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ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 600139

2. To: (Receiving Organization)	3. From: (Originating Organization)	4. Related EDT No.:
Distribution	TWRS Safety Programs Engineering Support	N/A
5. Proj./Prog./Dept./Div.:	6. Cog. Engr.:	7. Purchase Order No.:
SY-101 Mitigation/Safety	K. L. Pearce/2C130	N/A
8. Originator Remarks: Transmittal of WHC-SD-WM-OMM-011 for approval and release.		9. Equip./Component No.: N/A
		10. System/Bldg./Facility: 241-SY-101-Tank Farms
11. Receiver Remarks:		12. Major Assm. Dwg. No.: N/A
		13. Permit/Permit Application No.: N/A
		14. Required Response Date: 9/94

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Impact Level	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-OMM-011		0	Void Fraction Instrument Operation and Maintenance Manual	QS	1,2	1	

16. KEY

Impact Level (F)	Reason for Transmittal (G)	Disposition (H) & (I)
1, 2, 3, or 4 (see MRP 5.43)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Impact Level for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng. K. L. Pearce	K.L. Pearce	9/13/94	L6-37	~~J. D. Martin~~	N/A	9/13/94	L7-04	~~1~~	
1	1	Cog. Mgr. R. E. Bauer	R.E. Bauer	9/13/94	L6-37	D. B. Graves	D.B. Graves	9/13/94	L6-38	1	1
1	1	QA 9/13/94 M. L. McElroy	M.L. McElroy		S1-57	M. Gimera	M. Gimera	9/13/94	L7-05	1	1
1	1	Safety L. S. Krogsrud	L.S. Krogsrud	9/14/94	R3-08						
		Env.									
1	1	J. R. Biggs		9/13/94	01						
1	1	T. I. Stokes	T.I. Stokes	9/13/94	H5-09						

18.	19.	20.	21. DOE APPROVAL (if required)
K. L. Pearce K.L. Pearce 9/13/94 Signature of EDT Originator Date	Authorized Representative for Receiving Organization Date	R. E. Bauer R.E. Bauer 9/13/94 Cognizant/Project Engineer's Manager Date	Ltr. No. [] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-2 (07/91) GEF097

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BD-7400-172-1 (07/91)

RELEASE AUTHORIZATION

Document Number:	WHC-SD-WM-OMM-011, REV. 0
Document Title:	Void Fraction Instrument Operation and Maintenance Manual
Release Date:	9/14/94

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9/14/94 — (Date)

SUPPORTING DOCUMENT

1. Total Pages 44

2. Title	3. Number	4. Rev No.
Void Fraction Instrument Operation and Maintenance Manual	WHC-SD-WM-OMM-011	0

5. Key Words	6. Author
Void Fraction OMM Operation SY-101 In Situ	Name: K. L. Pearce K. L. Pearce Signature Organization/Charge Code 8D620/N2BG1

7. Abstract

This Operations and Maintenance Manual (O&MM) addresses riser installation, equipment and personnel hazards, operating instructions, calibration, maintenance, removal, and other pertinent information necessary to safely operate and store the Void Fraction Instrument.

Final decontamination and decommissioning of the Void Fraction Instrument are not covered in this document.

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9. Impact Level QS

10. RELEASE STAMP

OFFICIAL RELEASE BY WHC
DATE SEP 14 1994
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MASTER

VOID FRACTION INSTRUMENT OPERATION AND MAINTENANCE MANUAL

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September 1994

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VOID FRACTION INSTRUMENT OPERATION AND MAINTENANCE MANUAL

1.0 GENERAL EQUIPMENT INFORMATION

1.1 INTRODUCTION

Gas can be trapped in tank waste in three forms: void gas (bubbles), dissolved gas, or adsorbed gas. Void fraction is the volume percentage of a given sample that is comprised of void gas. The void fraction instrument (VFI) acquires the data necessary to calculate void fraction.

The VFI was initially designed for deployment in Waste Tank SY-101 using 4-inch or larger risers. During measurement sequences, the VFI must be restricted from rotation and inserted slowly to minimize waste disturbance. The VFI samples vertical profiles. Rotation of the entire VFI to other angles after a measurement sequence is complete allows for other vertical sampling runs.

As the device is inserted, a sample chamber fills with waste. Once in position, the remote-actuated sample chamber cover slides over the sample chamber and seals the waste sample inside. A pressurization chamber, previously charged with nitrogen, is then opened to the sample chamber. After the pressure in these two chambers equalize, the pressure is recorded. The sample chamber cover is then retracted and the waste pressure at that elevation is recorded. During these test sequences, the VFI records the pressures and temperatures required to calculate the void fraction of that sample. The device is then lowered to take another sample. This process is repeated until the tank waste is adequately characterized.

The VFI is controlled from an integrated personal computer system which is housed in the control console. Raising and lowering the void fraction assembly is controlled with a crane. The console will be placed and operated outside the radiation zone of the tank. Interconnecting cables will be placed above ground and routed between the control console and the instrument. The VFI and support equipment are portable and are only temporarily installed at any given location.

The void fraction system is depicted in Figure 1.1. The system consists of the following subsystems:

- A control console (Unit 1) and a power distribution skid (Unit 4) located outside the tank farm perimeter fence. A disconnect skid located within 10 feet of the site service disconnect. (There is no Unit 2 for the VFI.)

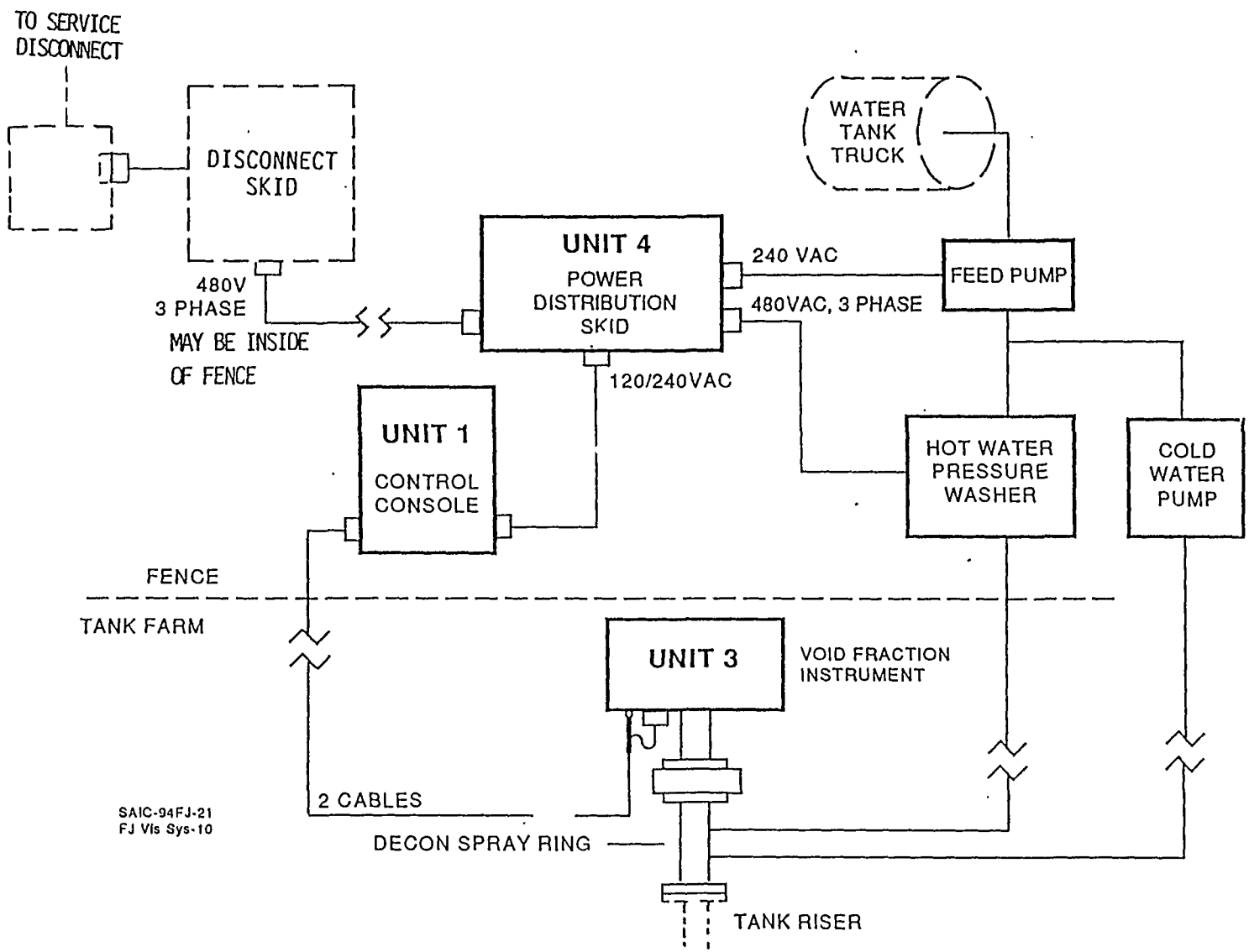


Figure 1.1 Void Fraction System

- A VFI (Unit 3) is lowered into a tank riser by a crane.
- A decontamination system which consists of a decon spray ring mounted on the riser, a hot water pressure washer, a cold water pressure washer, a feed pump, and a water tank truck outside the fence.

Electrical power for the various units is provided from a local power distribution panel feed from a site service disconnect.

The VFI was designed to obtain data from a hazardous area (NEC) classified as Class I, Division 1, Group B.

1.2 SCOPE

This operations and maintenance manual (O&MM) addresses VFI deployment, equipment and field hazards, operating instructions, calibration, maintenance, removal, and other pertinent information necessary to safely operate and store the VFI system.

Final decontamination and decommissioning of the in situ VFI is not covered in this document.

The system shall only be operated by specially-trained personnel. Operations personnel will consult with the specially-trained void fraction system personnel to perform deployment, removal, and provide general field assistance as required to operate the void fraction instrument.

1.3 EQUIPMENT DESCRIPTION

Refer to WHC-SD-WM-SDD-046, "Void Fraction System Design Description," for a more detailed description of the equipment.

1.4 EQUIPMENT, ACCESSORIES, AND DOCUMENTS SUPPLIED

Installation Drawing H-2-818363 identifies all the components required to install, operate, and remove the VFI from a tank riser.

The primary VFI equipment referenced on the above drawing is listed below:

-- H-2-821719, "Void Fraction Instrument Assembly"
-- H-2-818150, "Viscometer/Void Fraction Control Console Assembly"
-- H-2-821314, "Viscometer/Void Fraction Power Distribution Skid Assembly"
-- H-2-821444, "Void Meter Decontamination Spool Piece Assembly"

-- H-2-818151, "Viscometer/Void Fraction Cable Assemblies"
-- H-2-818155, "Viscometer/Void Fraction Cable Assemblies"

A full list of documentation regarding the in situ void fraction instrument can be found in WHC-SD-WM-SDD-046.

1.5 DOCUMENTATION REQUIRED BUT NOT SUPPLIED

The following must be documented and used in conjunction with this O&MM for installation, operation, and removal of the in situ void fraction instrument in any application:

- Safety assessment controls associated with void fraction system installation, operation, and removal.
- A readiness review must be completed prior to operation of the in situ void fraction system.
- Job control system (JCS) work packages which control installation, maintenance, and removal of the void fraction instrument.
- Occasional access to the primary enclosure for maintenance work will be required. Approved job plans must be reviewed before executing any maintenance activities.

2.0 FUNCTION DESCRIPTION

2.1 GENERAL

The function of the VFI is to obtain in situ measurements of the void fraction values of the waste. The tested and calibrated void fraction device can be used through 4-inch risers on a tank to obtain in situ tank data (pressures and temperatures) which can be reduced with analytical methods and converted into void fraction data. The design is based on a perfect gas approximation for the compressibility of the gases contained in the waste.

See WHC-SD-WM-SDD-046 for detailed information regarding this tool and relevant design information, calculations, safety equipment list, etc.

2.2 OVERALL BLOCK DIAGRAM

-- H-2-821616, "Void Fraction Instrument Functional Block Diagram"

2.3 DESIGN MEDIA

-- H-2-821615, "Void Fraction Instrument Drawing Tree" (not required for VFI installation, operation, or removal)

-- H-2-818363, "In Situ Viscometer/Void Fraction Instrument Systems Installation"

2.4 SIMPLIFIED SCHEMATIC DIAGRAMS

-- H-2-818156, "Viscometer/Void Fraction Elementary Diagram"

2.5 VENDOR DATA

-- VI 22606

2.6 INSTRUMENTATION AND CONTROL (I&C) EQUIPMENT

The primary function of the I&C equipment is to control the opening and closing of two- and three-way valves and to measure temperatures and pressures. The computer system is the primary operator interface. Through the computer the operator can input necessary parameters, read status data, and initiate automated sequences. The computer then automatically records set of data which are needed for the void fraction determination.

3.0 PRECAUTIONS AND LIMITATIONS

3.1 PERSONNEL PRECAUTIONS

- In case of fire or other emergency in the control console, all power shall be secured to the cabinet by opening the main electrical safety switch feeding the cabinet.

- The lifting of the VFI is "a critical lift" and all precautions addressed in WHC-CM-6-4, "Hoisting and Rigging Manual," and the site-specific procedure must be followed.

- The VFI may become highly contaminated (radiologically and chemically) in the sampling arm area. Appropriate controls are to be exercised prior to storing the system after withdrawal depending on the radiation monitor reading.

  Note: If the sample chamber cover becomes stuck shut, it may contain 22 cubic inches of waste pressurized up to 500 psig.

- There is high voltage present in the control console and in the VFI enclosure. Only qualified personnel are permitted to work on these items when powered up.

- The multitude of cables and hoses around the control console, electrical distribution panel, and decontamination equipment present a personnel trip/fall hazard. The cables and hoses shall be isolated by barricades to the extent possible to alleviate the trip hazards.

- Decontamination spool piece could have HOT water (200°F maximum) flowing through the stainless steel tubing.

.2 EQUIPMENT PRECAUTIONS

- The VFI lower arm or support mast may not easily pass through (may become stuck in) a 4-inch riser. Care must be taken to slowly lower and raise the instrument while passing through the riser.

- The VFI must be inserted into the riser using a crane for support and centering. Impact-limiting devices must be installed on the riser or severe riser damage could result if the instrument was dropped.

- The lower arm of the VFI may encounter high-yield strength waste or foreign objects in the waste. The arm can fully support the entire VFI weight statically. Slow insertion helps assure no permanent arm damage occurs from dynamic loading.

- Supply power to a subsystem must be OFF when connecting or disconnecting any electrical equipment or cables to that subsystem.

- Failure to hook up or remove the power and interconnecting cables in the sequence prescribed in this manual could result in generation of unacceptable equipment voltages and in electrical arcing or sparking.

- The sample chamber may become plugged with high-yield strength waste and prevent successful testing. Intermittent visual inspection is recommended to monitor such a condition.

- The VFI arm may be bent if not supported correctly when in the horizontal position.

4.0 PREPARATION FOR VFI DEPLOYMENT

4.1 INSTALLATION DRAWING

The following installation drawing shall be used for installing the VFI support systems:

-- H-2-818363, "In Situ Viscometer/Void Fraction Instrument Systems Installation"

This is a site-specific installation drawing for SY-101 only.

4.2 SITE INFORMATION

4.2.1 Equipment Location

Firm, level ground is required for placement of the control console and the decontamination equipment. The distance between the control console and the VFI shall be no greater than 250 feet.

Control console SHALL NOT be placed inside a radiation zone.

4.2.2 Electrical Power

The in situ void fraction system requires a 480 VAC, 3-phase, 4-wire, 60 amp service receptacle (typical welding outlet).

4.3 TOOLS AND MATERIALS REQUIRED FOR INSTALLATION

Tools and materials required for deployment of the VFI onto any 4-inch riser are listed on H-2-818363, "In Situ Viscometer/Void Fraction Instrument Systems Installation"). Tools and materials not listed on the installation drawing will be specified in the JCS work package or installation work plan.

Radio communication devices for communicating with the crane operator or field PIC are required, as well as a monitor located by the control console to show the in-tank camera view.

4.4 VFI PACKAGING

The VFI is not contaminated for the first shipment to the field. It is supplied with a weather-tight storage container shown on H-2-824490. Transport of the contaminated VFI will require an approved transport container and associated safety paperwork.

4.5 INSTALLATION

4.5.1 Pre-equipment Installation

4.5.1.1 Select a section of ground with a large enough area to hold the control console, disconnect skid, power distribution skid, and decontamination equipment.

4.5.1.2 Install the H-2-815302 footings for the control console, disconnect skid, and power distribution skid per H-2-818363.

4.5.2 Power Distribution Skid Installation

4.5.2.1 Set up the disconnect and power distribution skids per H-2-818363, but do not electrically connect at this time.

4.5.3 Control Console/Work Tent Installation

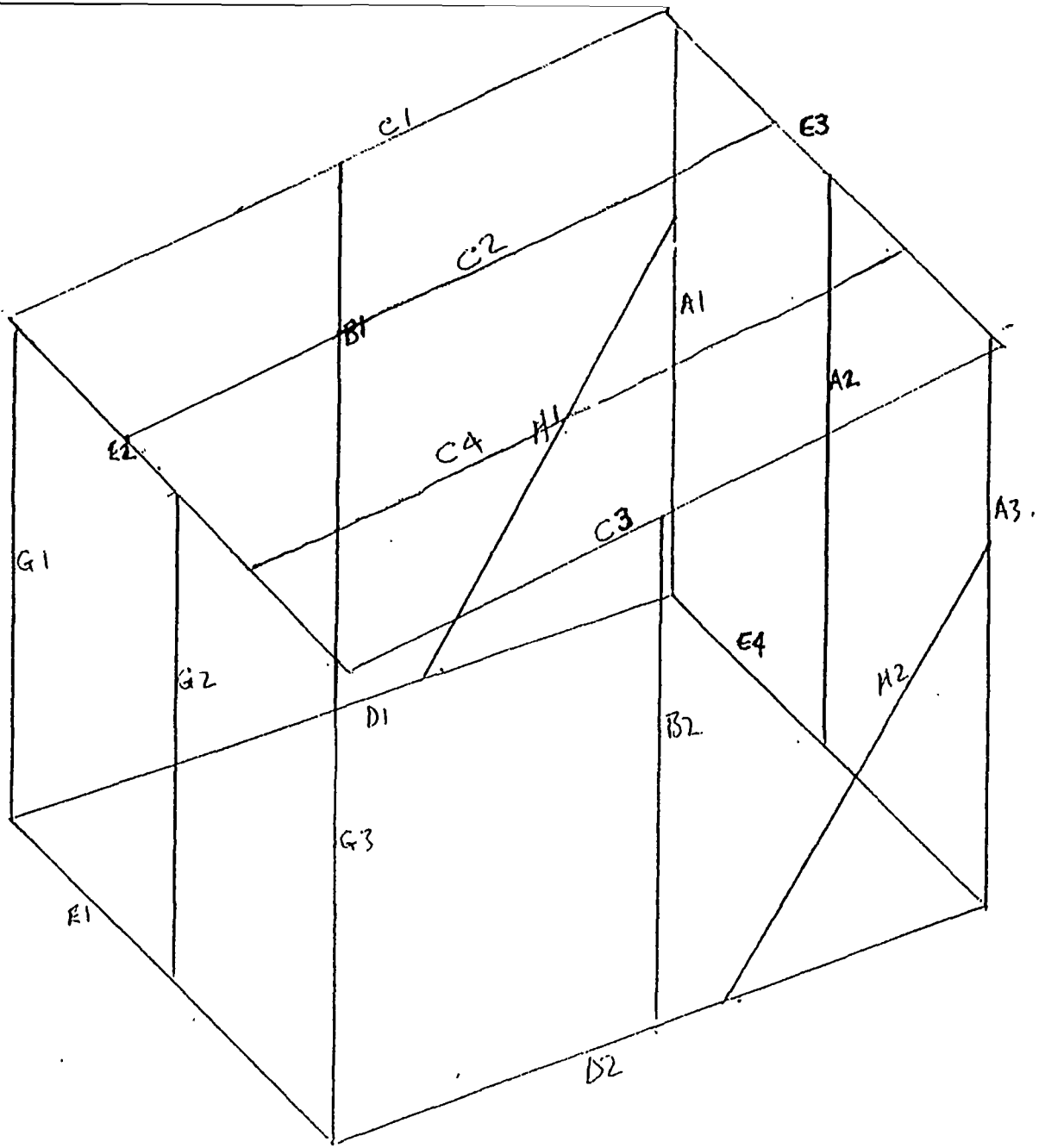
4.5.3.1 Set up the control console per H-2-818363. The control console has a temporary weather enclosure (work tent) that is not referenced by the installation drawing. See Figure 4.1 for work tent frame assembly.

4.5.4 Decontamination Equipment Installation

4.5.4.1 Locate the decontamination equipment so the attached electrical power cords will reach the power distribution skid receptacles. Do not connect electrical connections at this time.

4.5.4.2 Connect the decontamination equipment water lines to the water supply tank and decontamination spool piece per SK-2-61342.

4.5.4.3 Install ball valve and decontamination spool piece onto a 4-inch riser per H-2-818363 or other relevant installation drawing for other tank installations.



3PC @ 8'8" = A
2PC @ = B
4PC @ 7'8½" = C
2PC @ 7'8" = D
4PC @ 7'8" = E
~~3PC @ = F~~
3PC @ 6'8" = G
2PC @ = H

Figure 4.1 Work Tent Frame Assembly

4.5.4.4 Verify rubber wiper is installed on top of the decontamination spool piece.

4.5.4.5 Install short and tall impact limiters per H-2-818363.

Note: The short impact limiter is on the bottom.

5.0 OPERATION OVERVIEW

5.1 INTRODUCTION

The VFI is fully calibrated and ready for use. The functions of the controls and indicators should be reviewed before use. The control console is common to both the VFI and the viscometer. In this manual, only those features of the console that are relevant to the VFI operation are discussed. The general layout of equipment in the control console (Unit 1) is shown in Figure 5.1. Figures 5.2 and 5.3 provide details for the annunciator panel and circuit breaker panel.

5.2 CONTROL CONSOLE

5.2.1 Local Power Distribution

The A/C power distribution for the heater, air conditioner, and cabinet instrumentation is via the 120/240 VAC cabinet feed. The power needs for the control console are specifically: 120/240 VAC at 30 amps.

5.2.2 HVAC

An 8000 BTU air conditioner provides cooling for the control console, while an 800 W electric heater provides heat for cold weather operation. Thermostats for both units are preset.

5.2.3 Controls and Indicators

The following controls and indicators effect the operation of the VFI:

- CB2 This circuit breaker is located on the circuit breaker panel at the bottom of the console. When the console power circuit breaker is switched ON, power is applied to the control console and the instrumentation is activated.

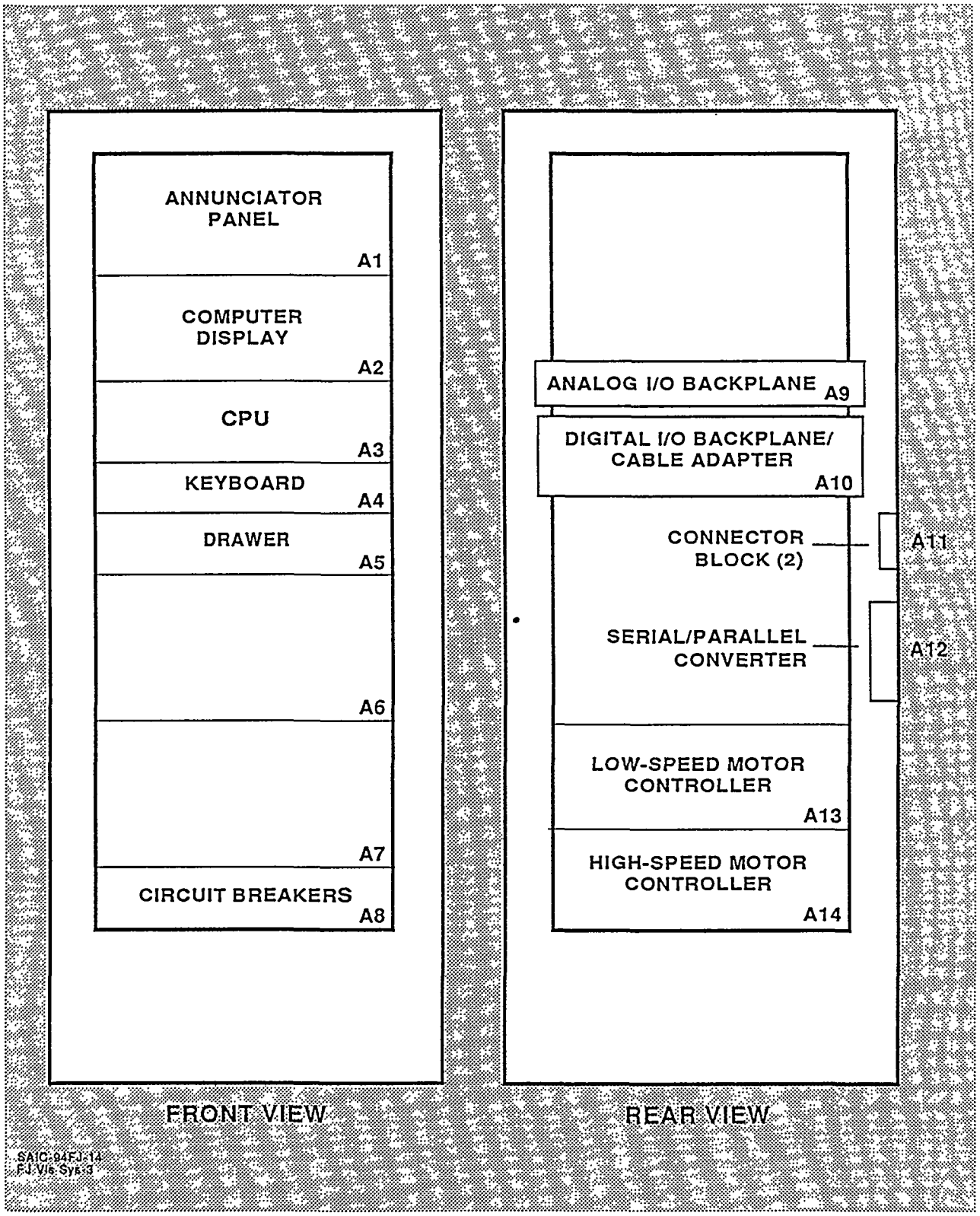


Figure 5.1 Control Console (Unit 1) General Equipment Layout

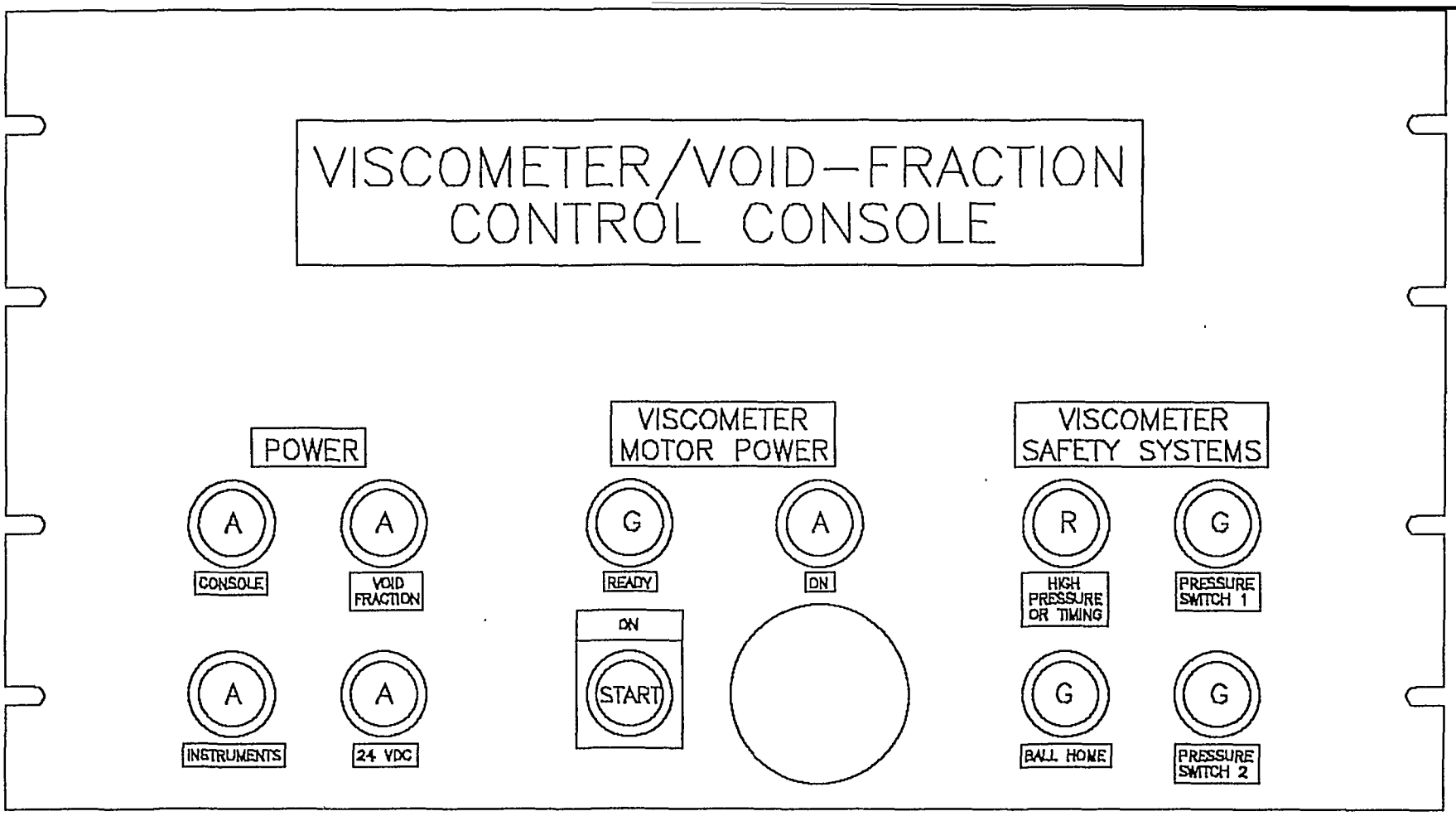


Figure 5.2 Annunciator Panel (1A1) Layout

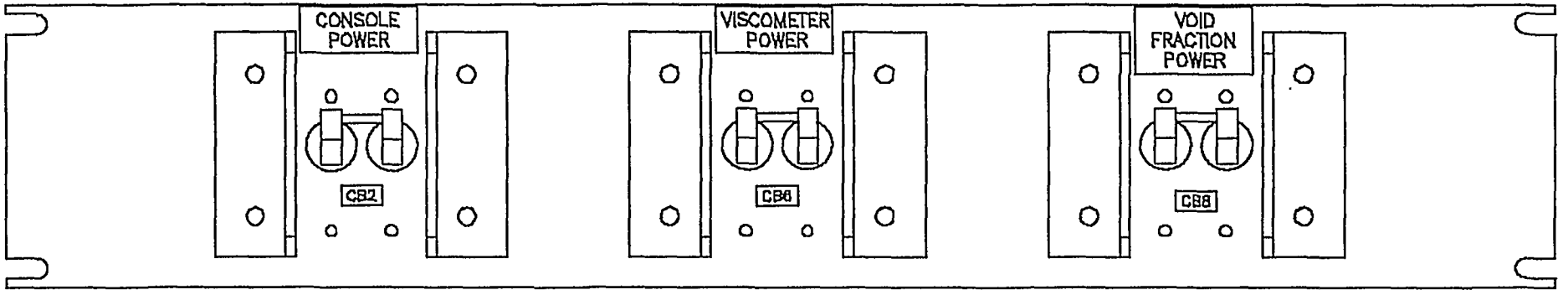


Figure 5.3 Circuit Breaker Panel (1A8) Layout

- CB8 This circuit breaker is located on the circuit breaker panel at the bottom of the console. CB8 ensures that the VFI and control section (located in the enclosure at the top of the instrument) gets power. CB8 should be turned off if the operation wants to shut down power to the VFI in an emergency situation.

The following indicators are located on the annunciator panel. Note that only three of the indicators physically existing on the panel are active in the void fraction mode of operation.

- CONSOLE Amber indicator light (DS1) which illuminates when the CB2 control breaker is switched ON to indicate that power is applied to the control console.
- INSTRUMENT Amber indicator light (DS2) which also illuminates when the CB2 breaker is switched ON to indicate that power is available to the electrical instrumentation in the control console.
- VOID FRACTION Amber indicator light (DS3) which illuminates when the CB8 circuit breaker is ON and indicates that power is available to the instrumentation and controls in the VFI enclosure.
- VISC INST Toggle switch in the back of the control console. This switch must be turned OFF or some of the viscometer safety system lights will illuminate.

5.3 COMPUTER SOFTWARE DESCRIPTION

5.3.1 Operator Interface

The VFI is controlled with a computer. The Labview software utilizes a graphical user interface which simplifies operation. Operator input is achieved with a mouse and icons on the computer monitor. The keyboard is used for entering comments to a data file and as an alternative to the mouse for setting values. The display on the monitor is referred to as the front panel.

5.3.2 Software and Data Storage

The void fraction software is stored on the computer's hard disk drive. A 3½-inch floppy diskette is required to retrieve data files from the hard drive.

5.3.3 Front Panel Menu

Figure 5.4 shows the VFI front panel. Each front panel control is represented by an icon on the computer's monitor. When the LabView program is running, a valve is actuated or an automated sequence is initiated by clicking on the appropriate icon. More descriptions of all the items below may be found in WHC-SD-WM-CSRS-020.

The following controls and indicators are available from the front panel:

- Two-way Solenoid Valve. This icon indicates the status (open or close) of a two-way valve. Click the icon to change the status of the valve.
- Three-way Solenoid Valve. This icon indicates which one of the two possible paths is allowed by a three-way valve. Click on the icon to switch from one path to the other.
- Wash and Dry Line. Clicking on this icon activates an automatic sequence which results in the chamber pressurizing line being washed with water and dried with nitrogen.
- Test Sequence. Clicking on this icon activates a cycle of valve openings and closings while temperatures and pressures are recorded to a file. This sequence includes one wash-and-dry sequence as described above. This sequence prompts a dialog box requesting if "another pressurization" is required. Clicking YES will recharge the pressurizing chamber and subsequently recharge the sample chamber without opening the sample chamber cover.
- Zero Level Gauge. Clicking on this icon sets the elevation value provided by the ultrasonic sensor to zero. All further readings will be shown as differentials to this reference elevation.
- Record Data. Writes information from front panel to disk file. Information consists of pressures, temperatures, elevation, and position of all solenoid valves.
- Pressure Indicator. Displays (numerically in psi units) the pressure at a preselected point.
- Temperature Indicator. Displays (numerically in °C) the temperature at a preselected point.
- Flow Indicator. Displays (numerically in cc) the nitrogen flow used when opening or closing the chamber or when rotating the sampling arm. The value retained by this display is the last flow reading from the last motion.

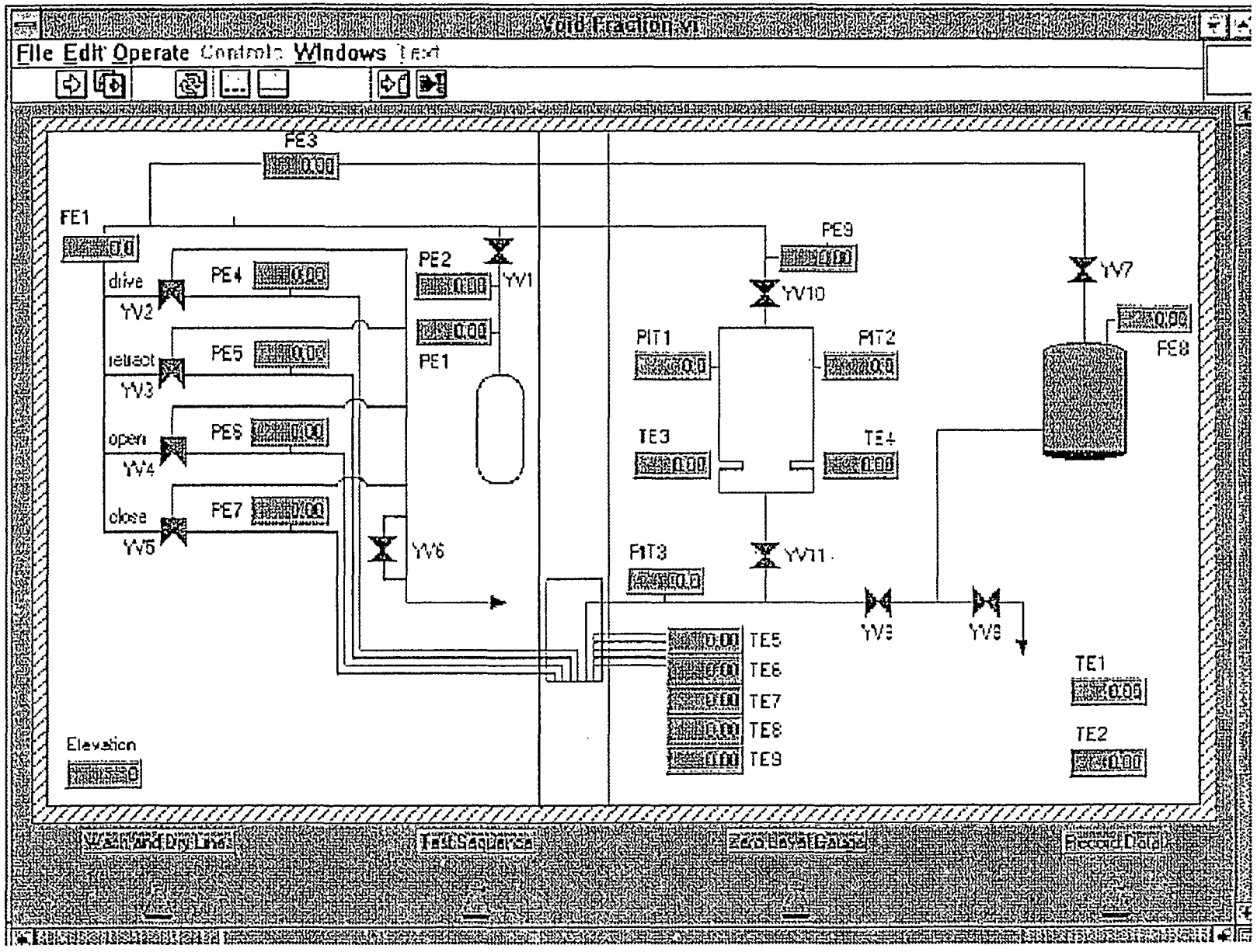


Figure 5.4 Void Fraction Instrument Front Panel Menu

- Elevation Indicator. Displays (numerically in centimeters) the elevation of the instrument with respect to the zero location.

- Water Level Indicator. Displays (graphically) the level of water in the tank. This instrument output will depend on the orientation (horizontal versus vertical). A full tank of water when vertical will "look" like a ⅛-tank when horizontal per the front panel readout.

6.0 OPERATING PROCEDURES

6.1 SYSTEM STARTUP PROCEDURES

6.1.1 Electrical Cable Connections

- Verify that the following circuit breakers and disconnect switches are in the OFF position:

  -- Power distribution and disconnect skids: CB1, CB2, DS1, DS2, and MS1 (see Figure 6.1)
  -- Control console: CB2, CB6, and CB8 (see Figure 5.3)
  -- Pressure water: power switch

  Note: Depending on standard site practices for connection to a weld receptacle, the service disconnect switch may also be required to be OFF.

- Verify that the switch labeled VISC INST (located on the inside right wall of the console, accessed from the rear) is in the OFF position.

- Connect the electrical cables to the equipment as follows:

  Note: Electrical cabling interconnections are shown in Figure 6.2. Decontamination water hose interconnections are indicated in Figure 6.3 and are detailed in SK-2-61342.

  -- W8 to Void Fraction Instrument J1. Connect the cable support grip to the nearby eye bolt using a threaded chain coupler.

  -- W9 to Void Fraction Instrument J2. Connect the cable support grip to the nearby eye bolt using a threaded chain coupler.

  -- W6 to W8P1. Connect the cable support grips on W6 and W8 together using a threaded chain coupler.

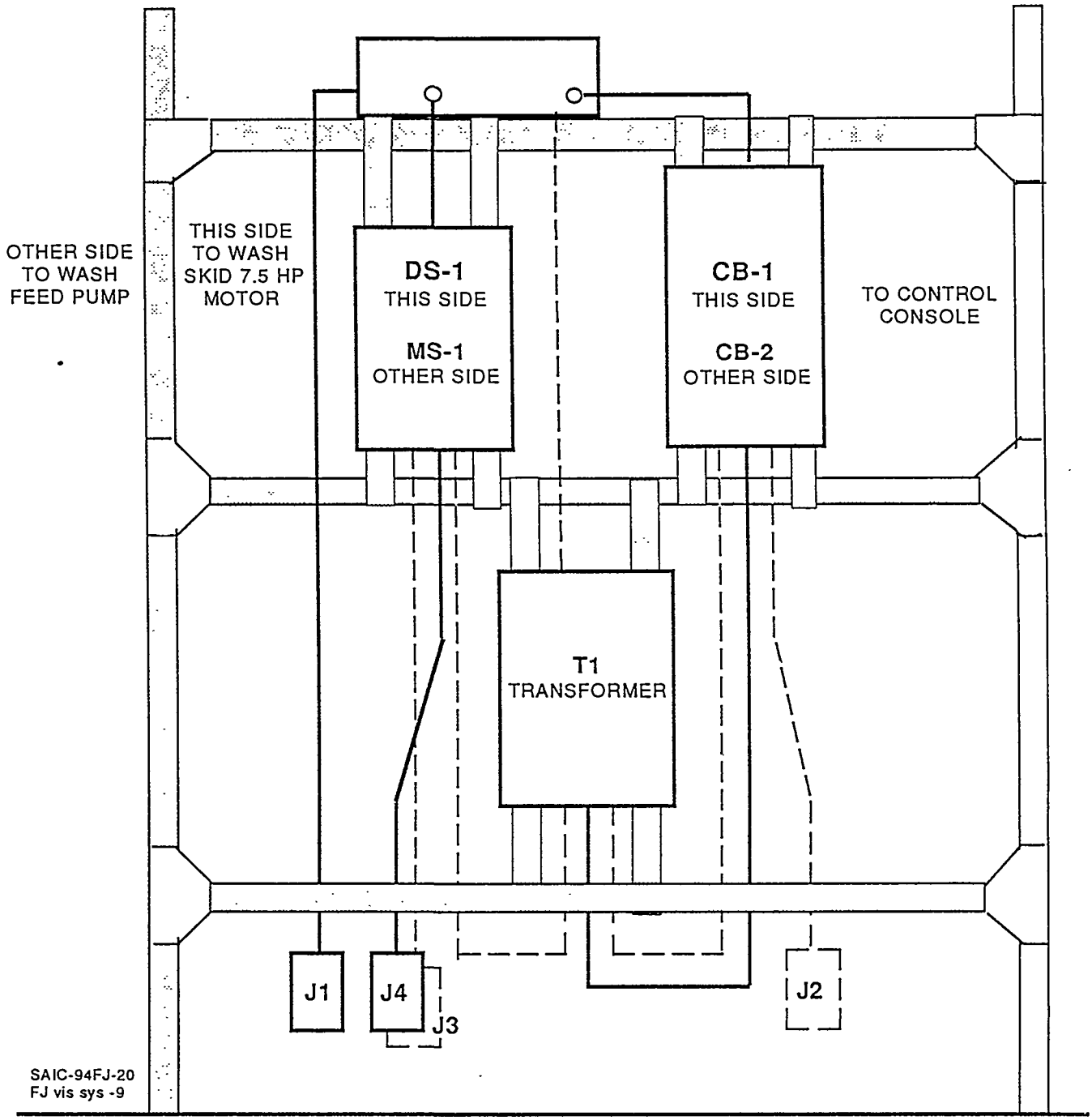


Figure 6.1 Power Distribution Skid Connections

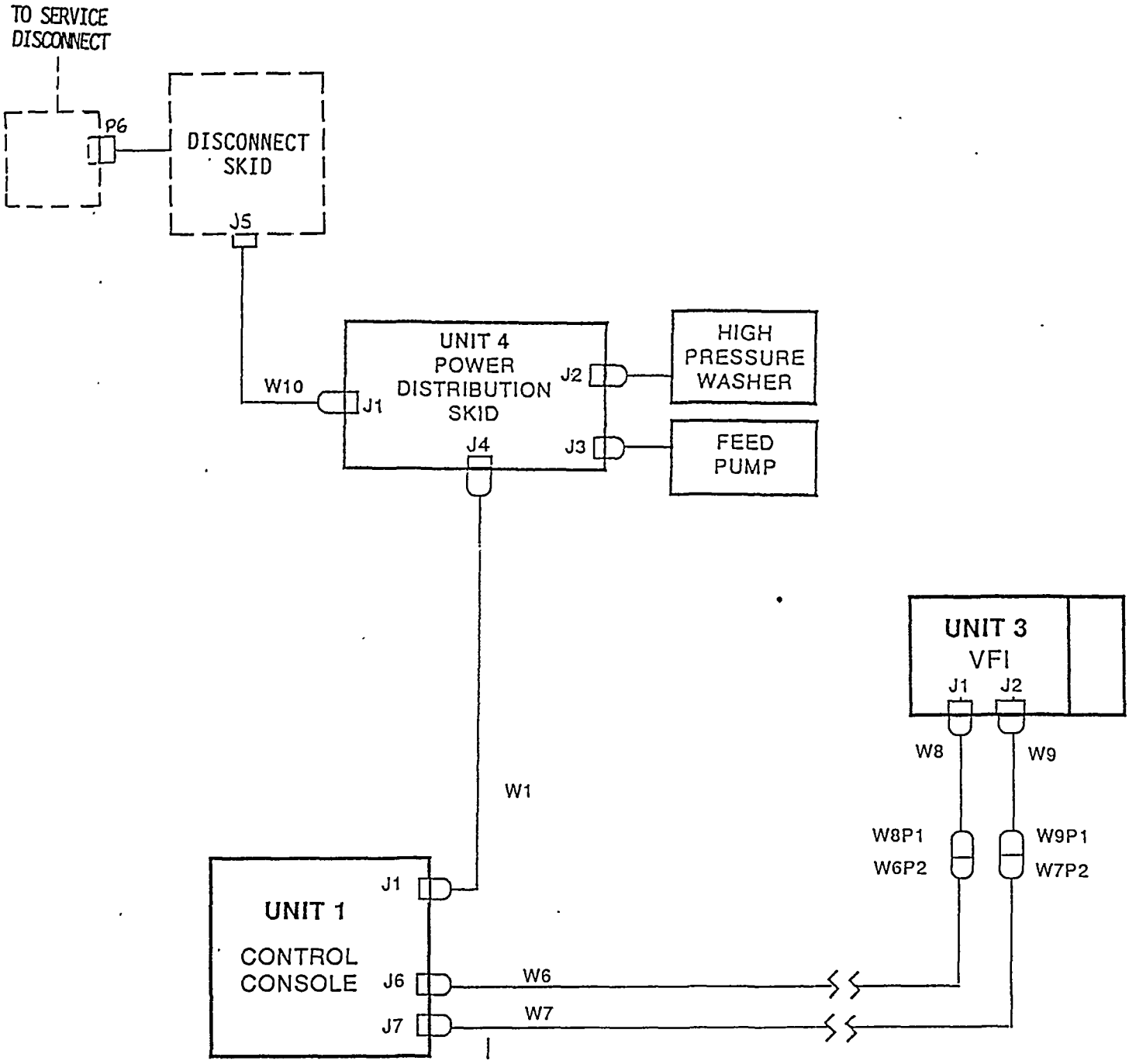


Figure 6.2 Void Fraction Instrument Cable Connections

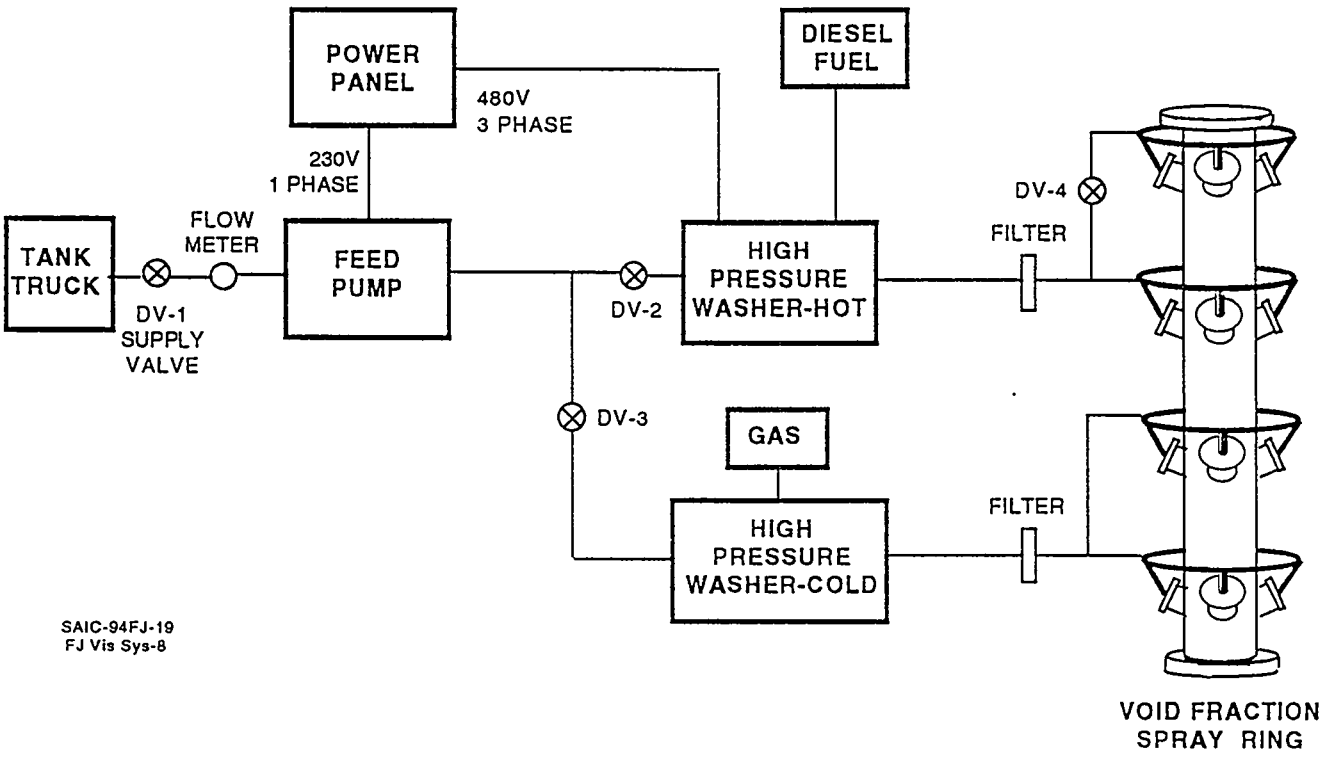


Figure 6.3 Void Fraction Decontamination System Block Diagram

-- W7 to W9P1. Connect the cable support grips on W7 and W9 together using a threaded chain coupler.

-- W7 to Control Console J7.

-- W6 to Control Console J6.

-- W1 to Control Console J1.

-- W1 to Power Distribution Skid J4.

-- Hot water high-pressure washer to Power Distribution Skid J2.

-- Feed pump to Power Distribution Skid J3.

-- W10 to Power Distribution Skid J1.

-- W10 to Disconnect Skid J5.

-- Disconnect Skid P6 to the service receptacle.

6.1.2 Disconnect and Power Distribution Skids

6.1.2.1 With the circuit breaker and switches (identified above) still in the OFF position, move the service disconnect switch to the ON position (if it had been OFF). (All lights on the annunciator panel should be OFF.)

6.1.2.2 Move the remote disconnect switch (DS2) to the ON position.

6.1.2.3 Move the power distribution circuit breakers and switches (CB1, CB2, and DS1, Figures 5.2 and 6.1) to ON position.

6.1.3 Control Console

6.1.3.1 Move the console power circuit breaker switch (CB5, Figure 5.3) to the ON position. Verify the following lights illuminate on the annunciator panel (Figure 5.2):

-- CONSOLE
-- INSTRUMENT

Note: If any of the lights fail to illuminate, proceed to the troubleshooting procedures in Section 8.1.

Power is now available for the following items:

-- Internal service light
-- Internal service duplex outlet
-- Air conditioner
-- Heater
-- Computer
-- Monitor

6.1.4 Computer

6.1.4.1 Computer system is turned on when the console power circuit breaker switch (CB2) is ON. Computer screen will display Windows™[1] interface.

6.1.4.2 Double click on LabView Run-Time icon (see Figure 5.4) to start LabView program.

6.1.4.3 Select "Void.11b" from the file selector dialog box and open file.

6.1.4.4 Select "Void Fraction.vi" from the file selector dialog box and open file.

The VFI front panel will then be displayed on the computer screen. The panel is shown in Figure 5.4.

6.2 PREOPERATION SEQUENCES

6.2.1 Pneumatic System Enclosure

6.2.1.1 On the VFI front panel menu, verify that the following conditions exist:

-- Water level indicator shows tank is approximately ⅛ full.
-- Pneumatic enclosure temperature indicators (TE1, TE2 and TE10) read between 0°C and 60°C.
-- Water tank drain valve icon (YV-8) is closed (icon is red).

6.2.1.2 Open pneumatic system enclosure. Open nitrogen supply cylinder manual valve (HV-1). Fill (or verify full) water tank (T-2). Close (or verify closed) the water tank fill and vent valves (HV4 and HV5). Close (or verify closed) PSV3 bypass valve HV-6. **DO NOT** adjust any other valves.

6.2.1.3 Close pneumatic system enclosure.

[1]Windows™ is a trademark of Microsoft Corporation, Redmond, WA.

6.2.1.4 Move CB8 on the circuit breaker panel (Figure 5.3) to ON position. Verify the VOID FRACTION lamp illuminates on the annunciator panel (Figure 5.2).

6.2.2 Nitrogen Gas Supply System

6.2.2.1 Verify nitrogen cylinder pressure at PE1 (should read above 2200 psia when full).

6.2.2.2 Open nitrogen supply by clicking on solenoid valve icon (YV1) (green indicates valve is open).

6.2.2.3 Verify operation of Pressure Regulator PCV1 by observing PE2 (should read 500 ± 20 psia).

6.2.2.4 Verify operation of Pressure Regulator PCV2 by observing PE3 (should read 200 ± 10 psia).

6.2.2.5 Verify operation of PCV3 by observing PE9 (should read 500 ± 20 psia).

6.2.2.6 Click on YV7 icon to open valve (color should be green). Confirm pressurization of Water Tank T-2 by observing PE8 (should read 200 ± 10 psia).

6.2.3 Unpacking the VFI

6.2.3.1 Click on the "CLOSE" icon (YV5) to close the sample chamber cover. Wait for flowmeter (FE1) to update.

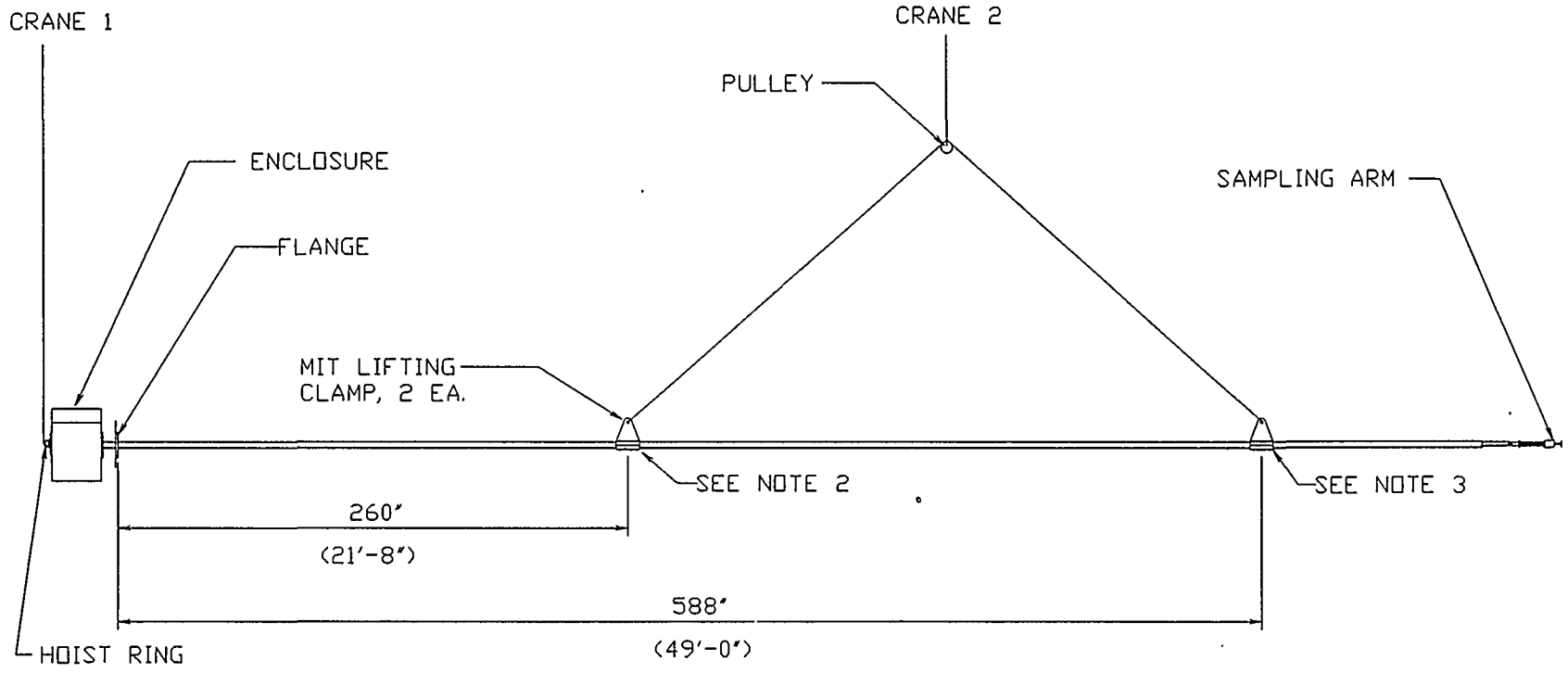
6.2.3.2 Click on the "RETRACT" icon (YV3) to positively assure the VFI arm is in alignment with the VFI mast.

6.2.3.3 Attach Crane #1 to the lifting bail at the top of the VFI with appropriate rigging.

6.2.3.4 Remove and store the 8 flange bolts securing the VFI to the storage container.

6.2.3.5 Slide the VFI out of the container, attaching 2 midpoint lifting clamps to the VFI per Figure 6.4. Attach Crane #2 to the midpoint clamp(s) to continue VFI removal.

6.2.3.6 Lift and set the VFI onto sawhorses capable of supporting the VFI (minimum of 3 sawhorses required) near the three lift points. (Leave room for arm motion to occur.)



NOTES:
1. LOCATE MIT CLAMPS WITHIN +/- 2".
2. LOWER EDGE OF CLAMP AT 1' BELOW BOTTOM OF 40' MARK ON MAST.
3. LOWER EDGE OF CLAMP AT 7' ABOVE BOTTOM OF 12' MARK ON MAST.

Figure 6.4 Midpoint Lifting Clamp Locations

6.2.3.7 Remove the split half nylon pieces from the VFI body and store for reuse. Remove any other protective equipment from the VFI at this time.

6.2.4 Pneumatic Cylinders (Sample Chamber and Rotation)

6.2.4.1 Open Solenoid Valve YV2. Confirm pressurization of drive-out line by observing PE4 (should read 500 psia). Verify forearm movement to horizontal (90° to the VFI mast) by visual observation and by total flow readout on FE1 (approximately 1230 SCCM).

6.2.4.2 Close Solenoid Valve YV2. Valve YV3 will then automatically open.

6.2.4.3 Confirm pressurization of retract line by observing PE5 (should read 500 psia). Verify that forearm returns to vertical (in-line with VFI mast) by visual observation and by total flow readout on FE1 (approximately 1250 SCCM).

6.2.4.4 Click on YV5 icon to open valve. Confirm pressurization of "CLOSE" line by observing PE7 (should read 500 psia). Verify sample chamber movement to closed position by visual observation and by total flow readout on FE1 (approximately 1100 SCCM).

6.2.4.5 Close YV5. Valve YV4 will then automatically open.

6.2.4.6 Confirm pressurization of "OPEN" line by observing PE6 (should read 500 psia). Verify sample chamber movement to open position by visual observation and by total flow readout on FE1 (approximately 1140 SCCM).

6.3 INSERTION

6.3.1 Verify that the sampling arm is in the vertical position (YV3 icon is green and forearm is aligned with VFI mast) and the sample chamber cover is closed (YV5 icon is green).

6.3.2 Lift VFI to vertical (2 cranes required) and position VFI over riser. Lower VFI to "field-determined" zero point.

6.3.3 Zero the elevation readout by clicking on the "Zero Level Gauge" switch on the computer front panel. Click on "Yes" in dialog box. Confirm that the elevation readout reads zero.

6.3.4 If the instrument used in Step 6.3.3 is not functioning properly, record the zero position by correlating the electroetched stripes on the VFI to some fixed reference point.

6.4 DATA COLLECTION

6.4.1 Lower the VFI into the tank until the arm pivot point is under the crust, if one is present.

6.4.2 Move forearm to horizontal position by clicking on YV2 icon.

Note: If YV1 is not OPEN, YV2 will not work reliably.

6.4.3 Lower the instrument to the first testing elevation.

6.4.4 Open Solenoid Valves YV1 and YV7. Verify the valves are open by reading pressures on PE3 and PE8 (should read 500 psi and 200 psi, respectively).

6.4.5 **INITIATE** test cycle by clicking the "Test Sequence" switch.

Note: If the "Test Sequence" switch is not used for testing, then the pressurizing line must be flushed with water and N_2 purged following a test using the Wash-and-Dry Line switch.

6.4.6 Lower the instrument approximately 2 feet and repeat Step 6.4.5.

Note: Remove the tall impact limiter when the hydrogen deflector is between 1 to 2 feet above the top of the impact limiter.

6.4.7 Repeat Steps 6.4.5 through 6.4.6 as required.

6.4.8 Decontaminate during upward lifts following Section 6.9 of this document.

CAUTION

DO NOT ATTEMPT TO ROTATE THE FOREARM TO THE VERTICAL POSITION WITHIN 50 INCHES OF TANK BOTTOM.

CAUTION

REINSTALL THE TALL IMPACT LIMITER WHENEVER THE HYDROGEN DEFLECTOR FLANGE IS 5.5 TO 6.5 FEET ABOVE THE TOP OF THE SHORT IMPACT LIMITER.

6.4.9 Raise the VFI and move forearm to vertical position (aligned with VFI mast) by clicking on YV3 icon.

6.4.10 Raise the VFI as required. The VFI can take approximately 34 samples before the nitrogen bottle should be replaced. Therefore, another vertical test run can be initiated by rotating the VFI as required and restarting at Step 6.4.1.

6.5 WITHDRAWAL

6.5.1 Position the sampling arm vertically as per Step 6.4.9.

6.5.2 Slowly lift the VFI from the riser. Monitor contamination and decontaminate per Section 6.9.

Note: Reinstall lifting clamps per field supervision direction (see Figure 6.4).

Note: Reinsert VFI to continue decontamination as required.

6.5.3 Close the riser.

6.5.4 Using two cranes, swing VFI to horizontal and reset on the sawhorses.

6.5.5 Replace the two exposed O-rings (H-2-821281-25) following standard radiological handling procedures.

6.6 SYSTEM SHUTDOWN

Note: If the VFI will be used in a second riser within 2 weeks, Section 6.6.1 may be skipped.

6.6.1 Reinstall in container.

6.6.1.1 Reinstall the split half nylon pieces on the VFI body. Replace any other protective equipment that was removed from the VFI at this time.

6.6.1.2 Click on the "CLOSE" icon (YV5) to close the sample chamber cover. Wait for flowmeter (FE1) to update flow.

6.6.1.3 Click on the "RETRACT" icon (YV3) to positively assure the VFI arm is in alignment with the VFI mast. Wait for flowmeter (FE1) to update flow.

6.6.1.4 Attach Crane #1 to the lifting bail at the top of the VFI with appropriate rigging. Attach Crane #2 to the midpoint lifting clamps.

6.6.1.5 Slide the VFI into the container, removing midpoint lifting clamps from the VFI when required. Support VFI with cranes and/or sawhorses during this process to prevent VFI bending damage.

6.6.1.6 Install and torque the 8 flange bolts, securing the VFI to the storage container.

6.6.2 Secure the VFI

6.6.2.1 Close the nitrogen supply cylinder hand valve (HV-1) housed in the pneumatic enclosure.

6.6.2.2 Move the void fraction circuit breaker (CB8) to OFF position. Verify the VOID FRACTION lamp turns OFF on the annunciator panel.

6.6.3 Termination of LabView

6.6.3.1 Click on "STOP" icon.

6.6.3.2 Click on File to open file menu, then select "Exit" form the file menu.

This will return the user to the Windows interface.

6.6.3.3 Select "Exit Windows" form the file menu.

6.6.3.4 Click on OK to end Windows session.

6.6.3.5 Insert a 3½-inch diskette into Drive "A:".

6.6.3.6 At the DOS prompt (C:\>), type:

copy c:\vf_data\mm-dd-yy*.* a:

This will copy all files that were created on this day to the diskette.

6.6.4 Disable Power to Control Console/Power Distribution Skid

6.6.4.1 Move the console power circuit breaker (CB2) to OFF position.

The following lamps will go out:

-- CONSOLE
-- INSTRUMENT

6.6.4.2 Move the power distribution skid switches and circuit breakers (CB1, CB2, DS1, and MS1) to OFF position.

6.6.4.3 Turn remote disconnect switch ON disconnect skid (DS2) to OFF position.

6.6.4.4 Turn site service disconnect to OFF position if required by standard site practices.

6.6.5 Disconnect Cables and Hoses

6.6.5.1 Disconnect all instrumentation and power cables connected to the VFI and coil away from heavily used areas.

6.6.5.2 Disconnect decontamination water hoses from tanker truck, feed pump, water pump/heater, and decontamination spool piece.

6.6.5.3 Disconnect power cables from power skid to feed pump and water pump/heater.

6.6.5.4 Winterize the pumps as per manufacturer's instructions if system will be stored in below-freezing conditions. Drain or blow out decontamination spool piece.

6.7 SUSPENSION OF SOFTWARE OPERATION

To temporarily suspend the LabView program:

6.7.1 Click on the LabView "STOP" icon.

6.7.2 Operation is resumed by clicking on the "RUN" button.

6.8 DATA FILE ACCESS

Switch from LabView to the program manager by simultaneously pressing the ALT and TAB keys.

Open the "Accessories" window, then double-click on the "Write" icon.

In file menu, select "Open...".

Select a file from the file selector box:

-- C:\DATA\mm-dd-yy\mm-dd-yy.DAT

The "mm-dd-yy" refers to the current month, day, and year, respectively.

6.9 DECONTAMINATION SPRAY SYSTEM

CAUTION

DO NOT RUN FEED PUMP FOR MORE THAN 5 MINUTES WITHOUT WATER FLOWING THROUGH DV2 OR DV3. NEVER RUN THE HIGH-PRESSURE PUMPS WITHOUT ADEQUATE WATER SUPPLY. (PUMP AND SYSTEM OVERHEATING CAN OCCUR.)

6.9.1 System Setup

6.9.1.1 Flush all antifreeze from pump if it has been winterized. Check diesel fuel level of heater tank and fill if necessary. Check gasoline level of cold water pump and refill if necessary. Check motor oil level on cold water pump and service as required.

6.9.1.2 Verify (on the high-pressure pumps) that the detergent addition valves are in OFF position.

6.9.1.3 Connect hoses per SK-2-61342.

6.9.1.4 Open Valves DV1, DV2, and DV3 (see Figure 6.3). Open garden hose connections at the high-pressure pump inlet points.

6.9.1.5 Move feed pump (30 psi maximum output) motor starter switch (MS1) on power distribution skid to ON position to purge air from hoses. Close DV2 and DV3 after purge.

6.9.1.6 Move MS1 to OFF.

6.9.1.7 Reconnect garden hoses.

6.9.1.8 Read water meter.

6.9.2 Decontamination Process--VFI Mast (or 2" water lance)

6.9.2.1 Verify DV4 is closed. Open DV2.

Note: ONLY run high-pressure pump when VFI mast is being retracted upward. Move MS1 to OFF position if the high-pressure pump has been off for more than 5 minutes.

6.9.2.2 Move MS1 to OPEN position. Turn high-pressure washer-hot switch to PUMP.

Note: Use of "pump and heat" selection should be implemented on a case-by-case basis per field direction and procedures.

6.9.2.3 Shut off high-pressure washer at the end of decontamination process.

6.9.2.4 Move MS1 to OFF position.

6.9.3 Decontamination Process--VFI Sample Arm

6.9.3.1 Position the VFI so that the arm is in the decontamination spool piece. (Reference: The top of Stripe #10 should be 20 inches above the top of the tall impact limiter to align the spray nozzles to best clean the sample chamber area.)

6.9.3.2 Open DV3 and DV4.

6.9.3.3 Move MS1 to the ON position.

6.9.3.4 Start the cold water pump. (The pump supplies approximately 4.5 gpm at 2000 psi when connected per this procedure.)

6.9.3.5 Turn on the high-pressure washer-hot switch to PUMP position. (This pump supplies approximately 3.5 gpm at 3000 psi if DV4 is closed and approximately 3.5 gpm at 1500 psi if DV4 is open.)

6.9.3.6 Spray for approximately 5 minutes or longer as required to achieve effective decontamination.

CAUTION

DO NOT LIFT THE VFI MAST CLEAR OF THE RUBBER WIPER DURING DECONTAMINATION PROCESS. THE WATER WILL NOT BE ADEQUATELY CONTAINED.

Note: During this time:

- *Rotate the VFI ± 45°*
- *Slowly move the VFI up and down (no more than 6 inches in either direction from the beginning reference given in Step 6.9.3.1)*
- *Open and close the sample chamber cover at least 5 times*
- *Verify sample chamber cover is closed prior to performing Step 6.9.3.7*

TRG approval of this document allows the sample chamber cover to be actuated in the decontamination spool piece as required to facilitate an effective decontamination.

6.9.3.7 Turn the high-pressure pumps OFF.

6.9.3.8 Move MS1 to the OFF position.

6.9.3.9 Wait 1 minute to drain any residual water pockets above the chamber).

6.9.3.10 Open the sample chamber cover. Wait 1 minute.

6.9.3.11 Retract VFI from riser as required.

7.0 MAINTENANCE

Replacement of components such as pneumatic valves that are on the primary containment path requires leak checking and retesting prior to field service.

The O-rings may be replaced without retest.

Detailed procedures will be developed as necessary for VFI maintenance not sufficiently addressed within this document.

7.1 HARDWARE CHANGE-OUT UNDER NORMAL CONDITIONS

7.1.1 Enclosure Preparation

Power should be shut off at the control console prior to any maintenance activities associated with the VFI. The nitrogen supply bottle should be closed and excess pneumatic pressure vented.

7.1.2 Cylinder Replacement

The nitrogen cylinder will have to intermittently be replaced. The bottle is a size G-3 and secured inside the VFI pneumatic enclosure. No special procedures are required. The following information is presented for information and guidance.

- Verify HV-1 is closed prior to cracking any lines open.
- It is recommended that nitrogen pressure be vented from the system prior to cracking open any lines.

- Keep dirt and other foreign material out of the piping system.
- Do not readjust any regulators without engineering approval.
- If several failures have occurred, the internals of the piping system may be contaminated. If contaminated, the VFI should not be used without performing detailed engineering reviews.

During system startup, the software will alarm if the cylinder pressure is not between 2000 to 2200 psig. If this alarm occurs, the bottle should be replaced/refilled prior to initiating the operation unless sufficient engineering has been performed to do otherwise.

Replacement of pneumatic components following an alarm condition associated with the VFI during operation may warrant special precautions. Waste may enter cylinder packings or back up the pressurizing lines and result in the pneumatic piping system being contaminated internally.

7.1.3 (TK-2) Water Tank

The VFI has a water tank, located inside of the pneumatic enclosure, that must be full prior to any in-tank operation.

7.1.3.1 Open fill (HV-5) and vent (HV-4) valves on tank TK-2 (see Figure 6.5 for locations).

7.1.3.2 Fill water tank with deionized or distilled water.

7.1.3.3 Close valves HV-5 and HV-4.

This water tank must be drained for winterization. Computer system must be operational to drain the water tank.

7.1.3.4 Place catch basin underneath the external swagelock cap located on outside of VFI enclosure (see Figure 6.6). Remove the swagelock cap.

7.1.3.5 Open the drain valve YV8 (icon color is green) and catch the drained water. Reinstall swagelock cap after tank has been drained and close YV8 (icon is red).

Note: Tank TK-2 is pressurized to 200 psig during operation. The general guidance and information presented in Section 7.1.2 applies.

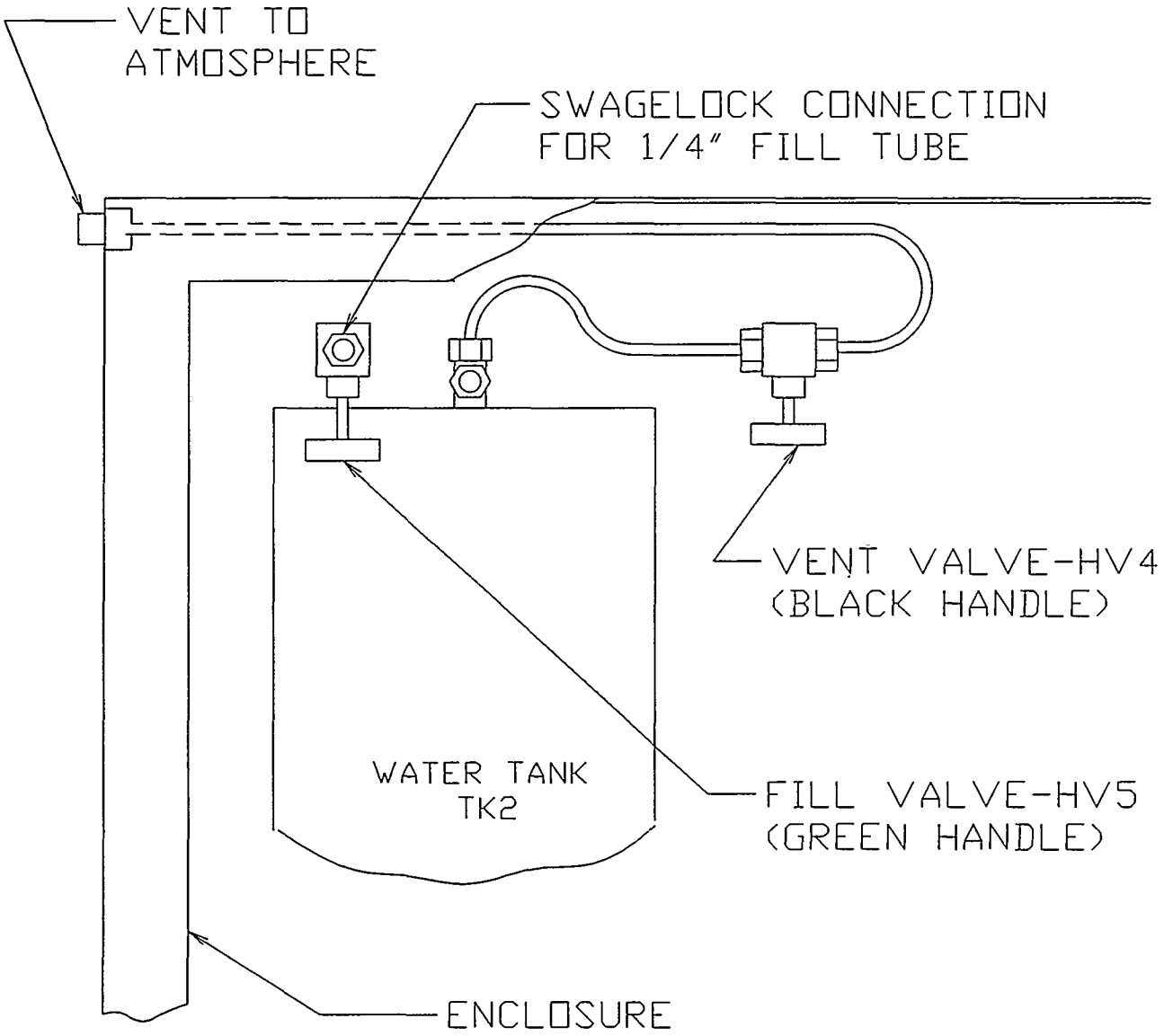


Figure 6.5 Water Tank (TK-2) Vent and Fill Valve Locations

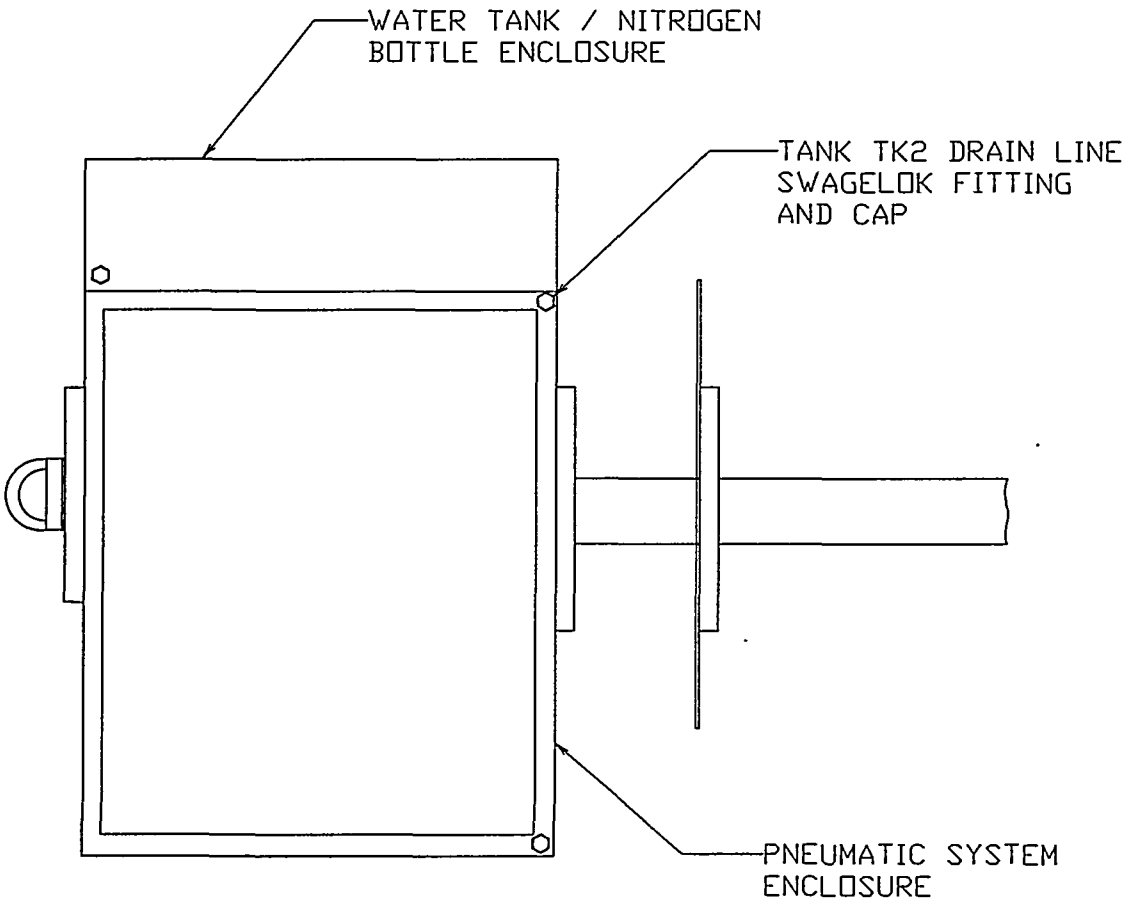


Figure 6.6 Water Tank (TK-2) Drain Line Cap Location

.2 PREVENTATIVE MAINTENANCE

.2.1 Visual Inspection

- Visually inspect components of the system for signs of damage or unusual wear.

.2.2 Filters

- Replace all filters in the console air conditioning unit according to manufacturer's instructions; see VI file/manufacturer's data.

.2.3 Mechanical and Electrical Checks

- Inspect all external cables for evidence of insulation damage or kinking after 160 operating hours.

.2.4 Decontamination System

- Check high-pressure pump(s) oil per manufacturer's instructions. If oil is milky indicating water contamination, change oil.

.3 SPARE PARTS LIST

.3.1 Instrument Lights

-- Panel instrument lights (6 each)
-- Square D - ZA2 BV03, 5, 31, and 41

7.3.2 Fuses

For:

-- Computer
-- HVAC
-- TB 6 (0.5, 1, 5 A as per H-2-821718)

7.3.3 Pneumatic Components

The following is a list of components that should be stocked for possible replacement:

-- 3-way Solenoid Valve ASCO USP8300D55F
-- 2-way Solenoid Valve ASCO
-- 2-way Solenoid Valve Circle Seal SV11-T-2NC-4-P-43
-- Pressure Transducer LM2345-M
-- Pressure Transducer LGS14.E3

-- Air Cylinder SSE-1 ⅛ x 4 -FS-OS-W-CS (open/close chamber)
-- Air Cylinder SSE-1 ½ x 4 -FS-OS-W-CS (rotate arm)
-- O-Rings Parker Seal 2-336-E740-75

7.4 CALIBRATION PROCEDURES

All replacement hardware must be calibrated and the system design description appendixes updated to match. Some software modifications may also be required after replacing some components.

8.0 TROUBLESHOOTING

The VFI is a newly developed system. The following people are the cognizant engineers that should be contacted with any troubleshooting questions not addressed in the following sections:

Mike Gimera	Electrical
JD Martin	Electrical
Dennis Graves	Mechanical
Troy Stokes	Overall System
Jim Alzheimer	PNL R&D Engineer

8.1 LOSS OF POWER

If instrument power is not available as evidenced by panel lights not turning on as indicated by the O&MM procedures, then the following steps should be taken:

8.1.1 Check Circuit Breakers

Recheck all circuit breakers on console (Figure 5.3, CB2 through CB8, reference H-2-818150 for breaker locations).

Note: Circuit breakers move to intermediate position when tripped.

8.1.2 Check Fuses

- Using continuity tester, check fuses (reference H-2-818150 and H-2-818153 for fuse locations and H-2-818156 and H-2-818152 for circuit references).

.2 COMPUTER SYSTEM FAILURE

.2.1 The computer system has failed if the mouse has no effect on the screen cursor, the program has terminated unexpectedly, or the computer screen is blank.

.2.2 Open Circuit Breaker CB2 to cut off power to the computer and all instrumentation. After 30 seconds, reapply power to the computer.

.2.3 If the problem still exists, contact engineering.

.3 COMPUTER SOFTWARE ERRORS

8.3.1 Error Messages

Analog hardware communications error:

"Error -10403 occurred at AI Group config."

OR

"Error -10401 occurred at AI Group config."

If this error occurs, the data acquisition board in the computer is not functioning properly. System inoperable, contact engineer to troubleshoot.

8.3.2 Record the specific details of the software error and any displayed error messages. Contact engineering to initiate corrective action.

8.4 INSTRUMENT HARDWARE FAILURE

8.4.1 Record the specific details of the hardware failure and any displayed error messages. Contact engineering to initiate corrective action.

9.0 RESPONSE TO ABNORMAL CONDITIONS

9.1 SAMPLE CHAMBER COVER STUCK SHUT (sampler did not depressurize)

(This section also applies if VFI cannot be removed for some other reason).

9.1.1 Do not attempt further removal of the VFI without TRG approval of specialized procedures.

9.1.2 Lower the VFI until the arm pivot point is under the crust, if a crust exists.

Notes: *1) Remove the tall impact limiter when the hydrogen deflector flange is between 1 to 2 feet away from the top of the tall impact limiter.*
2) Remove the short impact limiter when the hydrogen deflector flange is between 12 to 20 inches from the top of the short limiter.

9.1.3 Actuate the arm to the horizontal position.

9.1.4 Lower the VFI until the short impact limiter is removed.

9.1.5 Move CB8 and CB2 to the OFF position. Disconnect power and instrumentation cables at the control console that lead to the VFI.

9.1.6 Continue lowering VFI until VFI rests on the tank floor.

9.1.7 Secure VFI to riser per tank farm operations. Shut down remaining VFI equipment, site power, decontamination water, etc., per this document's standard shutdown procedures.

9.2 SOFTWARE ALARMS (PRESSURE/TEMPERATURE) - STARTUP

9.2.1 If the software alarms on startup, correct the problem prior to lifting VFI for operation.

9.3 SOFTWARE ALARMS (PRESSURE/TEMPERATURE) - DURING OPERATION (BEFORE REMOVAL)

9.3.1 If the software alarms during operation, stop testing. Go to Section 6.5 and remove the VFI from the riser.

9.3.2 If the VFI cannot be retracted for some reason, refer to Section 9.1 and follow the same steps. Open the sample chamber between Steps 9.1.3 and 9.1.4.

9.4 DACS NOTIFICATION OF ALARM

Two responses are possible:

1) In the event a DACS-monitored parameter goes out of range, the VFI will be retracted per Section 6.5 of this document.

2) In the event a hydrogen or other immediately hazardous tank condition develops, all VFI operations will be terminated until TRG provides approval to continue or withdraw the VFI from the riser.

9.5 EXCESS WATER ADDITION

9.5.1 Terminate all VFI operations. Contact TRG for approval to continue installation, operation, or withdrawal.

9.6 VFI ARM ACTUATES IN LOWER 50 INCHES OF TANK

9.6.1 Retract VFI arm to vapor space for visual inspection. If no damage, continue testing. If damaged, remove VFI from tank per 6.5 if possible.

10.0 REFERENCES

- WHC-SD-WM-SDD-046, "Void Fraction System Design Description."
- WHC-SD-WM-CSRS-020, "Software Requirements Specification for Tank 101-SY Void Fraction Instrument"
- WHC-SD-WM-CSDD-015, "Void Fraction System Computer Software Design Description."
- H-2-821615, "Void Fraction Instrument Drawing Index Tree."
- VI 22606, "In Situ Void Fraction Instrument Vendor Information."