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ENGINEERING DATA TRANSMITTAL

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Tank Closure Project

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RESULTS OF THE VIDEO CAMERA/CAD MODELING SYSTEM TEST

PA Kabage
CH2M HILL Hanford Group, Inc.
Richland, WA 99352
U.S. Department of Energy Contract DE-AC27-99RL14047

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Key Words: Video, CAD, Volume Measurement Error, CTF

Abstract: This report contains the results of the Video Camera/Computer Aided Design (CAD) Modeling System test performed at the Cold Test Facility (CTF).

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1.0 PURPOSE AND INTRODUCTION

The purpose of this report is to convey the results of the error determination of the Video Camera/CAD Modeling System for tank volume measurement. A test was performed according to test plan; document RPP-17663, Rev. 0. The scope of the test plan was to conduct a test of the Video/CAD Modeling System using simulated tank conditions for the purpose of determining the error in the method. The simulated conditions included both solid waste configurations on the tank floor and a representation of the edge of a pool of liquid waste in the center of the tank. The test plan was divided into three parts:

Part I: Generated videotapes, at the Cold Test Facility (CTF), that simulated post-retrieval tank conditions using known volumes of materials.

Part II: Determined the volume using the Video/CAD Modeling System.

Part III: Compared the calculated values against known values and determined the error.

This report is also divided into three parts to coincide with the test plan.

2.0 PART I: VIDEOTAPE GENERATION AT CTF

2.1 EXCEPTIONS

During performance of the Video Camera/CAD Modeling System test, there were four (4) exceptions recorded. These exceptions do not affect the accuracy of the error determination of the Video Camera/CAD Modeling System. The following provides a summary of the exceptions and their resolutions. Included as Attachments 1 and 2 are the working copies of the Test Plan for the Video Camera/CAD Modeling System, (RPP-17663, Rev. 0), and the Procedure for the Video/CAD Volume Measurement Technique Verification, (RPP-18334, Rev. 0).

2.1.1 Exception 1

Description: Performed steps out of order in Section 2.1 to perform work more efficiently.

Resolution: Added statement "The following steps may be performed in any order." to Section 2.1.

2.1.2 Exception 2

Description: No third stiffener ring to measure to.

Resolution: Third stiffener ring not needed because of the large distance between stiffener rings in C-106 and the small volumes of simulant used in the test.

2.1.3 Exception 3

Description: Section 2.3 steps 37 and 48 camera height adjustment.

Resolution: The order steps 37 and 48 are performed have no impact on the outcome of the test. Changed wording to reflect either height in both steps, as long as both heights are used for making each videotape.

2.1.4 Exception 4

Description: Section 2.3 steps 44, 47, 51 and 54 require turning off and on facility lighting.

Resolution: Tank was dark enough to videotape with only the tank lights off. For safety reasons, facility lighting remained on.

2.2 RESULTS OF PART I

Part I of the test plan was completed successfully with the resolved exceptions from section 2.1 of this document. Simulated waste conditions were setup and three videotapes were made and turned over to the modeler to perform Part II of the test plan.

3.0 PART II: VOLUME ESTIMATION

The volume estimation was performed, by the modeler, as described in the test plan document RPP-17663, Rev. 0, section 7.3. The modeling results of videotapes 1, 2, and 3 are contained in Attachments 3, 4 and 5 respectively.

4.0 PART III: ERROR DETERMINATION

4.1 OBJECTIVE/PURPOSE

The purpose of this section is to calculate the error in the Video Camera/CAD Modeling System technique.

4.2 INPUT DATA

The input data for the error calculation includes: the simulated waste configuration volume estimations; the simulated liquid pools diameter estimations; the simulated waste configuration volume actual measurements; the simulated liquid pools diameter actual measurements. The estimated values can be found in Appendices C, D and E as part of the modeling results of videotapes 1, 2, and 3 respectively. The actual values can be found in the data sheets in Appendix A of this document. All of the actual and estimated values may also be found in Table 1 located in section 4.5.

4.3 METHOD OF ANALYSIS

To determine the error or precision of the total volume or diameter estimates an 80% confidence interval on the mean of the estimated volume/diameter to the actual volume/diameter was calculated. The equation for an 80% confidence interval is:

$$LL(0.10): \hat{\mu} - t_{(df,0.90)} \times \hat{\sigma}(\hat{\mu})$$

$$UL(0.90): \hat{\mu} + t_{(df,0.90)} \times \hat{\sigma}(\hat{\mu}).$$

where LL(0.10) and UL(0.90) are the lower and upper limits of a two-sided 80% confidence interval on the mean. In this equation, the average is $\hat{\mu}$, the standard deviation of the mean is $\hat{\sigma}(\hat{\mu})$, and $t_{(1,0.90)}$ is the 90.0% quantile from Student's t_{df} distribution, where df is degrees of freedom. The degrees of freedom equal the number of observations minus one. The standard deviation of the mean equals the standard deviation divided by the square root of the number of observations.

The confidence interval will give a range of the estimated percentage of actual volume estimated. To calculate the error bound subtract the LL(0.90) from 1. This gives the upper limit (largest) of the percent difference of the estimated volume/diameter to the actual volume/diameter.

4.4 USE OF COMPUTER SOFTWARE

Microsoft Excel was used to perform the statistical analysis. See Appendix F for the spreadsheet verification per procedure TFC-ENG-CHEM-D-33, Rev. A.

4.5 RESULTS

Three (3) videotapes were made at the CTF. Each was set up with different simulated waste configurations to represent waste remaining in a Tank Farm waste tank post-retrieval. Each videotape contained three (3) simulated solid waste configurations and one (1) simulated liquid waste pool edge per the Test Plan. Solid configurations 1 and 3, of each videotape, were located against or near the wall of the tank. In all three of the videotapes, the largest estimation error occurred on simulated solid waste configuration 2. Simulated solid waste configuration 2, of each videotape, was located away from the side of the tank.

The three solid waste configuration volumes, in each videotape, were combined for a total tank solid waste volume. These were combined since the total volume of solid waste in a tank will be based on the sum of the solid waste configuration volume estimations. This resulted in three data points for analysis. The error for solid waste configurations is at most 18% at the 80% confidence level. See Tables 1, 2, and 3 for calculations.

Each videotape contained one simulated liquid pool edge. This resulted in three data points for analysis. The error for simulated liquid pool edges is at most 2% at the 80% confidence level. See Tables 1, 2, and 3 for calculations.

Table 1. Error Determination Calculation.

Video	Configuration	Estimated Volume (ft^3)	Actual Volume (ft^3)
1	1	18.93	17.81
1	2	11.09	17.81
1	3	42.05	41.55
2	1	18.61	17.81
2	2	5.33	11.87
2	3	24.51	29.68
3	1	30.08	30.42
3	2	6.92	14.10
3	3	34.29	32.65

Table 2. Error Determination Calculation for Total Volumes.

Total Volumes / Videos	Estimated (ft^3)	Actual (ft^3)	Ratio (Estimated/Actual)	Error with 80% Confidence	
Video 1	72.07	77.17	0.9339	**Average**	0.8913
Video 2	48.45	59.36	0.8162	**Standard Deviation**	0.0652
Video 3	71.29	77.17	0.9238	**N**	3
				t-value(0.90,2)	1.886
				RHW	0.0710
				LL	**0.8203**
				UL	0.9624

Table 3. Error Determination Calculation for Pool Diameter.

Pool Diameters / Videos	Estimated Diameter (ft)	Actual Diameter (ft)	Ratio (Estimated/Actual)	Error with 80% Confidence	
Video 1	34.38	34.85	0.9864	**Average**	0.9878
Video 2	39.35	40.08	0.9818	**Standard Deviation**	0.0067
Video 3	36.38	36.56	0.9950	**N**	3
				t-value(0.90,2)	1.886
				RHW	0.0073
				LL	**0.9804**
				UL	0.9950

N = Number of data points
RHW =Relative Half Width
LL =Lower Limit
UL =Upper Limit

4.6 CONCLUSION

The error determination of the Video Camera/CAD Modeling System was calculated for solid waste volumes and liquid waste diameters through simulated methods videotaped at CTF. The error rates were calculated using an 80% confidence level. The error in the solid waste volume estimation is 18% for the test condition (solid configurations being placed greater than 19 feet from the camera location, reference Appendix D, page 1 of 6). This error value is less than the estimated 20% error presented in the Tank 241-C-106 Component Closure Action Data Quality Objectives (RPP-13889). The measurement of solid configurations within 19 feet in a 100 series tank (75 feet diameter) would require a second video from a separate location to be within the error value. The error in liquid estimation for the test condition of measuring a pool diameter is 2%.

APPENDIX A
WORKING COPY OF TEST PLAN

WORKING COPY

RPP-18744, Rev. 0

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TEST PLAN FOR THE VIDEO CAMERA/CAD MODELING SYSTEM

PA Kabage
CH2M HILL Hanford Group, Inc.
Richland, WA 99352
U.S. Department of Energy Contract DE-AC27-99RL14047

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Key Words: Video, CAD, Volume Measurement, Test Plan

Abstract: This test plan provides the guidance for determining the accurac y of the Video Camer/Computer Aided Design (CAD) Modeling System.

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TERMS AND ACRONYMS

CAD	Computer Aided Design
CH2M HILL	CH2M-HILL Hanford Group, Inc.
CTF	Cold-Test Facility
DQO	Data Quality Objectives
FERIB	Facility Emergency Response Information Board
JHA	Job Hazards Analysis
MOU	Memorandum of Understanding
MSDS	material safety data sheet
ORP	Office of River Protection
QA	Quality Assurance
QAT	Quality Assurance Technician
RHW	Relative Half Width
RPP	River Protection Project
S&H	Safety and Health
SST	Single Shell Tank
TPA	Tri-Party Agreement
UCL	upper confidence level

TEST PLAN FOR THE VIDEO CAMERA/CAD MODELING SYSTEM

1.0 PURPOSE AND INTRODUCTION

The purpose of this Test Plan is to determine the measurement accuracy of the Video Camera/Computer Aided Design (CAD) Modeling System (Video/CAD System).

The Tri-Party Agreement (TPA) Milestone M-45-00 and TPA Appendix H requirements include that the residual waste volume limits are not to exceed 360 ft^3 (i.e., 10.195 m^3 or 2693 gal) for 100 series SSTs and 30 ft^3 (i.e., 0.850 m^3 or 224 gal) for the 200 series SSTs. During the residual waste characterization DQO process for the SSTs, Ecology stated that the volume determination would use the upper confidence limit (UCL) of the volume measurement system. In other words, TPA compliance is based upon the volume measurement of a given SST plus the measurement error for the volume measurement technique. The tank 241-C-106 Data Quality Objectives (RPP-13889) requires concurrence on this test plan by Ecology, ORP, and CH2M HILL.

The Video/CAD System is the baseline method used to determine the volume of waste in an SST in support of SST retrieval and closure. This technique will be used on both 100 and 200 series SSTs. The Video/CAD System requires videotapes of the post-retrieval residual waste remaining in the tank. As stated in section 8.1 of the tank 241-C-106 DQO, the Video/CAD measurement "residual waste volume measurements are obtained by inserting a video camera into a tank riser and obtaining a videotape of the tank interior. The videotape is used to identify the physical shapes of the waste and to develop a three-dimensional model of the waste surface. The model is developed using a CAD program. The residual waste volume is then estimated using the dimensions and configuration of the tank." The videotapes of the tank interior will not only show tank waste but will also show key in-tank references that can be used to determine waste height and location. Some key in-tank references are: knuckle, stiffener rings, weld joints on the tank bottom, equipment on the floor of the tank such as pipes, and equipment through risers such as thermo-couple trees and pumps. The data gathered from viewing the videotape will be used to build a computer model of each unique waste configuration on the tank bottom. The model will include the configuration height, volume and location in the tank.

The test will consist of making multiple videotapes of simulated post-retrieval tank conditions using known and controlled conditions. The videotapes will then be used to establish a volume using the Video/CAD System. The measured volumes will then be evaluated against the known simulated tank residual waste volumes to establish the UCL of the Video/CAD System.

The field activities covered by this Test Plan will be conducted at the Cold Test Facility (CTF) located in the 600 Area of the Hanford Site. The volume calculation and comparison activities covered by this Test Plan will be conducted in Sigma 1 located on George Washington Way.

This Test Plan has been developed in accordance with HNF-IP-0842, *RPP Administration*, Vol. 4, Sec. 4.28, "Testing Practices Requirements." Additional documents that pertain to this work include:

- Memorandum of Understanding (MOU) between the CTF and the Tank Closure Project.
- RPP-10680, *Hanford Cold Test Facility Management Plan*.
- RPP-13889, *Tank 241-C-106 Component Closure Action Data Quality Objectives*

2.0 SCOPE

The scope of this test plan is to conduct a blind test of the Video/CAD System using simulated tank conditions. The simulated conditions include both solid waste configurations on the tank floor and a representation of the edge of a pool of liquid waste in the center of the tank. The test plan is divided into three parts:

Part I: Generate videotapes that simulate post-retrieval tank conditions using known volumes of materials. (Section 6.0)

Part II: Determine the volume using the Video/CAD System. (Section 7.0)

Part III: Compare the calculated values against the known values and determine the error. (Section 8.0)

Parts I and II will be conducted 'blind,' i.e., the personnel conducting the video/CAD modeling will not know the location of the simulated liquid pool edge or the volume of material used to simulate the post retrieval tank conditions.

3.0 TANK CONDITIONS

3.1 POST RETRIEVAL

Per the TPA and Appendix H, the maximum residual waste volume cannot exceed 360 ft^3 per tank for 100 series tanks and 30 ft^3 per tank for 200 series tanks. The remaining waste in the tanks may consist of liquids and solids. The solids may be various shapes, sizes and in different locations of the tank. Some solids may be up against the side of the tank while others may be free-standing and more centrally located. Liquids remaining in the tank are expected to be in the center of the tank. The pool of waste may also be covering solid waste. The internal tank configuration will be simulated and will include representations of the stiffener rings and tank risers. Debris on the floor of the tank will also be simulated.

3.2 WASTE VOLUME CONFIGURATIONS IN THE 100 SERIES SSTS

To support this test, the final configuration of the post retrieval waste is assumed. Several waste configurations have been considered and the final test configurations for the test are as follows:

- Based on the dished bottom configuration of the SSTs, a flat-topped pool of waste in the center of a SST with a diameter of approximately 45 ft is equal to approximately 360 ft^3. We will simulate the edge of a circular pool of liquid waste by marking an arc on the tank bottom in the available test area of the CTF tank. The known diameter of the arc will be less than 45 ft.

- The expected configuration of solid waste is a series of waste bergs (configurations) located around the tank. We will simulate this condition by setting up three configurations throughout the available test area of the CTF tank. The simulant will consist of sand or gravel.

3.3 CTF COMPARED TO 100 SERIES TANKS

Table 1 compares the configuration of the CTF tank to the 100 series tank.

Table 1. Comparison of 100 series SSTs and CTF.

100 Series SSTs	CTF Tank
Diameter = 75 ft.	Diameter = 75 ft.
Carbon steel construction	Carbon steel construction
Stiffener rings	Tape, grease pen or chalk marking to represent stiffener rings
Dish bottom	Flat bottom
Knuckle	90° angle from tank wall to tank bottom

The stiffener rings can be simulated using markings on the walls of the tank. Equipment and debris in the tanks can be simulated, i.e., use pipe of known diameter on the floor of the tank. In the field (in the tank), it is assumed that debris such as pipe, pumps and other miscellaneous equipment residing on the tank bottom would be available from past surveillance of the tank or existing operating records and will be known to the modeler. The primary differences between the two tanks that are a concern in this test are the lack of a knuckle at CTF and the flat bottom of the CTF tank. For measuring waste bergs, the shape of the knuckle and dished bottom will not affect the video mapping process. To simulate the pool of waste, an arc can be marked (using chalk, grease pen or tape) on the bottom of the tank indicating the edge of the liquid.

Not all of the space in CTF will be available for this test due to other activities in the tank. Since the test will be conducted in approximately 30% of the CTF tank, and the CTF tank is representative of 100 series tanks, no more than 120 ft^3 of waste simulant will be used in the CTF

portion of this test in a single video. Figures 1 and 2 represent the general test configuration in the CTF tank.

Figure 1. Plan View of CTF Tank Setup.

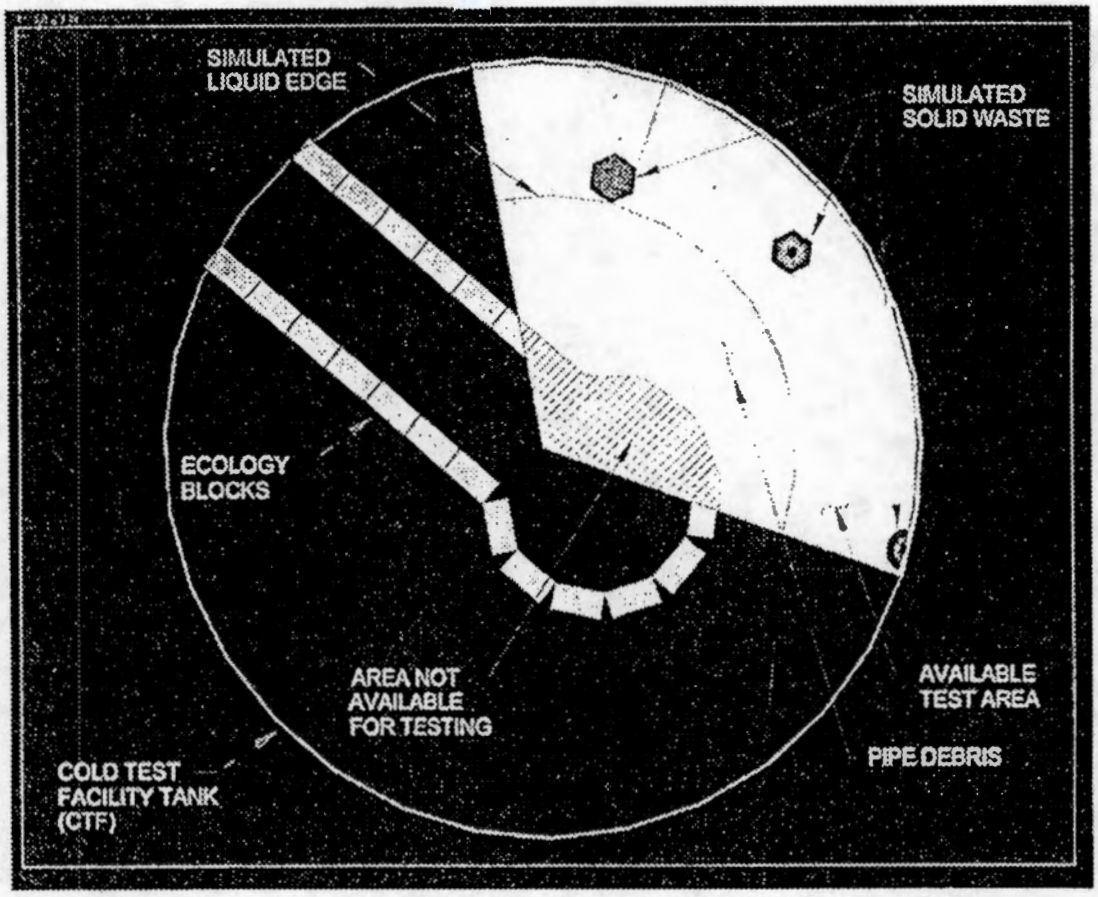
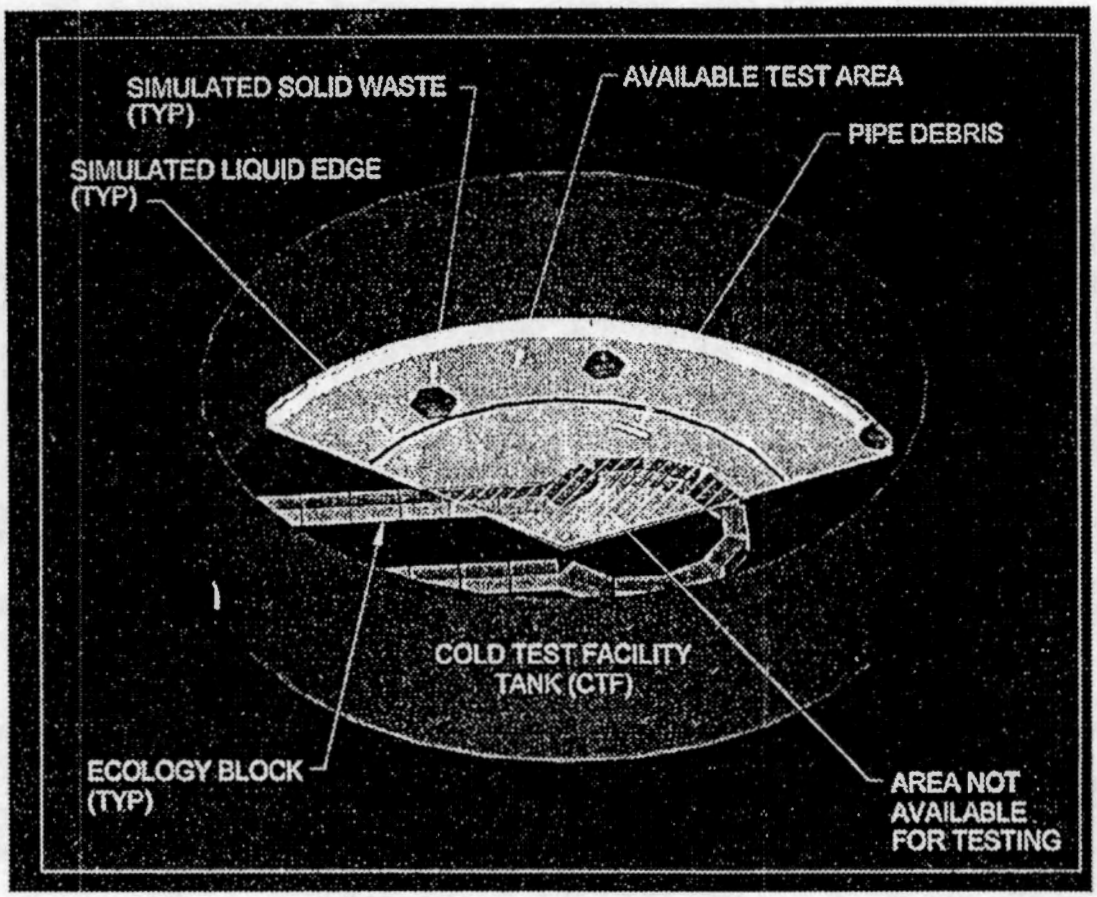


Figure 2. Isometric View of CTF Tank Setup.



4.0 TEST REQUIREMENTS

4.1 PART I: CTF

- Represent the expected tank residual waste configuration
- Represent a liquid pool edge with a diameter of less than 45 feet
- Include in-tank references similar to those in the field
- Maintain integrity of blind test
- Include adequate observations for sound statistical analysis
- Perform video recording at night using the camera light as the only light source

4.2 PART II: VIDEO/CAD

- Part I must be completed
- Maintain integrity of blind test
- Perform modeling using AutoCAD Land Development Desktop Software

4.3 PART III: ERROR DETERMINATION

- Parts I and II must be completed
- Document assumptions
- Document methods to determine residual waste on tank walls and on stiffener rings
- Liquid pool edge relative to the known value
- Results of Parts I and II relative to the known CTF tank residual values

5.0 STATISTICS

5.1.1 Sample Size Determination

If the data consists of two configuration estimates divided by their known volumes, and the standard deviation of the two ratios is 20%, then one is 80% confident that the method can estimate the C-106 volume within 44%. When three observations are obtained, one is 80% confident that the volume is within 22% of the estimate. Table 2 gives the relative half-widths (RHW) for two to five observations. The results are based on the width of an 80% confidence interval as discussed below.

Table 2. Values for Calculating 80% Confidence Intervals.

Number of Observations	Degrees of Freedom	80% Confidence t-value	Relative Half-Width
2	1	3.078	$2.176\hat{\sigma}$
3	2	1.886	$1.089\hat{\sigma}$
4	3	1.638	$0.819\hat{\sigma}$
5	4	1.533	$0.686\hat{\sigma}$

The equation for an 80% confidence interval is:

$$LL(0.1): \hat{\mu} - t_{(df,0.9)} \times \hat{\sigma}(\hat{\mu})$$

$$UL(0.9): \hat{\mu} + t_{(df,0.9)} \times \hat{\sigma}(\hat{\mu}).$$

where LL(0.1) and UL(0.9) are the lower and upper limits of a two-sided 80% confidence interval on the mean. In this equation, the average is $\hat{\mu}$, the standard deviation of the mean is $\hat{\sigma}(\hat{\mu})$, and $t_{(1,0.9)}$ is the 90% quantile from Student's t_{df} distribution with df degrees of freedom. The degrees of freedom equal the number of observations minus one. The standard deviation of the mean equals the standard deviation divided by the square root of the number of observations. The RHW values in Table 2 equal the t-value, divided by the square root of the number of observations, times the standard deviation. The RHW indicates the precision for different sample sizes. Note, for example, that the value for two observations is twice as large as that for three observations. When the sample size is increased to four observations, the RHW decreases further, but the change is much smaller.

We will make three videotapes at the CTF. Each video we will have three waste simulant configurations and one simulated liquid edge. Each configuration will be considered an observation and each simulated liquid edge will be considered an observation. For subsequent videotapes, both the volume and location of the simulated waste configurations and the simulated liquid edge will change.

5.1.2 Number of Videos

In order to test the reproducibility of the method, three videos will be taken. It is best if the number of configurations is the same for each video. Using the same number of configurations will result in a "balanced" data for the statistical analysis. When data is balanced, the interpretation of variance components is improved. Thus three videos, each with three simulated waste configurations and one liquid pool edge, will allow for an adequate analysis of the data.

6.0 TEST PLAN PART I: CTF

This CTF part of the test plan describes how the video tapes of the representative post-retrieval residual waste configurations will be made at the CTF. The video tapes will then be used by CH2M HILL to determine the waste configuration volumes by computer modeling of information shown on the video. The simulated waste conditions will include both simulated waste configurations of various volumes and a simulated edge of a pool of waste in the center of the tank. As identified in Section 5.1.2, a total of three videos will be made of different simulated residual waste configurations.

6.1 TEST SETUP/CONDITIONS AT CTF

This section provides details on the tank setup and conditions for testing. The intent of this test is to replicate post-retrieval in-tank conditions where feasible. This will allow CH2M HILL to provide a video similar to what may be achieved in the field.

6.1.1 General Test Location and Conditions

Various waste configurations could exist in a subject tank. However, because of on-going work at CTF, the test will be conducted in the eastern 30% of the CTF tank that is unoccupied. Since the computer modeler focuses on one waste configuration at a time, using part of the CTF tank will be representative of the entire SST.

The portion of the CTF tank to be used for the test will be cleared of unwanted equipment prior to placement of simulated waste configurations. Portions of the existing centrally located ecology block key-hole shape will be covered prior to video taping to limit existing CTF reference points in the tank. The CTF tank will be set up to simulate expected post-retrieval tank conditions as described in section 3.1.

6.1.2 Blind Test

The test conducted at CTF will be a blind test. The computer modeler will not be knowledgeable of the details of this test plan, will not read or review this test plan nor be permitted to enter the

CTF facility prior to completion of modeling. The test configurations will be decided on the day of the test by the Test Director. The Quality Assurance Technician (QAT) will witness the placement of each configuration and document each test configuration location and volume. Thompson Mechanical personnel will be responsible for setting up each test configuration, including placing the simulant material in the CTF tank, under the direction of the Test Director. The computer modeler will not discuss test configuration details with the Test Director, the QAT or Thompson Mechanical for the duration of the CTF and Video/CAD testing.

6.1.3 Lighting Conditions

In the field, tank lighting is non-existent with the exception of the video camera light. Therefore, the video taping will be performed at night with the camera light as the only light source.

6.1.4 Solid Waste Simulant

One requirement of this test is to determine waste volumes from an in-tank video. Since only the volume is of concern, the type of material used to simulate the waste is not critical to the test. Therefore, either sand or gravel will be used for the test at CTF.

6.1.5 Solid Waste Configuration Volumes

Configurations of the waste simulant in the tank will range in volume from approximately 2.5 to 115 cubic feet. Therefore, sand or gravel piles of various sizes, shapes and known volumes will be staged in the CTF tank. A QAT will observe all volume measurements. These simulated waste configurations are similar to those anticipated in the tank subsequent to retrieval.

6.1.6 Liquid Volumes

The bottom of the tank will be marked to simulate the edge of a circular pool of liquid waste. The diameter of the simulated pool of liquid will be less than 45 ft. A QAT will observe marking of the simulated pool edge. These simulated waste configurations are similar to those anticipated in the tank subsequent to retrieval.

6.1.7 In-tank References

Reference points in the tank will be selected to represent actual field conditions. The following are examples that will be represented in the CTF tank as reference points: stiffener rings, equipment through a riser, debris on the bottom of the tank (a pipe of known diameter). Stiffener rings will be simulated by marking the side of the tank with a grease pen, chalk or tape. Equipment through a riser will be simulated by hanging PVC pipe above the tank so it is near the tank bottom. Debris on the bottom of the tank will be simulated by placing a piece of pipe on the floor of the CTF tank.

After Part I of the test is completed, the Test Director, in the presence of the QAT, will present the video tapes and data packets to the modeler. Attachment 1 contains the sign-off sheet to be signed by the Test Director, the QAT and the modeler as each video tape and data packet is turned over to the modeler. The data packet, for each videotape, will contain the measured locations and heights of the video camera, simulated stiffener rings and diameter of simulated pipe debris. This information will be recorded on Data Sheets 1 and 2 in Attachment 2. Only Data Sheets 1 and 2 will be given to the modeler. CTF tank drawings have been given to the modeler. This information is the same as that available to the modeler from actual tank configuration sources such as drawings, previous measurements and documentation of debris left in subject tank for all 100 and 200 series tanks, including C-106. The modeler will use as-built drawings to obtain information unique to the CTF tank such as the tank diameter and plates and weld joints on the tank bottom. All data gathered at the CTF will be done in the presence of the QAT and be signed-off by both the QAT and the Test Director.

6.1.8 Camera Location

In tank C-106, the camera is expected to be located in Riser 14 which is near the center of the tank. The C-106 Riser 14 camera location is subject to change depending on retrieval activities. Riser 7 is another viable option for camera placement in C-106. Riser 7 is located near the wall of the tank. The farther the camera is from the tank center, the easier it is to estimate the dimensions of waste in a tank. Therefore, we will locate the camera near the center of the CTF tank for this test. The camera height above the CTF tank will be adjustable to 15 and 25 feet above the tank bottom.

6.1.9 Weather Conditions

Since the interest in this test is with waste volumes the simulated waste configurations will be covered, if necessary, to prevent changes to the measured volumes due to wind or rain.

6.1.10 Videos

In the field, video tapes will be taken from two elevations: 15 feet and 25 feet above the tank floor. These distances will be measured in the presence of the QAT and included on the data sheets and signed-off by the QAT and the Test Director. Three videos will be made at CTF. These videos will be viewed by the computer modeler to collect information regarding the size of waste configurations and input this information into the computer model. The modeler will also use the videos to collect information to determine the location of the liquid pool edges.

6.2 DATA COLLECTION

All in-tank references (camera, waste configurations and simulated liquid pool edges) will have their locations and heights measured and recorded on data sheets. All key measurements will be

witnessed and signed-off by both the QAT and the Test Director. See Attachment 2 for sample data sheets.

A data packet consisting of Data Sheets 1 and 2 will be delivered to the modeler with the corresponding videotapes. The data packets and video tapes will be delivered to the modeler by the Test Director in the presence of the QAT. The Test Director, the QAT and the modeler will all sign the Videotape and Data Packet Sign-off Sheet located in Attachment 1.

6.3 OBJECTIVES AT CTF

The objective of this test is to provide a video product similar to what is achieved in the single shell tanks (SSTs), collect information on the waste configurations by viewing the video and then translating this information to a computer model to determine the volume of waste that was staged in the CTF tank. Three videos will be produced of different waste configurations to provide a statistically reliable determination of the error.

6.4 SAFETY PRECAUTIONS AND LIMITATIONS AT CTF

Precautions and warnings listed in this Test Plan are used to notify the Test Director of any special or unique potentially hazardous conditions and their effects. Lack of listing precautions is not intended to signify that hazardous conditions will not exist.

All personnel present at CTF during or involved in testing shall comply with safety precautions and requirements in this test plan. Changes affecting any safety requirements prescribed in this document will require a document revision and approval by the original approving functions.

All personnel working at CTF will receive a facility safety and emergency orientation for the CTF. All personnel are to be familiar with the facility emergency response information board (FERIB), located near the entrance to the CTF administration building Bldg. 672. This provides basic emergency response information, including staging area locations and emergency contacts. All personnel are to report to Bldg. 672 upon arrival and departure from the CTF site and are to sign the in-out log for the Video Observation Technique Test.

The emergency contact numbers for the CTF are 911 (standard phone) or 373-3800 (cellular phone), for cases of bodily injury requiring immediate medical attention or immediate fire hazard. For all other emergencies or off-normal events the point of contact is the CTF Manager or building warden (as identified on the facility emergency response information bulletin board). Tank Farm Central Command and Control should also be contacted 373-2689 (or alternate phone 373-3475) whenever 911 has been contacted. CTF management will post the emergency contact numbers in Bldg. 672.

The hazards associated with this test program have been identified and addressed through a Job Hazards Analysis (JHA), in accordance with CH2M HILL procedures, for use by CH2M HILL-

employed test personnel. The JHA for CTF General Maintenance/Testing is included for reference as Attachment 3 of this document. The JHA provides a means to familiarize test personnel with potential hazards, and associated precautions and controls to mitigate them prior to starting the test. Failure to comply with the JHA and required personnel protective gear could result in serious bodily injury or equipment damage. If conditions are noted that are not addressed in the JHA, or if test personnel plan to perform activities that are not covered, then the JHA shall be revised and approved by the Safety Representative and reviewed by test personnel before starting work. Test personnel who are not direct employees of CH2M HILL shall also comply with a separate job hazards analysis covering the specific activities they are to perform, as approved by the CH2M HILL Safety Representative.

System walk-downs and site inspections will be conducted to review hazards, maintain a clean and orderly test site, verify compliance with the JHA, mitigate potential problems, and identify any new hazards. New hazards will be reported immediately to the Safety Representative. If an unexpected hazard or condition arises, all testing will be stopped until the hazard/condition can be evaluated by the Test Director and Safety personnel.

6.5 WASTE MANAGEMENT AT CTF

The materials used for this test program are designated non-regulated. Before testing, the Test Director or designee will provide documentation including estimated materials, quantities to be used, and material safety data sheets (MSDSs), as applicable, to the CTF Waste Management Lead. At completion of testing, the Test Director or designee will provide documentation of actual materials and quantities to the CTF Waste Management Lead for waste designation.

6.6 TOOLS, EQUIPMENT, AND SUPPLIES AT CTF

The following items may be required to complete the test.

- Fork-Lift
- Two-Way radios
- Simulant (Sand or Gravel)
- Measuring tape
- Miscellaneous hand tools
- Video camera and tape
- Tarp for covering simulant material
- Marking tape, chalk or grease pen

- Other tools or equipment as needed per the direction of the Test Director

6.7 CTF INFRASTRUCTURE

Testing will utilize the CTF open-top test tank, which is 75 feet in diameter and 27 feet deep. The floor of the tank is at ground level and accessible through a port on the west side of the tank. An elevated superstructure spans the tank diameter in two perpendicular directions. The video camera will be located on the lower deck level of the superstructure (which is 35 ft above the tank floor) and the simulated waste configurations will be located on the tank floor. We will use approximately one third of the East side of the tank. The lower deck level is accessible via stairs or elevator from the ground level.

A 600-ft^2 test trailer, MO-673, is located at ground level beside the tank for use as a control room. The test trailer has access to telephone and site network (Hanford Local Area Network, or HLAN) communication systems. The phone number for the control trailer is 376-2242. Contact can also be made via the CTF administrative building (Bldg. 672, located near the entrance gate to the CTF), at 373-0465 or 373-0466.

Other features of the CTF include:

- Portable safety shower and eye wash station.
- Potable and fire suppression (i.e., hydrant) water sources.
- Fall protection (i.e., hand rails and decking).
- Electrical power to support testing.
- More than one acre of lay-down area.
- Paved vehicle access and parking.

7.0 TEST PLAN PART II: VIDEO CAMERA/CAD MODELING

7.1 OBJECTIVE

The objective of the Video/CAD test is to use the video tapes created at the CTF to determine the volume of each simulated waste configuration. The volume determination consists of two parts: the volume of the simulated waste bergs and the diameter of the simulated liquid waste pool. The computer modeler will generate a report containing, for each test video: 1) the total volume of the test configurations, 2) the volume of each simulated waste configuration, and 3) the estimated diameters of the liquid pool edges.

7.2 BLIND TEST

The blind test conducted at CTF will continue in Part II of this test plan. The computer modeler will not be permitted to view any of the test documents generated as a result of the test at CTF with the exception of the video tapes created and the data sheet packets designed for the modeler. The computer modeler will not discuss volume details with the Test Director, the QAT or Thompson Mechanical throughout the CTF and Video/CAD testing.

7.3 COMPUTER MODELING

The computer modeler must be familiar with AutoCAD Land Development Desktop, Release 2i. The modeler must also have knowledge in geometry, trigonometry, drafting and tank construction.

AutoCAD Land Development Desktop software will be used to model the waste configurations and determine their volumes. The computer modeler will build a digital terrain model (DTM), using the software, with the information obtained from viewing the videos.

The modeler views the videos recorded at the CTF and obtains still, representative photos to perform analysis on. Using the photos, known dimensions of in-tank references that appear in the photos and information about the geometry of the tank and the in-tank reference items, the modeler comes up with data to input into the CAD software.

The computer modeler will utilize known reference points on the bottom of the tank and as-built drawings to determine the diameter of liquid.

7.4 SAFETY PRECAUTIONS AND LIMITATIONS

Precautions and warnings listed in this Test Plan are used to notify the Test Director of any special or unique potentially hazardous conditions and their effects. Lack of listing precautions is not intended to signify that hazardous conditions will not exist.

All personnel present during or involved in testing shall comply with safety precautions and requirements in this test plan. Changes affecting any safety requirements prescribed in this document will require a document revision and approval by the original approving functions.

7.5 WASTE MANAGEMENT

Only typical office waste will be generated as a result of this Video/CAD test.

7.6 TOOLS, EQUIPMENT, AND SUPPLIES

The following items may be required to complete the test.

- CTF generated videos from section 6.0
- Still photographs generated from videos
- Relevant drawings
- Ruler
- Computer capable of supporting AutoCAD Land Development Desktop software, Release 2i
- AutoCAD Land Development Desktop software, Release 2i
- Other tools or equipment as needed per the direction of the Test Director

8.0 TEST PLAN PART III: DETERMINATION OF MEASUREMENT ERROR

8.1 OBJECTIVE

The volumes calculated in part II of the test plan will be compared with the known volumes used at CTF in Part I of the test plan. The UCL of the Video/CAD method will be determined using these volumes. The error calculation will consist of:

- Total measurement error for the Video/CAD system.
- Measurement error of the waste berg volume measurements
- Measurement error of the liquid pool edge and location relative to the camera location

The UCL is simply the mean of the ratios plus the RHW. As described in Section 5.0 the RHW is the error measurement or precision of the estimates at a given confidence level. Using the example of three measurements and the ratios of the three measurements having a standard deviation of 20%, we are 95% confident that our estimate is within 50% (RHW) of the actual volume. The UCL would then be the mean volume plus 50% of the volume.

8.2 SAFETY PRECAUTIONS AND LIMITATIONS

Precautions and warnings listed in this Test Plan are used to notify the Test Director of any special or unique potentially hazardous conditions and their effects. Lack of listing precautions is not intended to signify that hazardous conditions will not exist.

All personnel present during or involved in testing shall comply with safety precautions and requirements in this test plan. Changes affecting any safety requirements prescribed in this document will require a document revision and approval by the original approving functions.

8.3 WASTE MANAGEMENT

Only typical office waste will be generated as a result of this Video/CAD test.

8.4 TOOLS, EQUIPMENT, AND SUPPLIES

The following items may be required to complete the test.

- Calculated volumes from part II of this test plan
- Computer
- Other tools or equipment as needed per the direction of the Test Director

9.0 QUALITY ASSURANCE

Documents generated as part of this Test Plan will consist of the following:

- Test Procedure
- Completed data sheets
- Test exceptions and documented resolutions
- General and supplemental test data, as appropriate
- Training records as appropriate
- Calibration records as required per the Test Director or the QAT
- Video recordings of CTF tank with simulated waste configurations

- Computer models
- Report

Any major addition or change to the scope of this Test Plan will require a document revision and must be approved by those who approved the original document. Minor changes to the document that do not affect the prerequisites, scope, or test objectives may be made by the Test Director, and will be documented (redlined, signed, and dated) by the Test Director on the workplace copy. Unexpected conditions, deviations, or readings, or other test exceptions, shall be dispositioned and documented as test exceptions. Errors noted in the test procedures, which require correction to complete the test, shall be redlined, signed, and dated in the workplace copy by the Test Director, or designee, and shall also be documented as test exceptions.

10.0 RESPONSIBILITIES

Each company or organization participating in this test will designate personnel to assume the responsibilities and duties as defined herein for their respective roles. The designees shall become familiar with this Test Plan and the systems involved to the extent that they can perform their assigned duties. Attachment 4 provides a list of assigned personnel and their responsibilities. These lead individuals have the option to designate personnel for these roles.

A pretest briefing for all personnel involved in the test shall be conducted at the facility at the beginning of each shift. When new test team members assume test duties, they can be briefed individually.

Specific staff or organization roles and responsibilities include the following:

10.1 TEST ADVISOR

- Responsible for approving all changes to the scope of work as defined in the MOU.

10.2 CTF MANAGER

- Provide CTF site access and personnel needed to support setup, execution, and demobilization of testing equipment as defined in the MOU.

10.3 TEST DIRECTOR

- Ensures the testing is conducted in accordance with the Test Plan and MOU and reports directly to the Test Advisor on progress and significant issues.

- Coordinates and directs testing.
- This plan is under the direct control and supervision of the assigned Test Director.
- Confirms that all pre-start requirements have been met before allowing the test to begin.
- Stops any test, which in their judgment may cause adverse impacts to personnel or equipment until the problem has been resolved. If a test is to be suspended for a period of time, ensures that the system is left in a safe mode. Before restarting suspended test, re-verifies the test prerequisites.
- Informs support staff of any adverse hazards introduced by the test.
- Reviews recorded data, discrepancies, and exceptions.
- Obtains information or changes necessary to clear or resolve objections during the performance of the test.
- Approves Execution and Test Approval page (Attachment 5) when test has been performed.
- Signs Exceptions Form when exception has been resolved.

10.4 COMPUTER MODELER

- Does not know what volumes will be used for the test at CTF and will not be present at CTF during testing.
- Provides input as to what in-tank reference points are typical for a SST to assist in approximating tank conditions.

10.5 QUALITY ASSURANCE

- Assist with the resolution of test
- Support cold testing which includes: witness tests, document test data and independently verify test volumes and maintain secrecy from computer modeler.
- Approve this plan

10.6 SAFETY

- Prepare Job Hazards Analysis (JHA)
- Revise JHA when notified by the Test Director and CTF Management of new hazards

- Approve this test plan

10.7 WITNESSES (PROVIDED BY PARTICIPATING ORGANIZATIONS)

- Witness the test as identified by the QAT or the Test Director.
- May include Design Authority, Component Engineer and Test Advisor.
- Review test data as needed.
- Assist the Test Director when requested.
- Sign Execution and Test Approval page when test has been completed.
- Approve this test plan as required.

11.0 RECORDING TEST EXCEPTIONS

Should any test exceptions occur during the test, complete the items required in Attachments 6 and 6.

12.0 CHANGE CONTROL

Requirement changes to this test plan or associated procedure may be made using a red-line method, provided the change is approved (initialed) by the Test Director and the Design Authority. Red-line changes shall be documented by ECN after the test is completed.

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ATTACHMENT 1

VIDEOTAPE AND DATA PACKET SIGN-OFF SHEET

Videotape ID: 1 and corresponding Data Sheets 1 and 2 were delivered to modeler.

Test Director	10-13-03 Date	QAT	10-13-03 Date
Modeler	10-13-03 Date	0710 HRS.	

Videotape ID: 2 and corresponding Data Sheets 1 and 2 were delivered to modeler.

Test Director	10-13-03 Date	QAT	10-13-03 Date
Modeler	10-13-03 Date	0710 HRS.	

Videotape ID: 3 and corresponding Data Sheets 1 and 2 were delivered to modeler.

Test Director	10-13-03 Date	QAT	10-13-03 Date
Modeler	10-13-03 Date	0710 HRS.	

ATTACHMENT 2

Date: N/A Time: N/A	Videotape ID: 1

VIDEO/CAD VOLUME MEASUREMENT

DATA SHEET 1 (GIVE TO MODELER WITH VIDEOTAPE)

CAMERA			
		Distance (ft/in)	**Videotape Frame**
1	Height above tank bottom	25 ft	0.0
2	Height above tank bottom	15 ft	12.05
3	Distance from reference 1	43 ft. 1 1/4 in	N/A
4	Distance from reference 2	40 ft. 4 3/4 in	N/A
SIMULATED RISER EQUIPMENT (PVC PIPE)			
5	Distance from reference 1	53 ft. 7 in	ft/in
6	Distance from reference 2	58 ft. 11 1/2 in	ft/in
7	Outer diameter of simulated riser equipment	2 1/4"	in
8	Horizontal distance from simulated riser equipment to camera (center to center)	25 ft. 2 in	ft/in
SIMULATED PIPE DEBRIS (PVC PIPE)			
9	Outer pipe diameter	3 1/2 in	inches

NOTE: Reference 1 is the center vertical line of the M4 entry way in the CTF tank. Reference 2 is the center vertical line of the M1 manway in the CTF tank. Both references are located on CTF drawings (H-6-15313, H-6-15314 and H-6-15316). M4 and M1 are designations used on the drawings.

P.A. Kehrer	10-9-03	[illegible]	10-9-03
Test Director	Date	QAT	Date

Date: N/A Time: N/A	Videotape ID: 1

VIDEO/CAD VOLUME MEASUREMENT

DATA SHEET 2 (GIVE TO MODELER WITH VIDEOTAPE)

SIMULATED STIFFENER RINGS				
1	Vertical distance of lowest ring to tank bottom	4' 5 3/4" ft/in	4' 5 3/4" ft/in	4' 5 3/4" ft/in
2	Distance between the lowest two stiffener rings	4' 5 3/4" ft/in	4' 5 3/4" ft/in	4' 6" ft/in
3	Distance between the second and third stiffener rings	N/A ft/in	N/A ft/in	N/A ft/in

Comments:
Only 2 stiffener rings were needed. See exception 2

[signature]	10-9-03	[signature]	10-9-03
Test Director	Date	QAT	Date

Date: 10-9-03 Time: 10:30pm	Videotape ID: 1

VIDEO/CAD VOLUME MEASUREMENT

DATA SHEET 3 (*DO NOT* GIVE TO MODELER)

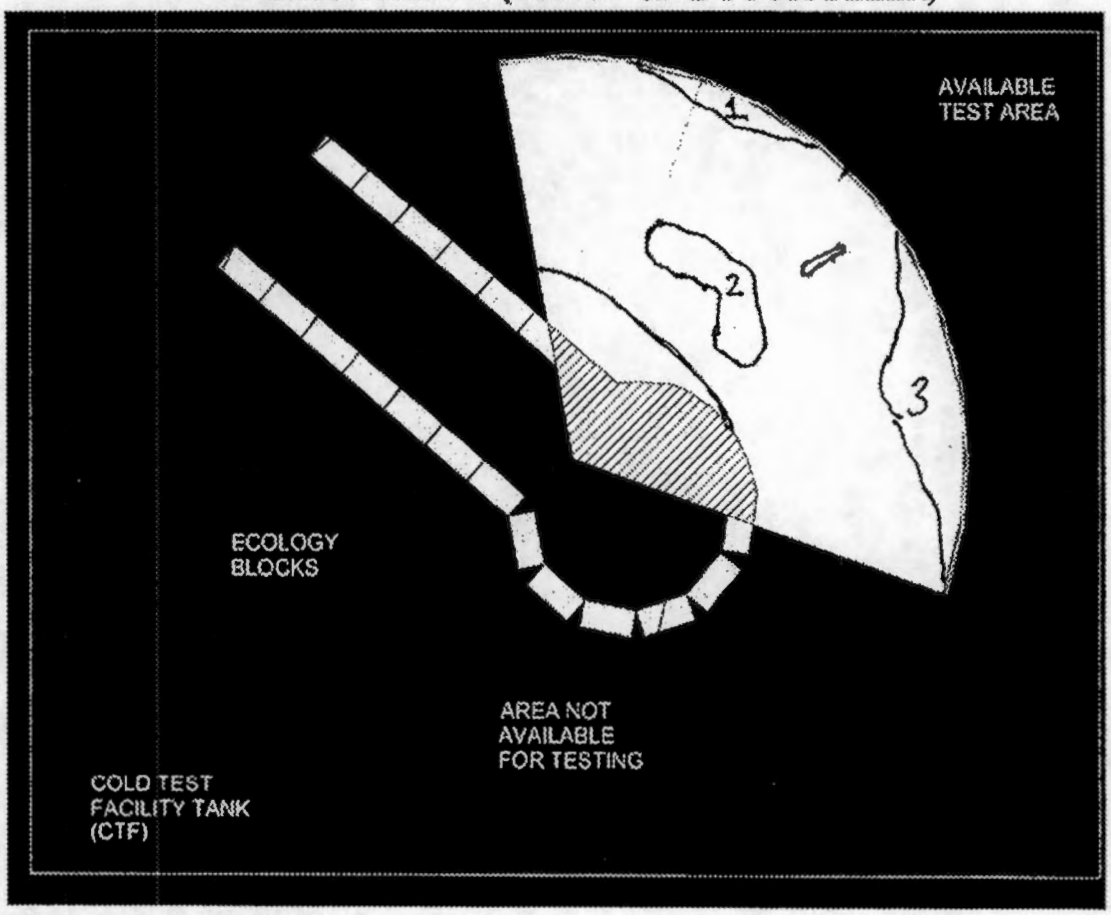
SIMULATED LIQUID POOL EDGE				
1	Distance from tank wall	20ft 3/4" ft/in	20ft 1in ft/in	20ft 1in ft/in
CONFIGURATION 1				
2	Material used for configuration	coarse sand		
3	Volume	17.808		ft^3
Comments: 24 buckets from video ID#2 + 0 buckets = 24 x .742				
CONFIGURATION 2				
4	Material used for configuration	coarse sand		
5	Volume	17.808		ft^3
Comments: 16 buckets from video ID#2 + 8 buckets = 24 x .742				
CONFIGURATION 3				
6	Material used for configuration	coarse sand		
7	Volume	41.552		ft^3
Comments: 40 buckets from video ID#2 + 8 buckets + 8 buckets = 56 x .742 = 41.552 ft^3				

P.A. Fahey	10-9-03	[signature]	10-9-03
Test Director	Date	QAT	Date

Date: 10-09-03 Time:	Videotape ID: 1

VIDEO/CAD VOLUME MEASUREMENT

DATA SHEET 4 (*DO NOT* GIVE TO MODELER)



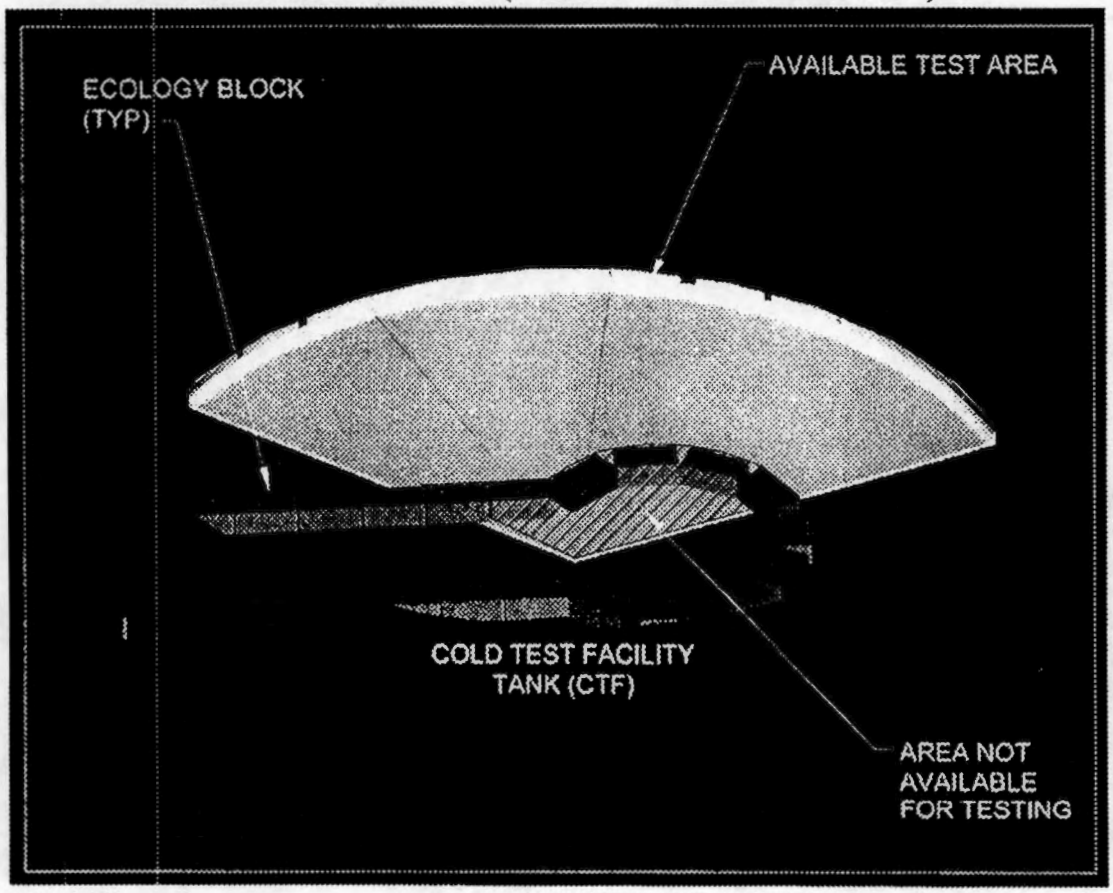
1 = configuration 1 see data sheet 3

P. A. Kohlz	10-9-03		10/9/03
Test Director	Date	QAT	Date

Date: 10-9-03 Time:	Videotape ID: 1

VIDEO/CAD VOLUME MEASUREMENT

DATA SHEET 5 (*DO NOT* GIVE TO MODELER)



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Date: N/A Time: ~~N/A~~ N/A	Videotape ID: 2

VIDEO/CAD VOLUME MEASUREMENT

DATA SHEET 1 (GIVE TO MODELER WITH VIDEOTAPE)

	CAMERA		
		Distance (ft/in)	**Videotape Frame**
1	Height above tank bottom	15 ft.	0.0
2	Height above tank bottom	25 ft.	16.25
3	Distance from reference 1	43 ft 1 1/4 in	N/A
4	Distance from reference 2	40 ft. 4 3/4 in	N/A
	SIMULATED RISER EQUIPMENT (PVC PIPE)		
5	Distance from reference 1	53 ft. 7 in	ft/in
6	Distance from reference 2	58 ft. 11 1/2 in	ft/in
7	Outer diameter of simulated riser equipment	2 1/4 "	in
8	Horizontal distance from simulated riser equipment to camera (center to center)	25 ft. 2 in.	ft/in
	SIMULATED PIPE DEBRIS (PVC PIPE)		
9	Outer pipe diameter	3 1/2 "	inches

NOTE: Reference 1 is the center vertical line of the M4 entry way in the CTF tank. Reference 2 is the center vertical line of the M1 manway in the CTF tank. Both references are located on CTF drawings (H-6-15313, H-6-15314 and H-6-15316). M4 and M1 are designations used on the drawings.

P. A. Kelsey	10-9-03	[signature]	10-9-03
Test Director	Date	QAT	Date

M4 to camera: 8" to inside tank surface of wall: 43' 9 1/4" - 8" = 43' 1 1/4"
M1 to camera: 8" " " " " " 41' 3/4" - 8" = 40' 4 3/4"
M1 to pipe: 8" " " " " " 59' 7 1/2" - 8" = 58' 11 1/2"
M4 to pipe: 8" " " " " " 54' 3" - 8" = 53' 7"

Date: N/A Time: N/A	Videotape ID: #2

VIDEO/CAD VOLUME MEASUREMENT

DATA SHEET 2 (GIVE TO MODELER WITH VIDEOTAPE)

SIMULATED STIFFENER RINGS				
1	Vertical distance of lowest ring to tank bottom	4' 5 3/4" ft/in	4' 5 3/4" ft/in	4' 5 3/4" ft/in
2	Distance between the lowest two stiffener rings	4' 5 3/4" ft/in	4' 5 3/4" ft/in	4' 6" ft/in
3	Distance between the second and third stiffener rings	N/A ft/in	N/A ft/in	N/A ft/in

Comments:
Only 2 stiffener rings were needed

[signature]	10-9-03	[signature]	10-9-03
Test Director	Date	QAT	Date

Date: 10-9-03 Time: 6:20pm	Videotape ID: #2

VIDEO/CAD VOLUME MEASUREMENT

DATA SHEET 3 (*DO NOT* GIVE TO MODELER)

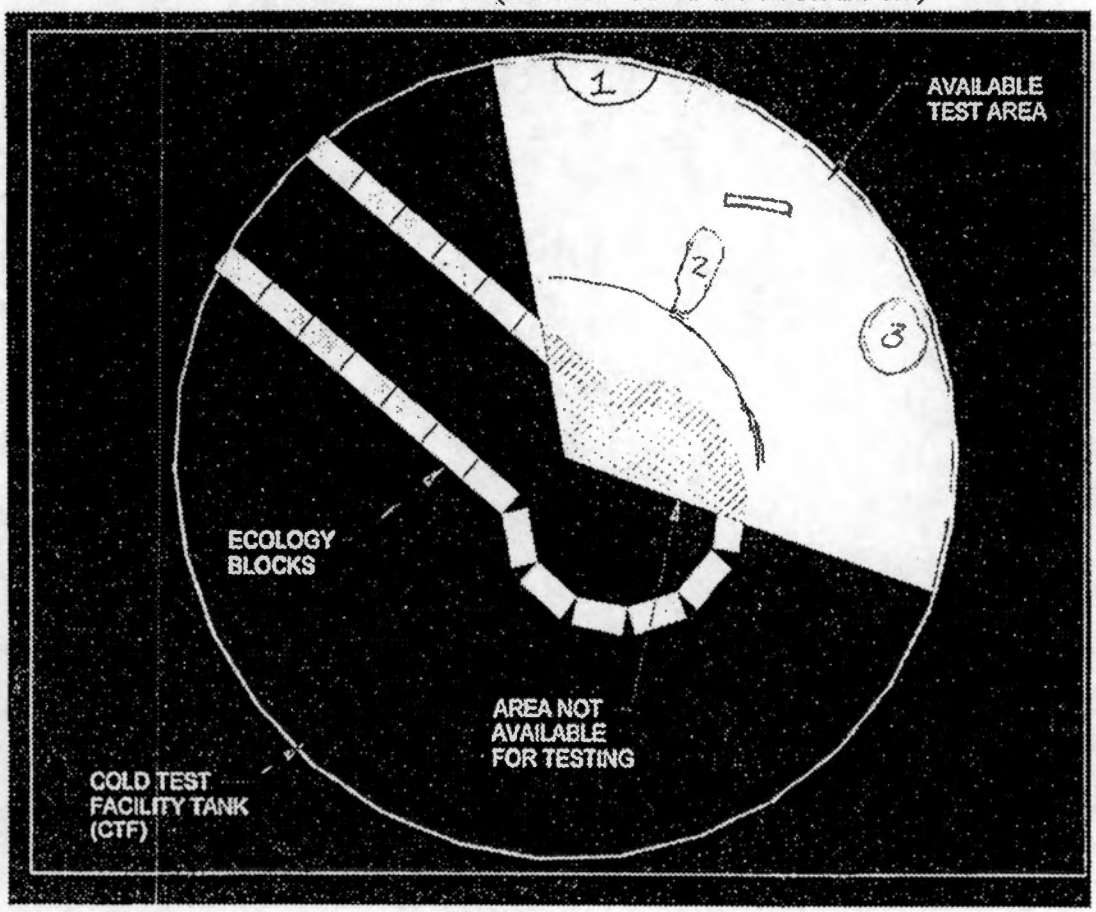
SIMULATED LIQUID POOL EDGE				
1	Distance from tank wall	17ft 5½in ft/in	17ft. 5" ft/in	17ft 6" ft/in
CONFIGURATION 1				
2	Material used for configuration	coarse sand		
3	Volume	17.808ft³		ft³
Comments: 8 buckets + 8 buckets + 8 buckets = 24 x .742 = 17.808ft³ ≈ 3½ ft tall x 4' from wall at base Each bucket = .742ft³				
CONFIGURATION 2				
4	Material used for configuration	coarse sand		
5	Volume	11.872		ft³
Comments: 8 buckets + 8 buckets = 16 x .742 = 11.872 ≈ 7ft long x 4 ft wide x 1 ft height				
CONFIGURATION 3				
6.	Material used for configuration	coarse ~~gravel~~ sand 10-9-03		
7	Volume ?	29.68		ft³
Comments: 8 buckets + 8 buckets + 8 buckets + 8 buckets + 8 buckets = 40 x .742 = 29.68				

P.A. Kelly	10-9-03		9 Nov 03 ~~10-8-03~~
Test Director	Date	QAT	Date

Date: 10-9-03 Time: N/A	Videotape ID: #2

VIDEO/CAD VOLUME MEASUREMENT

DATA SHEET 4 (*DO NOT* GIVE TO MODELER)



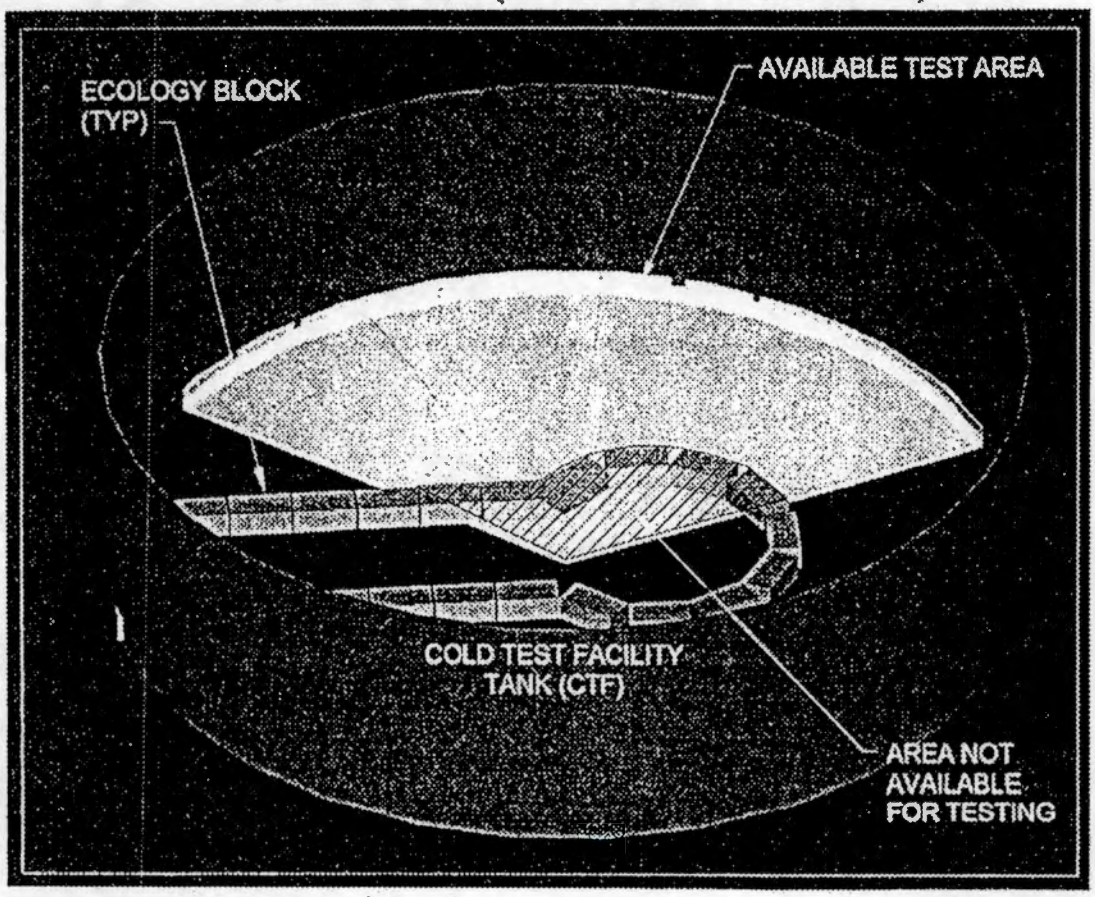
1 = Configuration 1 see data 3

Test Director	10-9-03 Date	QAT	10-9-03 Date

Date:_____ Time:_____	Videotape ID: #2

VIDEO/CAD VOLUME MEASUREMENT

DATA SHEET 5 (*DO NOT* GIVE TO MODELER)



Date: N/A Time: N/A	Videotape ID: #3

VIDEO/CAD VOLUME MEASUREMENT

DATA SHEET 1 (GIVE TO MODELER WITH VIDEOTAPE)

	CAMERA		
		Distance (ft/in)	**Videotape Frame**
1	Height above tank bottom	15 ft.	0.0
2	Height above tank bottom	25 ft.	22.02
3	Distance from reference 1	43ft. 1 1/4 in	N/A
4	Distance from reference 2	40ft. 4 3/4 in	N/A
	SIMULATED RISER EQUIPMENT (PVC PIPE)		
5	Distance from reference 1	53ft. 7in	ft/in
6	Distance from reference 2	58ft. 11 1/2 in	ft/in
7	Outer diameter of simulated riser equipment	2 1/4"	in
8	Horizontal distance from simulated riser equipment to camera (center to center)	25ft. 2 in	ft/in
	SIMULATED PIPE DEBRIS (PVC PIPE)		
9	Outer pipe diameter	3 1/2 in	inches

NOTE: Reference 1 is the center vertical line of the M4 entry way in the CTF tank. Reference 2 is the center vertical line of the M1 manway in the CTF tank. Both references are located on CTF drawings (H-6-15313, H-6-15314 and H-6-15316). M4 and M1 are designations used on the drawings.

[signature]	10-10-03	[signature]	10-10-03
Test Director	Date	QAT	Date

Date: N/A Time: N/A	Videotape ID: 3

VIDEO/CAD VOLUME MEASUREMENT

DATA SHEET 2 (GIVE TO MODELER WITH VIDEOTAPE)

SIMULATED STIFFENER RINGS				
1	Vertical distance of lowest ring to tank bottom	4' 5 3/4" ft/in	4' 5 3/4" ft/in	4' 5 3/4" ft/in
2	Distance between the lowest two stiffener rings	4' 5 3/4" ft/in	4' 5 3/4" ft/in	4' 6" ft/in
3	Distance between the second and third stiffener rings	N/A ft/in	N/A ft/in	N/A ft/in
Comments: Only 2 stiffener rings were needed.				

P. A. Kney — Test Director — 10-10-03 Date

QAT — 10-10-03 Date

Date: 10-10-03 Time: 7:45 pm	Videotape ID: 3

VIDEO/CAD VOLUME MEASUREMENT

DATA SHEET 3 (*DO NOT* GIVE TO MODELER)

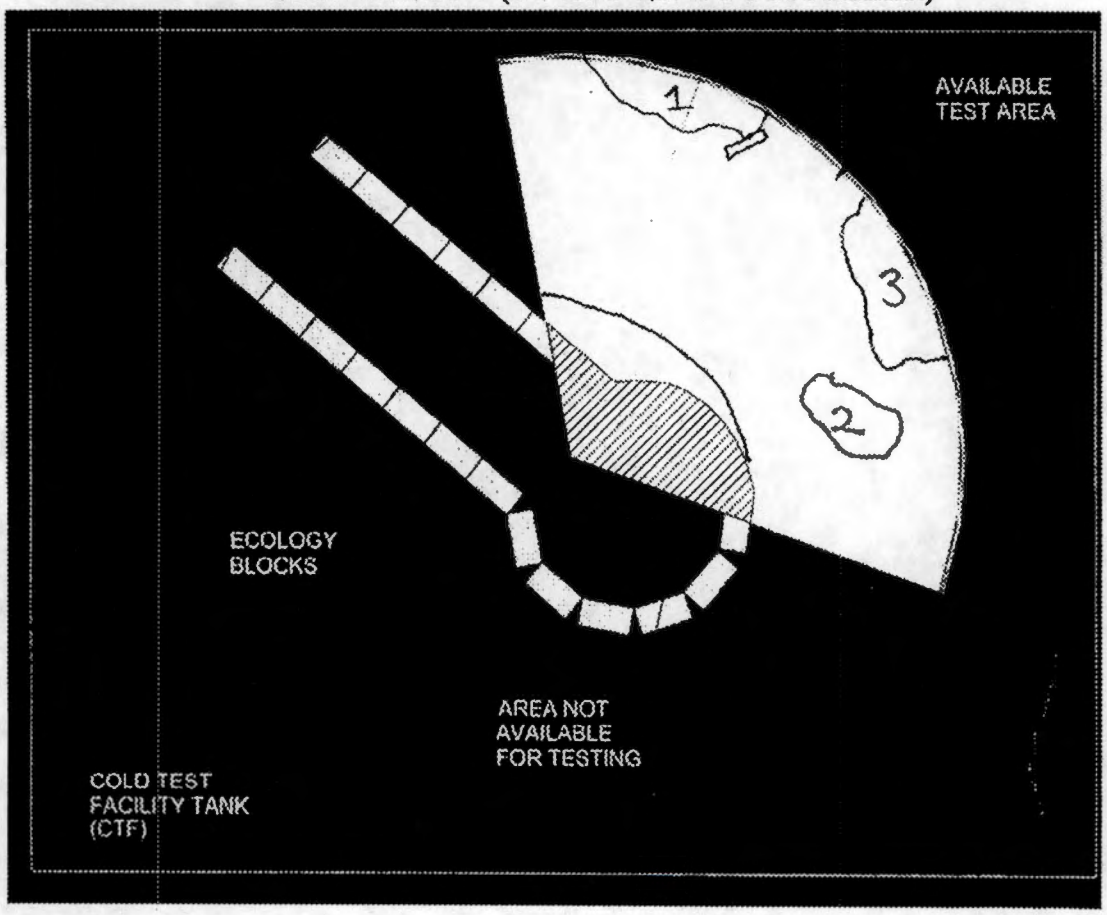
SIMULATED LIQUID POOL EDGE				
1	Distance from tank wall	19' 2 3/4" ft/in	19' 2 1/2" ft/in	19' 2 3/4" ft/in
CONFIGURATION 1				
2	Material used for configuration	coarse sand		
3	Volume	30.422		ft^3
Comments: 24 + 24 - 7 = 41 buckets				
CONFIGURATION 2				
4	Material used for configuration	coarse sand		
5	Volume	14.098		ft^3
Comments: 8 buckets + 7 buckets + 4 buckets = 19 buckets				
CONFIGURATION 3				
6	Material used for configuration	coarse sand		
7	Volume	32.648		ft^3
Comments: 56 - 8 - 4 = 44 buckets				

[signature]	10-10-03	[signature]	10-10-03
Test Director	Date	QAT	Date

Date: 10-10-03 Time: 8:20pm	Videotape ID: 3

VIDEO/CAD VOLUME MEASUREMENT

DATA SHEET 4 (*DO NOT* GIVE TO MODELER)

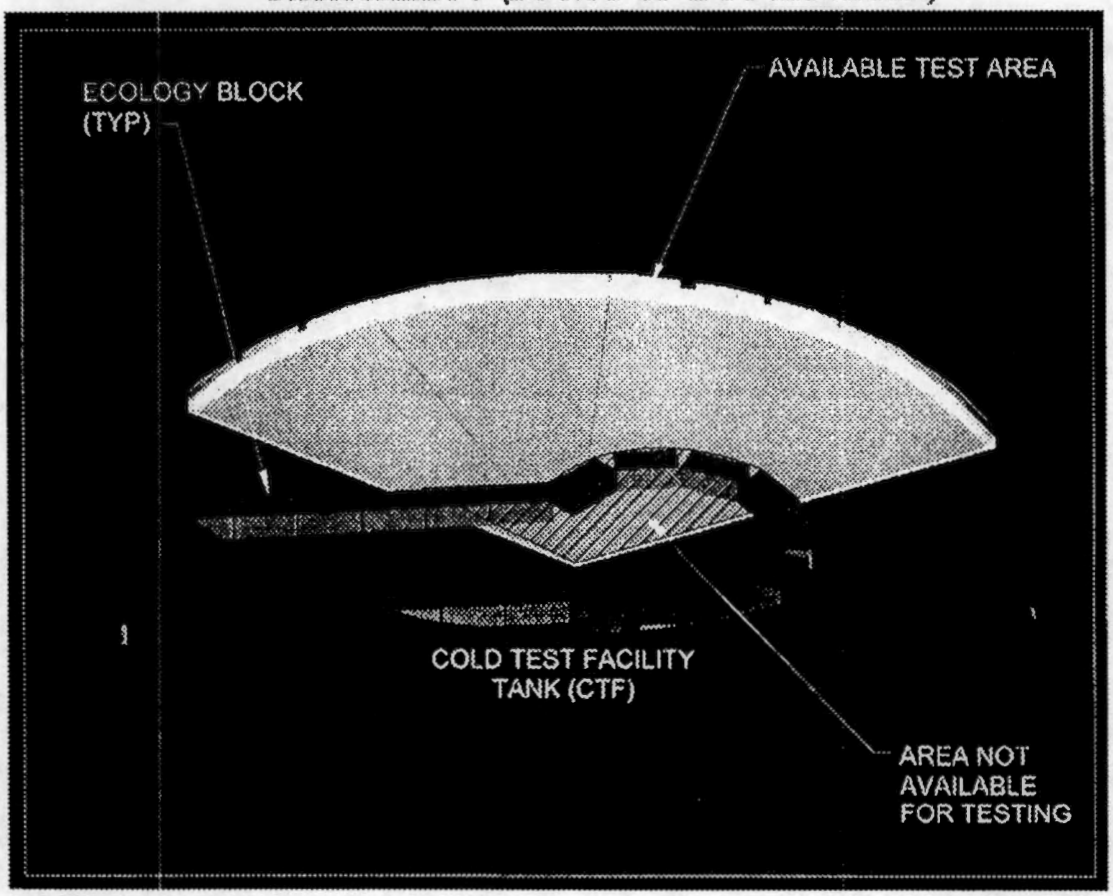


Test Director — 10/10/03 Date — QAT — 10-10-03 Date

Date: 10-10-03	Videotape ID: 3
Time:	

VIDEO/CAD VOLUME MEASUREMENT

DATA SHEET 5 (*DO NOT* GIVE TO MODELER)



ATTACHMENT 3

JOB HAZARDS ANALYSIS

TANK FARM JOB HAZARD ANALYSIS

STANDING JHA NO:	COMPLETED:	EXPIRES:
TF-SJHA-0415 Rev0	05/28/03	05/28/04

PREPARED BY: Michael Powers/Ken Worley

TITLE: CTF General Maintenance/Testing JHA

DESCRIPTION AND LOCATION OF WORK:
This JHA supports general maintenance and or equipment testing/demonstrations at the Cold Test Facility.

LIMITATIONS/RESTRICTIONS:
Not covered by this JHA:

- Roof Work
- Electrical panel outages/breaker maintenance

SIGNATURES:

SAFETY: Signature on file	FIRE SAFETY: Signature on file	ENVIRONMENTAL	RAD CON:
IH: Signature on file	WASTE:	OPERATIONS:	ENGINEERING:
OTHER: Signature on file	OTHER:	OTHER:	OTHER:

JHA SECTIONS

SAFETY HAZARDS	CONTROLS	ADDITIONAL TEXT
Fall Hazards	• Training for workers who will be exposed to a fall of six feet or greater • Employ guard railing or personal fall arrest system as fall protection for platforms 6 feet or more above a lower level	
Falling Objects	• Restrict access to area beneath work • Wear hard-hats when there is a potential for falling objects.	
Slips Trips	PPEs Footwear (ANSI Z41) • Substantial (Leather or equally firm shoe or boot) • Worker awareness briefing • Secure hoses, cords, lines, portable equipment • Material control before/during activity • Housekeeping before/during activity • * Be aware of slick walking surfaces during the winter months	

JHA SECTIONS		
SAFETY HAZARDS	CONTROLS	ADDITIONAL TEXT
Exposed or Rotating/Moving Machinery (e.g., Pinch, Nip Points)	• Ensure manufacturer installed or recommended guards are in place and operational at • pinch and nip points • Control loose clothing, gloves, long hair • Remove jewelry that could come into contact with equipment	
Hand and Portable Power Tools	• Inspect tools for proper guards, electrical cords, plugs, grounds, and function • Specify special tools for hazardous (flammable, explosive) atmospheres • GFCI protection required	
Portable Ladders	• 044390 LADDER SAFETY • Assign users who have completed training in recognizing ladder hazards, safe practice • rules, and inspection criteria • Visually inspect the portable ladder before use to ensure its safe condition • Select proper type and size of ladder for the job • Protect against exposure to moving vehicles/equipment, and doorways • Good Housekeeping around top and base of ladder-way • Proper placement, lashing, or holding ladder required if used on slippery surfaces. Note: • Slip-resistant feet are not a substitute for requirement.	
Scaffold User	• 044383 USER SCAFFOLD SAFETY • Ensure Scaffold has been inspected prior to use • Scaffold Users must be trained • Scaffold Users - Follow any special instructions entered on attached scaffold Status Tag	
Medium Risk = > 50 VAC and < 600 VAC	• 044480 Medium Risk Electrical Safety or Equivalent • Lockout/Tagout • Insulated Tools • Do not wear conductive accessories unless rendered nonconductive by covering, wrapping, insulating • Electrical equipment used for verifying that circuits are de-energized are tested for proper operation before testing the de-energized circuit	
Other Hazards	• Visitors are not allowed to operate the site elevator unless trained and authorized by CTF management.	

INDUSTRIAL HYGIENE	CONTROLS	ADDITIONAL TEXT
Heat Stress	• 020193 HEAT STRESS CBT • Train workers/supervisors in heat stress recognition, prevention, and control • Obtain general (weather station) WBGT readings • Provide water/fluids at work location • WBGT readings may be obtained by contacting the Hanford Met. Station at 373-2716. • Request "WBGT readings for Hammer area".	
Other Hazards	• Be aware of cold stress issues. Wear appropriate winter clothing and take warm-up breaks as needed. • Be aware of blowing dusts/particles. Goggles may be required at the direction of CTF management.	
Manual Lifting/back mounted equipment	• Use lifting device when feasible • Workers with previous injuries need lifting tools/helpers • Keep object close to the body when lifting • Do not twist while lifting • Evenly support the object by both arms • Minimize repetitive lifting	
Awkward position of shoulders, knees, back, and neck	• Minimize duration	
Chemicals /Chemical Products	• Brief description of chemical use/activity • Obtain and review appropriate MSDS based on chemicals products used/potentially released • Ensure workers' EJTA reflects hazardous waste exposure	
FIRE SAFETY	**CONTROLS**	**ADDITIONAL TEXT**
Construction and Modification Doors, Walls, Floors, HVAC, Roofs	• Fire Marshall Permit	
Fire Hydrants	• Fire Marshall Permit	
Compressed Gases	• Fire Marshall Permit	

ATTACHMENT 4

ASSIGNED PERSONNEL AND TEST RESPONSIBILITIES

The following table contains the list of positions defined by this test plan and the individuals assigned to each position. These lead individuals have the option to designate personnel for these roles. This list is to be posted at the test site in trailer Bldg. 672 and red-lined as necessary to keep the list up to date.

Position or Title	Lead Individual	Contact Phone Number
Task Advisor	Ron Calmus	372-3385
Test Director	Patricia Kabage	372-0036
S&H Representative	Ken Worley	376-1949
CTF Management	Jamie Morris	373-9340
Quality Assurance	Joel Cannon	372-3241
Design Authority	Ray Merriman	~~373-0915~~ 372-1653 REM 10/9/03
System Engineer	Andy Cockrell	373-4189

ATTACHMENT 5

EXECUTION AND TEST APPROVAL

Any equipment non-conformance or anomalies will be listed on the Exceptions List (Attachment 5).

EXECUTED BY

Test Director/Organization	Date	Test Operator/Organization	Date
Test Operator/Organization	Date	Test Operator/Organization	Date
Test Operator/Organization	Date	Test Operator/Organization	Date
Test Operator/Organization	Date	Test Operator/Organization	Date

WITNESSES

Witness/Organization	Date	Witness/Organization	Date
Witness/Organization	Date	Witness/Organization	Date
Witness/Organization	Date	Witness/Organization	Date
Witness/Organization	Date	Witness/Organization	Date

ATTACHMENT 6

EXCEPTIONS LIST

Number each exception sequentially as it occurs and record the exception
Enter name and organization of objecting party for each exception.
Enter planned action to resolve each exception when such determination is made.
Enter the exception number on the applicable procedure step
The Test Director and Quality Assurance approve the resolution.

No.	EXCEPTION	RESOLUTION	SIGNATURE/DATE
1	Performed steps out of order in section 2.1 to perform work more efficiently	Added statement "The following steps may be performed in any order." to section 2.1	10/16/03 Test Director 10/16/03 Quality Assurance
2	No third stiffener ring to measure to.	3rd stiffener ring not needed because of the large distance between stiffener rings in C-106 and the small volumes of simulant used in test.	10/16/03 Test Director 10/16/03 Quality Assurance
3	Section 2.3 steps 37 and 48 camera height adjustment	The order steps 37 and 48 are performed have no impact on the outcome of the test. Changed wording to reflect either height in both steps. As long as both heights are used for making each videotape.	10/16/03 Test Director 10/16/03 Quality Assurance
			Test Director Quality Assurance
4	Section 2.3 steps 44, 47, 51 and 54 require turning off and on facility lighting	Tank was dark enough to video tape with only the tank lights off. For safety reasons facility lighting remained on.	10/16/03 Test Director 10/16/03 Quality Assurance
			Test Director Quality Assurance

NO.	EXCEPTION	RESOLUTION	SIGNATURE/DATE
			Test Director Quality Assurance
			Test Director Quality Assurance
			Test Director Quality Assurance
			Test Director Quality Assurance
			Test Director Quality Assurance
			Test Director Quality Assurance
			Test Director Quality Assurance

ATTACHMENT 7

GENERAL DATA SHEET

General Data Sheet for testing the Video Observation Technique at CFT Test Personnel Comments, Observations, or Supplemental Data	
Test Procedure Section	Page:
Date:	Time:
Test Description:	

Comments, Observations, or Data:

Data sheet entries by:		Date:
Reviewed by: Test Director		Date:
Reviewed by: QAT		Date:

(Make additional copies of this page as needed)

RPP-18744, Rev. 0

APPENDIX B
WORKING COPY OF PROCEDURE

WORKING COPY

(18) SOA-3 OCT 0 9 2003

ENGINEERING DATA TRANSMITTAL

1. EDT 820116

1A. Page 1 of

2. To: (Receiving Organization)
Tank Closure Project

3. From: (Originating Organization)
Tank Closure Project

4. Related EDT No.:
N/A

7. Purchase Order No.:
N/A

5. Proj./Prog./Dept./Div.:
SST Projects

6. Design Authority/Resp. Engr./Design Agent:
R.E. Merriman.

9. Equip./Component No.:
N/A

10. System/Bldg./Facility:
N/A

8. Originator Remarks:
For Review, Approval and Release

12. Major Assembly Dwg. No.:
N/A

13. Permit/Permit Application No.:
N/A

11. Receiver Remarks:

11A. Design Basis Document? ☐ Yes ☒ No

14. Required Response Date:
N/A

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	RPP-18334		0	VIDEO/CAD MEASUREMENT PROCEDURE	Q	1	1-4	1-4
							REM 10/9/03	

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
See TFC-ESHQ-Q-INSP-C-05	1. Approval 2. Review 3. Post-Review	1. Approved 2. Approved w/comment 3. Reviewed no comment 4. Reviewed w/comment 5. Disapproved

17. SIGNATURE/DISTRIBUTION

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN
1	1	Design Auth. R.E. Merriman R1-14	R.E. Merriman	10/9/03	R1-14						
1	1	Resp. Engr. For Patricia Kabele	M. Hankinbalch	10/9/03							
1	1	Resp. Mgr. T.L. Sams S7-83	Tony Sams	10/7/03							
1	1	QA J.M. Cannon S7-07	Joel Cannon	10/8/03							
1	1	Safety R.E. Butler S7-07	RE Butler	10/8/03							
		Env.									
		Design Agent									
1	1	M.A. Haq R1-14	M.A. Haq	10/08/03							

18. R.A. Hay 10-8-03
Signature of EDT Originator — Date

19. DOE APPROVAL (if required)
Ctrl. No.

20. R.E. Merriman 10/9/03
Design Auth./Resp. Engr./Resp. Mgr. — Date

RPP-18334, Rev. 0

VIDEO CAMERA/CAD MODELING SYSTEM: PROCEDURE FOR TEST PLAN PART I (RPP-17663)

PA Kabage
CH2M HILL Hanford Group, Inc.
Richland, WA 99352
U.S. Department of Energy Contract DE-AC27-99RL14047

EDT/ECN: 820116 UC:
Cost Center: Charge Code:
B&R Code: Total Pages: 6

Key Words: Video, CAD, Volume Measurement, Procedure

Abstract: This procedure provides the steps to perform Part I of the Test Plan for the Video Camera/CAD Modeling System (RPP-17663).

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Barbara Wolski 10/9/03
Release Approval Date

OCT 0 9 2003
DATE
STA. 3
78
Release Stamp

Approved For Public Release

TABLE OF CONTENTS

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2.0 TEST PROCEDURE 2
- 2.1 FIXED DATA 2
- 2.2 STAGE TEST AREA FOR VIDEOTAPING 3
- 2.3 VIDEO TAPING 4

PROCEDURE FOR THE VIDEO/CAD VOLUME MEASUREMENT TECHNIQUE VERIFICATION

1.0. INTRODUCTION

This test procedure is designed to be used in conjunction with document RPP-17663, Rev. 0. RPP-17663 is the Test Plan for the Video Camera/CAD Modeling System. This procedure covers the steps to perform the CTF portion of the test plan, section 6.0. All of the data sheets referred to in this document can be found in Attachment 2 of the test plan document.

2.0 TEST PROCEDURE

2.1 FIXED DATA

NOTE: This section only needs to be performed once during the entire test and may be performed at any time before videotaping occurs. Also, references 1 and 2 are described at the bottom of Data Sheet 1. # The following steps may be performed in any order. 10-9-03 Exception 1 10-9-03 10-9-03

1. **MEASURE** distance from reference 1 to the camera
2. **RECORD** distance on Data Sheet 1, Line 3
3. **MEASURE** distance from reference 1 to the simulated riser equipment
4. **RECORD** distance on Data Sheet 1, Line 5
5. **MEASURE** distance from reference 2 to the camera
6. **RECORD** distance on Data Sheet 1, Line 4
7. **MEASURE** distance from reference 2 to the simulated riser equipment
8. **RECORD** distance on Data Sheet 1, Line 6
9. **MEASURE** horizontal distance from simulated riser equipment to camera (center to center)
10. **RECORD** distance on Data Sheet 1, Line 8
11. **MEASURE** vertical distance from lowest simulated stiffener ring to the tank bottom
12. **RECORD** distance on Data Sheet 2, Line 1

13. **REPEAT** steps 11 and 12 until three measurements have been taken along the length of the stiffener ring

14. **MESURE** distance between the lowest two stiffener rings

15. **RECORD** distance on Data Sheet 2, Line 2

16. **REPEAT** steps 14 and 15 until three measurements have been taken along the length of the stiffener rings

Steps not needed only 2 stiffener rings needed

17. **MEASURE** distance between the second and third stiffener rings (the stiffener ring closest to the tank floor is the first stiffener ring)

18. **RECORD** distance on Data Sheet 2, Line 3

exception 2 10-9-03 RG 10-9-03

19. **REPEAT** steps 17 and 18 until three measurements have been taken along the length of the stiffener ring

20. **MARK** camera umbilical to indicate when the camera is 15 and 25 feet above the tank bottom

21. **RECORD** simulated debris outer pipe diameter on Data Sheet 1, Line 9

22. **RECORD** outer pipe diameter of simulated riser equipment on Data Sheet 1, Line 7

2.2 STAGE TEST AREA FOR VIDEOTAPING

23. **ENSURE** test area of the tank is free of undesired items (i.e. ecology blocks, troughs, etc.).

24. **ENSURE** ecology blocks, that may appear in the videotape, are covered

25. **STAGE** a waste berg as directed by Test Director

NOTE: Thompson Mechanical will bring waste simulant into the CTF tank, incrementally, and place it in the test area under the direction of the Test Director.

26. **RECORD** simulated waste berg location on Data Sheet 4

27. **RECORD** simulated waste berg volume on Data Sheet 3

28. **RECORD** type of material used for simulant on Data Sheet 3

29. **REPEAT** steps 25 through 28 until three bergs are set up in the test area

30. **MARK** a simulated liquid pool edge on the tank bottom

31. **MEASURE** the simulated liquid pool edge distance from the tank wall

32. **RECORD** distance on Data Sheet 3, Line 1.

33. **REPEAT** steps 31 and 32 until three measurements have been taken along the length of the simulated liquid edge

34. **RECORD** liquid pool edge on Data Sheet 4

35. **PLACE** simulated pipe debris in test area under the direction of the Test Director

36. **RECORD** simulated pipe debris location on Data Sheet 4

2.3 VIDEO TAPING

Exception 3

37. **SET** camera at ~~25~~ 25 or 15 feet above the tank bottom 10-9-03

38. **RECORD** camera height above tank bottom on Data Sheet 1, Line 1

39. **POWER ON** camera and video taping equipment

40. **LABEL** new videotape

41. **RECORD** videotape ID onto data sheets 1, 2 , 3 4 and 5

42. **INSERT** videotape into recorder

43. **RECORD** videotape frame number on Data Sheet 1, Line 1

Exception 4

44. **TURN-OFF** tank ~~and facility~~ lighting that illuminates the test area of the tank 10-9-03

45. **START** recording

- Using a wide angle zoom setting, Pan across the simulated tank floor and wall, using different Tilt settings as necessary.
- Zoom in on each area of simulated waste, individually and together as appropriate.
- Zoom in on any simulated in-tank debris, individually and with nearby simulated waste.
- Using a wide angle zoom setting, Pan across the simulated tank floor and wall, using decreasing Tilt settings.
- Obtain any additional views as necessary.

46. **STOP** recording

Exception 4 47. **TURN-ON** tank ~~and facility~~ lighting 10-9-03

Exception 3 48. **SET** camera at 25 or 15 feet above the tank bottom, whichever was not used in step 37. 10-9-03

49. **RECORD** camera height above tank bottom on Data Sheet 1, Line 2

50. **RECORD** videotape frame number on Data Sheet 1, Line 2

Exception 4 51. **TURN-OFF** tank ~~and facility~~ lighting 10-9-03

52. **START** recording

- Using a wide angle zoom setting, Pan across the simulated tank floor and wall, using different Tilt settings as necessary.
- Zoom in on each area of simulated waste, individually and together as appropriate.
- Zoom in on any simulated in-tank debris, individually and with nearby simulated waste.
- Using a wide angle zoom setting, Pan across the simulated tank floor and wall, using decreasing Tilt settings.
- Obtain any additional views as necessary.

53. **STOP** recording

Exception 4 54. **TURN-ON** tank ~~and facility~~ lighting 10-9-03

55. **REMOVE** videotape from recorder

56. **ENSURE** videotape ID matches the ID on the data sheets

57. **SET ASIDE** data sheets and videotape to go to modeler (see NOTE below)

58. **POWER-OFF** camera and videotaping equipment

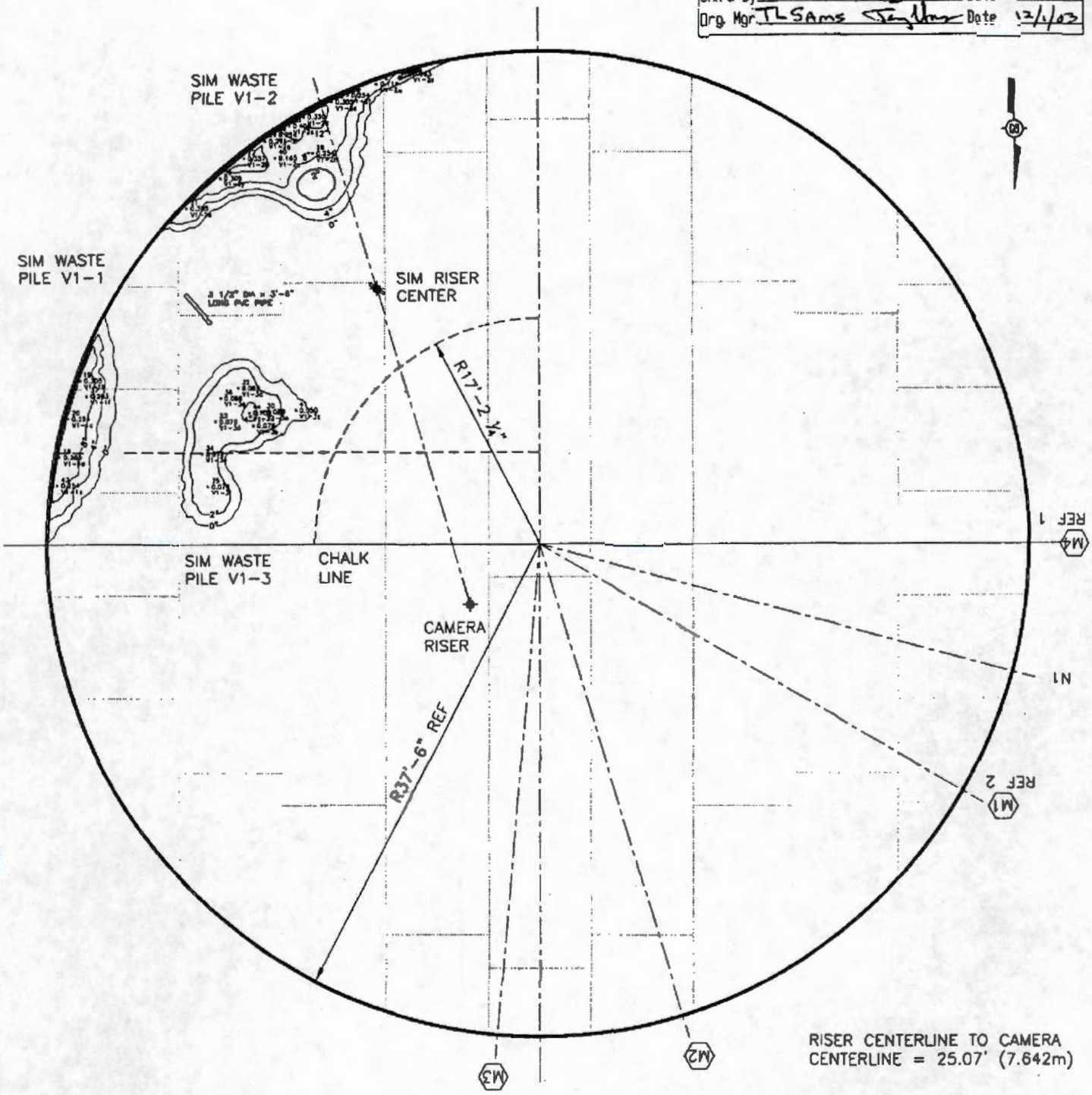
59. **REPEAT** steps 23 through 58 until a total of three videotapes are made

NOTE: The videotape and relevant data sheets will be given to the modeler at a mutually agreed upon time and place so both the QAT and the Test Director are present. The QAT, the Test Director and the modeler will all sign the Videotape and Data Packet Sign-off Sheet located in Attachment 1 of the test plan.

APPENDIX C
MODELING DOCUMENTATION OF VIDEO 1

H:\CHG\CTF\CAD FILE\RPP-18744-V1.dwg

Attachment	V1	Sheet No.	1 of 9
Originator	John M. Winett	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11-20-03
Org. Mgr.	T.L. Sams	Date	12/1/03



RISER CENTERLINE TO CAMERA CENTERLINE = 25.07' (7.642m)

CTF Video No. 1

H:\CHG\CTF\CAD FILE\RPP-18744-V1.dwg

Attachment	V1	Sheet No.	2 of 9
Originator	John M. Vinett	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11-20-03
Org. Mgr.		Date	

Cold Test Facility Site Volume Table: Unadjusted

Site	Stratum	Surf1	Surf2	Cut cu.m.	Fill cu.m.	Net cu.m.	Method
SWP1-1	V1-P1	CTFbottom	SWP V1-1	0.000	0.538	0.538 (F)	Grid
				0.000	0.534	0.534 (F)	End area
						0.536 (F)	Average
SWP1-2	V1-P2	CTFbottom	SWP V1-2	0.000	1.193	1.193 (F)	Grid
				0.000	1.189	1.189 (F)	End area
						1.191 (F)	Average
SWP1-3	V1-P3	CTFbottom	SWP V1-3	0.000	0.313	0.313 (F)	Grid
				0.000	0.314	0.314 (F)	End area
						0.314 (F)	Average

AutoCAD LAND DEVELOPMENT DESKTOP, Release 2i, VOLUME ESTIMATE

Based on 10/10/03 Video Recording at the Cold Test Facility (CTF)

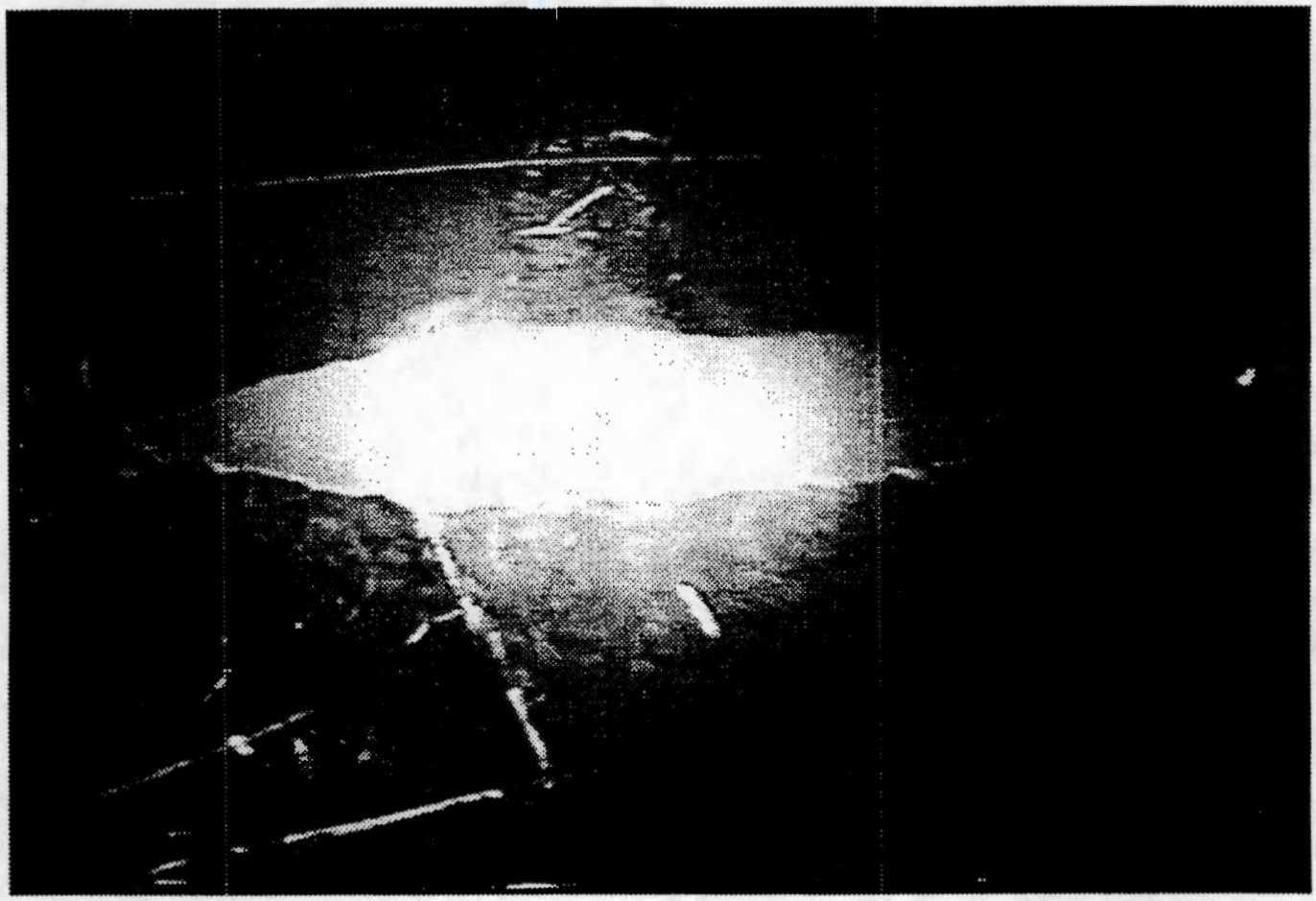
VIDEO TAPE No. 1

VOLUME CONVERSION TABLE FOR CTF VIDEO MEASUREMENT RESULTS:

Description:	Cubic Meters:	Cubic Feet:	Gallons:
WASTE PILE V1-1 TOTAL SOLIDS:	0.536	18.93	142
WASTE PILE V1-2 TOTAL SOLIDS:	1.191	42.05	315
WASTE PILE V1-3 TOTAL SOLIDS:	0.314	11.09	83
VIDEO No. 1 GRAND TOTAL:	2.041	72.07	539

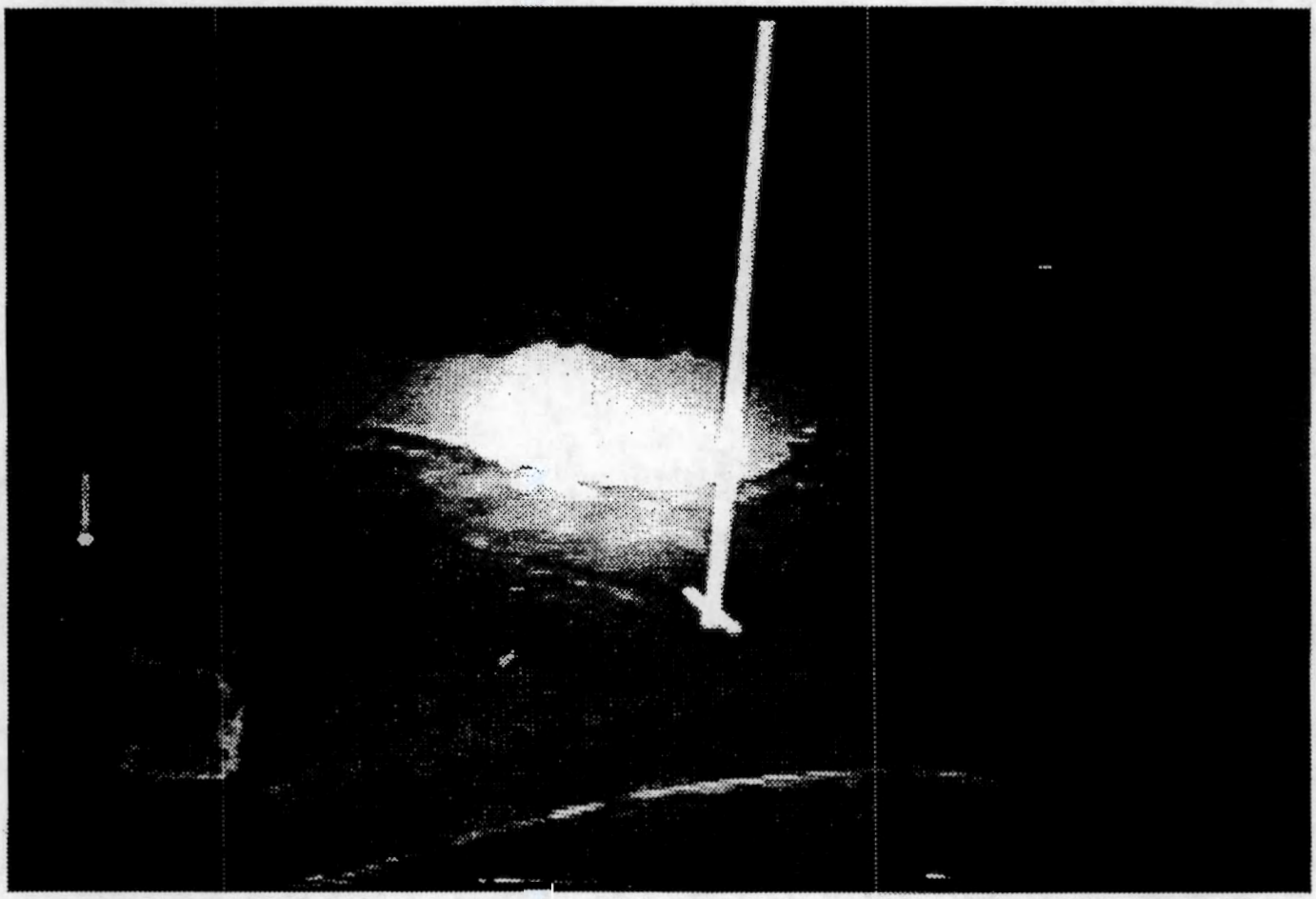
CTF Video No. 1

Attachment V1		Sheet No. 3 of 9	
Originator John H. Winett		Date	10-23-03
Chk'd By C. A. Bentz		Date	11-20-03
Org. Mgr.		Date	



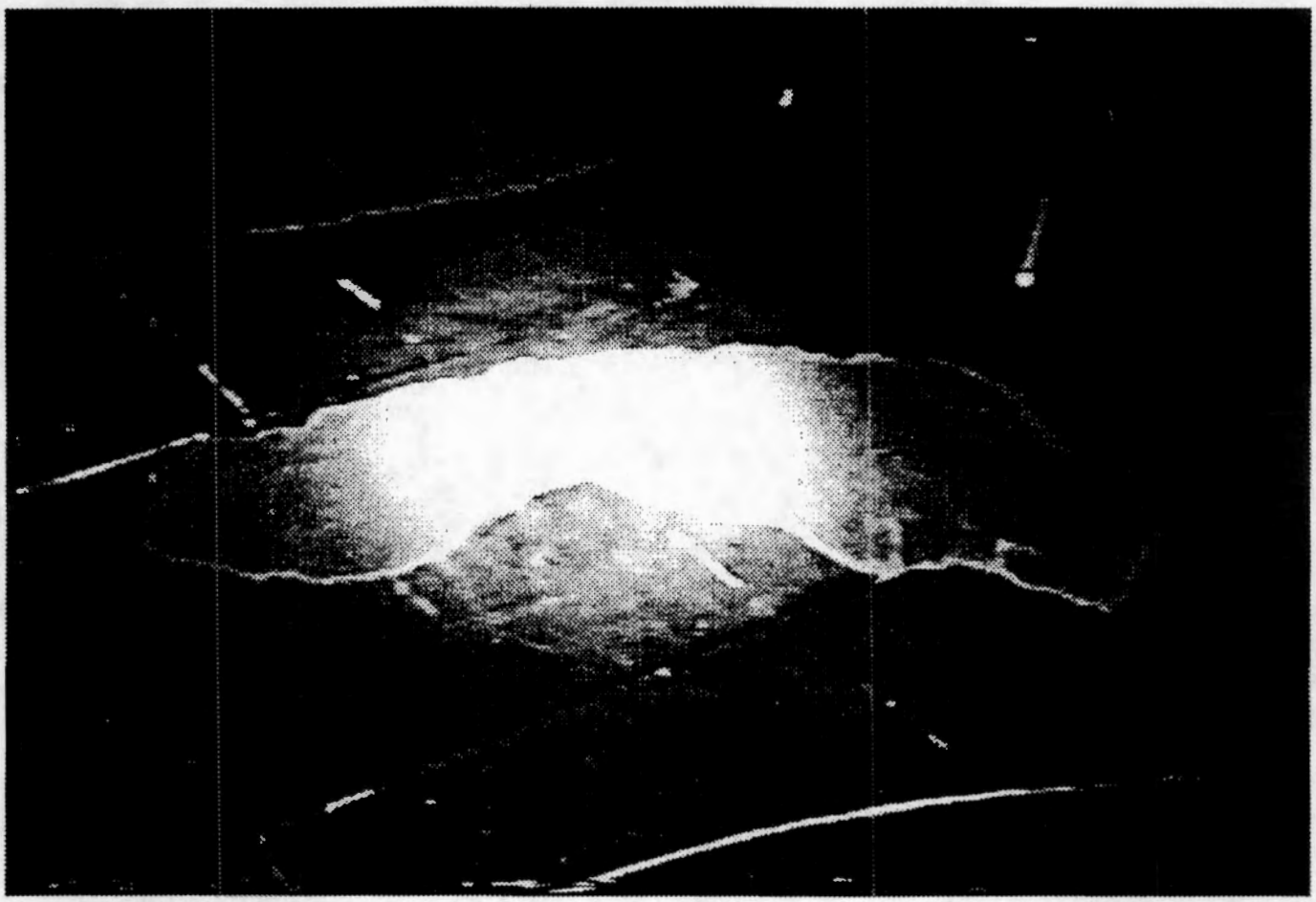
CTF Video No. 1, Recorded 10/10/2003, Simulated Waste Pile (SWP) V1-1.

Attachment	V1	Sheet No. 4 of 9	
Originator	John H. Wing	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11-20-03
Org Mgr		Date	



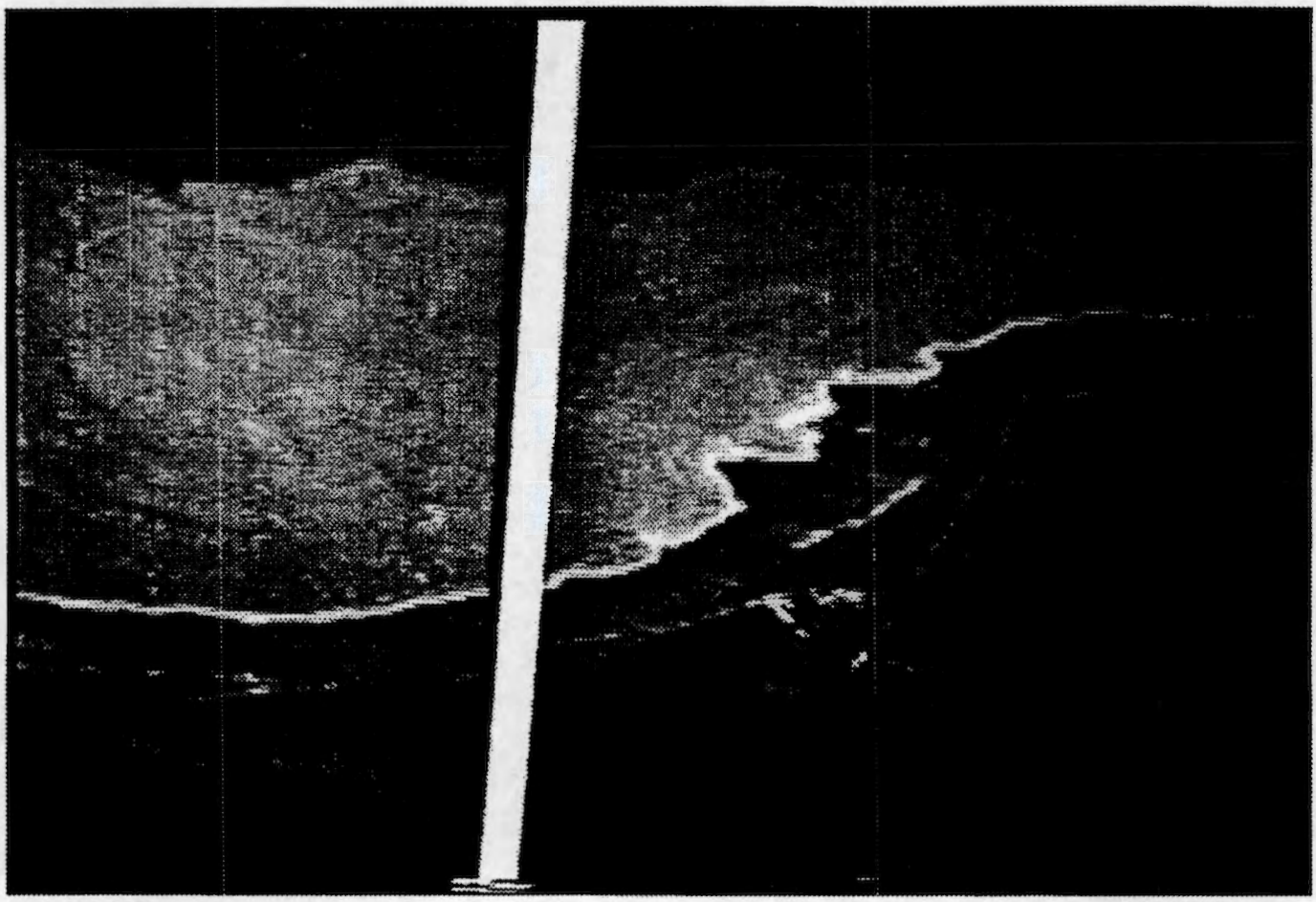
CTF Video No. 1, Recorded 10/10/2003, Simulated Waste Pile (SWP) V1-2.

Attachment	V1	Sheet No.	5 of 9
Originator	John M. Winett	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11-20-03
Org Mgr		Date	



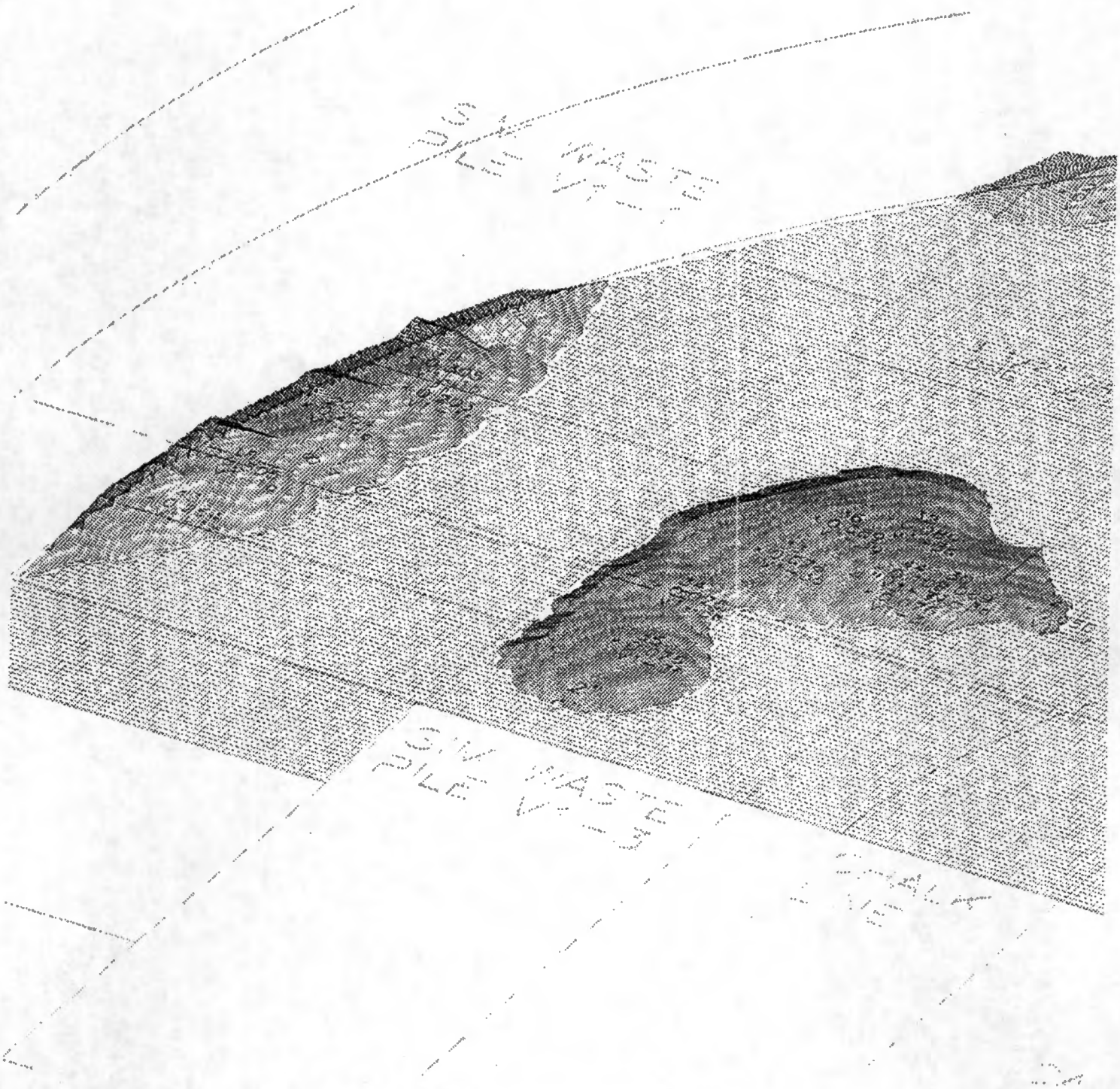
CTF Video No. 1, Recorded 10/10/2003, Simulated Waste Pile (SWP) V1-3.

Attachment	V1	Sheet No. 6 of 9	
Originator	John M. Vimett	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11-20-03
Grp. Mgr.		Date	



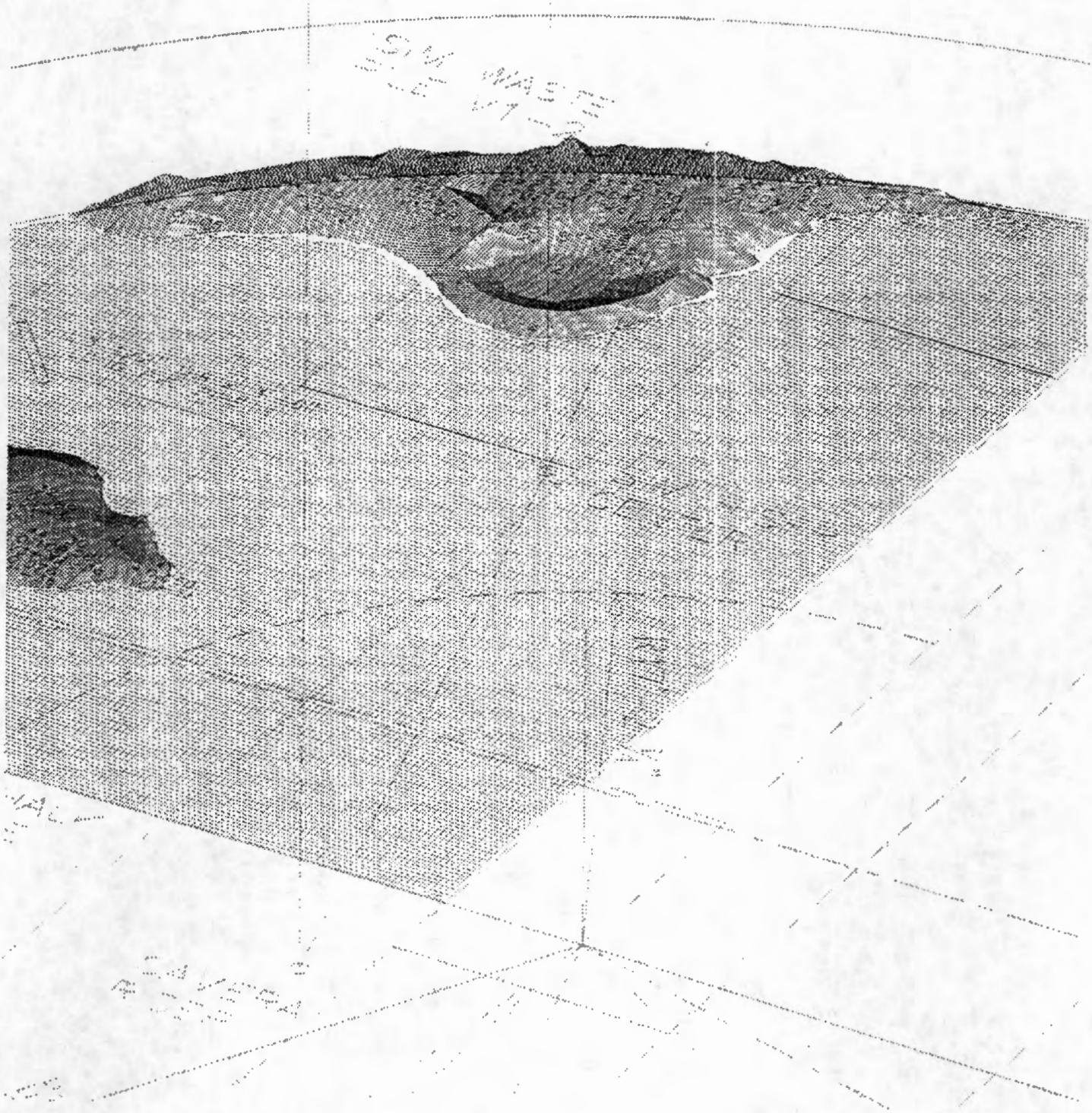
CTF Video No. 1, Recorded 10/10/2003, Simulated Waste Pile (SWP) V1-2.

Attachment	V1	Sheet No. 2 of 9	
Originator	John H. Winett	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11-20-03
Org Mgr		Date	

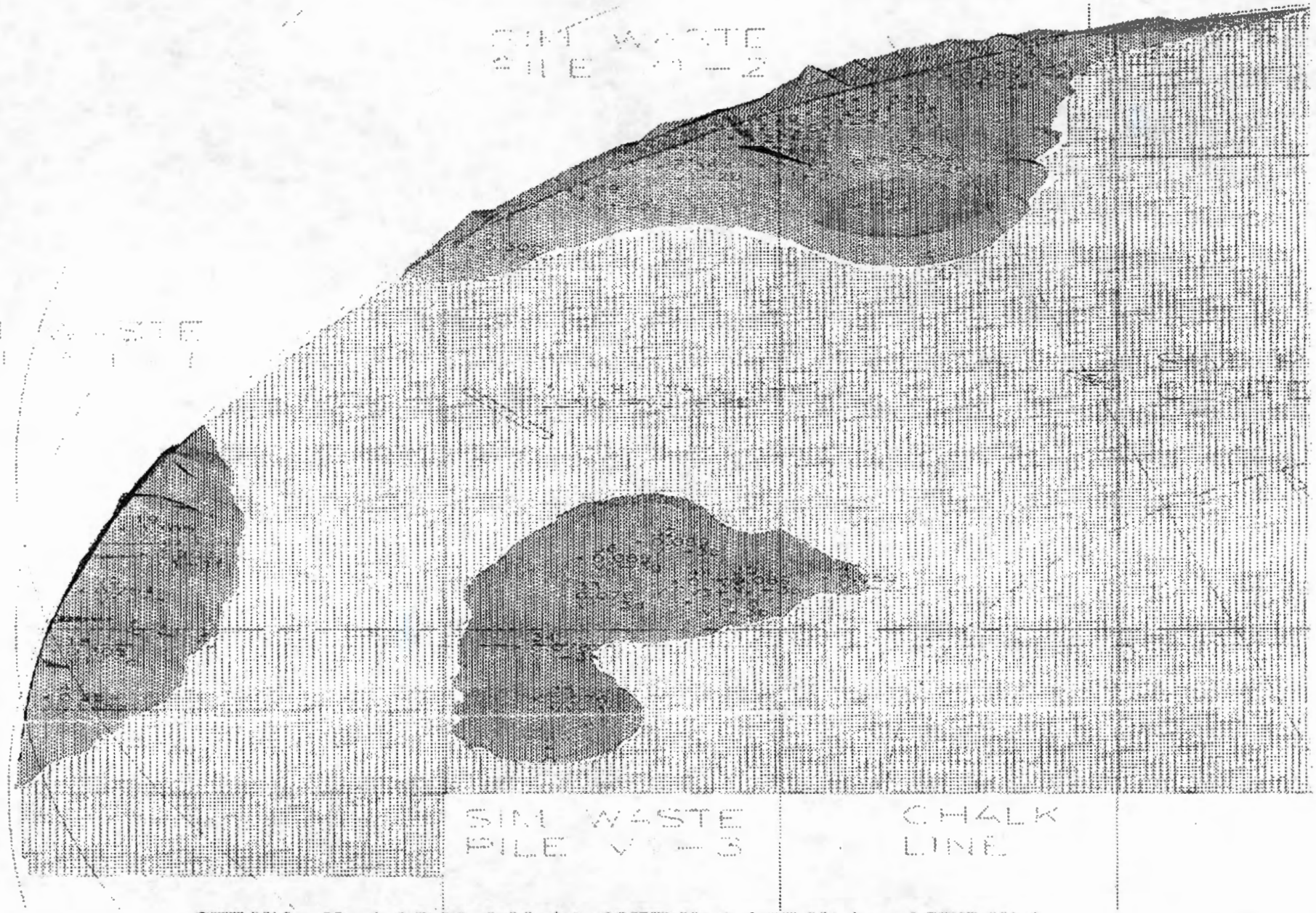


CTF Video No. 1, 3-D Mesh Model of SWP V1-1 and SWP V1-3.

Attachment	V1	Sheet No.	8 of 9
Originator	John H. Winett	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11-20-03
Org Mgr.		Date	



CTF Video No. 1, 3-D Mesh Model of SWP V1-2.



CTF Video No. 1, 3-D Mesh Model of SWP V1-1, SWP V1-2, and SWP V1-3.

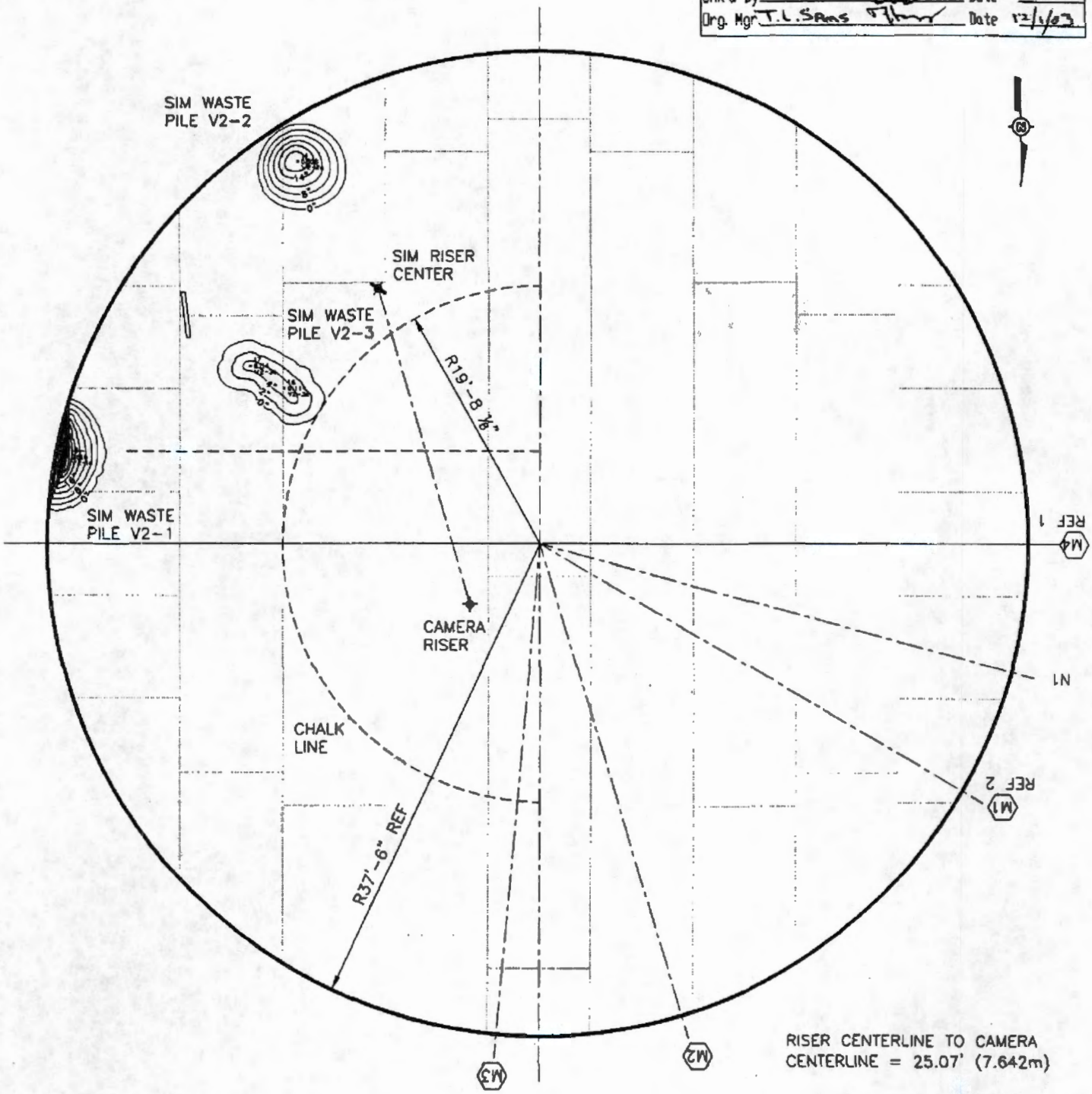
Results of the Video Camera/CAD Modeling System Test **RPP-18744 Rev. 0**

Attachment V1		Sheet No. 9 of 9	
Originator John H. Winett		Date	10-23-03
Chk'd By C. A. Bentz		Date	11-20-03
Org. Mgr.		Date	

APPENDIX D
MODELING DOCUMENTATION OF VIDEO 2

H:\CHG\CTF\CAD FILE\RPP-18744-V2.dwg

Attachment	V2	Sheet No.	1 of 6
Originator	John M. Vinetti	Date	10-17-03
Chk'd By	C. A. Bentz	Date	11/20/03
Org. Mgr	T.L. Sears	Date	12/1/03



RISER CENTERLINE TO CAMERA CENTERLINE = 25.07' (7.642m)

CTF Video No. 2

H:\CHG\CTF\CAD FILE\RPP-18744-V2.dwg

Attachment V2		Sheet No. 2 of 6	
Originator John M. Vinett		Date	10-17-03
Chk'd By C. A. Bentz		Date	11-20-03
Org. Mgr.		Date	

Cold Test Facility Site Volume Table: Unadjusted

Site	Stratum	Surf1	Surf2	Cut cu.m.	Fill cu.m.	Net cu.m.	Method
SWP2-1	V2-P1	CTFbottom	SWP V2-1	0.000	0.525	0.525 (F)	Grid
				0.000	0.529	0.529 (F)	End area
						0.527 (F)	Average
SWP2-2	V2-P2	CTFbottom	SWP V2-2	0.000	0.694	0.694 (F)	Grid
				0.000	0.695	0.695 (F)	End area
						0.694 (F)	Average
SWP2-3	V2-P3	CTFbottom	SWP V2-3	0.000	0.151	0.151 (F)	Grid
				0.000	0.151	0.151 (F)	End area
						0.151 (F)	Average

AutoCAD LAND DEVELOPMENT DESKTOP, Release 2i, VOLUME ESTIMATE

Based on 10/10/03 Video Recording at the Cold Test Facility (CTF)

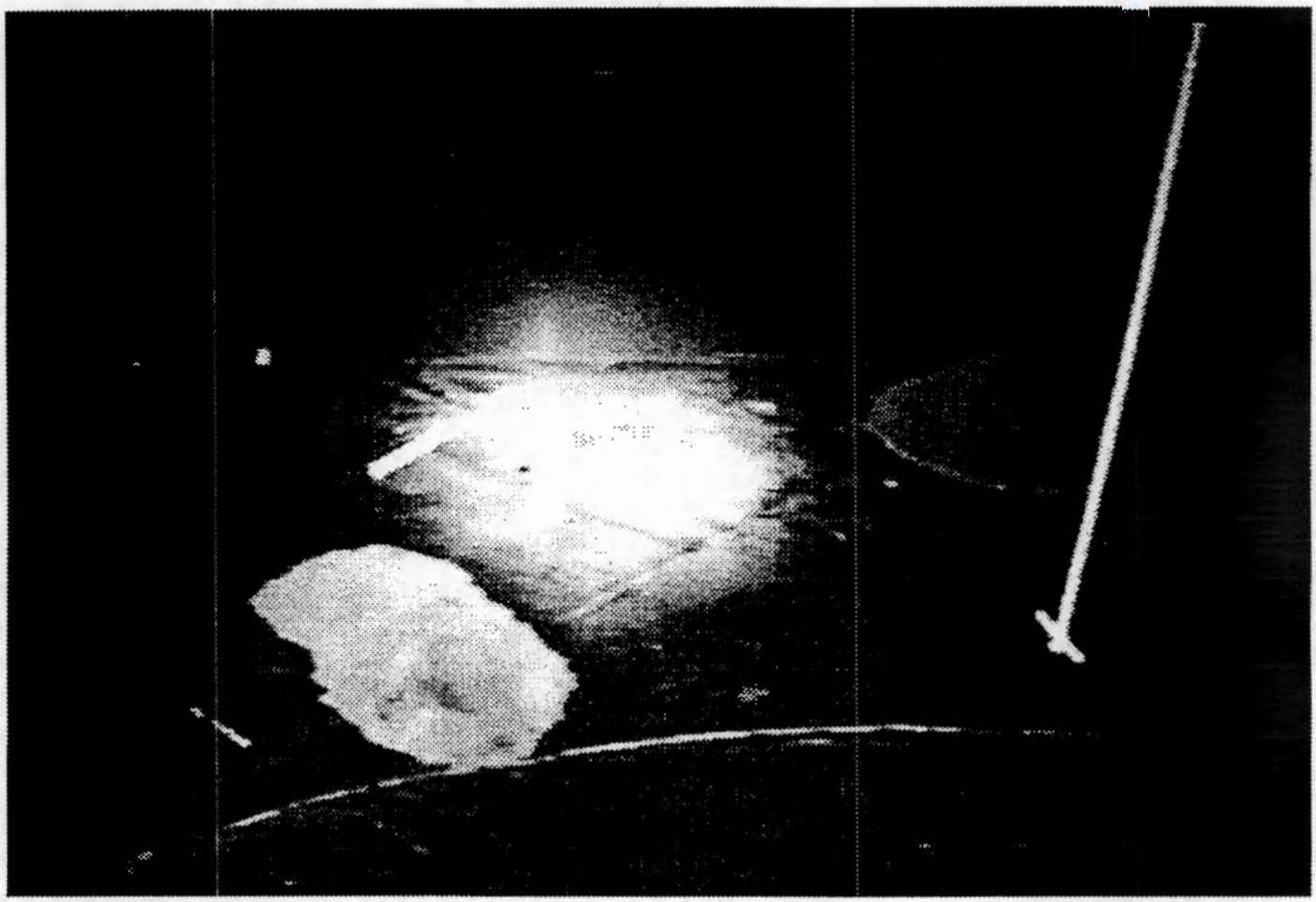
VIDEO TAPE No. 2

VOLUME CONVERSION TABLE FOR CTF VIDEO MEASUREMENT RESULTS:

Description:	Cubic Meters:	Cubic Feet:	Gallons:
WASTE PILE V2-1 TOTAL SOLIDS:	0.527	18.61	139
WASTE PILE V2-2 TOTAL SOLIDS:	0.694	24.51	183
WASTE PILE V2-3 TOTAL SOLIDS:	0.151	5.33	40
VIDEO No. 2 GRAND TOTAL:	1.372	48.45	362

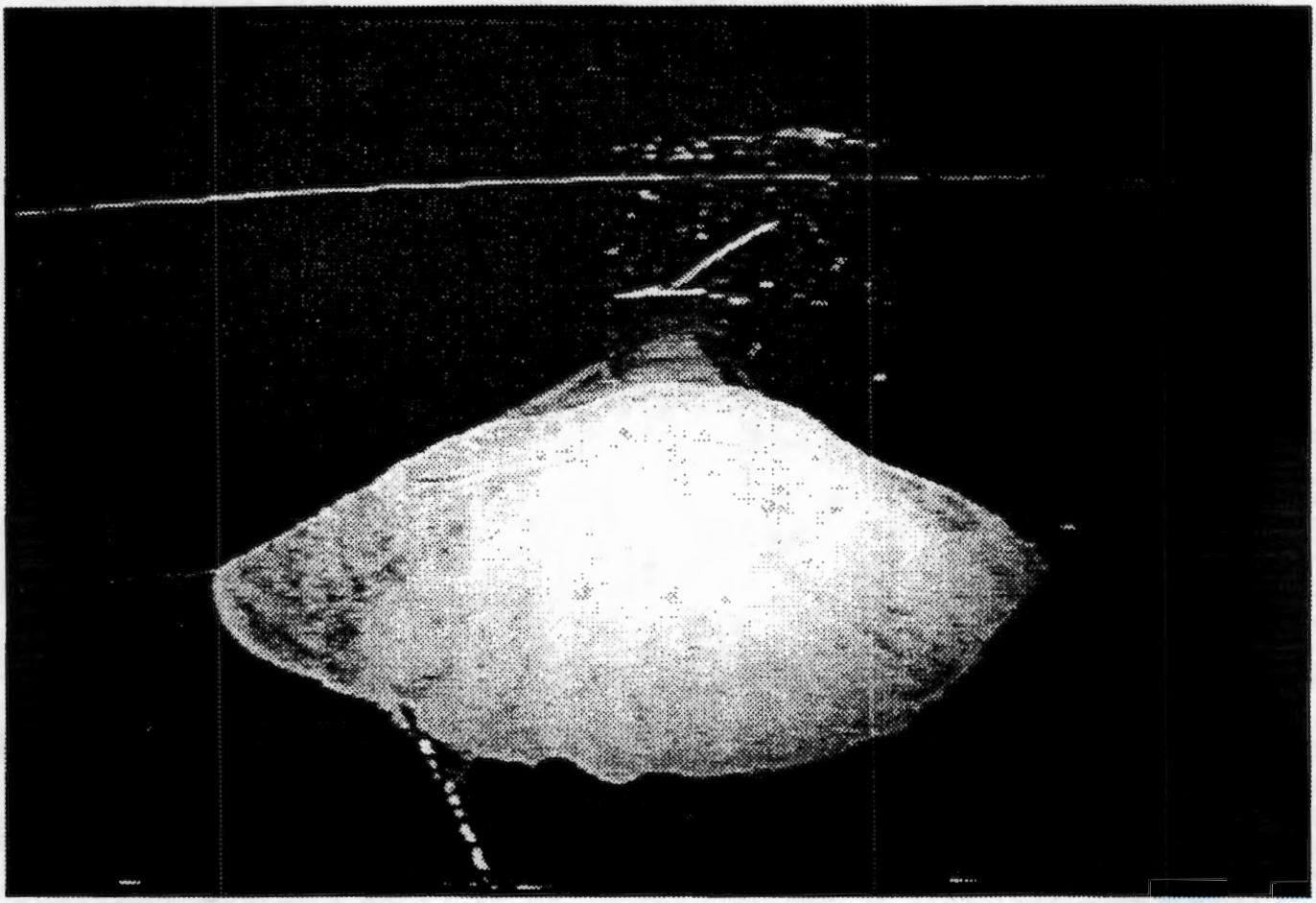
CTF Video No. 2

Attachment	V2	Sheet No.	3 of 6
Originator	John M. Winslett	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11-20-03
Org. Mgr.		Date	



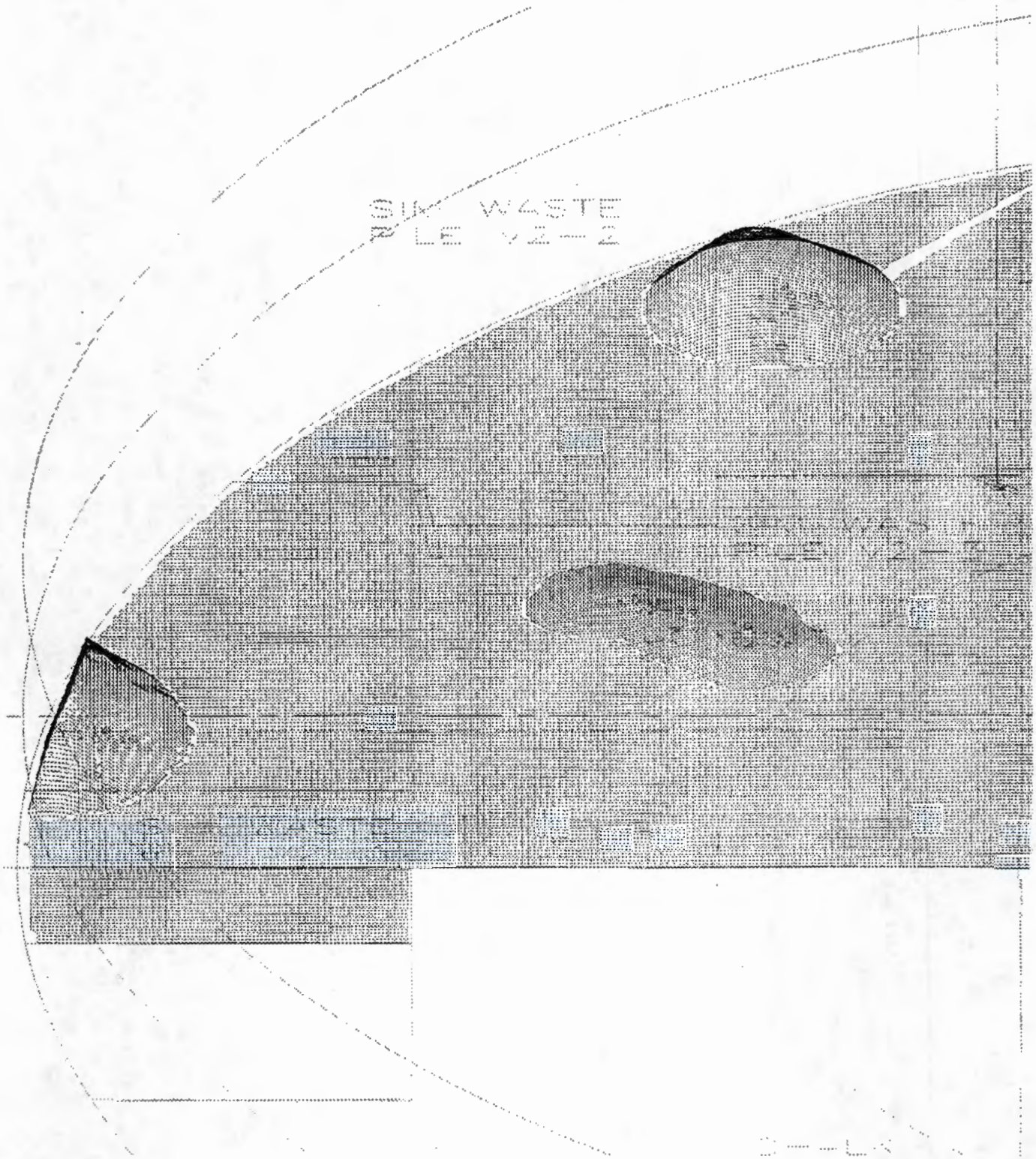
CTF Video No. 2, Recorded 10/10/2003, Simulated Waste Pile (SWP) V2-2 and V2-3.

Attachment V2		Sheet No. 4 of 6	
Originator John M. Winett		Date	10-23-03
Chk'd By C. A. Bentz		Date	11-20-03
Org. Mgr.		Date	

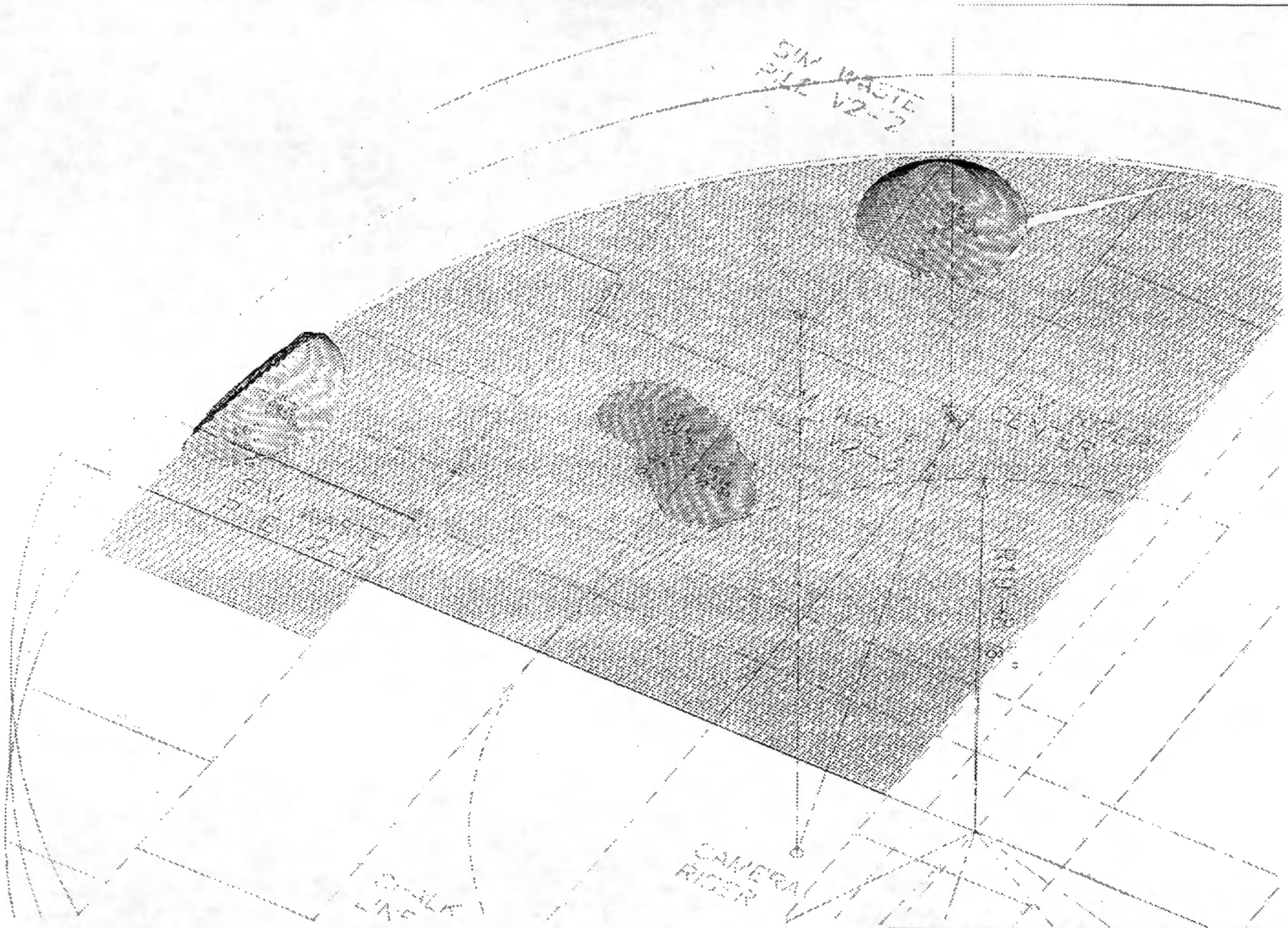


CTF Video No. 2, Recorded 10/10/2003, Simulated Waste Pile (SWP) V2-1.

Attachment	V2	Sheet No.	5 of 6
Originator	John M. Winett	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11-20-03
Org Mgr		Date	



CTF Video No. 2, 3-D Mesh Model of SWP V2-1, SWP V2-2 and SWP V2-3.



Attachment	V2	Sheet	No. 6 of 6
Originator	John M. Wimett	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11-20-03
Org. Mgr.		Date	

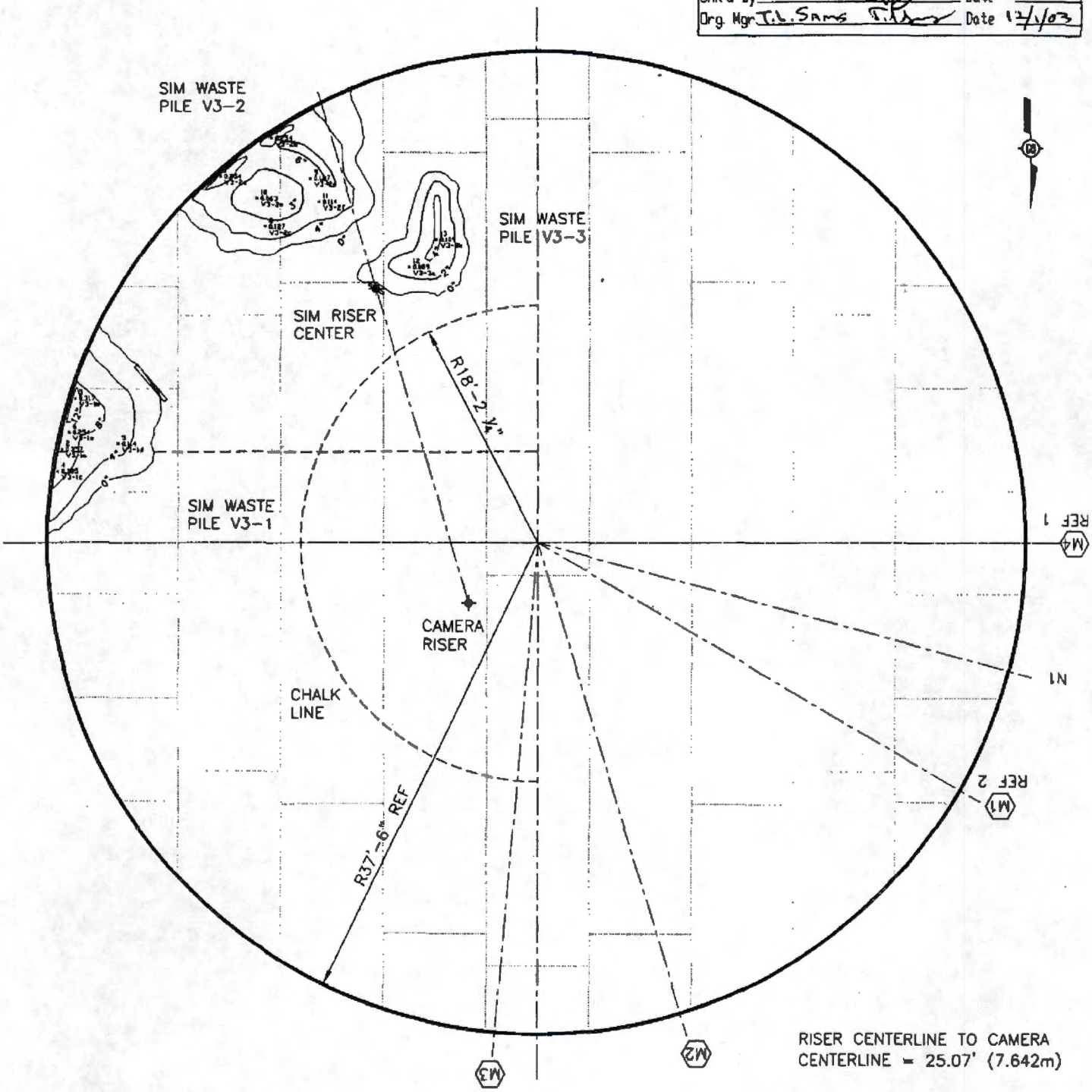
CTF Video No. 2, 3-D Mesh Model of SWP V2-1, SWP V2-2 and SWP V2-3.

Results of the Video Camera/CAD Modeling System Test **RPP-18744 Rev. 0**

APPENDIX E
MODELING DOCUMENTATION OF VIDEO 3

H:\CHG\CTF\CAD FILE\RPP-18744-V3.dwg

Attachment	V3	Sheet No.	1 of 6
Originator	John M. Winett	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11/20/03
Org. Mgr	T.L. Sams	Date	12/1/03



RISER CENTERLINE TO CAMERA CENTERLINE = 25.07' (7.642m)

CTF Video No. 3

Results of the Video Camera/CAD Modeling System Test

RPP-18744 Rev. 0

H:\CHG\CTF\CAD FILE\RPP-18744-V3.dwg

Attachment	V3	Sheet No.	2 of 6
Originator	John M. Winett	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11-20-03
Org. Mgr.		Date	

Cold Test Facility Site Volume Table: Unadjusted

Site	Stratum	Surf1	Surf2	Cut cu.m.	Fill cu.m.	Net cu.m.	Method
SWP 1	V3-P1	CTFbottom	SWP V3-1	0.000	0.841	0.841 (F)	Grid
				0.000	0.862	0.862 (F)	End area
						0.852 (F)	Average
SWP 2	V3-P2	CTFbottom	SWP V3-2	0.000	0.941	0.941 (F)	Grid
				0.000	1.000	1.000 (F)	End area
						0.971 (F)	Average
SWP 3	V3-P3	CTFbottom	SWP V3-3	0.000	0.195	0.195 (F)	Grid
				0.000	0.196	0.196 (F)	End area
						0.196 (F)	Average

AutoCAD LAND DEVELOPMENT DESKTOP, Release 2i, VOLUME ESTIMATE

Based on 10/10/03 Video Recording at the Cold Test Facility (CTF)

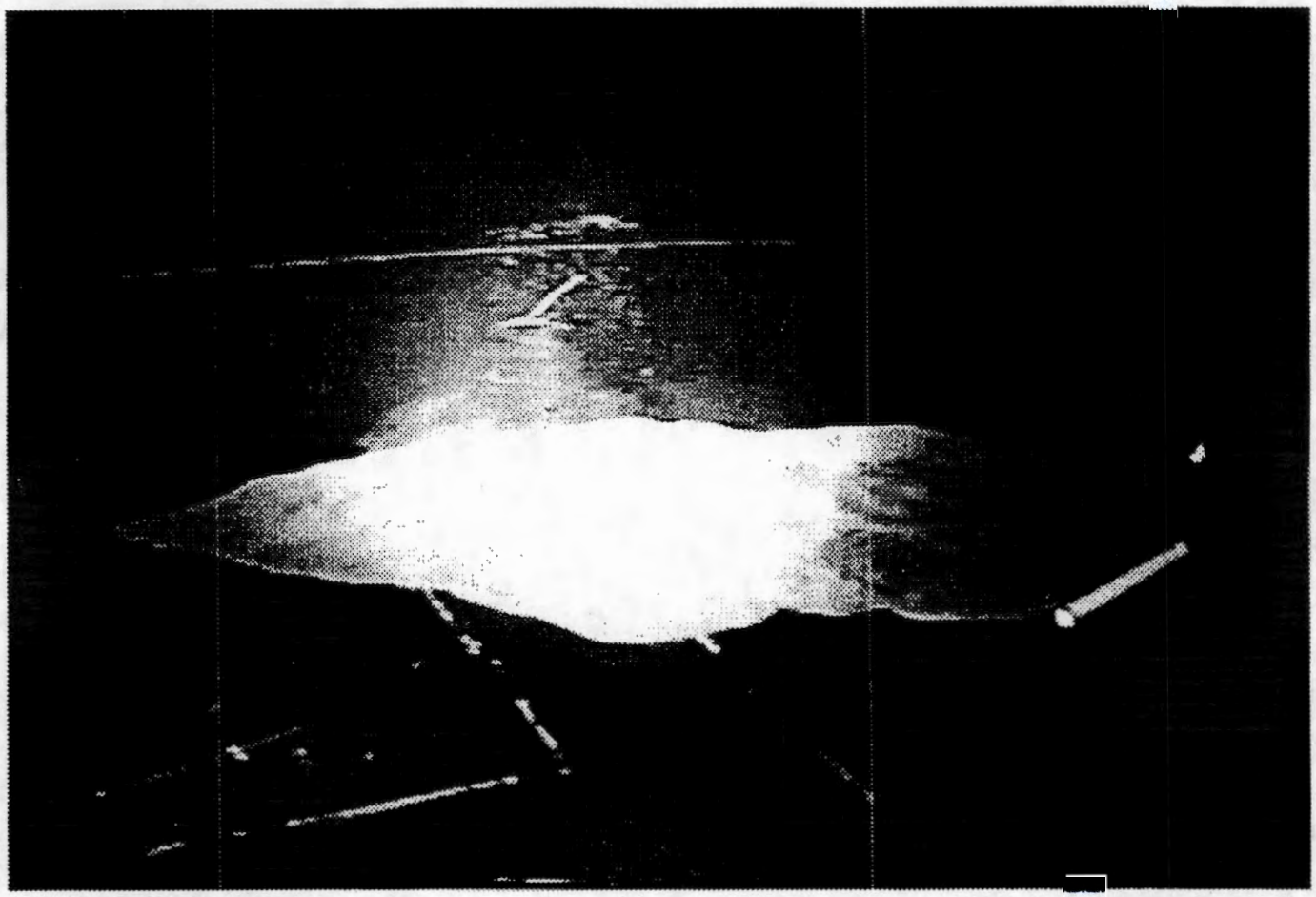
VIDEO TAPE No. 3

VOLUME CONVERSION TABLE FOR CTF VIDEO MEASUREMENT RESULTS:

Description:	Cubic Meters:	Cubic Feet:	Gallons:
WASTE PILE V3-1 TOTAL SOLIDS:	0.852	30.08	225
WASTE PILE V3-2 TOTAL SOLIDS:	0.971	34.29	256
WASTE PILE V3-3 TOTAL SOLIDS:	0.196	6.92	52
VIDEO No. 3 GRAND TOTAL:	2.019	71.29	533

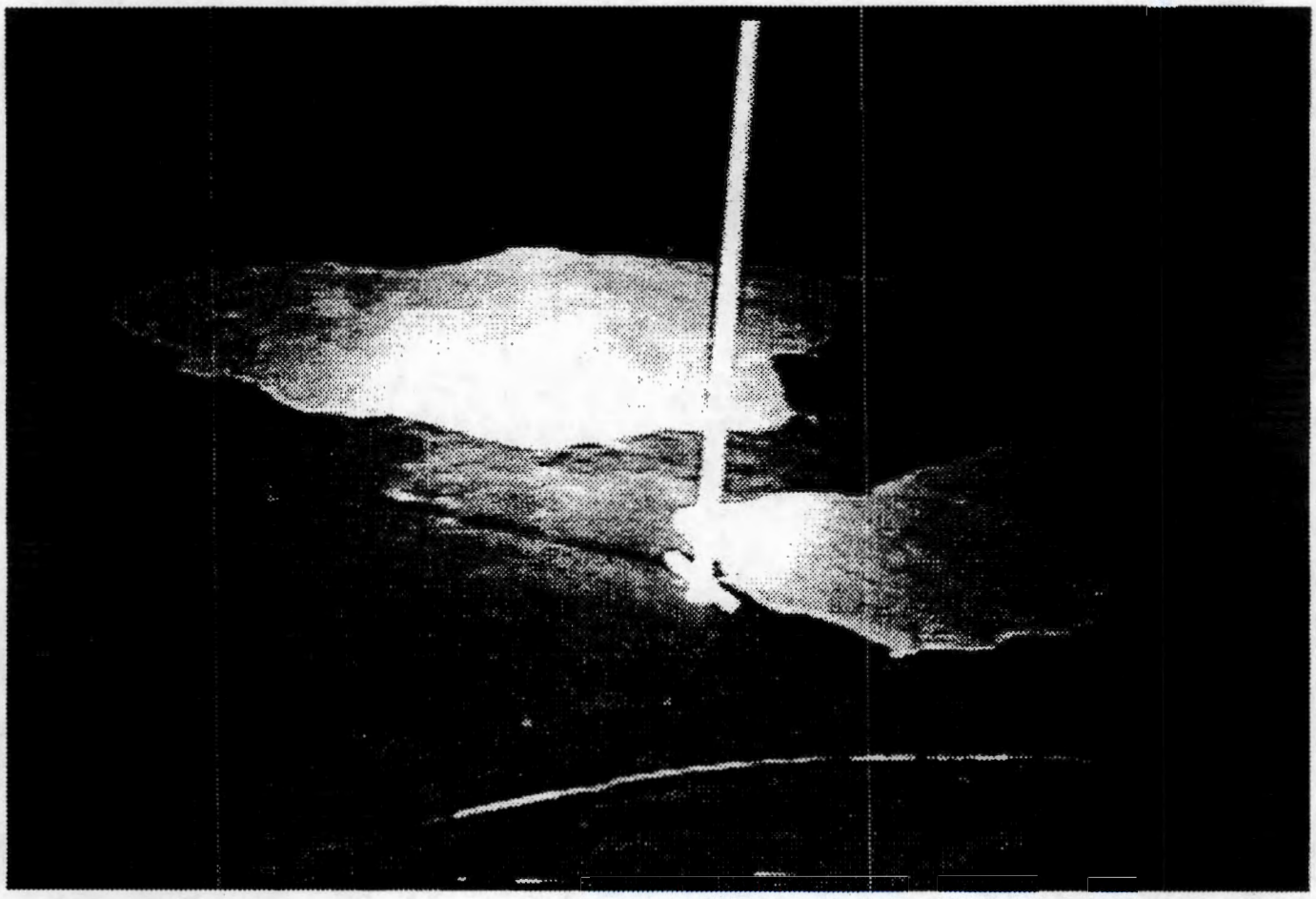
CTF Video No. 3

Attachment	V3	Sheet No.	3 of 6
Originator	John H. Winett	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11-20-03
Org. Mgr.		Date	



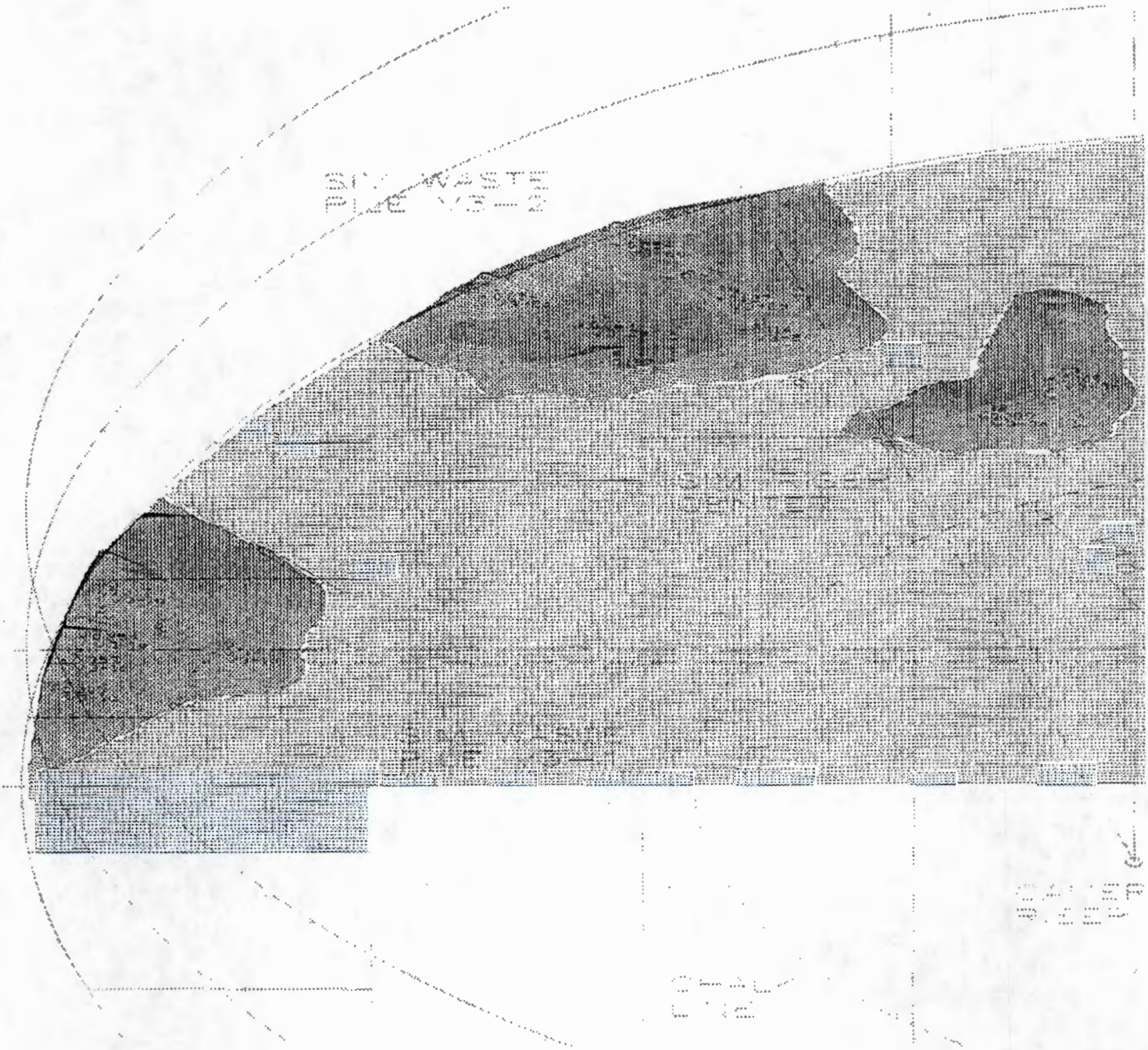
CTF Video No. 3, Recorded 10/10/2003, Simulated Waste Pile (SWP) V3-1.

Attachment	V3	Sheet No. 4 of 6	
Originator	John M. Winett	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11-20-03
Org. Mgr.		Date	

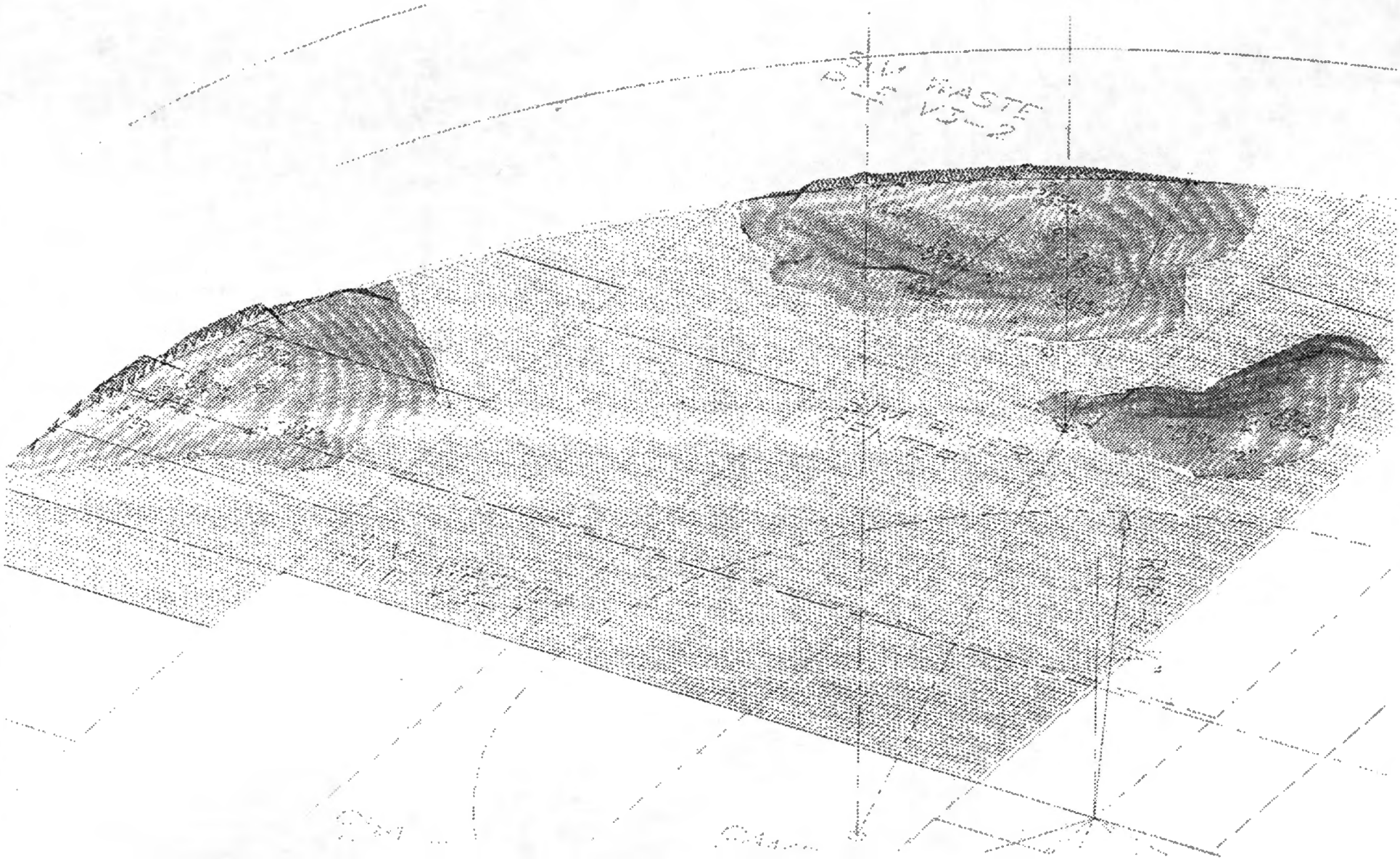


CTF Video No. 3, Recorded 10/10/2003, Simulated Waste Pile (SWP) V3-2 and V3-3.

Attachment	V3	Sheet No.	5 of 6
Originator	John H. Vinette	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11-20-03
Org. Mgr.		Date	



CTF Video No. 3, 3-D Mesh Model of SWP V3-1, SWP V3-2 and SWP V3-3.



CTF Video No. 3, 3-D Mesh Model of SWP V3-1, SWP V3-2 and SWP V3-3.

Results of the Video Camera/CAD Modeling System Test **RPP-18744 Rev. 0**

Attachment	V3	Sheet No.	6 of 6
Originator	John H. Winett	Date	10-23-03
Chk'd By	C. A. Bentz	Date	11-20-03
Org Mgr		Date	

APPENDIX F
SPREADSHEET VERIFICATION

	A	B	C	D	E	F	G	H
1	Video	Measurement	Estimated Volume	Actual Volume				
2	1	1	18.93	17.81				
3	1	2	11.09	17.81				
4	1	3	42.05	41.55				
5	2	4	18.61	17.81				
6	2	5	5.33	11.87				
7	2	6	24.51	29.68				
8	3	7	30.08	30.42				
9	3	8	6.92	14.10				
10	3	9	34.29	32.65				
11								
12								
13	Total Volumes		Estimated	Actual			Error with 80% Confidence	
14		Video 1	72.07	77.168	0.9339363		Average	0.891324
15		Video 2	48.45	59.36	0.8162062		Standard Deviation	0.06525
16		Video 3	71.29	77.168	0.9238285		N	3
17							t-value(0.90,2)	1.886
18							RHW	0.071049
19							LL	**0.820274**
20							UL	0.962373
21	Pool Diameters							
22			Estimated Diameter	Actual Diameter	Ratio (Estimated/ Actual)		Error with 80% Confidence	
23		1	34.375	34.8473	0.9864475		Average	0.987765
24		2	39.354	40.0835	0.9817997		Standard Deviation	0.006722
25		3	36.375	36.5560	0.9950487		N	3
26							t-value(0.90,2)	1.886
27							RHW	0.00732
28							LL	**0.980446**
29							UL	0.995085

	A	B	C	D	E	F	G	H
1	Video	Measurement	Estimated Volume	Actual Volume				
2	1	1	18.93	17.808				
3	1	2	11.09	17.808				
4	1	3	42.05	41.552				
5	2	4	18.61	17.808				
6	2	5	5.33	11.872				
7	2	6	24.51	29.68				
8	3	7	30.08	30.422				
9	3	8	6.92	14.098				
10	3	9	34.29	32.648				
11								
12								
13	Total \		Estimated	Actual			Error with 80% Confidence	
14		Video 1	=SUM(C2:C4)	=SUM(D2:D4)	=C14/D14		Average	=AVERAGE(E14:E16)
15		Video 2	=SUM(C5:C7)	=SUM(D5:D7)	=C15/D15		Standard Deviation	=STDEV(E14:E16)
16		Video 3	=SUM(C8:C10)	=SUM(D8:D10)	=C16/D16		N	3
17							t-value(0.90,2)	1.886
18							RHW	=H17*H15/SQRT(H16)
19							**LL**	**=H14-H18**
20							UL	=H14+H18
21	Pool D							
22			Estimated Diameter	Actual Diameter	Ratio (Estimated/Actual)		Error with 80% Confidence	
23		1	34.375	34.847266666666	=C23/D23		Average	=AVERAGE(E23:E25)
24		2	39.354	40.083533333333	=C24/D24		Standard Deviation	=STDEV(E23:E25)
25		3	36.375	36.556	=C25/D25		N	3
26							t-value(0.90,2)	1.886
27							RHW	=H26*H24/SQRT(H25)
28							**LL**	**=H23-H27**
29							UL	=H23+H27

Spreadsheet Owner: C W Burrup
Spreadsheet File Number: 118
File Name of Spreadsheet: C106_Error_Estimate_Final.xls
Location of Spreadsheet: \\Chardocs on AP012\All By Staff Member\Burrup\C106 Vol Estimates
Brief Description of Spreadsheet: Calculates the precision of estimating volumes of bergs and diameters of pools at an 80% confidence level.
Assumptions:

Worksheet Name	Cell	Intended Formula Function	Cell Formula	Checked By	Date
Computations	A2 to D10	Data table - input data	None		10/31/03
	C14	Computes total estimated volume for video 1 by summing the video 1 estimates	=SUM(C2:C4)		10/31/03
	C15	Computes total estimated volume for video 2 by summing the video 2 estimates	=SUM(C5:C7)		10/31/03
	C16	Computes total estimated volume for video 3 by summing the video 3 estimates	=SUM(C8:C10)		10/31/03
	D14	Computes total actual volume for video 1 by summing the video 1 volumes	=SUM(D2:D4)		10/31/03
	D15	Computes total actual volume for video 2 by summing the video 2 volumes	=SUM(D5:D7)		10/31/03
	D16	Computes total actual volume for video 3 by summing the video 3 volumes	=SUM(D8:D10)		10/31/03
	E14	Computes ratio of estimated volume to actual volume for Video 1	=C14/D14		10/31/03
	E15	Computes ratio of estimated volume to actual volume for Video 2	=C15/D15		10/31/03
	E16	Computes ratio of estimated volume to actual volume for Video 3	=C16/D16		10/31/03
	H14	The average of the volume ratios for video 1, 2, and 3	=AVERAGE(E14:E16)		10/31/03
	H15	The standard deviation (sd) of the volume ratios for video 1, 2, and 3	=STDEV(E14:E16)		10/31/03
	H16	The number (N) of ratios used in the average calculation (number of videos)	NA		10/31/03
	H17	The t-statistic (tval) for a 2-sided 80% Confidence Interval with N-1 degrees of freedom.	NA - from statistics table		10/31/03
	H18	The Relative Half Width (RHW) of an 80% Confidence Interval - this is the precision (t-val*sd/sqrt(N))	=H17*H15/SQRT(H16)		10/31/03
	H19	The lower limit of the 80% confidence interval (average - RHW)	=H14-H18		10/31/03
	H20	The upper limit of the 80% confidence interval (average + RHW)	=H14+H18		10/31/03
	B23 through D25	Data table - input data	NA		10/31/03
	E23	Computes ratio of estimated diameter to actual diameter for Video 1	=C23/D23		10/31/03
	E24	Computes ratio of estimated diameter to actual diameter for Video 2	=C24/D24		10/31/03

Worksheet Name	Cell	Intended Formula Function	Cell Formula	Checked By	Date
	E25	Computes ratio of estimated diameter to actual diameter for Video 3	=C25/D25		10/31/03
	H23	The average of the diameter ratios for video 1, 2, and 3	=AVERAGE(E23:E25)		10/31/03
	H24	The standard deviation (sd_y) of the diameter ratios for video 1, 2, and 3	=STDEV(E23:E25)		10/31/03
	H25	The number (N) of ratios used in the average calculation (number of videos)	NA		10/31/03
	H26	The t-statistic (tval) for a 2-sided 80% Confidence Interval with N-1 degrees of freedom.	NA - from statistics table		10/31/03
	H27	The Relative Half Width (RHW) of an 80% Confidence Interval - this is the precision (t-val*sd_y/sqrt(N))	=H26*H24/SQRT(H25)		10/31/03
	H28	The lower limit of the 80% confidence interval (average - RHW)	=H23-H27		10/31/03
	H29	The upper limit of the 80% confidence interval (average+RHW)	=H23+H27		10/31/03

Approvals
Owner: Cary W Barrup
Verifier: Alexis N. Naikinmalkar 10/31/03