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16. Abstract:

The SOVIT system, developed at Texas Tech University, has been used to demonstrate the use of an innovative technology known as "in-situ soil vitrification" for soil stabilization purposes. The design and construction of the equipment was sponsored by TxDOT. This document contains a description of the systems and components contained in the SOVIT system. Instructions are given for the operation and maintenance of the equipment. Equipment storage and operational safety concerns are also provided.

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SOVIT SYSTEM OPERATION AND MAINTENANCE MANUAL

by

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and John W. Walter

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Not intended for construction, bidding, or permit purposes. The engineer in charge of the research study was Priyantha Jayawickrama, Ph.D., P.E. , Texas Tech University.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: Volumes greater than 1000 l shall be shown in m^3.				
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celcius temperature	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.71	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celcius temperature	1.8C + 32	Fahrenheit temperature	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

* SI is the symbol for the International System of Units. Appropriate

(Revised September 1993)

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SOVIT System Operation and Maintenance Manual

1. INTRODUCTION

This guide will familiarize you with the operational, maintenance and safety features for the SOVIT system. This manual is supplemented with operation manuals for each of the various components mounted on the portable SOVIT unit. We urge ALL personnel who will be responsible for operation of the device to read these publications carefully and follow the procedures to help assure safe and proper operation of the SOVIT system.

***WARNING:* The SOVIT system should be stored indoors, and protected from excess moisture and dust. Storage ambient temperature should be regulated, as extreme heat or temperatures below freezing could cause irreversible damage.**

***WARNING:* Dangerous electrical voltages are exposed in many locations on the SOVIT system. Operators should be very experienced with high voltage / high power electrical equipment and should be very well familiarized with the equipment before operation. It is recommended that all operators are trained in the operation and hazards of the equipment.**

***WARNING:* The off-gases created during operation of this device can be dangerous and/or highly carcinogenic if inhaled. Proper care should be taken to avoid exposure to operators and other persons.**

2. SYSTEM OVERVIEW

The SOVIT system consists of a field deployable apparatus for sub-grade repair and stabilization by vitrifying soils in place. General operation of the system begins by the deployment of the device at a selected site. The torch consists of a head assembly and two concentric graphite electrodes, which are lowered into position in the ground. The exhaust collection shroud is then placed around the torch and connected to the exhaust system. All pumps and fan motors are then activated and power is applied to the torch. The "melt" process is accomplished by striking an arc between the graphite electrodes to create hot plasma-gas. This gas is then forced to the tip of the electrode by air injected through the torch head and then through an annulus formed between the electrodes. During operation, additives may be added to the melt through a material feed system to vary the melt characteristics. Due to the extreme temperatures generated during torch operation, the head assembly is cooled by an internal water supply system. The off-gas exhaust generated by the process is collected within an insulated shroud and routed to the spray quench and scrubber system for treatment. An array of process control and instrumentation equipment is available to the operator to monitor operating parameters of each sub-system. Several safety interlocks are designed into the system for operator and equipment protection.

3. SYSTEM OPERATION

3.a Gantry and Torch Articulation System

The gantry is constructed of structural steel tubing and acts as the main support structure for all components. This structure is bolted directly to a trailer and allows the unit to be mobile for relocation to different sites.

The torch head, trolley and boom are supported on a slider, which is guided with a set of c-channel rails to allow the torch to extend approximately 30 inches beyond the end of the trailer. The slider also contains a one horsepower cable winch to raise and lower the torch and trolley along a set of vertical rails called the boom. During travel, the slide and trolley are secured into the "travel position" with webbing and lever-action load binders. Once the device is positioned at the site the trailer jacks are deployed to level the trailer. At this time the travel straps can be removed. The slide is then manually withdrawn from the gantry for the "deployed position".

The boom acts as a guide for the trolley, which carries the torch assembly. The boom can be fixed in two positions, vertical or tilted to 30 degrees. The winch uses 3/8" cable to raise and lower the torch assembly at approximately 1 inch per second or 5 feet per minute and is activated by a hand held pendant switch. The winch requires power to articulate (i.e. power in, power out) and has an automatic friction clutch brake to support the torch head at any vertical position. To avoid inadvertent damage to the winch motor or unspooling of the cable, limit switches are located at both extreme positions on the boom and are triggered by the trolley.

3.b Torch Head Assembly

The torch assembly consists of a stainless steel torch head, two concentric graphite electrodes and an air shroud. The torch head serves as the main connection point for the electrical supply lines, electrodes, and cooling water and air supply hoses. The head has threaded support for both the anode and cathode electrodes. Each section of the head is individually water cooled and electrically isolated from one another. The concentric graphite electrodes consist of a tubular exterior cathode and an interior solid anode. The annulus formed between the two electrodes provides a passage for material to be injected directly into the melt with the material feed system. The electrodes are threaded into position in the torch head.

The air shroud is fed with a separate air supply and forms a second annulus on the exterior of the cathode. The purpose of this shroud is to cool the cathode and reduce electrode degradation by hot plasma gas scouring the tip of the electrode as it exits from the interior annulus. This shroud is secured by clamping to the torch head.

Figure 1. Torch Head Assembly

3.c Cooling Water System

The cooling water system consists of a centrifugal pump, supply tank, de-ionization tank and a heat exchanger. The purpose of the cooling water system is to provide cooling water to the anode and cathode sections of the torch head and to the power supply cabinet. The cooling system is initially charged with de-ionized water with a quality of 1 Mohms or greater. The water is drawn from the tank by a centrifugal pump at a rate of 18.5 gpm. A minimum flow orifice then directs approximately 3 gpm directly back to the supply tank. This is to insure the pump is not allowed to run dry. A second stream of approximately 1.5 gpm is supplied to the power supply cabinet. A third stream of 0.5 to 1 gpm of flow is directed through the deionizer and returns directly back to the tank. The purpose is to polish the supply and keep the conductance of the water below 0.5Mohms. An indicator light is provided to warn the operator should this condition arise. The remaining 12 - 13 gpm is directed to both the anode and cathode sections of the torch head cooling passages. This flow then returns through a heat exchanger and discharges back to the supply tank.

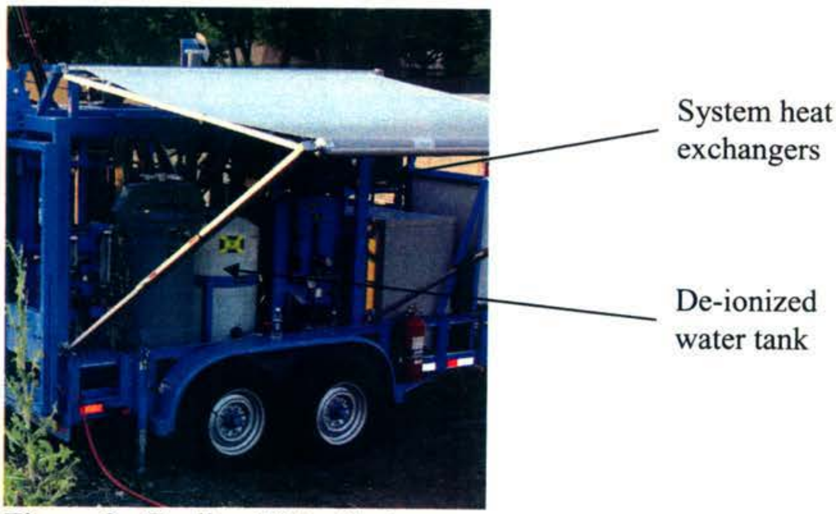

Figure 2. Cooling Water System

3.d Exhaust and Quench System

This system consists of an exhaust shroud, stainless steel flexible hose, quench chamber, centrifugal separator, two diaphragm pumps, supply tank, and blower. During torch operation, off-gas consisting mostly of steam, created by moisture contained within the soil, and fly ash are generated. These constituents are collected in an insulated exhaust shroud that covers the melt area. The off-gas is drawn through the exhaust system by a blower, which can generate approximately –8.0 inches water column vacuum pressure. As the exhaust gas travels through the quench chamber it is quenched with nine misting nozzles with 1.5 gpm of water. This initial treatment cools the exhaust and reduces the solid particulates in the gas stream. Towards the end of the chamber, the quenched gas passes through a stainless steel chevron demister pad. This component continues to reduce the moisture and solid particulate content within the exhaust stream before it is drawn through the centrifugal separator. The centrifugal separator directs the exhaust stream tangentially through the separator creating a spinning motion in the gas. This action effectively separates any remaining solids and moisture in the exhaust stream through condensation on the canister sidewall. The liquid and solids then drain to the bottom of the canister and are withdrawn by a small diaphragm pump back to the supply tank. The remaining exhaust gas is withdrawn from the top of the canister to the blower and then discharged to atmosphere. The hot exhaust gas can be tempered with ambient air through two manually operated dampers located at each end of the quench chamber. The dampers allow low temperature ambient air to be drawn into the hot exhaust stream to regulate the stream temperature.

The water supply for this system originates from a stainless steel supply tank located below the quench chamber. The water used in this system must be clean but not deionized. Water is drawn from the tank through a small diaphragm pump at a rate of 2 gpm. Approximately 0.5 gpm of the total flow is directed through a minimum flow orifice discharging directly back to the supply tank to insure the pump is not allowed to run dry. The remaining 1.5 gpm is directed to the spray nozzles and then gravity drains back to the supply tank.

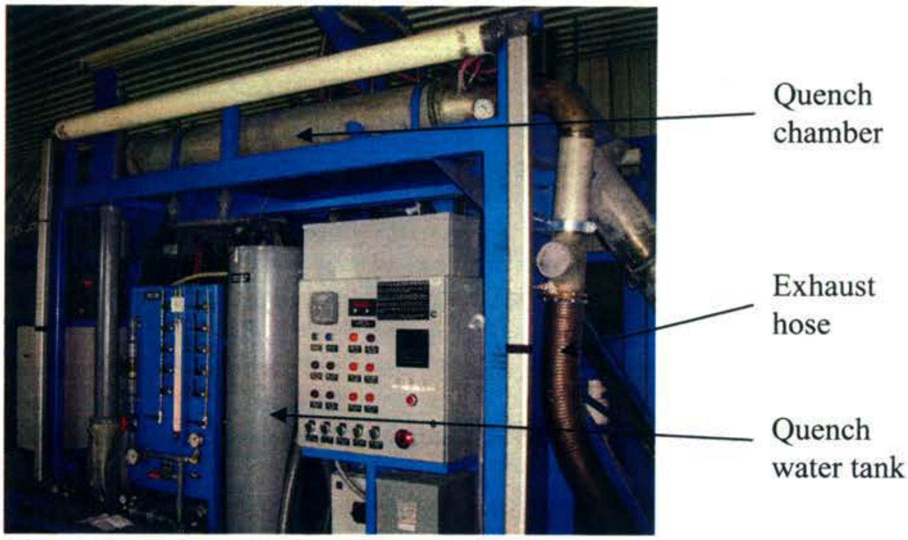

Figure 3. Exhaust and Quench System

3.e Air Supply and Material Feed System

Compressed air is supplied to the system through a compressor mounted external to the SOVIT trailer. The air usage is divided to supply 25 SCFM @ 85 psig directly to the shroud cooling air while the material feed system requires 5 SCFM @ 85 psig. Each diaphragm pump requires approximately 2 – 4 SCFM @ 20 – 40 psi. The material feed system consists of a blow tank capable of holding five cubic feet of additive material. Conveyance of the material is accomplished by dense phase flow combining the compressed air and material. This flow is then directed thru ¾" diameter tubing to the torch head where it is injected into the melt through the internal annulus of the torch. The shroud cooling air is plumbed directly to the torch head and directed to the exterior annulus.

Figure 4. Air Supply Panel and Material Feed Tank

3.f Torch Power Supply and Control System

The power supply for the torch consists of a separate trailer-mounted diesel generator, a large isolation transformer, a power distribution box, and six power converter modules. The 480VAC three-phase output from the generator is sent through the isolation transformer located on the SOVIT trailer, where it is also stepped down to 240VAC. The output of the transformer is fed to the power distribution box. There the power is split into six paths, and sent through a three-phase contactor and fuse block for each module. The power then is fed to the converter modules.

The power converter modules are located in the three power converter boxes (two modules to a box). Each module takes the three-phase 240 VAC from the transformer and converts it to a regulated DC current. The maximum voltage that can be supplied to the arcjet is 320 VDC, and the absolute maximum current per module is 300 A (giving 1800 A absolute maximum to the arc). The output current should typically be limited to a total of 1500 A, for protection of the power converter system.

The controller for the power converters is powered by an uninterruptible power supply (UPS) system mounted in the main SOVIT control panel. The power switch for the controller is located on the middle right side of the panel. The indicators directly above this switch show the status of the UPS. The power converter modules are controlled from the keypad on the upper right side of the panel. The screen attached to the keypad displays the total output current set-point. The set-point of the converters is controlled with the "F1" and "F2" buttons. The current is initialized to zero on start-up. The "F1" button serves to raise the set-point, and the "F2" button will lower the set-point. The "YES" button will change the set-point to a current of 300 A. Button "1" will turn on the six contactors to feed power to the converters. Button "2" will turn off the six contactors and set the current set-point to zero.

Figure 5. Torch Power Supply and Control System

3.g Process Control and Instrumentation

The control panel located on the driver's side of the SOVIT system is the main control and monitoring station. This panel allows the operator to monitor the critical sub-system performance and to activate the SOVIT system for operation. This panel is connected to all of the sensors, which will give the operator warning and/or alarm indication through warning lights and an audible buzzer. The start and stop functions for the motors and raising or lowering of the torch head are performed at this station as well.

The cooling water system and quench system have individual control panels which contain the actual valves, flow meters and pressure gauges that give the operator positive control for each of these systems. The air and material feed system also has a control panel located on the passenger side at the rear of the SOVIT system. Here, the operator can adjust the flow of graphite powder and the material injection through the multiple pressure and flow regulators contained here.

A list of all the components, valves, sensors and regulators is provided in section 9. The item number contained in the list corresponds to the number on the process instrumentation diagram located in the print section of this manual. This will allow the operator to locate and identify the function of each item on the SOVIT system.

4. START-UP PROCEDURE (DEPLOYMENT)

<u>The start-up procedure is as follows</u>: (Reference Figures 6 & 7)

1. Trailer leveled with trailer jacks.
2. Remove travel chains and retract torch from the gantry.
3. Verify control panel disconnect switch is in the "OFF" position.
4. Connect generator to Isolation Transformer.
5. Control panel disconnect switch in "ON" position.

6. Winch Drive Motor selector switch to "START" position.
7. Lower Torch Head to desired position.
8. Install Exhaust shroud, seal and secure all handles.
9. Visually inspect all tank levels:
   a. Quench Water
   b. Cooling Water
   c. Material Feed Tank
   d. Graphite Starter.
10. Connect Air Compressor to SOVIT system and turn on.
11. Open Supply valve to graphite starter powder (Run Time 30 seconds). *Alternative starting method: insert steel wool into electrode annulus.*
12. Close starter air supply valve. Open material feed air supply valves.
13. Set Air Flow at 5 SCFM to center annulus and 12 SCFM to air shroud.
14. Depress and Hold "RESET" button until lights shut off.
15. Set Cooling Water Pump Motor selector switch to "START" position.
16. Set Exhaust Blower Pump Motor selector switch to "START" position.
17. Set Quench Water Pump Motor selector switch to "START" position.
18. Set Heat Exchanger Fan Motor selector switch to "START" position.
19. Turn on power converter controller and wait 30 seconds.
20. Turn on contactors to allow power to flow to the converters.
20. Set current to 300A and allow to run for 10 minutes.
21. After 10 minutes, operator may gradually (over a 3 to 5 minute period) increase the current to the maximum value (See the tips section below).
22. Open material feed supply valve and set feed rate. *Alternative feed method: manually shovel fill material into the hole around the electrodes during operation*

Tips During Torch Operation:

1. During operation, the operator may adjust material feed rate and current as necessary.
2. If voltage and power continue to drop, raise torch several inches and then lower back into the melt.
3. The distance between the bottom of the torch and the top of the melt influences the DC voltage supplied to the torch. The larger the gap the higher the voltage. During melting operation a typical operating range is 70 to 100 volts DC.
4. The maximum operating current depends upon the rated output of the generator and the capacity of the three AC to DC conversion units on the trailer. Under no conditions for a 180

kW generator should the operating current be set above 1400 Amps. This is also the maximum value for a larger generator. For a smaller generator the maximum current is less.

5. The temperature of the exhaust gases from the shroud entering the Exhaust and Quench system should be 500 degrees F or lower. Open or close the bleed air intake to obtain this temperature. The water flow into the water quenching portion of the exhaust should be adjusted so that the exit temperature is 200 degrees F.

Reset Button

Selector Switches:
Winch Drive Motor
Cooling Water Pump
Exhaust Blower Pump
Quench Water Pump
Heat Exchanger Fan

Control Panel
Disconnect Switch

Figure 6. Start-Up Procedure, driver's side

Graphite Powder
Tank and Valve

Air-Flow Control
Panel

Figure 7. Start-Up Procedure, passenger's side

5. OPERATING PARAMETERS AND SAFETY INTERLOCKS

The following is a list of standard operating parameters that are visually inspected during torch operation.

There are five conditions that indicate power should be shutdown to the torch should certain operating conditions arise. Each of these shutdown conditions is indicated with a "RED" indicator light on the control panel.

Interlock #1: Cooling Water High Temperature
Interlock #2: Cooling Water Loss of Flow
Interlock #3: Low Exhaust Pressure
Interlock #4: Exhaust Gas High Temp. Danger
Interlock #5: Air Supply Loss of Flow

There are five warning indicators that will assist the operator to correct several operating conditions should they arise during operation. An "AMBER" light on the control panel indicates each of these warning conditions. Note that these warning conditions DO NOT indicate shutdown of power to the torch head.

Warning #1: Low Cooling Water Tank Level
Warning #2: Low Quench Water Tank Level
Warning #3: Exhaust Gas High Temperature Alert
Warning #4: Torch Head Position – High Limit
Warning #5: Torch Head Position – Low Limit

A note on the "BUZZER":
The buzzer will activate if an illuminated light on the control panel indicates a fault condition. (EXCEPTION: The head low and high position warning lights. The operator can quickly depress the blue button once to deactivate the buzzer for 1 minute. If the fault is an amber warning light and the operator clears the fault condition within the one-minute time limit, the buzzer will reset itself and the operation may continue. The operator may temporarily deactivate the buzzer in one-minute increments indefinitely.

After the buzzer has activated, depressing the BLUE button and holding it down for 5 seconds will permanently deactivate it. The blue button will illuminate indicating the buzzer is no longer operational. The only way to reset the buzzer to active mode is to completely reset the system.

Figure 8. Interlock and Warning Panel

6. SHUTDOWN PROCEDURE

1. Set current set-point to zero.
2. Release clamps on exhaust shroud to free the torch seal.
3. Raise torch to upper limit.
4. Allow remaining components to run for 30 minutes after melt process has been completed.
5. "STOP" Heat Exchanger Fan Motor
6. "STOP" Cooling Water Pump Motor
7. "STOP" Quench Water Pump Motor
8. "STOP" Off-gas Exhaust Fan Motor
9. "STOP" Air compressor
10. Turn off power converter controller

Please note the torch will continue to be very hot. It is NOT recommended to handle or stow the torch for travel 90 minutes after operation has ceased.

Figure 9. Exhaust Shroud

7. ELECTRICAL GROUNDING PROCEDURES

To ensure the safety of the operator and other personnel, the system must be adequately grounded. The ground cable from the bottom of the transformer housing must be connected to a suitable grounding rod, which is driven into the ground a minimum of 30 inches.

8. SPECIFICATIONS AND CAPACITIES

Table 8.1: Valves

System	Valve #	Function
Cooling Water System	V-200	T-200 Tank Drain
	V-201	Cooling Water Pump Supply Shut-off
	V-202	Minimum Flow Orifice Supply Shut-off
	V-203	Deionizer Supply Shut-off
	V-204	Torch Cooling Water Supply Shut-off
Quench Water System	V-100	T-100 Tank Drain
	V-101	Quench Chamber Drain Return Line Shut-off
	V-102	T-100 Level Indicator Shut-off
	V-103	Quench Pump Supply Line Shut-off
	V-104	Minimum Flow Orifice Supply Shut-off
	V-105	Quench Spray Nozzle Supply Shut-off
	V-106	Tempering Air Damper @ Q.C. Inlet
	V-107	Trim Air Damper @ Q.C. Outlet
	V-108	Fan Supply Line Drain
Air Supply and Material Feed System		
	V-300	Graphite Injection Air Supply Shut-off
	V-301	Additive Injection Air Supply Shut-off
	V-302	Shroud Air Supply Shut-off
	V-303	T-301 Additive Tank Air Supply Shut-off
	V-304	T-300 Graphite Material Feed Shut-off
	V-305	T-301 Material Feed Shut-off

Table 8.2: Capacities of Components

System	Item #	Description	Capacity/Spec
Cooling Water System	T-200	Cooling Water Tank	65 gal. (Deionized Water)
	P-200	Cooling Water Pump	18.5 gpm @ 37.5 psi
	MFO-200	Minimum Flow Orifice	3.0 gpm @ 37.5 psi
	DI-200	Deionizer Tank	0.5 gpm @ 37.5 psi
	B-200	Heat Exchanger	8500 Btu/hr
	E-200	Heat Exchanger Fan	500 scfm
Exhaust Gas System	T-100	Quench Water Tank	24.4 gal. (Filtered Water)
	P-100	Quench Water Pump	1.8 gpm @ 31.5 psi
	MFO-100	Minimum Flow Orifice	0.5 gpm @ 31.5 psi
	E-100	Quench Chamber	n/a
	S-100	Chevron Demister	n/a
	S-101	Mesh Demister Pad	n/a
	B-100	Exhaust Fan	159 scfm @ 7.6 in. W.C.
Material Feed System	T-300	Graphite Material Tank	0.07 CF (Graphite Powder)

	J-300	Graphite Jet Eductor	15 scfm @ 40 psig
	T-301	Additive Material Tank	6.0 CF (Additive)
	J-301	Additive Jet Eductor	15 scfm @ 40 psig

Table 8.3A: Sensors and Indicators - Cooling Water System

Item #	Item Type	Measures	Special Note
LI-200	Visual	Tank Level	
LS-200	Float Lever	Tank Level	Warning Indicator
TS-200	Probe	Cooling Water Supply Temperature	P.S. Interlock
TI-200	Dial	Cooling Water Supply Temperature	
PI-200	Dial	Cooling System Pressure	
AI-200	Indicator Light	Cooling Water Conductivity	
FI-200	Piston Spring	Cooling Water Flow Rate	
FS-200	Piston	Cooling Water Flow	P.S. Interlock
TI-201	Dial	Cooling Water Temperature From Torch	
TI-202	Dial	Cooling Water Temperature Tank Return	

Table 8.3B: Sensors and Indicators - Exhaust Gas System

Item #	Item Type	Measures	Special Note
LI-100	Visual	Tank Level	
LS-100	Float Lever	Tank Level	Warning Indicator
TI-100	Dial	Tank Water Temperature	
TI-101	Dial	Quench Water Supply Temperature	
PI-100	Dial	Quench Water System Pressure	
FI-100	Piston/Spring	Quench Water Flow Rate	
TI-103	Dial	Exhaust Gas Temp. w/ Tempering Air	
TI-104	Dial	Exhaust Gas Temp. From Shroud	
TS-102	Thermocouple	Exhaust Gas @ Quench Chamber Exit	P.S. Interlock
TI-105	Dial	Exhaust Gas Temperature w/ Trim Air	
PS-100	Diaphragm/Piston	Exhaust Gas Vacuum Pressure	P.S. Interlock

Table 8.3C: Sensors and Indicators - Material Feed/Air Supply System

Item #	Item Type	Measures	Special Note
FS-300	Vane Flow Switch	Supply Air Flow	P.S. Interlock
PI-302	Dial	Shroud Air Supply Pressure	
FI-302	Piston/Spring	Shroud Air Supply Flow Rate	
PI-300	Dial	Graphite Injection Air Supply Pressure	
FI-300	Piston/Spring	Graphite Injection Air Supply Flow Rate	
PI-301	Dial	Additive Injection Air Supply Pressure	
FI-301	Piston/Spring	Additive Injection Air Supply Flow Rate	
REG-300		Graphite Injection Air Supply	
REG-301		Additive Injection Air Supply	
REG-302		Shroud Air Supply	
REG-303		T-301 Tank Air Supply	
R.V.	Piston/Spring	T-301 Tank Pressure Relief Valve	

Table 8.4: Manometer Station (PI-101)

Side #1 Valve Open	Side #2 Valve Open	Measurement
A1	B2	ΔP Across Spray Quench Area
A2	B3	ΔP Across Chevron Demister
A3	B4	ΔP Across Centrifugal Separator
A2	B4	ΔP Across Entire Exhaust System (Total)
A5	B5	Spare Ports

9. MAINTENANCE ITEMS

Strainers located on the cooling water and quench water pump inlets should be disassembled and cleaned before each operation.

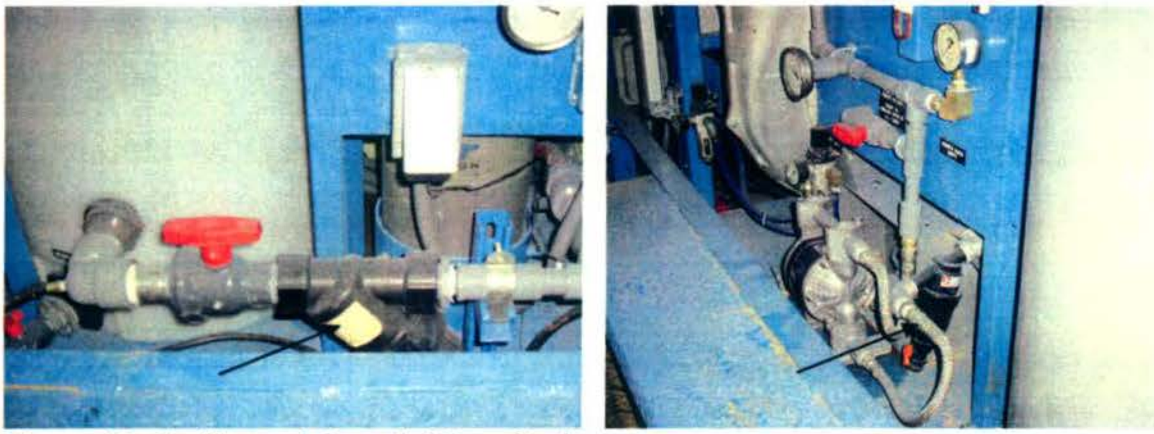

Figure 10. Cooling and Quench Water Strainers

The Conductivity sensor located below the cooling water control panel should be checked before each run to make sure the water in the system is maintained at its proper water quality.

Figure 11. Conductivity Sensor

All water tanks should be filled with fresh water at the beginning of each day.

All hoses and electrical cables should be visually inspected for abrasion, cuts or damage at the beginning of each day. If any parts are found to be defective, they should be replaced immediately.

All water systems should be flushed with fresh water and the tanks emptied and cleaned if the device is to be placed into long-term storage.