoir boundaries must be determined if meaningful long term pressure response predictions of the reservoir are to be made with confidence. These boundaries, at least with respect to the first 3 wells, could be found with long term testing of the 3 wells as outlined by Drs. Witherspoon and Narasimhan at the seminar. This would involve flow testing each well at 200 gpm to 400 gpm for approximately one month and monitoring all wells during each test. This type of flow test is essential in defining the reservoir boundaries since geological data alone cannot accurately determine them. Accurate long term reservoir pressure response prediction using the computer code developed by Aerojet's Thermal Analysis Branch is dependent upon the ability to define the boundaries.

WC Kettenacker

W. C. Kettenacker
Thermal Analysis

jr

Attachments: As stated

cc: w/attachments
DGoldman
WCKettenacker
ECLemmon
JLLiebenthal
LGMiller
NEPace
RCStoker
JFWhitbeck
HWCampen
SCohen
WWMadsen

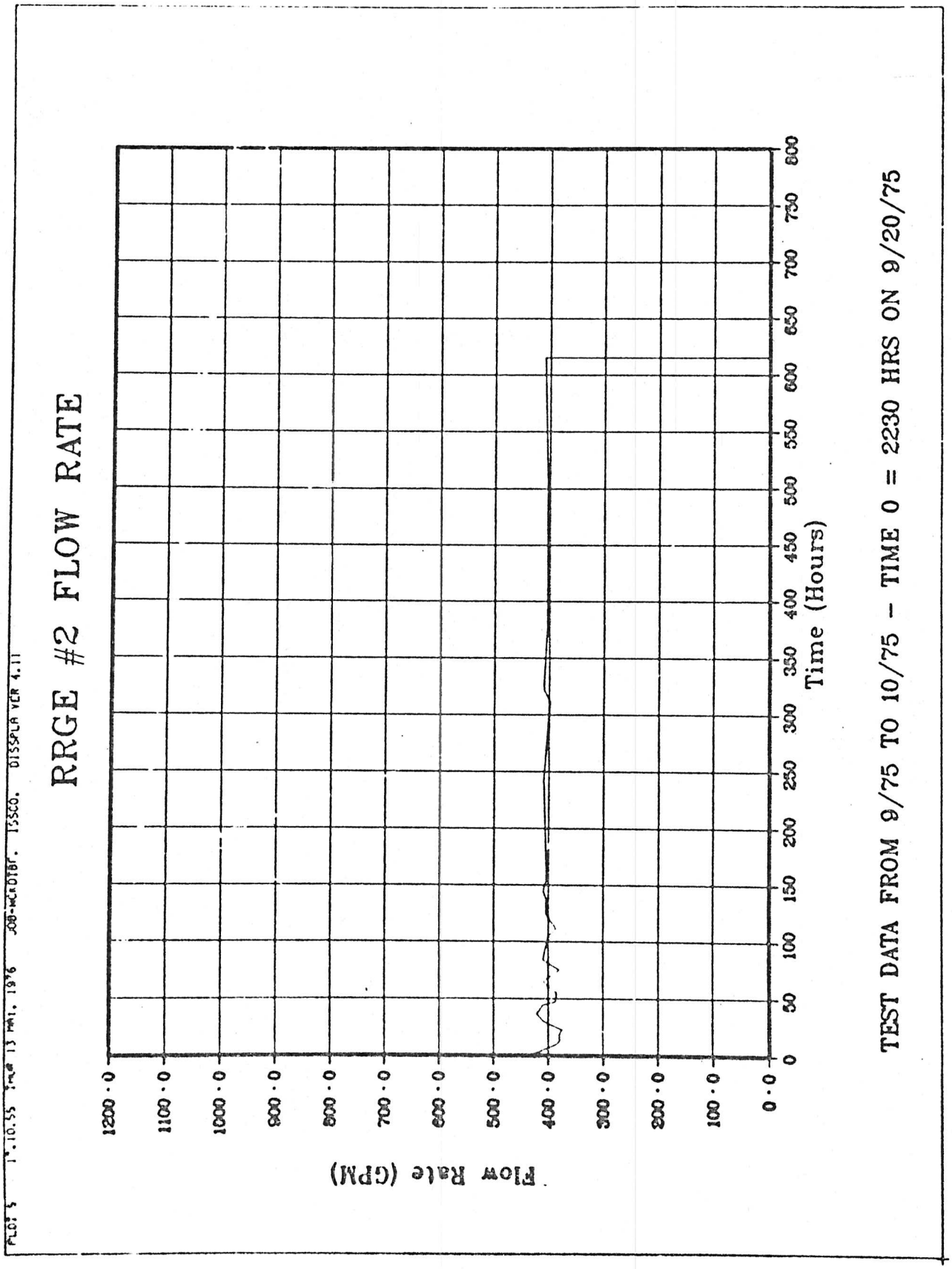

Figure 1A - Test Data Flow Rate from RRGE #2 - Flow Test of 9/75 to 10/75.

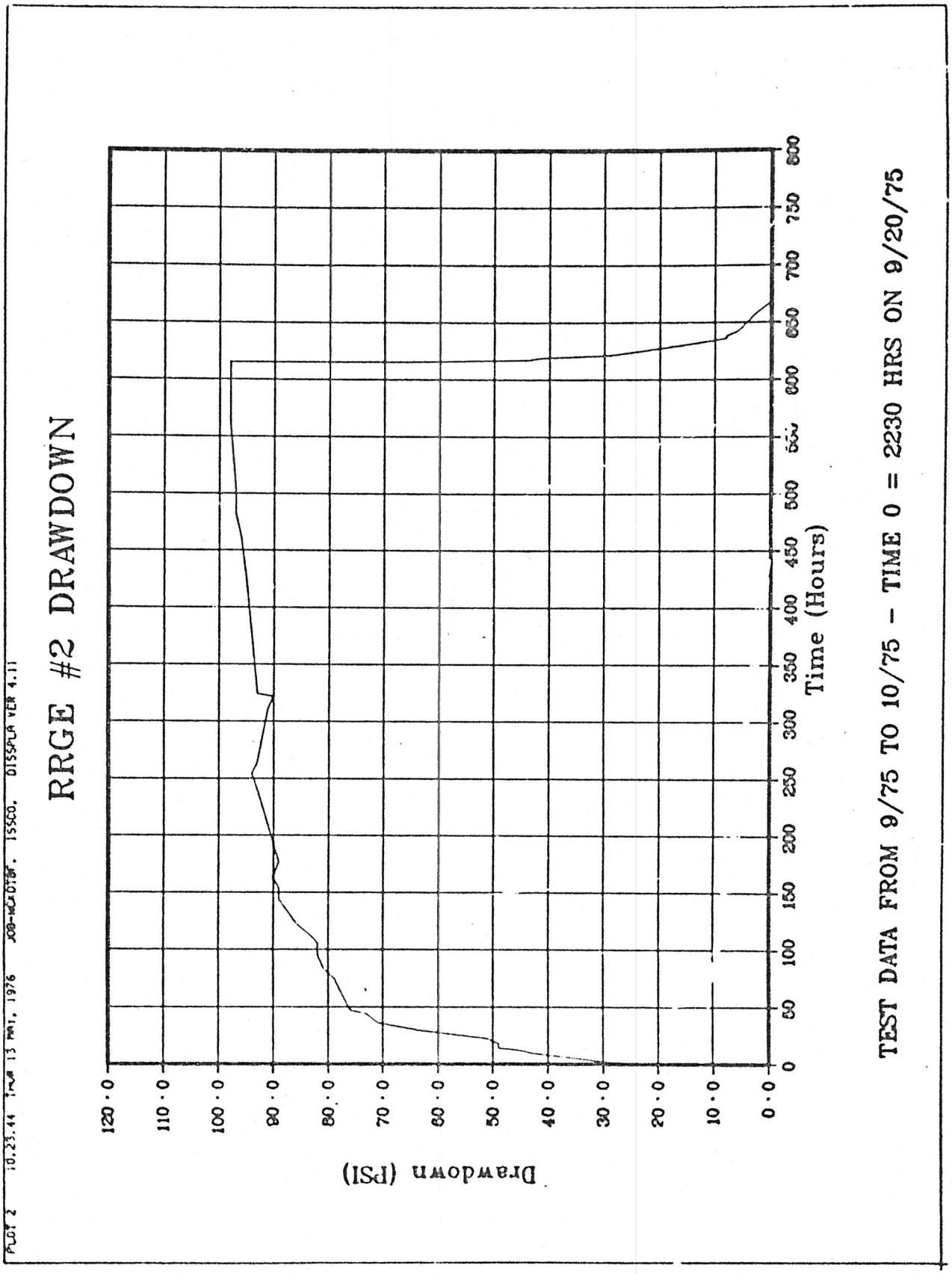

Figure 1B - Test Data Drawdown in RRGE#2 with Flow Rate of Figure 1A.

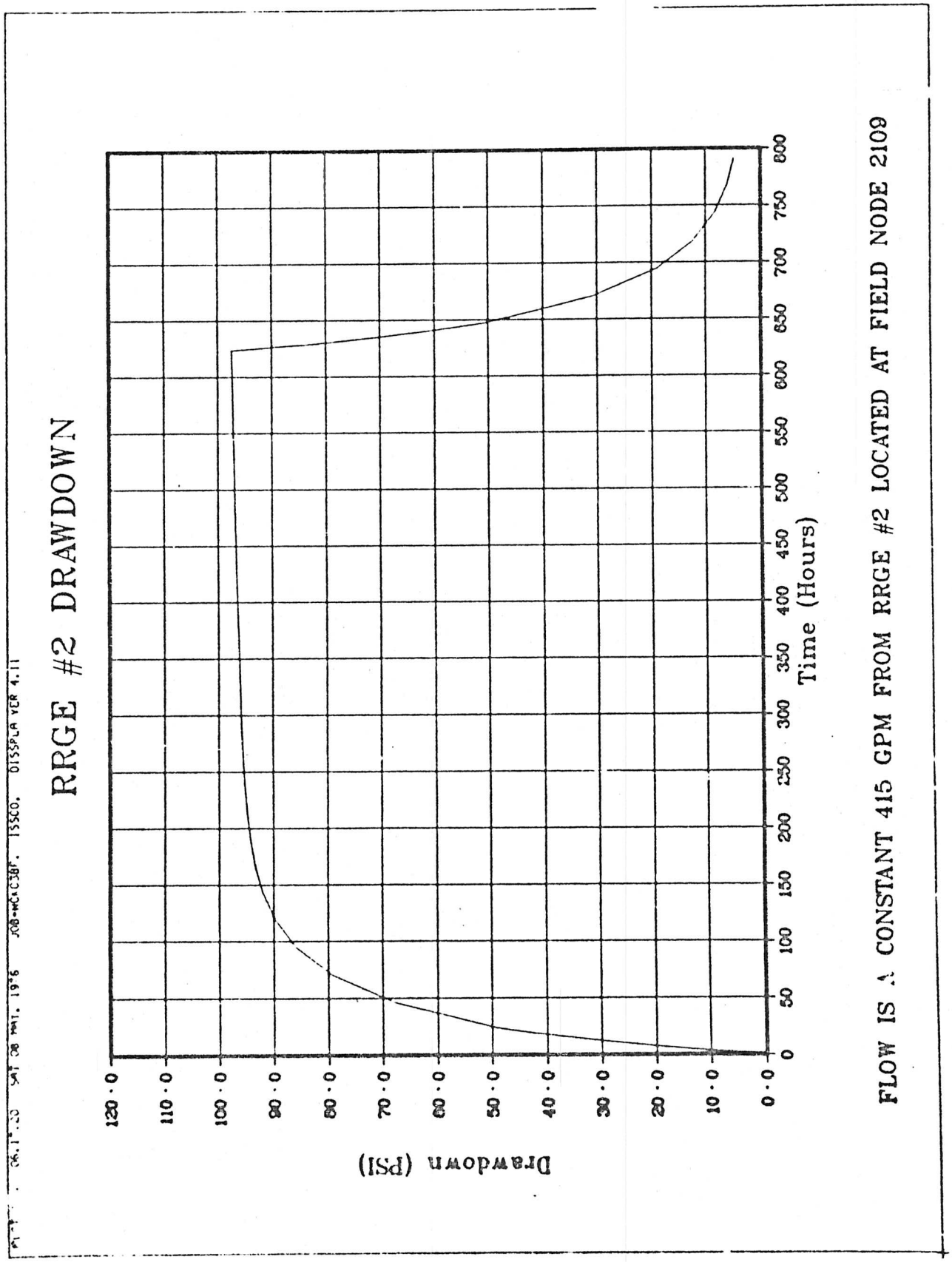

Figure 1C - Computer Predicted Drawdown in RRGE #2 with a 415 GPM Constant Flow Rate.(This graph to match Figure 1B.).

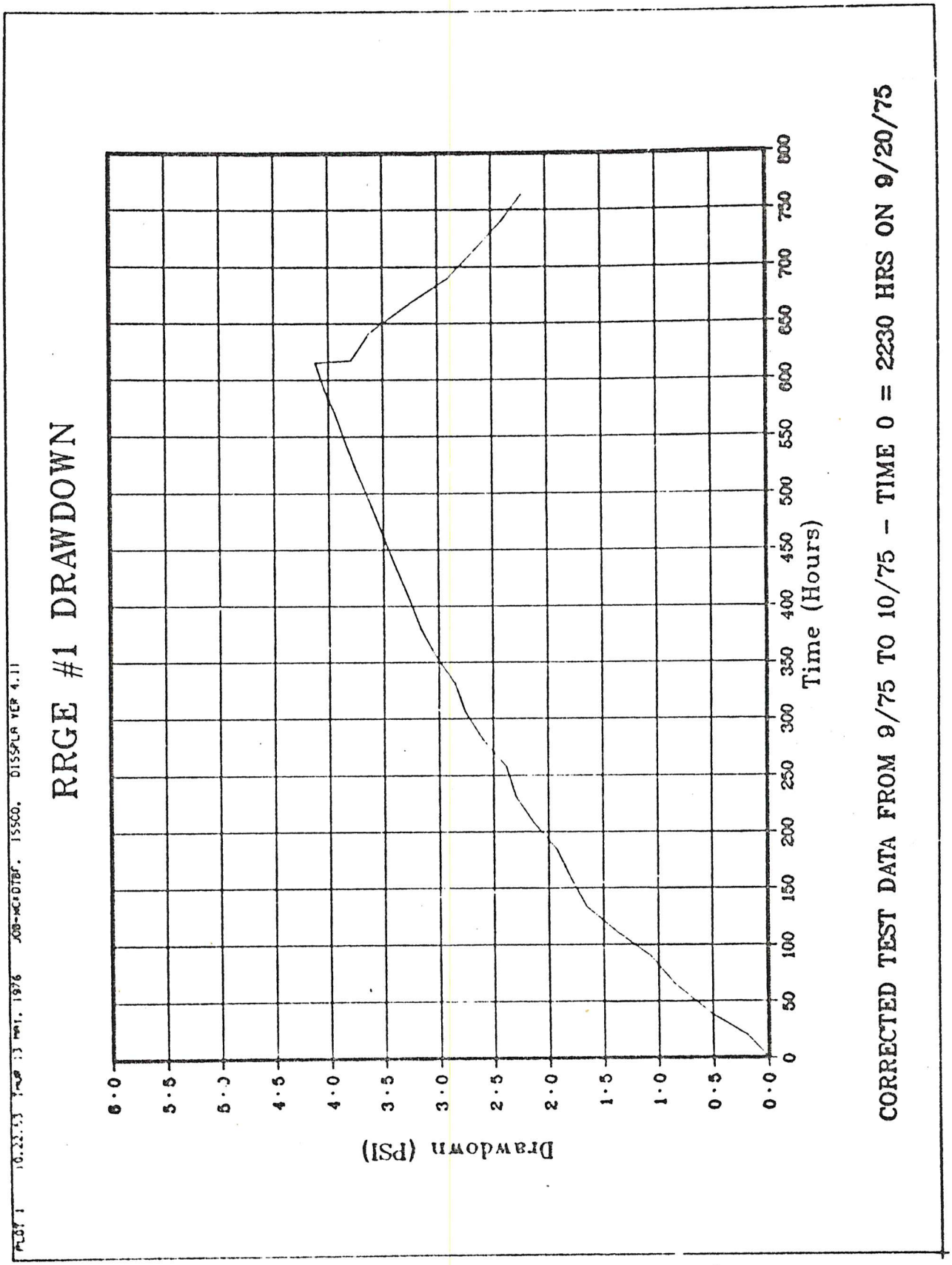

Figure 1D - Test Data Drawdown in RRGE #1 with Flow Rate of Figure 1A in RRGE #2 (Corrected to eliminate tidal effects).

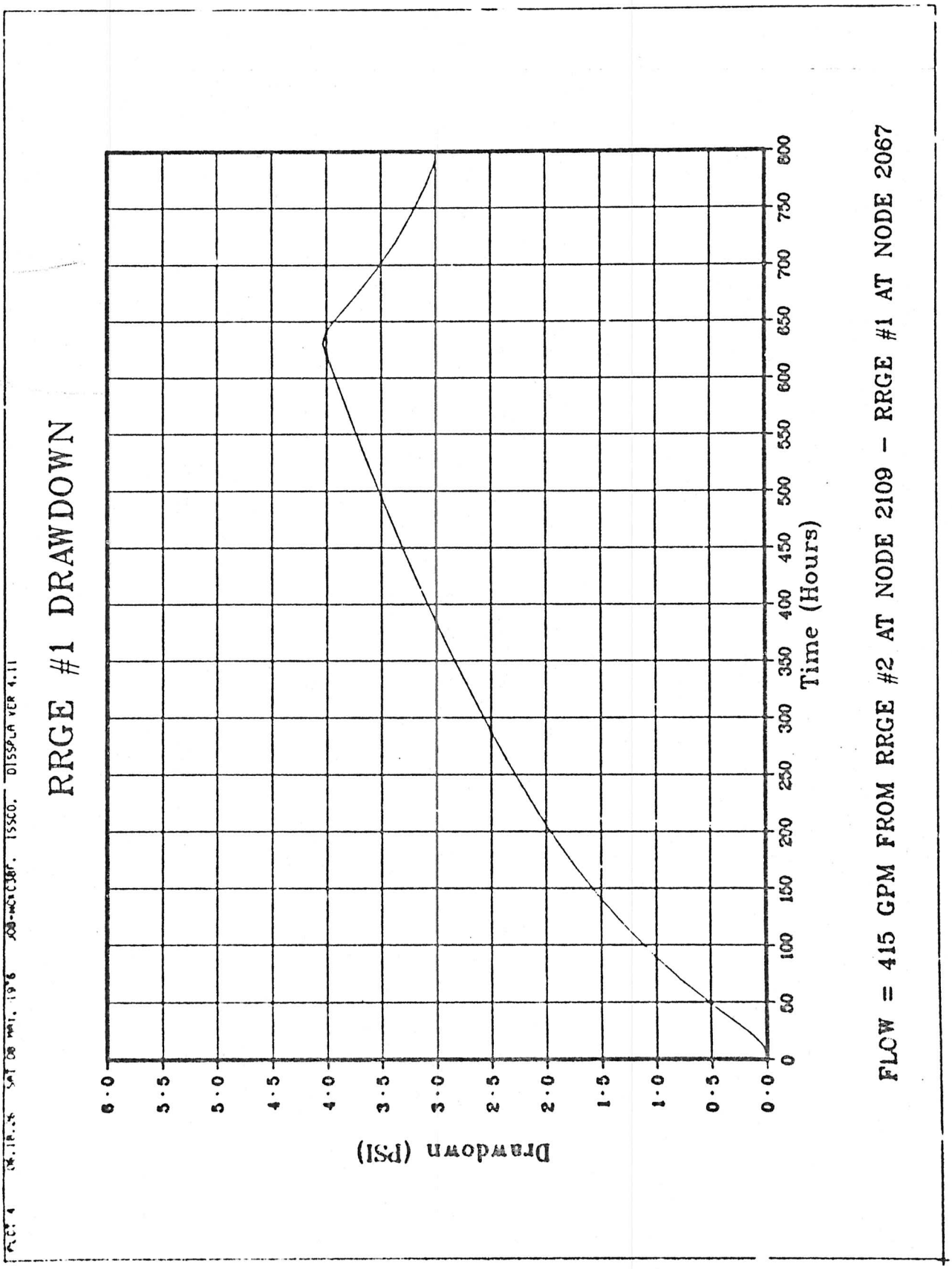

Figure 1E - Computer Predicted Drawdown in RRGE #1 with a 415 GPM Constant Flow Rate in RRGE #2 (This graph to match Figure 1D).

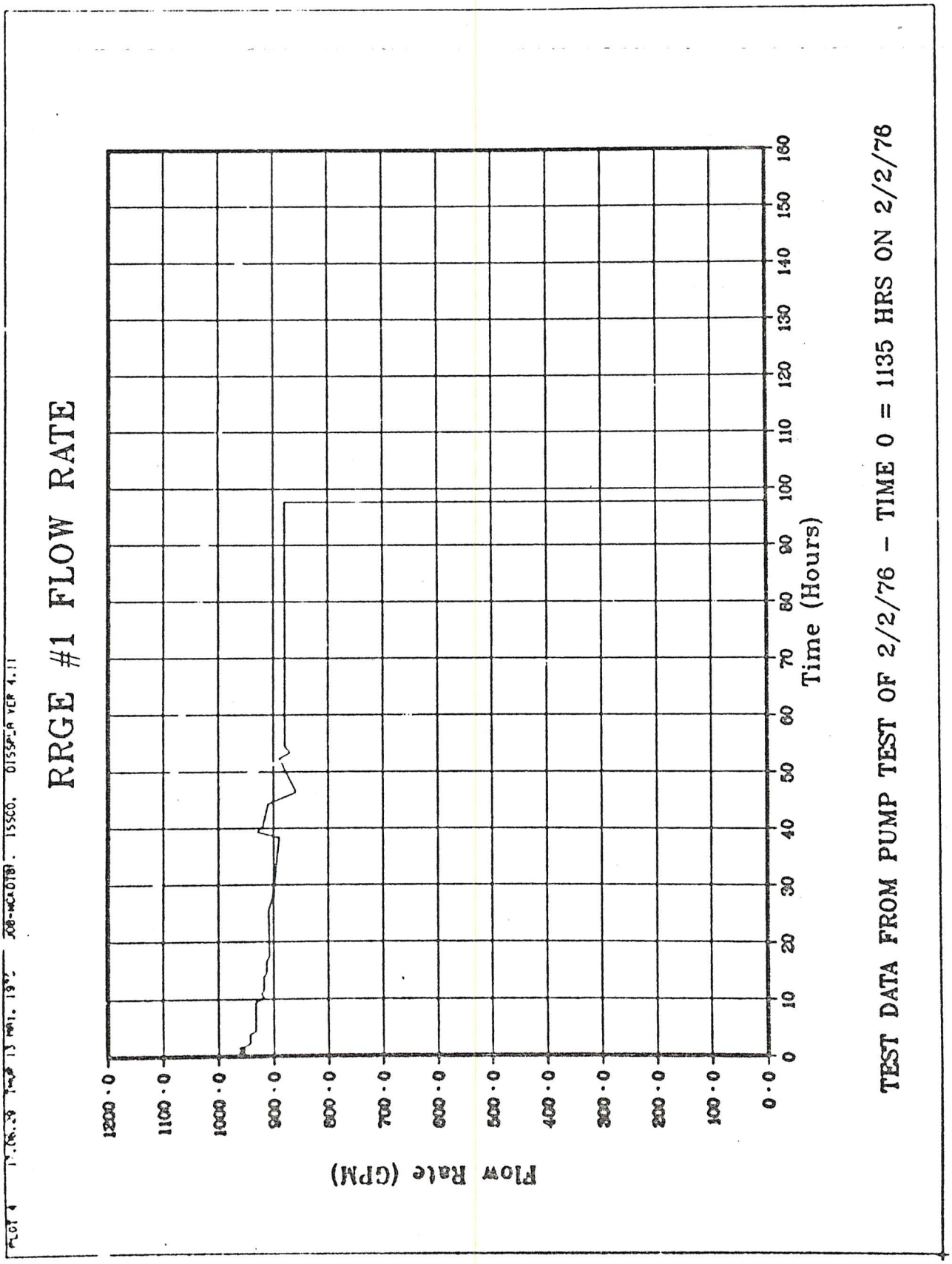

Figure 2A - Test Data Flow Rate in RRGE #1 - Pump Test of 2/76.

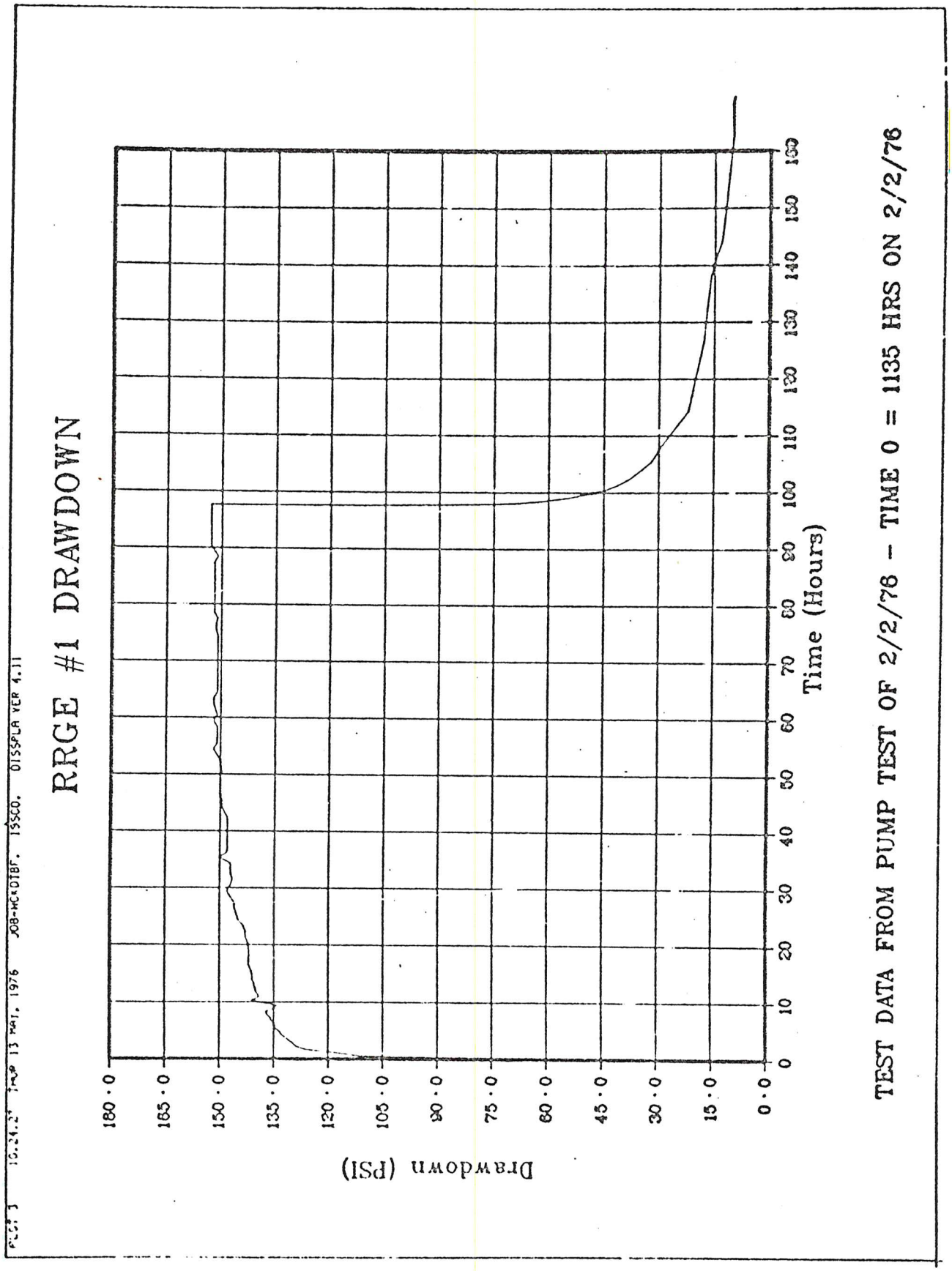

Figure 2B - Test Data Drawdown in RRGE #1 with Flow Rate of Figure 2A.

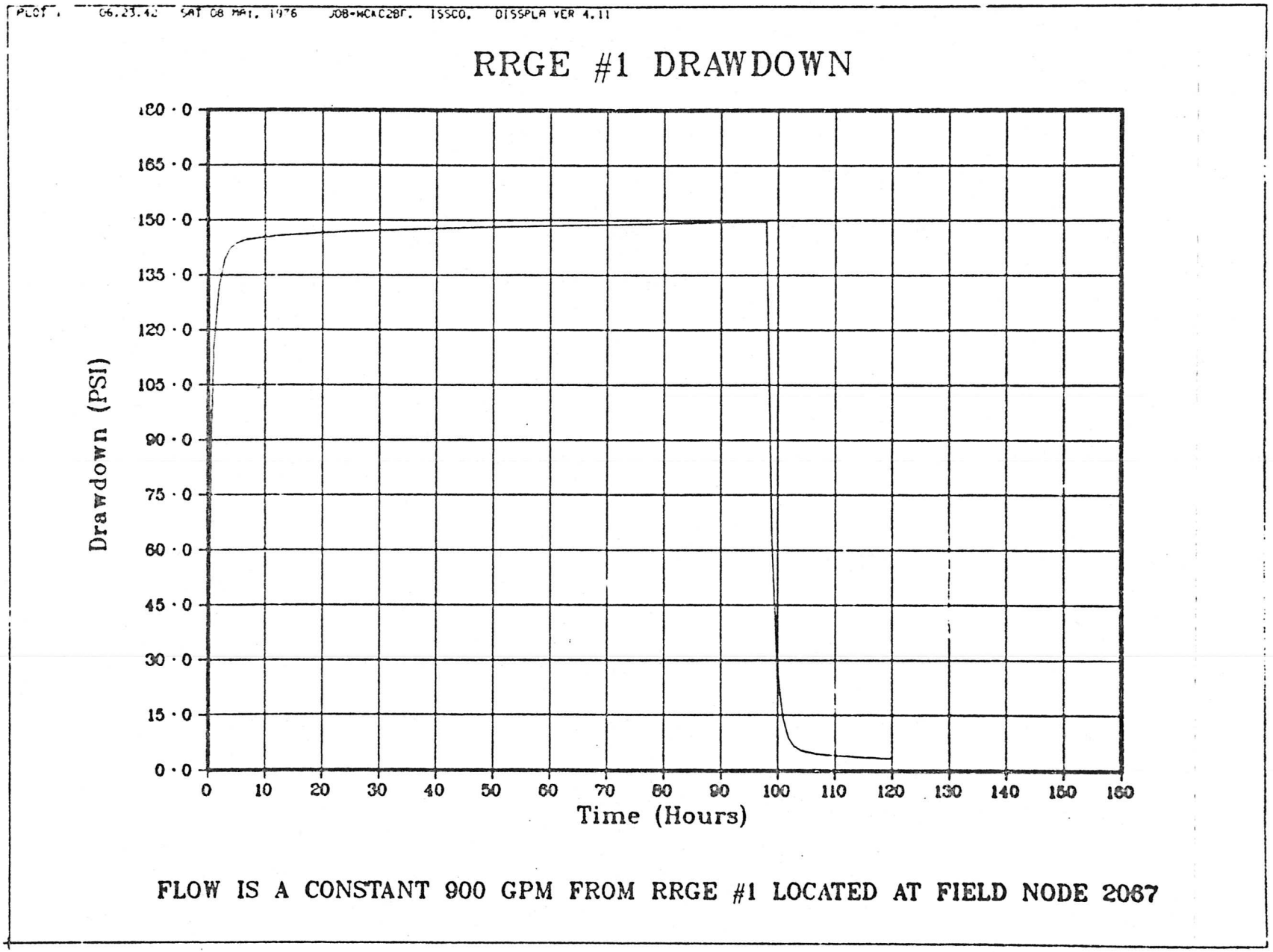

Figure 2C - Computer Predicted Drawdown in RRGE #1 with a 900 GPM Constant Flow Rate (This graph to match Figure 2B).

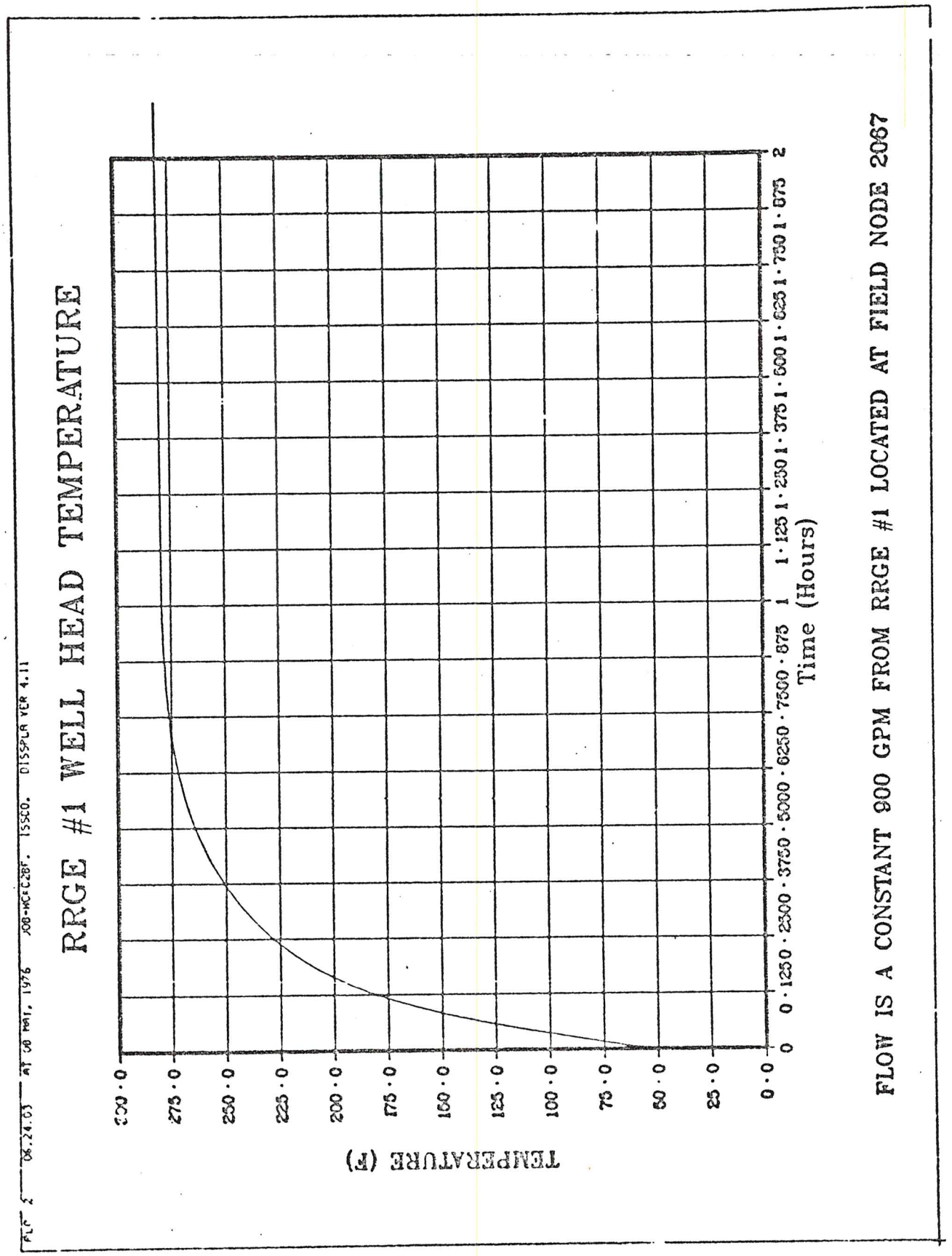

Figure 3 - Computer Predicted Well Head Temperature from Undisturbed Well
(Results taken from computer run to generate Figure 2C).