NYE COUNTY NUCLEAR WASTE REPOSITORY

PROJECT OFFICE

TECHNICAL PROCEDURE

TITLE:	Revision: 0
Instrumentation Calibration, Collection and Processing of Data in ESF Tunnels	Date: 10/27/98
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PROCEDURE No.:	SUPERSEDES:
TP - 9.3	Original Issuance March 22, 1996
APPROVAL Project Manager Date Les W Brudshaw 10.29.98	CONCURRENCE On-Site Geotechnical Representative 10-29-98 Date Principal Investigator 10-29-98 Date Project Quality Assurance Officer 10-29-98 Date

1. PURPOSE

The purpose of this procedure is to provide instructions for calibration and installation of sensoring instruments in the Exploratory Studies Facility (ESF) tunnels and retrieval and

processing of data from these instruments for the Nye County Nuclear Waste Repository Project Office (NWRPO). The implementation of this procedure ensures that these instrument assemblies are properly installed and that data collected and processed from these instrument assemblies are properly installed and that data collected and processed from these instrument assemblies as part of the Nye County Independent Scientific Investigation Program meet NWRPO quality assurance (QA) requirements for scientific data.

2. SCOPE

This procedure describes activities required to calibrate and install monitoring instrumentation in the ESF tunnels, which includes installation in the ECRB tunnel (a tunnel currently being excavated off the Main Tunnel). In addition, it describes activities necessary to collect and process data from these instruments.

2.1 APPLICABILITY

This procedure applies to the NWRPO principal investigator (PI) or designated personnel and contractors performing the scientific investigation tasks listed in the above section. These individuals shall be referred to herein as NWRPO personnel.

2.2 TRAINING

NWRPO personnel shall be trained before conducting work and shall document that they have read and understand this procedure. Personnel performing the tasks described in this technical procedure shall be professional geoscientists or engineers with applicable previous experience. Personnel performing laboratory and field calibrations as well as data-collection tasks shall be trained in procedures specifically applicable to the instrumentation used. Personnel involved in the processing of data shall be trained in the use of the spreadsheet and database programs used. Special computer expertise is not required for these programs, which were developed under a separate NWRPO technical procedure entitled "Computer Modeling and Data Analysis Quality Assurance Procedure."

3. DEFINITIONS

Campbell Equipment: The CR10 data logger and sensors for measuring and logging air temperature, relative humidity, thermocouple temperature, barometric pressure, volumetric water content and soil water potential.

Solomat Equipment: The Solomat data logger and sensors for measuring air velocity

TDR: Time Domain Reflectometry

4. RESPONSIBILITIES

The project QA Officer shall be responsible for the coordination of the internal review of this technical procedure.

The PI shall be responsible for the preparation and modification of this procedure, as well as oversight of the performance of this procedure.

NWRPO personnel shall be responsible for the implementation of this procedure.

5. PROCESS

This procedure controls the activities performed by NWRPO personnel related to laboratory and field calibration as well as the collection and processing of data (including correcting for electronic drift) from the ESF tunnels. Any deviation from this procedure shall be documented in the field and/or office logbooks (i.e., scientific notebooks).

The performance of the tasks specified in this procedure shall be documented in scientific notebooks or computer text files, as appropriate. All documentation shall meet the requirements of QAP-3.2, "Procedures for Documentation of Scientific Investigations."

5.1 CALIBRATION OF EQUIPMENT

5.1.1 TEMPERATURE & RELATIVE HUMIDITY SENSOR (CAMPBELL SCIENTIFIC, HMP35C, 3 UNITS)

Each HMP35C unit measures both temperature and relative humidity. Both temperature and relative humidity probes are factory calibrated to nationally recognized standards if available. However, if national standards do not exist for particular probes, the best available standard will be used, e.g., the manufacturer's calibration, a field calibration, or

other appropriate method. It is understood that the unavailability of a national standard for calibration purposes will not impact the data adversely. The temperature sensor is also calibrated by NWRPO in a laboratory against a recently calibrated reference temperature. The small difference between the reference temperature and that measured by HMP35C is recorded as the sensor-specific "offset". The calibration offsets are stored in a database and used to correct temperature measurements. The calibration should be performed periodically (at least twice per year) and whenever collected data suggest malfunctioning sensors.

The relative humidity probes shall be sent to the manufacturer for recalibration once every year and whenever collected data suggest malfunctioning sensors.

5.1.2 PRESSURE SENSOR (CAMPBELL SCIENTIFIC, VAISALA, 1 UNIT)

The pressure sensor is factory calibrated as mentioned above. It is also calibrated by NWRPO in a laboratory against a recently calibrated reference pressure. The small difference between the reference pressure and that measured by Vaisala is recorded as sensor-specific "offset". The calibration offsets are stored in a database and used to correct pressure measurements. The calibration shall be performed periodically (at least twice per year) and whenever collected data suggests malfunctioning sensors.

5.1.3 MOISTURE CONTENT SENSOR (CAMPBELL SCIENTIFIC, CS615, 2 UNITS)

The TDR probes are factory calibrated as mentioned above. The TDR probes are used to measure volumetric water content for a range of moisture (dry to wet). The TDR probes shall be sent to the manufacturer for recalibration once every year and whenever collected data suggest malfunctioning sensors.

5.1.4 SOIL MOISTURE BLOCK (CAMPBELL SCIENTIFIC, 227, 2 UNITS)

The soil moisture blocks are factory calibrated as mentioned above. The soil moisture blocks are not as reliable as TDR probes and will be only used as an indicator of soil wetness in the wet moisture range. There is no need for further calibration of the soil moisture blocks.

5.1.5 AIR VELOCITY SENSOR (SOLOMAT, 3 UNITS)

The air velocity sensors are factory calibrated as mentioned above. The air velocity sensors shall be sent to the manufacturer for recalibration once every year and whenever collected data suggest malfunctioning sensors.

5.2 PROGRAMMING DATA LOGGERS

5.2.1 CR10 DATA LOGGER

The procedure includes test programs to wire each sensor individually and in combination to ensure program integrity and reasonableness of sensor outputs. Test programs are combined to develop a final program for logging data using all sensors every 5 minutes. Attachment I includes a copy of the test and final programs. The program is tested both by using manual inputs and checking the expected outputs (in case of TDR and soil moisture probes) and by connecting all the sensors, logging for 70 hours and checking the reasonableness of measured outputs.

5.2.2 SOLOMAT DATA LOGGER

A program has been written to log three air velocity sensors once every 5 minutes. This data logger can be used in the future to increase the number of sensors and include other environmental factors. Attachment II includes a copy of the test and final programs.

5.3 CORRECTION OF TEMPERATURE AND PRESSURE SENSORS FOR ELECTRONIC DRIFT

The following steps are taken to adjust temperature and pressure sensors for electronic drift after routine recalibration. The difference in calibration curve offsets for successive laboratory calibrations are determined. The difference between these current and previous calibration offsets is assumed to be equal to the drift in the calibration curve of a particular probe. It is further assumed that this drift occurred at a constant rate over the time period between calibrations. The measured values are then adjusted for the constant drift for the entire period.

5.4 INSTALLING THE INSTRUMENTS IN THE ESF TUNNELS

The selection of the location for the installation of the assembly is coordinated with the ESF test coordinator and the Principal Investigator (PI). At least three stations within the ESF are required to obtain a full range of observations needed for this test. These three stations should have different moisture and heat characteristics. Three sets of anemometers, temperature, and humidity probes (labeled A, B, and C in Figure 1) are installed at 3 different distances from the wall of the tunnel. The anemometer is directed to measure air velocity into the tunnel. Two 1.25 inch boreholes are drilled to accommodate the TDR probes. These boreholes are filled with saturated silica flour and the TDR probes are inserted. A sample of silica flour with similar moisture content and density is collected and sent to a soil laboratory for soil-moisture retention analysis.

Wiring connections for the Campbell CR10 sensors are given in Attachment III.

5.5 COLLECTING AND DOWNLOADING DATA

Data is stored in the CR10 data logger, the Storage Module, and the Solomat data logger. The Storage Module is a backup storage area for the CR10 data. A portable field computer shall be used to download data from each data logger. The frequency of downloads shall be determined by the PI and may vary, based on the needs of the project. The procedure to download temperature, relative humidity, pressure, and soil moisture content from the CR10 data logger and the Storage Module are detailed in their respective manufacturers' manuals. The procedure for downloading air velocity data from the Solomat data logger is detailed in its respective manual.

The name of the downloaded files from the data loggers shall include a six-digit date and a two-character qualifier for each specific data source. The first character in the qualifier for the CR10 is the letter 'c', for the Storage Module the letter 'd' and for the Solomat, the letter 'e'. The second character in the qualifier designates the sequential number of the download episode for the day of interest. For example, the file name *111897c1.???* represents the first download of ESF data from the CR10 on November 18, 1997. Question marks in the file extension represent the file type and are automatically assigned

by the data logger. A sample of the raw data file from the CR10 including field headers is shown in Attachment IV.

Once downloaded into the portable field computer, the raw data shall be converted to Lotus 123 spreadsheet format (wk1) with a time column included. The raw data spreadsheet files shall be transferred to computer diskette and archived at the NWRPO.

5.6 PROCESSING DATA

Copies of diskettes containing raw data spreadsheet files shall be sent to the office of the contractor responsible for data analysis (MET in Newport Beach, CA). These files may also be sent electronically via modem through an internet server, but their transmission shall be documented and followed by corresponding diskettes, labeled with filename(s), data, and name of the NWRPO personnel involved in the data collection. The recipient of the data shall verify that the data on the diskettes is identical to the data transferred electronically.

The data shall be entered into the Microsoft Access program by trained personnel. Two databases shall be used for processing the data: *nye-ESF.mdb* for manipulating data, and *stor-ESF.mdb* for data storage. These databases currently reside on the MET network disk drive in the directory *Mp133::C:\projects\nyecount\tunnel*.

5.6.1 PROCESSING RAW DATA

Before converting the data generated in the field to a database format for data manipulation and storage, the following steps shall be used to process the raw spreadsheet files.

1.0 Reading New Data into Microsoft Excel

Open the spreadsheet file. As discussed previously, specific data sources will have a two-digit qualifier in the filename as shown below.

Name	Filename[a]
CR10 data logger	******c1.dat
Solomat data logger	******e1.csv

[a] Asterisks in the filename are placeholders for the 6-digit download date.

2.0 Checking Data for Errors

- Verify that the maximum and minimum values for pressure, temperature, relative humidity, and air velocities for stations A, B, and C as well as volumetric water content in the TDR's are within acceptable ranges. To accomplish this, enter the following equations in separate rows at the end of each column: =MAX(<range>) and =MIN(<range>), where <range> is the range of the cells for that column. The maximum and minimum values for each column will be displayed; use these values for the appropriate verification. The acceptable range will be determined by the PI.
- Check units of pressure (psia), temperature (degrees Celsius [°C]), relative humidity (percent), volumetric water content (fraction), and soil water potential (mbars).

3.0 Updating the Data Entry Log

Record the start and end dates and times in a notebook for later inclusion in the Transfer Log tables (see Section 5.6.2) Use the format mm/dd/yy hh:mm:ss AM/PM. The Transfer Log tables are an important part of the chain of custody for data files.

4.0 Naming the Data Range for Export to Microsoft Access

- Highlight the entire range of data below the column headers.
- Select 'Insert' from the main menu, then select 'Name'.
- In the dialog box that appears, type 'Data' to name the range.

5.0 Saving the files for export to Microsoft Access

Save the files to the filenames and directories listed below.

Name	Filename[a]	Directory
CR10 data logger	******tn.wk1	Mp133::c:\projects\nyecount\tunnel
Solomat data logger	******s1.wk1	Mp133::c:\projects\nyecount\tunnel

[a] Asterisks in the filename are placeholders for the 6-digit download date.

5.6.2 ENTERING AND MANIPULATING DATA IN THE DATABASE

When the data files have been processed using the procedures discussed in Section 5.6.1, they can then be imported into Microsoft Access for data manipulation and storage. These data shall be entered into the database within two days of downloading, at which time the appropriate graphs and reports shall be produced. Detailed procedures for entering, documenting, and manipulating data in Microsoft Access database programs are presented in a user's manual developed for NWRPO. The manual titled "Nye County NWRPO Database User's Manual" is in the NWRPO archives and is on file in MET's office in Newport Beach, CA.

After entering the data into Microsoft Access, record data file transfer information in data file transfer logs (Attachment V). The procedure for filling in the transfer logs is as follows:

Open the Tunnel Transfer Log table. Referring to the notebook when necessary, update the log data with the following information:

- Date the new data were received
- Name of the original data file
- Start date of data
- End date of data
- Name of individual from whom data were received
- Name of person who received data
- Type of media used to send the data (e.g., diskette, modem, etc.)
- Path where the original file is saved (e.g., computer::\directory)
- Name of individual who entered the new data into the database

- Date the data file was updated

Upon successful import into database tables, the data can be manipulated to produce a variety of plots and reports, following procedures described in the user's manual named above.

5.6.3 BACKING UP THE DATABASE

The tunnel database directory *Mp133::c:\projects\nyecount\tunnel* is backed up onto two optical disks on a weekly basis. One copy of the optical disk is kept on site and the second is stored at an off-site facility.

6. REFERENCES

All manuals related to the installation and operation of NWRPO instruments in the ESF tunnel are maintained at the Nye County Geotechnical Representative's office, including, but not limited to:

- The Campbell Scientific manual for operation of CR10 data loggers
- The Solomat manual for operation of data loggers

7. RECORDS

7.1 VERIFICATION OF CALCULATIONS

Calculations made in all databases are documented using MET calculation sheets. Typically, these calculations include general mathematical equations, equivalent instrument-specific formulas for spreadsheets and databases, and samples of the original and processed data demonstrating verification of the calculations. These calculations are on file at the MET office as necessary supporting documentation required by NWRPO technical procedure entitled "Computer Modeling and Data Analysis Procedure Quality Assurance Procedure."

7.2 DATA FILE TRANSFER TABLE

An example Data File Transfer Log is presented in Attachment V

7.3 DATA BACKUP AND MAINTENANCE TABLE

A table summarizing data backup and maintenance is presented in Attachment VI

8. ATTACHMENTS

- Attachment I - Copy of the CR10 data logger program
- Attachment II - Copy of the SOLOMAT data logger program
- Figure 1- Approximate Location of the Probes in the ECRB Tunnel
- Attachment III - Instrument Serial Numbers and Wiring Connections
- Attachment IV - Sample output file from the CR10 data logger
- Attachment V - Sample Data File Transfer Log
- Attachment VI - Database Backup and Maintenance Table Template

9. TEST CONDITIONS

The appropriateness of the test conditions shall be determined by field personnel.

10. PERSONNEL REQUIREMENTS

There are no specific personnel requirements other than those described in Section 2.2.

11. SPECIAL ENVIRONMENTAL TEST/STORAGE CONDITIONS

There are no special requirements for environmental test or storage conditions.

12. INSPECTION HOLD POINTS

There are no applicable inspection hold points.

13. ACCEPTABLE DETAIL AND ACCURACY LEVELS

Verification of calculations shall be made with a relative error of less than 1 in 1,000.

ATTACHMENT I - Copy of CR10 Data Logger Program

```
;{CR10}
;File Name ECRB2.csi
;Modified All1.csi 7/24/98 to store data to storage module

;Modified ALL.CSI 3/28/98 to change thermocouple type
;
; ALL1.CSI
;
;changes made by Dave Montazer in Las Vegas
;
;Program for 3 HMP35C, 1 CS105, 2 CS615, 2 227 Campbell sensors
;measuring Tref (3), RH (3), thermocouple temp (1),
;barometric pressure (1), volumetric water content (2),
;soil water potential (2)
;
;wiring instruction
;
;HMP35C
;3 oranges to single ended channels 1 through 3 (probe #1 channel 1 etc.
;3 greens to single ended channels 4 through 6 (probe #1 channel 4 etc.)
;all blacks to E3
;all yellows to E2
;all reds to 12V
;all clear to G
;all whites and purples to AG or G
;
;changed thermocouple wiring on 3/28/98 Dave Montazer
;From:
;thermocouple wire to differential channel 5 (single channels 9 and 10)
;to:
;
;CR10TCR thermocouple
;Clear to AG
;Black to E3
;Red to single ended channel 9
;
;End of wiring change 3/28/98 Dave Montazer
;
;CS105 pressure sensor
;Brown (normally blue!) to single ended channel 7
;Green to C1
;Red to 12V
;White to AG
;Black to G
;Clear to G
;
;CS615
;Greens to P1 & P2
;Oranges to C5
;Reds to 12V
;Blacks and clears to G
;
;227
;Reds to single ended channels 11 & 12
;Blacks to E1
;Whites to AG
```

```
Page   2, Table 1

;Clears to G

*Table 1 Program
  01: 15.0      Execution Interval (seconds)

; program for the HMP35C

1:  Batt Voltage (P10)
 1: 1         Loc [ Battery_V ]

; program for the HMP35C

2:  Temp (107) (P11)
 1: 3         Reps
 2: 1         In Chan
 3: 3         Excite all reps w/Exchan 3
 4: 2         Loc [ Ref_Tempc ]
 5: 1.0       Mult
 6: 0.0       Offset
;changed code on 3/28/98 Dave Montazer
;from:
;3:  Thermocouple Temp (DIFF) (P14)
; 1: 1         Reps
; 2: 3         25 mV Slow Range
; 3: 5         In Chan
; 4: 1         Type T (Copper-Constantan)
; 5: 2         Ref Temp Loc [ Ref_Tempc ]
; 6: 5         Loc [ TC_TEMP_C ]
; 7: 1.0       Mult
; 8: 0.0       Offset
;to:
3:  Temp (107) (P11)
 1: 1         Reps
 2: 9         In Chan
 3: 3         Excite all reps w/EXchan 3
 4: 5         Loc [ TC_TEMP_C ]
 5: 1.0       Mult
 6: 0.0       Offset
;End of code change 3/28/98 Dave Montazer
;
4:  Excite-Delay (SE) (P4)
 1: 3         Reps
 2: 5         2500 mV Slow Range
 3: 4         In Chan
 4: 2         Excite all reps w/Exchan 2
 5: 15        Delay (units 0.01 sec)
 6: 2500      mV Excitation
 7: 8         Loc [ RH          ]
 8: .1        Mult
 9: 0.0       Offset

5:  Do (P86)
 1: 41        Set Port 1 High
```

```
6:  Excite-Delay (SE) (P4)
 1: 1          Reps
 2: 25         2500 mV 60 Hz Rejection Range
 3: 7          In Chan
 4: 1          Excite all reps w/Exchan 1
 5: 100        Delay (units 0.01 sec)
 6: 0          mV Excitation
 7: 11         Loc [ P_mb       ]
 8: .184       Mult
 9: 600        Offset

7:  Z=X*F (P37)
 1: 11         X Loc [ P_mb       ]
 2: .0145      F
 3: 12         Z Loc [ P_psi      ]

8:  Do (P86)
 1: 51         Set Port 1 Low

; Program for CS615 units
9:  Do (P86)
 1: 45         Set Port 5 High

10:  Beginning of Loop (P87)
 1: 1          Delay
 2: 2          Loop Count

11:  End (P95)

12:  Pulse (P3)
 1: 2          Reps
 2: 1          Pulse Input Channel
 3: 21         Low Level AC, Output Hz
 4: 13         Loc [ 615kHZ#1   ]
 5: .001       Mult
 6: 0.0        Offset

13:  Do (P86)
 1: 55         Set Port 5 Low


14:  Z=1/X (P42)
 1: 13         X Loc [ 615kHZ#1   ]
 2: 15         Z Loc [ 615msec#1  ]

15:  Z=1/X (P42)
 1: 14         X Loc [ 615kHZ#2   ]
 2: 16         Z Loc [ 615msec#2  ]
```

```
16:  Polynomial (P55)
 1: 2          Reps
 2: 15         X Loc [ 615msec#1 ]
 3: 17         F(X) Loc [ 615H2O#1  ]
 4: -.187      C0
 5: .037       C1
 6: .335       C2
 7: 0.0        C3
 8: 0.0        C4
 9: 0.0        C5

; Program for two 227 sensors
17:  AC Half Bridge (P5)
 1: 2          Reps
 2: 14         þ 250 mV Fast Range
 3: 11         SE Channel
 4: 1          Ex Channel Option
 5: 250        mV Excitation
 6: 19         Loc [ RS#1       ]
 7: 1.0        Mult
 8: 0          Offset

18:  BR Transform Rf[X/(1-X)] (P59)
 1: 2          Reps
 2: 19         Loc [ RS#1       ]
 3: 1          Multiplier (Rf)

19:  Z=X (P31)
 1: 19         X Loc [ RS#1       ]
 2: 23         Z Loc [ dumin      ]

20:  Do (P86)
 1: 3          Call Subroutine 3

21:  Z=X (P31)
 1: 24         X Loc [ dumout     ]
 2: 21         Z Loc [ 227SWP#1   ]

22:  Z=X (P31)
 1: 20         X Loc [ RS#2       ]
 2: 23         Z Loc [ dumin      ]

23:  Do (P86)
 1: 3          Call Subroutine 3

24:  Z=X (P31)
 1: 24         X Loc [ dumout     ]
 2: 22         Z Loc [ 227SWP#2   ]

25:  If time is (P92)
 1: 0          Minutes (Seconds --) into a
 2: 10         Interval (same units as above)
 3: 10         Set Output Flag High
```

```
26:  Set Active Storage Area (P80)
 1: 1         Final Storage Area 1
 2: 10        Array ID or Loc [ _________ ]

27:  Real Time (P77)
 1: 1110      Year,Day,Hour/Minute

28:  Average (P71)
 1: 22        Reps
 2: 1         Loc [ Battery_V ]
;CHANGE MADE BY M. HOUSEL 7/24/98 TO STORE DATA TO
;STORAGE MODULE

29:  Serial Out (P96)
 1: 71        SM192/SM716/CSM1

;END OF CHANGE TO PROGRAM BY M. HOUSEL 7/24/98

*Table 2 Program
  02: 0.0        Execution Interval (seconds)

*Table 3 Subroutines
1:  Beginning of Subroutine (P85)
 1: 3         Subroutine 3

2:  IF (X<=>F) (P89)
 1: 23        X Loc [ dumin      ]
 2: 3         >=
 3: 17.009    F
 4: 30        Then Do

3:  Polynomial (P55)
 1: 1         Reps
 2: 23        X Loc [ dumin      ]
 3: 24        F(X) Loc [ dumout     ]
 4: -99       C0
 5: 0.0       C1
 6: 0.0       C2
 7: 0.0       C3
 8: 0.0       C4
 9: 0.0       C5

4:  Else (P94)

5:  IF (X<=>F) (P89)
 1: 23        X Loc [ dumin      ]
 2: 4         <
 3: 5         F
 4: 30        Then Do
```

```
6:  Polynomial (P55)
 1: 1         Reps
 2: 23        X Loc [ dumin     ]
 3: 24        F(X) Loc [ dumout    ]
 4: 0.06516   C0
 5: .95117    C1
 6: -.25159   C2
 7: -.03736   C3
 8: .03273    C4
 9: -.00394   C5

7:  Else (P94)

8:  Z=X*F (P37)
 1: 23        X Loc [ dumin     ]
 2: .1        F
 3: 23        Z Loc [ dumin     ]

9:  Polynomial (P55)
 1: 1         Reps
 2: 23        X Loc [ dumin     ]
 3: 24        F(X) Loc [ dumout    ]
 4: .15836    C0
 5: 6.1445    C1
 6: -8.4189   C2
 7: 9.2493    C3
 8: -3.1685   C4
 9: .33392    C5

10:  End (P95)

11:  End (P95)

12:  End (P95)

End Program
```

Page 7, Input Locations

Addr	Name	Flags	#Reads	#Writes	Blocks
1	[Battery_V]	RW-	1	1	----- ------ ---
2	[Ref_Tempc]	RW-	2	1	Start ------ ---
3	[Ref_Tem#2]	RW-	1	1	----- Member ---
4	[Ref_Tem#3]	RW-	1	1	----- ------ End
5	[TC_TEMP_C]	RW-	1	1	Start ------ ---
6	[TC_TEMP#2]	R--	1	0	----- ------ ---
7	[TC_TEMP#3]	R--	1	0	----- ------ ---
8	[RH]	RW-	1	1	Start ------ ---
9	[RH#2]	RW-	1	1	----- Member ---
10	[RH#3]	RW-	1	1	----- ------ End
11	[P_mb]	RW-	2	1	Start ------ ---
12	[P_psi]	RW-	1	1	----- ------ ---
13	[615kHZ#1]	RW-	2	1	Start ------ ---
14	[615kHZ#2]	RW-	2	1	----- ------ End
15	[615msec#1]	RW-	2	1	----- ------ ---
16	[615msec#2]	RW-	2	1	----- ------ ---
17	[615H2O#1]	RW-	1	1	Start ------ ---
18	[615H2O#2]	RW-	1	1	----- ------ End
19	[RS#1]	RW-	4	2	Start ------ ---
20	[RS#2]	RW-	4	2	Start ------ End
21	[227SWP#1]	RW-	2	1	----- ------ ---
22	[227SWP#2]	RW-	2	1	----- ------ ---
23	[dumin]	RW-	7	3	----- ------ ---
24	[dumout]	RW-	3	3	Start ------ ---
25	[_____]	R--	1	0	----- ------ ---
26	[_____]	R--	1	0	----- ------ ---
27	[_____]	R--	1	0	----- ------ ---
28	[_____]	R--	1	0	----- ------ ---

ATTACHMENT II - Copy of the Solomat Data Logger Program

LOGGER SETUP : Continuous log

12:12:53 08/27/1998

Auto Interval	:Off
Log Interval	:00:05:00
Meter File	:FILE05
File Resume	:On
Warm Up	:Off
On Overflow	:Stop
Power Down	:Enabled
Meter Status	:
Meter Date	:08/27/1998
Meter Time	:12:12:50
Remaining memory	:10000 rdgs
Battery voltage	:N/A Hrs

Channel Setup

11:59:16 08/27/1998

Instrument :Save
Channel mode :MULTI
Dwell Time :00:03.0
Short Term Avg:01:00.0
Fast Update :Off
MX/DAC Active :Off
User units :

					Alarm							T/C	
Ch	Probe/Symbol/Name	CH	ON	Sk	Act	High	Low	MxBx	MxSk	DT	STA	Sk	803
1	Hotwire - 12 m/s		X	A		0	0	0	1	X	X	*	39
2	Hotwire - 12 m/s		X	B		0	0	0	1		X	*	39
3	Hotwire - 12 m/s		X	C		0	0	0	1		X	*	39
4	Pt100 ½C			A		0	0	0	1			*	39
5	Pt100 ½C			A		0	0	0	1			*	39
6	Pt100 ½C			A		0	0	0	1			*	39
7	Pt100 ½C			A		0	0	0	1			*	39
8	Pt100 ½C			A		0	0	0	1			*	39
9	Pt100 ½C			A		0	0	0	1			*	39
10	Pt100 ½C			A		0	0	0	1			*	39
11	Pt100 ½C			A		0	0	0	1			*	39
12	Pt100 ½C			A		0	0	0	1			*	39
13	Pt100 ½C			A		0	0	0	1			*	39
14	Pt100 ½C			A		0	0	0	1			*	39
15	Pt100 ½C			A		0	0	0	1			*	39
16	Pt100 ½C			A		0	0	0	1			*	39
17	Pt100 ½C			A		0	0	0	1			*	39
18	Pt100 ½C			A		0	0	0	1			*	39
19	Pt100 ½C			A		0	0	0	1			*	39
20	Pt100 ½C			A		0	0	0	1			*	39
21	Pt100 ½C			A		0	0	0	1			*	39
22	Pt100 ½C			A		0	0	0	1			*	39
23	Pt100 ½C			A		0	0	0	1			*	39
24	Pt100 ½C			A		0	0	0	1			*	39
25	Pt100 ½C			A		0	0	0	1			*	39
26	Pt100 ½C			A		0	0	0	1			*	39
27	Pt100 ½C			A		0	0	0	1			*	39
28	Pt100 ½C			A		0	0	0	1			*	39
29	Pt100 ½C			A		0	0	0	1			*	39
30	Pt100 ½C			A		0	0	0	1			*	39
31	Pt100 ½C			A		0	0	0	1			*	39
32	Pt100 ½C			A		0	0	0	1			*	39

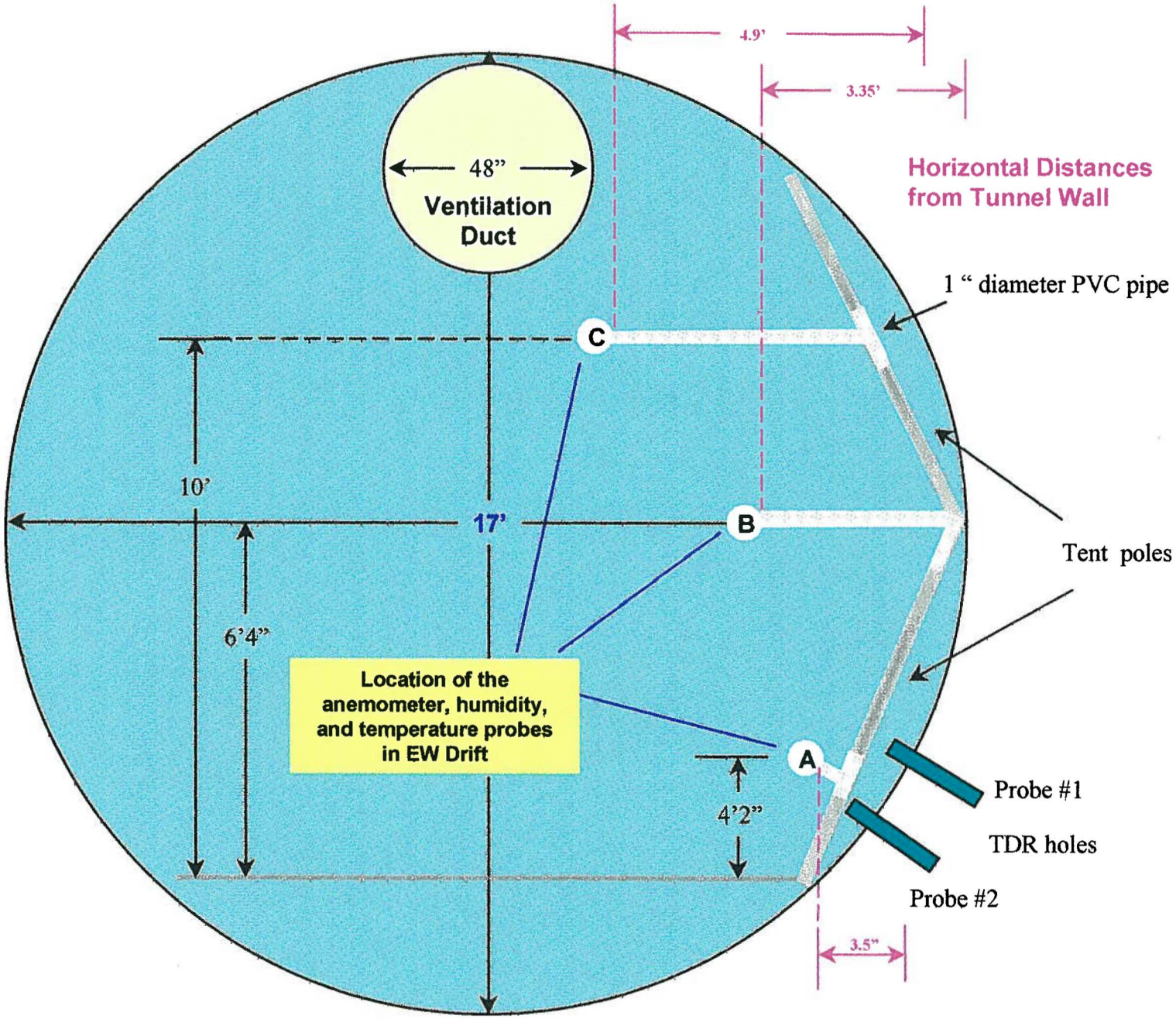

Figure 1 - Approximate Location of the Probes in the ECRB Tunnel

ATTACHMENT III

Serial Numbers and Wiring Instructions for Campbell Scientific CR10 Sensors

	Serial #	orange	green	black	yellow	red	clear	white	purple	brown
HMP35C probe #1	P3420030	SC1	SC4	E3	E2	12V	G	AG/G	AG/G	
HMP35C probe #2	P3510014	SC2	SC5	E3	E2	12V	G	AG/G	AG/G	
HMP35C probe #3	P2350004	SC3	SC6	E3	E2	12V	G	AG/G	AG/G	
CS105	P2110027		C1	G		12V	G	AG		SC7
CS615 #1	437726	C5	p1	G		12V	G			
CS615 #2	432730	C5	p2	G		12V	G			
227#1				E1		SC11	G			
227#2				E1		SC12	G			

SC = Single Ended Channel
C = Control Channel
P = Pulse Channel

AG = Analog Ground
G = Ground
E = Excitation Channel

The thermocouple wire was connected to differentiate channel 5 (Single Channels 9 and 10)

Attachment IV

10	1998	92	1740	14.34	22.81	22.47	22.57	23.07	0	0	25.31	26.36
10	1998	92	1750	13.34	22.84	22.41	22.54	23.06	0	0	25.25	26.37
10	1998	92	1800	13.09	22.97	22.43	22.53	23.05	0	0	25.11	26.37
10	1998	92	1810	13.04	23.02	22.43	22.42	22.97	0	0	25.01	26.37
10	1998	92	1820	13.01	23.12	22.46	22.51	23.01	0	0	25.11	26.37
10	1998	92	1830	12.99	23.24	22.57	22.57	23.15	0	0	26.56	26.4
10	1998	92	1840	12.98	23	22.58	22.31	23.08	0	0	26.94	26.44
10	1998	92	1850	12.98	22.93	22.64	22.35	22.98	0	0	26.64	26.47
10	1998	92	1900	12.98	22.76	22.64	22.2	22.91	0	0	26.73	26.49
10	1998	92	1910	12.98	22.61	22.5	22.08	22.84	0	0	26.85	26.52
10	1998	92	1920	12.97	22.78	22.66	22.26	22.81	0	0	26.67	26.48
10	1998	92	1930	12.97	22.58	22.53	22.07	22.75	0	0	27	26.51
10	1998	92	1940	12.96	22.79	22.66	22.31	22.73	0	0	26.7	26.51
10	1998	92	1950	12.96	22.48	22.48	21.99	22.69	0	0	27.24	26.55
10	1998	92	2000	12.96	22.54	22.5	22.08	22.64	0	0	27.11	26.53
10	1998	92	2010	12.95	22.36	22.31	21.89	22.57	0	0	27.42	26.61
10	1998	92	2020	12.95	22.5	22.41	22.03	22.57	0	0	27.2	26.57
10	1998	92	2030	12.95	22.66	22.48	22.19	22.55	0	0	27.06	26.63
10	1998	92	2040	12.94	22.73	22.61	22.25	22.59	0	0	27.1	26.61
10	1998	92	2050	12.94	22.66	22.58	22.22	22.57	0	0	27.26	26.67
10	1998	92	2100	12.93	22.77	22.63	22.31	22.57	0	0	27.09	26.67
10	1998	92	2110	12.93	22.84	22.73	22.38	22.61	0	0	27.08	26.66
10	1998	92	2120	12.93	22.77	22.7	22.32	22.61	0	0	27.18	26.66
10	1998	92	2130	12.92	22.72	22.66	22.27	22.59	0	0	27.28	26.72
10	1998	92	2140	12.92	22.81	22.71	22.36	22.59	0	0	27.02	26.69
10	1998	92	2150	12.91	22.79	22.75	22.36	22.6	0	0	27.13	26.66
10	1998	92	2200	12.91	22.68	22.65	22.24	22.59	0	0	27.38	26.69
10	1998	92	2210	12.9	22.63	22.55	22.17	22.57	0	0	27.37	26.72
10	1998	92	2220	12.9	22.93	22.68	22.36	22.59	0	0	26.48	26.71
10	1998	92	2230	12.9	23.11	22.77	22.47	22.63	0	0	26.21	26.69
10	1998	92	2240	12.89	23.35	22.85	22.59	22.66	0	0	25.79	26.75
10	1998	92	2250	12.89	23.42	22.92	22.66	22.73	0	0	25.76	26.71
10	1998	92	2300	12.89	23.53	23.01	22.75	22.77	0	0	25.58	26.65
10	1998	92	2310	12.88	23.64	23.06	22.8	22.82	0	0	25.51	26.65
10	1998	92	2320	12.88	23.62	23.07	22.81	22.87	0	0	25.54	26.66
10	1998	92	2330	12.88	23.71	23.12	22.86	22.91	0	0	25.4	26.66
10	1998	92	2340	12.87	23.71	23.13	22.88	22.95	0	0	25.41	26.66
10	1998	92	2350	12.87	23.81	23.2	22.92	22.98	0	0	25.21	26.61
10	1998	93	0	12.87	23.91	23.26	23.01	23.02	0	0	24.99	26.58
10	1998	93	10	12.87	23.86	23.25	22.97	23.06	0	0	25.03	26.58
10	1998	93	20	12.86	24.01	23.34	23.05	23.09	0	0	24.75	26.55
10	1998	93	30	12.86	24.05	23.4	23	23.12	0	0	24.61	26.53
10	1998	93	40	12.86	24.07	23.44	23.08	23.15	0	0	24.59	26.52
10	1998	93	50	12.86	24.14	23.51	23.1	23.19	0	0	24.4	26.5
10	1998	93	100	12.85	24.09	23.51	23.05	23.2	0	0	24.36	26.46
10	1998	93	110	12.85	24.09	23.5	23.12	23.21	0	0	24.43	26.46
10	1998	93	120	12.85	24.13	23.54	23.1	23.26	0	0	24.34	26.44
10	1998	93	130	12.85	24.06	23.52	23.04	23.25	0	0	24.4	26.42
10	1998	93	140	12.85	24.01	23.47	23.06	23.27	0	0	24.48	26.45
10	1998	93	150	12.85	24.05	23.48	23.04	23.29	0	0	24.3	26.38
10	1998	93	200	12.84	24	23.45	23.03	23.29	0	0	24.3	26.39
10	1998	93	210	12.84	24.04	23.46	23.05	23.29	0	0	24.21	26.36
10	1998	93	220	12.84	23.97	23.43	22.99	23.29	0	0	24.27	26.36
10	1998	93	230	12.84	23.86	23.34	22.99	23.29	0	0	24.52	26.34
10	1998	93	240	12.84	23.69	23.22	22.84	23.27	0	0	24.79	26.35
10	1998	93	250	12.84	23.54	23.07	22.77	23.23	0	0	24.95	26.34

25.69	925	13.41	1.366	1.415	0.732	0.707	0.02	0.006	-4953	-5117	6999	6999
25.89	925	13.42	1.368	1.417	0.731	0.706	0.019	0.006	-4592	-5649	6999	6999
25.97	925	13.42	1.369	1.418	0.73	0.705	0.019	0.006	-4577	-6999	6999	6999
26.11	925	13.42	1.37	1.418	0.73	0.705	0.018	0.006	-4370	-4220	6999	6999
26.29	925	13.42	1.371	1.419	0.729	0.705	0.018	0.005	-5082	-4324	6999	6999
27.47	925	13.42	1.379	1.422	0.725	0.703	0.016	0.005	-4955	-4647	6999	6999
28.17	926	13.42	1.38	1.423	0.725	0.703	0.016	0.004	-4549	-5736	6999	6999
27.79	926	13.42	1.38	1.423	0.725	0.703	0.016	0.004	-5577	-6999	6999	6999
27.83	926	13.42	1.38	1.423	0.725	0.703	0.016	0.005	-4154	-4766	6999	6999
27.94	926	13.42	1.38	1.422	0.725	0.703	0.016	0.005	-4773	-5925	6999	6999
27.72	926	13.42	1.379	1.422	0.725	0.703	0.016	0.005	-4436	-6516	6999	6999
28.03	926	13.42	1.379	1.422	0.725	0.703	0.016	0.005	-5293	-5293	6999	6999
27.72	926	13.42	1.379	1.422	0.725	0.703	0.016	0.005	-4290	-5535	6999	6999
28.23	926	13.43	1.379	1.422	0.725	0.703	0.016	0.005	-5048	-6999	6999	6999
28.07	926	13.43	1.379	1.422	0.725	0.703	0.016	0.005	-3873	-5320	6999	6999
28.4	926	13.43	1.379	1.422	0.725	0.703	0.016	0.005	-5640	-6560	6999	6999
28.22	926	13.43	1.379	1.422	0.725	0.703	0.016	0.005	-5123	-6999	6999	6999
28.09	926	13.43	1.379	1.422	0.725	0.703	0.016	0.005	-4559	-5795	6999	6999
28.08	926	13.43	1.379	1.422	0.725	0.703	0.016	0.005	-3921	-5287	6999	6999
28.2	926	13.43	1.379	1.422	0.725	0.703	0.016	0.005	-4155	-6656	6999	6999
28.06	926	13.43	1.379	1.422	0.725	0.703	0.016	0.005	-5905	-5554	6999	6999
28.02	926	13.43	1.379	1.422	0.725	0.703	0.016	0.005	-4055	-5378	6999	6999
28.11	926	13.43	1.379	1.422	0.725	0.703	0.016	0.005	-5019	-5487	6999	6999
28.18	926	13.43	1.379	1.422	0.725	0.703	0.016	0.005	-4029	-6404	6999	6999
27.99	926	13.43	1.379	1.422	0.725	0.703	0.016	0.005	-3708	-6304	6999	6999
28.05	926	13.43	1.379	1.422	0.725	0.703	0.016	0.005	-4264	-4842	6999	6999
28.32	926	13.43	1.379	1.422	0.725	0.703	0.016	0.005	-5538	-6999	6999	6999
28.33	926	13.43	1.379	1.422	0.725	0.703	0.016	0.005	-5532	-6999	6999	6999
27.63	926	13.43	1.379	1.423	0.725	0.703	0.016	0.005	-6924	-6999	6999	6999
27.4	926	13.43	1.38	1.423	0.725	0.703	0.016	0.004	-6999	-6999	6999	6999
27.15	926	13.43	1.38	1.423	0.724	0.703	0.016	0.004	-5909	-6999	6999	6999
27.12	926	13.43	1.381	1.424	0.724	0.702	0.016	0.004	-5836	-6999	6999	6999
26.98	926	13.43	1.381	1.424	0.724	0.702	0.015	0.004	-5005	-4703	6999	6999
27.01	926	13.43	1.381	1.424	0.724	0.702	0.015	0.004	-4335	-4914	6999	6999
26.99	926	13.43	1.381	1.424	0.724	0.702	0.015	0.004	-4947	-5573	6999	6999
26.89	926	13.43	1.382	1.424	0.724	0.702	0.015	0.004	-4507	-5447	6999	6999
26.92	926	13.43	1.382	1.424	0.724	0.702	0.015	0.004	-5186	-6018	6999	6999
26.74	926	13.43	1.382	1.425	0.724	0.702	0.015	0.004	-4825	-6999	6999	6999
26.62	926	13.43	1.382	1.425	0.724	0.702	0.015	0.004	-6163	-6705	6999	6999
26.58	926	13.43	1.382	1.425	0.724	0.702	0.015	0.004	-5077	-5567	6999	6999
26.41	926	13.43	1.382	1.425	0.724	0.702	0.015	0.004	-4020	-5891	6999	6999
26.4	926	13.43	1.382	1.425	0.723	0.702	0.015	0.004	-4180	-6131	6999	6999
26.35	926	13.43	1.382	1.425	0.723	0.702	0.015	0.004	-4759	-4877	6999	6999
26.22	926	13.43	1.382	1.425	0.723	0.702	0.015	0.004	-5698	-5344	6999	6999
26.17	926	13.43	1.382	1.425	0.723	0.702	0.015	0.004	-4805	-6256	6999	6999
26.18	926	13.43	1.382	1.425	0.723	0.702	0.015	0.004	-4695	-6435	6999	6999
26.16	926	13.43	1.382	1.425	0.723	0.702	0.015	0.004	-5479	-6999	6999	6999
26.2	926	13.42	1.382	1.425	0.723	0.702	0.015	0.004	-5435	-6099	6999	6999
26.21	926	13.42	1.382	1.425	0.723	0.702	0.015	0.004	-4245	-5772	6999	6999
26.12	926	13.42	1.382	1.425	0.723	0.702	0.015	0.004	-5739	-5446	6999	6999
26.09	926	13.42	1.382	1.425	0.723	0.702	0.015	0.004	-4084	-4565	6999	6999
26.04	926	13.42	1.382	1.425	0.723	0.702	0.015	0.004	-5409	-5499	6999	6999
26.06	926	13.42	1.382	1.425	0.723	0.702	0.015	0.004	-5040	-5703	6999	6999
26.13	925	13.42	1.382	1.425	0.723	0.702	0.015	0.004	-4635	-6952	6999	6999
26.31	925	13.42	1.382	1.425	0.723	0.702	0.015	0.004	-4544	-5681	6999	6999
26.38	925	13.42	1.382	1.425	0.723	0.702	0.015	0.004	-4364	-5625	6999	6999

ATTACHMENT V - Sample Data File Transfer Log

Recieve Date	File Name	Begining Date	Ending Date	Recieved From	Recieved By	Media	Location	Update by	Date Updated	Date Graph Made	Date Submitted Re	Remark
19-Nov-97	111897c1.dat	11-Nov-97	20-Nov-97	Marcia Housel	MC	AOL		MC				
21-Nov-97	112097c1.dat	18-Nov-97	20-Nov-97	Marcia Housel	MC	AOL		MC				
02-Dec-97	112697c1.dat	20-Nov-97	26-Nov-97	Marcia Housel	MC	AOL		MC				
02-Dec-97	112697s1.cs	20-Nov-97	26-Nov-97	Marcia Housel	MC	AOL		MC				
11-Dec-97	121197c1.dat	03-Dec-97	11-Dec-97	Marcia Housel	MC	AOL		MC				
11-Dec-97	12119s2r.csv	20-Nov-97	03-Dec-97	Marcia Housel	MC	AOL		MC				power down
22-Dec-97	121697c1.dat	11-Dec-97	16-Dec-97	Marcia Housel	MC	AOL		MC				
22-Dec-97	121697s1.cs	11-Dec-97	16-Dec-97	Marcia Housel	MC	AOL		MC				
20-May-98	51998s1.csv	12-May-98	19-May-98	Claire Muirhead	MC	AOL	BlackBox::C:/Proje	MC	21-May-98	21-May-98		test data in
20-May-98	Ewd00100.d	02-Apr-98	19-May-98	Claire Muirhead	MC	AOL	BlackBox::C:/Proje	MC	21-May-98	21-May-98		test data in
28-May-98	052798s1.cs	12-May-97	27-May-98	Claire Muirhead	MC	AOL	BlackBox::C:/Proje	MC	01-Jun-98	01-Jun-98		test data
28-May-98	Ewd00101.d	02-Apr-98	27-May-98	Claire Muirhead	MC	AOL	BlackBox::C:/Proje	MC	01-Jun-98	01-Jun-98		test data

ATTACHMENT VI - DATABASE BACKUP AND MAINTENANCE TABLE TEMPLATE

FILE NAME	DATE BACKUP WAS MADE	MEDIA (OPTICAL, ETC.)	BACKUP MADE BY (SIGNATURE)	WAS SECOND COPY OF BACKUP MADE?	LOCATION OF FIRST BACKUP MEDIA	LOCATION OF SECOND BACKUP MEDIA	REMARKS (INTERMEDIATE FILES GENERATED, ETC.)

Attachment 7

TECHNICAL PROCEDURE INTERNAL REVIEW CHECKLIST

TP Number & Title : Instrumentation Calibration, Collection and Processing of Data in ESF Tunnels TP9-3 Date

1.	Draft TP in acceptable format.	QA Officer	
2.	TP transmitted to reviewers [1].	QA Officer	
	Designated Reviewers (Please Print)	1) Dow Davidson 2) 3)	
3a.	I have reviewed the TP and have found that no substantial revisions are necessary (Draft TP with marginal notes must accompany this form to the QA Officer).	1) 2) 3)	
OR			
3b.	I have reviewed the TP and have found that substantial revisions are necessary (Draft TP with marginal notes and a delineation of the major revisions must accompany this form to the QA Officer).	1) Dow Davidson 2) 3)	5-20-98
4.	All review comments have been addressed and the necessary revisions have been made.	1) 2) 3)	
5.	The author has adequately addressed all review comments and I consider this Procedure acceptable.	QA Officer	10-29-98
6.	I have reviewed both the reviewer's comments and the revised TP and assure that all comments have been resolved.	QA Officer	10-29-98

[1]At least one review is required; additional reviews are at the QA Officer's discretion.

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