FORM ENG-4

TEXACO INC.

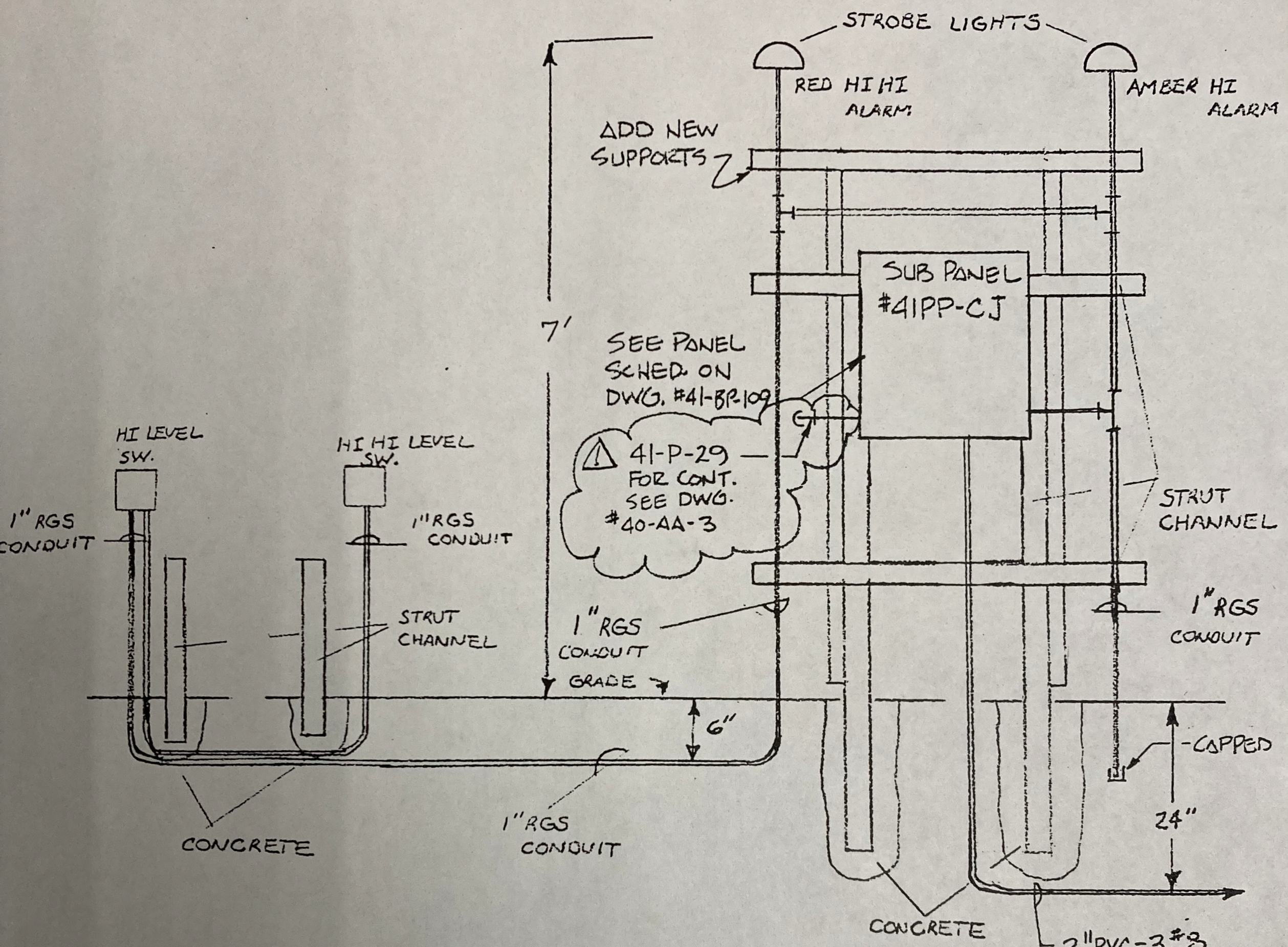
SHEET NO. _____

DATE 3/25/93

LOCATION TERA EST. NO. _____ BY JAR

SUBJECT CONDUIT ROUTING FROM SUB PANEL TO LEVEL SWITCHES C'K'D _____

APP'D JAC

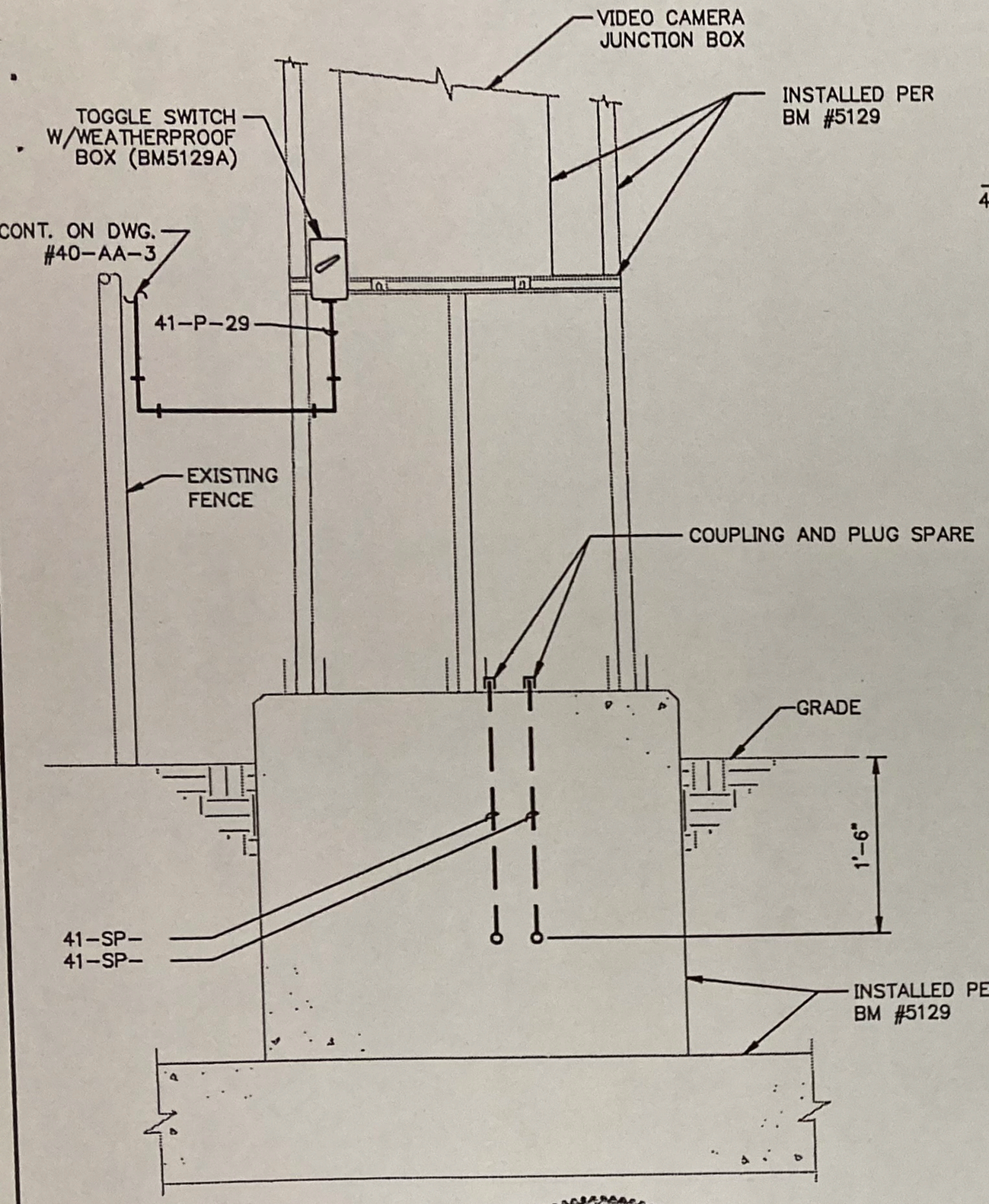


JEFFREY A. CURTIS
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER

Jeffrey A. Curtis 7/27/94

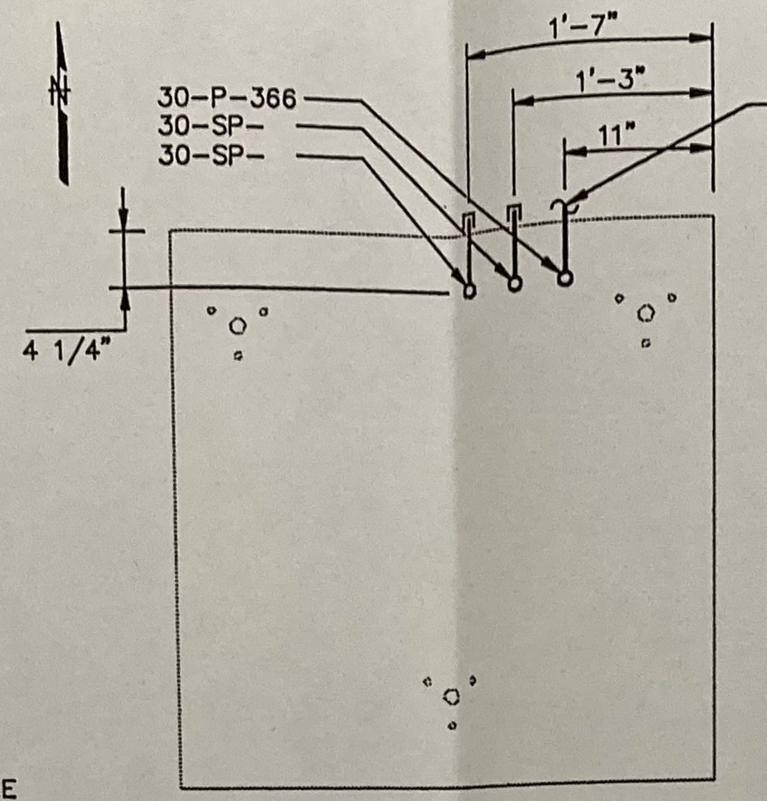
10/31/95

SK03-25-93
REV. 1



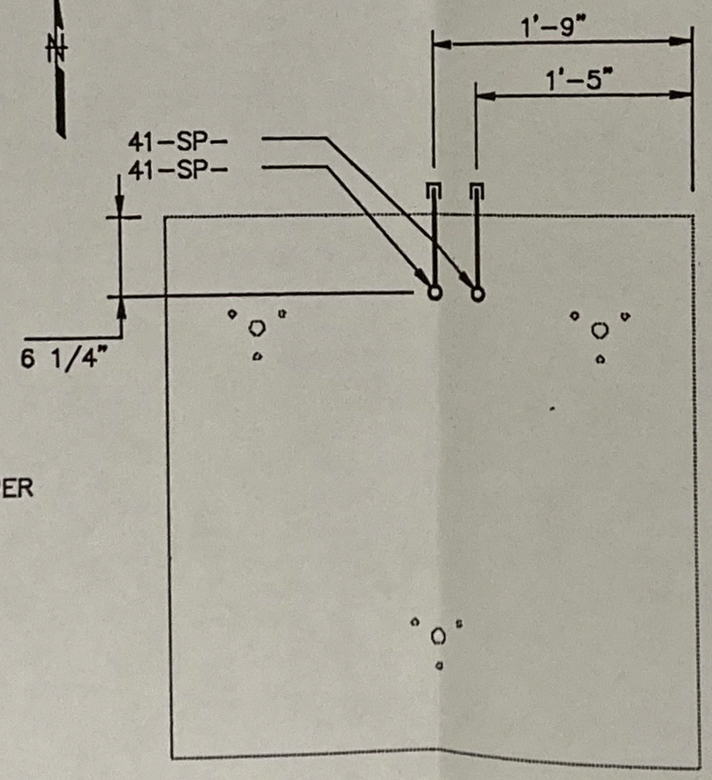
ELEVATION – LOOKING SOUTH

STUB-UP AT "A" ANCHOR



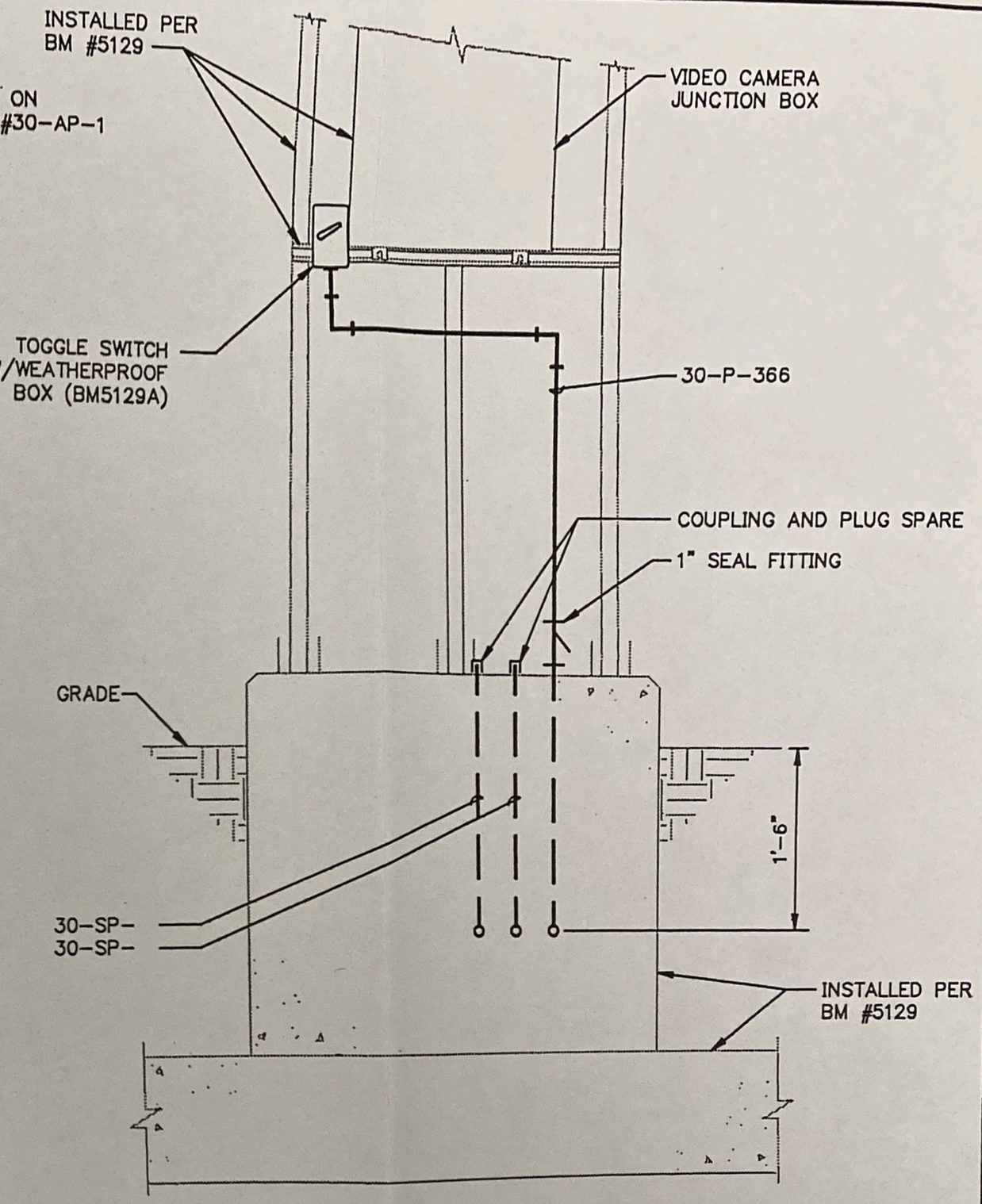
DETAIL – CONDUIT STUB-UP

STUB-UP AT CRUDE BOOSTER PUMP



DETAIL – CONDUIT STUB-UP

STUB-UP AT "A" ANCHOR



ELEVATION – LOOKING SOUTH

STUB-UP AT CRUDE BOOSTER PUMP

JEFFREY A. CURTIS
STATE OF WASHINGTON
9445
REGISTERED
PROFESSIONAL ENGINEER

Jeffrey A. Curtis 7/27/94

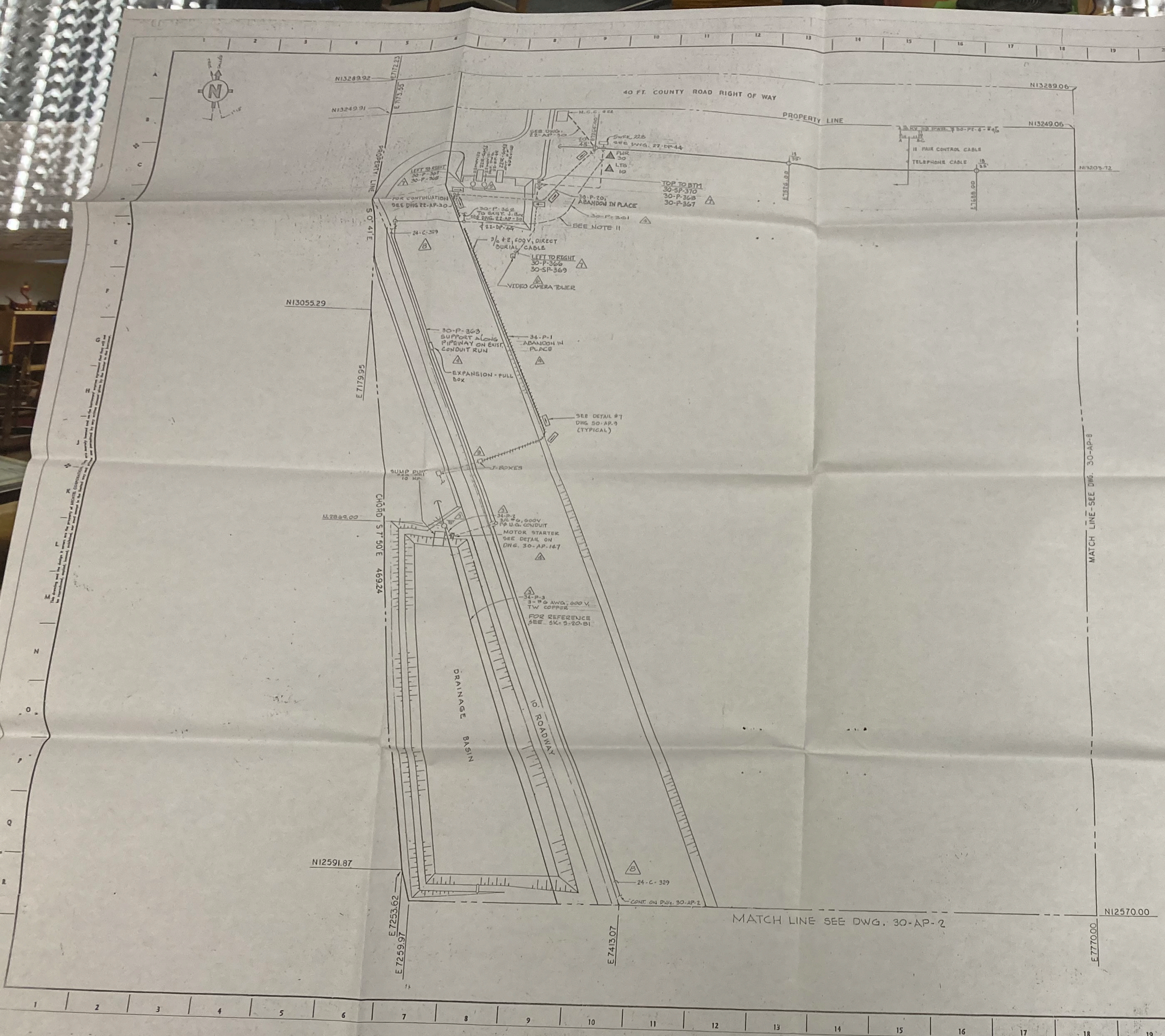
EXPIRES 10/31/95

BY	DATE	JOB		BY	DATE	DESCRIPTION	SYMBOL
APPROVED						REVISIONS	
WT	11/9/93	PSP305	5129A	JMB	10/26/93	ISSUED FOR CONSTRUCTION	0
JAC	4/18/94		5129A	DEH	3/31/94	AS-BUILT	1
		ESTIMATE	B OF M				

TEXACO REFINING & MARKETING INC.
PUGET SOUND PLANT
ANACORTES, WASHINGTON

TERA & CRUDE BOOSTER PUMP VIDEO CAMERA TOWER CONDUIT STUB-UP DETAILS

INITIALS–		DATE	SCALE: 3/4"=1'-0" (1=16)	
DWN BY	JMB	10/26/93	CAD FILE NO. 22BP0009	
CKD BY			DRAWING NO.	REV NO
APP'D BY			22-BP-25	1
CHF. ENGR. –		–		



SIZE A

GENERAL NOTES

1. ALL WOOD POLES, CROSSARMS, & LOG ANCHORS TO BE FULL PENTA-CHLOROPHENOL TREATED.
2. ALL FIELD CUTS ON 'PENTA' TREATED WOOD TO BE FULL 'PENTA' TREATED.
3. ALL OVERHEAD 4160 VOLT LINES TO BE #4/0 AWG, MEDIUM HARD DRAWN, STRANDED COPPER WIRE.
4. ALL OVERHEAD WIRE CONNECTIONS TO BE MADE WITH PRESSURE CONNECTORS AND SHALL BE TAPED WITH SCOTCH 33 ELECTRICAL TAPE.
5. ALL OVERHEAD STREET LIGHTING LINES TO BE #6 AWG, MEDIUM HARD DRAWN, SOLID COPPER WIRE.
6. UNDERGROUND STREET LIGHTING LINES TO BE #6 AWG BUTYL RUBBER INSULATED, NEOPRENE JACKETED, DIRECT BURIAL CABLE.
7. UNDERGROUND DIRECT BURIAL CABLE FOR 480 VOLT CIRCUITS TO BE #4 AWG, BUTYL RUBBER INSULATED, NEOPRENE JACKETED.
8. OPEN WIRE 480 VOLT CIRCUITS ON POLES TO BE MINIMUM OF #1/0 AWG, MEDIUM HARD DRAWN, STRANDED COPPER WIRE.
9. OPEN WIRE 120/208 VOLT CIRCUITS ON POLES TO BE #4 AWG, MEDIUM HARD DRAWN, SOLID COPPER WIRE.
10. PHASE DESIGNATION FOR 4160 VOLT CIRCUITS SHALL BE AS FOLLOWS:
    WHEN ALL THREE CONDUCTORS ARE ON THE SAME SIDE OF THE POLE PHASE DESIGNATION IS A, B, C READING FROM POLE TOWARD CROSSARM. WHEN ALL THREE CONDUCTORS ARE ON THE SAME CROSSARM BUT NOT ON THE SAME SIDE OF THE POLE AND TWO ON THE OTHER, PHASE DESIGNATION IS "A" FOR THE SINGLE CONDUCTOR, "B" FOR THE MIDDLE CONDUCTOR, AND "C" FOR THE OUTSIDE CONDUCTOR.
11. ENCASE UNDERGROUND CONDUITS IN RED CONCRETE.

SYMBOLS

- WOOD POLE — TOP NUMERAL (20) INDICATES POLE NO., LOWER " (45) " POLE HEIGHT.
- GUY STUB POLE — TOP NUMERAL (140) INDICATES POLE NO., LOWER " (40) " POLE HEIGHT.
- DOWN GUY WITH EXPANDING ANCHOR.
- DOWN GUY WITH LOG ANCHOR.
- OVERHEAD LINE
- UNDERGROUND CONDUIT OR DUCT
- DIRECT BURIAL CABLE
- DEADEND OF OVERHEAD LINE
- PWR 30 TRANSFORMER, 3Ø, 4160-480 VOLTS — PWR - DENOTES POWER SERVICE; 30 - INDICATES KVA RATING
- LTG 15 TRANSFORMER, 3Ø, 4160-120/208 VOLTS — LTG - DENOTES LIGHTING SERVICE; 15 (5) - INDICATES KVA RATING
- LTG 5 TRANSFORMER, 1Ø, 480-120/240 VOLTS
- ST 2 STREET LIGHTING TRANSFORMER, 2.5 KV — ST - DENOTES STREET LIGHTING; 2 - INDICATES CIRCUIT NO.
- 1-2 / 1-2 INCANDESCENT STREET LIGHT - MAST ARM MTD. OR WOOD POLE — 1 - INDICATES CIRCUIT NO.; 2 - INDICATES LIGHT NO.; I - INDICATES REFRACTOR TYPE
- 1-3 MERCURY VAPOR FLOOD LIGHT - MAST ARM MTD. ONE WOOD POLE — 1 - INDICATES CIRCUIT NO.; 15 - INDICATES LIGHT NO.
- M 2-23 II MERCURY VAPOR STREET LIGHT ON ALUMINUM STD. — 2 - INDICATES CIRCUIT NO.; 23 - INDICATES LIGHT NO.; II - INDICATES REFRACTOR TYPE
- M 1-20 II MERCURY VAPOR STREET LIGHT ON GALV. STEEL STD. — 1 - INDICATES CIRCUIT NO.; 20 - INDICATES LIGHT NO.; II - INDICATES REFRACTOR TYPE
- X-ARM
- SECONDARY RACK
- AERIAL CABLE — INDICATES POSITION OF CONDUCTORS ON POLES LOOKING IN THE DIRECTION OF THE ARROW.
- CABLE MARKER - SEE DETAIL 7, DWG. 50-AP-9

REFERENCE DRAWINGS

ELECTRICAL DISTRIBUTION - KEY INDEX PLAN	30-RP-100
- 13.8 KV & 15 KV PWR. DIAG.	30-AP-80
- STREET LTG. PLAN	30-AP-95
- ONE LINE DIAGRAM	30-RP-101
- SECTION & DETAILS	30-AP-134
CRUDE BOOSTER PUMPS - STATION LAYOUT	22-AP-30

No.	DATE	REVISIONS	BY	CHK'K	APPR'D SUPVR.	APPR'D ENG'R	APPR'D CLIENT
5	8/31/94	AS BUILT PWR. TO MOV'S & VIDEO CAMERA AND					
4	10/5/91	ADDED 30-SP-369, CHGD T-M CHANGED TO P.T.C.					
3	8/14/90	ADDED 30-SP-370, 30-P-367 & 30-P-368					
2	10/3/90	ADDED NEW FEEDER TO SUMP PUMP 34Q-GM1					
1	5/20/81	ACO POLE #130 & ELECT. SERVICE					
		TEXACO REVISIONS					
1		CHANGED 34Q-GM1 FROM 7½ TO 10 HP	DHL				
½	10/28	RELOCATED PUMP STA., RESPACED POLES	DHL				
0	7/25/94	ISSUED FOR CONSTRUCTION	DHL				
No.	DATE	REVISIONS	BY	CHK'K	APPR'D SUPVR.	APPR'D ENG'R	APPR'D CLIENT

SCALE 1" = 30' | DESIGNED D.H.L. | DRAWN B.G.M.

BECHTEL CORPORATION
SAN FRANCISCO

THE TEXAS COMPANY
PUGET SOUND WORKS

ELECTRICAL DISTRIBUTION PLAN
BLOCK 1

6400-_I
APPROVED BY THE TEXAS CO.

BECHTEL | JOB No. 2525 | DRAWING No. 30-AP-1 | REV. 10

Stamped for revisions Δ, Δ, Δ, Δ, and Δ only.

JEFFREY A. CURTIS — STATE OF WASHINGTON — 19645 — REGISTERED PROFESSIONAL ENGINEER
J. Jeffrey Curtis 7/25/94
EXPIRES 10/31/95

SCANNED
30EP0050

Texaco

TEXACO REFINING AND MARKETING INC.
PUGET SOUND PLANT

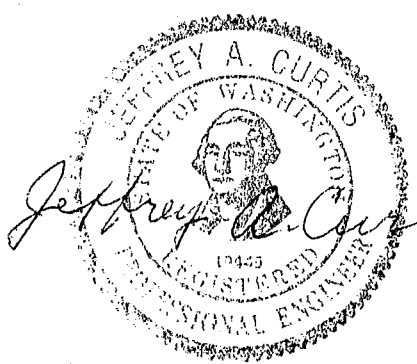
LEAK DETECTION SYSTEM FOR DOCK TRANSFER LINES
SYSTEM DESCRIPTION AND TESTING REPORT

July 28, 1995 Revision 0

Report Prepared by: Tim M. Lother

Tim M. Lother
Control Systems Specialist

Approved: J Thrapp 8/2/95



Jeffrey A. Curtis 8/2/95

EXPIRES 10/31/95

Texaco

TEXACO REFINING AND MARKETING INC.
PUGET SOUND PLANT

LEAK DETECTION SYSTEM FOR DOCK TRANSFER LINES
SYSTEM DESCRIPTION AND TESTING REPORT

TEXACO REFINING AND MARKETING INC.
PUGET SOUND PLANT

LEAK DETECTION SYSTEM FOR DOCK TRANSFER LINES
SYSTEM DESCRIPTION AND TESTING REPORT

1. GENERAL

1.1. INTRODUCTION

This report together with the drawings and documents listed in the appendixes describes the Dock Transfer Lines Leak Detection System installed at the Texaco Puget Sound Plant. The system is designed to quickly detect leaks on 12 pipelines carrying hydrocarbons between the loading/unloading dock and the plant, and report leaks to the operators before a major release of hydrocarbons to the environment occurs. This system fulfills the transfer line leak detection requirements of Washington State standard Chapter 173-180A WAC, Facility Oil Handling Operations and Design Standards.

The system is described in section 2 of this report, results of the testing performed on the system are summarized and described in section 3 of this report.

1.2. OVERVIEW OF THE CHAPTER 173-180A WAC LEAK DETECTION REQUIREMENTS

The leak detection requirements of the standard are primarily described in section WAC 173-180A-100.8 which states;

"(8) Facilities shall have the capability of detecting a transfer pipeline leak equal to eight percent of the maximum design flow rate within fifteen minutes for transfer pipelines connected to tank vessels. Leak detection capability shall be determined by the facility using best engineering judgment. Deficiencies with leak detection systems such as false alarms must be addressed and accounted for by the facility. Facilities may meet these requirements by:

(a) Visual inspection provided the entire pipeline is visible and inspected every fifteen minutes; or

(b) Instrumentation; or

(c) Completely containing the entire circumference of the pipeline provided that a leak can be detected within fifteen minutes; or
(d) Conducting an acceptable hydrotest of the pipeline immediately before the oil transfer with visual surveillance of the exposed pipeline every fifteen minutes; or
(e) A combination of the above strategies; or
(f) A method approved by the department which meets the standard identified in this section.

Leak detection system operation and operator response must be described in the facility operations manual."

Tank vessels are described in the definitions section as "a ship that is constructed or adapted to carry, or that carries, oil in bulk as cargo or cargo residue, and that:

Operates on the waters of the state; or
Transfers oil in a port or place subject to the jurisdiction of this state."

Transfer pipelines are described in the definitions section as "a buried or aboveground pipeline used to carry oil between a tank vessel or transmission pipeline and the first valve inside secondary containment at the facility provided that any discharge on the facility side of that first valve will not directly impact waters of the state. A transfer pipeline includes valves, and other appurtenances connected to the pipeline, pumping units, and fabricated assemblies associated with pumping units. A transfer pipeline does not include process pipelines, pipelines carrying ballast or bilge water, transmission pipelines, tank vessel or storage tanks. Instances where the transfer pipeline is not well defined will be determined on a case-by-case basis".

Oil or oils are described as "naturally occurring liquid hydrocarbons at atmospheric temperature and pressure coming from the earth including condensate and natural gasoline, and any fractionation thereof, including, but not limited to, crude oil, petroleum, gasoline, fuel oil, diesel oil, oil sludge, oil refuse, and oil mixed with wastes other than dredged spoil (soil?). Oil does not include any substance listed in Table 302.4 of 40 C.F.R. Part 302 adopted August 14. 1989, under section 101(14) of the federal Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by P.L. 99-499."

The interpretation of these standards can be summarized as all pipelines that carry oil and oil products to and from a tank vessel (ship) must be protected with a leak detection system from the tank vessel to the first valve inside secondary containment at the facility. The leak detection system is required to detect a eight percent of maximum design flow rate leak within 15 minutes, the type of system to be used is at the engineering discretion of the facility engineers.

Emergency shutdown of a transfer from a vessel to a facility is required as described in Vessel Transfer Requirements, section 173-180A-060.1.e which states "Each FPIC (Facility Person in Charge) shall ensure that the means of operating the emergency shutdown is immediately available while oil is being transferred between the facility and the vessel". Transfer Pipeline Requirements, section 173-180A-100, do not describe any additional emergency shutdown requirements. The interpretation of these specification sections is that an operator is required to be immediately available to shutdown the ships unloading operation (by shutdown of unloading pumps) if an emergency arises during a transfer from the ship to the facility. For transfers from the facility to the ship, a facility operator is required to be immediately available to shutdown transfer operations (by shutdown of transfer pumps or closure of valves) if an emergency situation arises during the transfer operation.

1.3. TEXACO PUGET SOUND PLANT DOCK TRANSFER LINES

There are eleven transfer lines that carry crude or finished products to or from the dock area. These include one 30" crude line, a 12" crude flush line, nine finished product lines varying in size from 8" to 14". Ballast lines are specifically exempted from leak detection requirements per the WAC standard, but it was decided to also include the 16" Ballast line in the leak detection system, as it could be accomplished while the system was being implemented.

The transfer lines are shown on PSP P&ID drawings 22-DA-0020, 22-DA-0040, and 21-DA-0190. The line numbers and descriptions are;

1.	30"-22-O-1,2	Crude Oil
2.	12"-22-O-18	840 Bunker Fuel Oil
3.	12"-22-O-89/115	MTBE/Flushing Crude Oil
4.	14"-22-O-120	Lead Free Gasoline
5.	14"-22-O-6	MTBE/Regular Gasoline
6.	14"-22-O-4	Lead Free Premium Gasoline
7.	8"-22-O-16	Low Sulfur Diesel (Line #3)
8.	8"-22-O-8	AV-Jet (Line #2)
9.	8"-22-O-10	AV-Jet (Line #1)
10.	8"-22-O-14	Low Sulfur Diesel (Line #2)
11.	8"-22-O-12	High Sulfur Diesel (Line #1)

The Ballast line is shown on PSP P&ID drawings 22-DA-0030, 22-DA-0050, and 09-DA-0150.

1.4. PHYSICAL LAYOUT OF THE PUGET SOUND PLANT DOCK TRANSFER LINES

Texaco's Puget Sound Plant is located off of Highway 20 near Anacortes, Washington. Drawing SK100794 shows an overall physical layout of the plant with Leak Detection equipment locations noted.

The 30" Crude Oil Line runs southeast from the dock to any one of six crude oil storage tanks, the farthest of which is 3.3 miles away. The crude line runs 1.5 miles south from the dock, then underground for seven tenths of a mile along the east side of West March Point Road. The line goes above ground again just south of North Texas Road, where it is piped to the crude booster pump. From the crude booster pump, the crude line runs south for a quarter of a mile, then east up the hill to the crude storage tanks. The crude tank elevation is approximately 150 feet higher than the elevation at the dock. Flow is always from the dock to the plant in this line, and all crude oils unloaded from tankers are transferred to the plant using this line.

The Crude Flushing Line follows the same physical routing, although the direction of flow is opposite that of the 30" Crude Oil Line. The Crude Flushing Line is used after heavy crude oils are unloaded from tankers, to displace the heavy crudes out of the 30" Crude Oil Line. During a flushing operation, the Crude Flushing Line is connected to the 30" Crude Oil Line at the dock, and lighter crudes in storage in the crude oil tanks are transferred down the line until all of the heavy crude oil in the 30" Crude Oil line is displaced out of the line to the tanks. This operation is performed to prevent heavier crude oils from setting up in the 30" Crude Oil line. This is rarely required and is basically performed only when heavier foreign crude oils are received.

The finished product lines originate at the shipping pumps west of the RP&S control room. They travel west, then north until they reach the crude booster pump area. From there, they follow the same route as

the crude line. All of the lines are underground going under North Texas Road and the railroad tracks. After coming under the railroad tracks all of these lines come above ground. Total length of the finished product lines is approximately 2.75 miles. The elevation of the shipping pumps is about 100 feet higher than the dock elevation.

2. DESCRIPTION OF THE PUGET SOUND PLANT DOCK TRANSFER LINES LEAK DETECTION SYSTEM

2.1. DESCRIPTION OF THE CONTROLOTRON 990LD SYSTEM

The Dock Transfer Lines Leak Detection system used is the Controlotron 990LD system. An abbreviated description of the system is that it is a Compensated Volume Balance System utilizing clamp-on transit time flow metering.

The Controlotron 990LD system utilizes clamp-on transit time (ultrasonic) flow meters to measure the flow rates. A meter is placed at both ends of the protected pipe segment, and the flow in and out of the protected segment is compared. A flow imbalance indicates a potential leak. Each meter has an associated temperature element which measures the temperature for temperature compensation of the flow signal. This type of meter is non-intrusive, the flow elements clamp on the outside of the pipe and no pipe tapping is required to install these devices. It was not necessary to modify the existing piping to install this system, which is a highly desirable feature in that each pipe tap creates an additional potential leak location.

The meter stations (referred to as Site Stations), which are located at varied remote locations, all communicate to a central computer (referred to as the Master Station) using RS232 communications over a combination of phone and fiber optic communication lines. The Master Station polls each Site Station once a minute to gather updated flow averages, temperature information, and other additional information provided by the Site Station electronics. The Master Station performs an involved mathematical comparison of the flow in and out of the protected segment, using all of the variables available from the Site Stations, each time an update is received. If conditions

indicating a potential leak are detected, the system issues an alarm warning which describes the condition. An output from the Master Station is connected to the plant's primary Distributed Control System which has an audible alert which brings the alarm to the operators attention. The Master Station also has an associated color printer which provides a hardcopy of leak warning and system status warning alarms. The Master Station is located in the RP&S (Receiving, Pumping & Shipping) control room where the primary operators responsible for operating the pipelines are located.

A more complete description of the system, and operation of the Master Station can be found in the Controlotron Master Station Field Manual for System 990LD Pipeline Leak Detector, which is attached to this report. This manual contains a great deal of general information on the system, and a technical overview of the metering and the software. There are various optional items discussed, such as various possible communications networks, which do not directly apply to the system installed at the Texaco Puget Sound Plant. For more specific information on the PSP site configuration, refer to the plant documentation as described below.

2.2. SUMMARY OF SITE SYSTEM DOCUMENTATION

Specific information on the installed system configuration can be found on various internal plant documents. Many of the documents prepared are very specific, showing exact wiring terminal connections, etc. Only the drawings required to provide an understanding of the system are included with this report, as overly detailed information would tend only to confuse.

The following internal plant documents are attached:

a) SK100794, Rev. 1	Plant 22 - Transfer Lines Leak Detection System - Scope Sketch
b) 22-DJ-34, Rev. 1	Plant 22 - Wharf, Leak Detection System Block Diagram
c) 22-DJ-35, Rev. 1	Plant 22 - Wharf, Leak Detection System Communication Block Diagram

d) 22-DA-0020, Rev. 9	Wharf and Loading Facilities Piping and Instrument Diagram, Product Shipping Pumps
e) 22-DA-0030, Rev. 4	Wharf and Loading Facilities Utility Flow Diagram, Onshore Utilities
f) 09-DA-0150, Rev. 4	Effluent Treating Unit, Piping & Instrument Diagram, Unit Tankage
g) 22-DA-0040, Rev. 7	Wharf and Loading Facilities Piping and Instrument Diagram, Offshore Field Lines
h) 22-DA-0050, Rev. 8	Wharf and Loading Facilities Utility Flow Diagram, Offshore Utilities
i) 21-DA-0190, Rev. 8	Wharf and Loading Facilities Piping and Instrument Diagram, Product Shipping Pumps
j) SK092894	Plant 22 - Leak Detection Site Station Single Path Flow Transducer Installation Details
k) SK101094	Plant 22 - Leak Detection Site Station Dual Path Flow Transducer Installation Details
l) 22-EJ-32, Rev. 0	Wharf & Loading Facilities Location Plan
m) 22-EJ-33, Rev. 0	N.W. Crude Oil Booster Pumps Instrument Location Plan
n) 24-EJ-17, Rev. 0	Blending Plant Instrument Location Plan
o) 24-EJ-37, Rev. 0	Offplot - W. Blending Plant Instrument Location Plan
p) 20-EJ-32, Rev. 0	Tankage Area - TK. 36, 38, & 39 Instrument Location Plan
q) 24-DR-36, Rev. 5	Plant 24 - Blending Plant, Control Room Equipment Location and Layout

2.3. DESCRIPTION OF THE CONTROLOTRON 990LD SYSTEM CONFIGURATION AT THE TEXACO PUGET SOUND PLANT

The Controlotron 990LD system, as described above, compares flow in and out of a protected segment. The plant P&ID drawings show the system transducer locations and are fairly self explanatory, the following description is intended to help clarify the specifics of the installed configuration.

With the Controlotron 990LD system, as well as with almost all other types of leak detection systems, the protected area boundary ends at

the location of the transducers. All piping and equipment between the two transducer is protected, all equipment outside of the boundary of the transducers is not looked at by the system. Location of the transducers determines the extent of coverage.

The leak detection arrangement on all of the nine finished product lines is very similar. The ultrasonic transducers at the plant side are all located on the piping as close to the discharge of the associated shipping pump as is possible. Locating the transducers on the suction side of the pump is not feasible, as the pump is blocked off or isolated when not in use, which would prevent the system from being able to see static leak events. Additionally, the piping on the suction side of the pump serves various loading and blending lines, so there are flows going to other lines than the lines that serve the dock. The ultrasonic transducers at the dock side are all located on the piping just to the North of the Wharf Fire Protection Building. This location is as close as is feasible to where the piping begins to tee off in various directions to the three berths and loading arms. The piping arrangement around the berths has to many possible optional arrangements to allow providing coverage right up to the loading arms and manifolds at the berths. The area of coverage then is from the shipping pump discharge to the wharf just before the takeoffs to the loading berths. The dock is manned on an continuous basis, with 24 hour a day coverage. Additionally, when a ship is loading or unloading, it is required that ships personnel provide a manifold watch at all times. The piping on the dock past the protection boundary is within line of sight of both the dock operator and the ship's personnel.

The leak detection arrangement on both the main 30" Crude Oil unloading line and the Crude Flushing line is very similar. At the dock, the ultrasonic transducers are located in the same location as described above for the product lines. At the plant side, the ultrasonic transducers are located within the secondary containment boundary of the plant, and are placed just before the lines start to tee off to the various crude oil storage tanks. The difference in these lines is that there is a crude booster pump which is located approximately halfway down the line which is required to boost the crude oil up the hill to the tanks. Since this pump is isolated when not in use, and the line is effectively blocked off at that location when idle, an ultrasonic transducer was located on the dock side of the

pump on each of these lines. This is provided to perform leak detection both when the pump and the lines are in service, as well static leak detection when they are out of service and the line is effectively two separate line segments. Should a leak occur when the line is idle, which would cause the crude oil stored in the lines to start draining, it can be detected on either side of the pump. Note that the sensitivity of the system is increased when there is no active flow, so that the very small flows that would occur under that condition can be detected (the only flow would be the flow at the leak location). Additionally, the system reports to the operator abnormal conditions such as the pipe being empty at the location of the transducer.

The leak detection arrangement on the Ballast Water line is very similar to the arrangement on all of the nine finished product lines. At the dock, the transducer is located with all the other transducers. At the plant side though, the transducer is located just before Ballast Water Receiving Tank 60, which is located within the Effluent Treating Plant.

2.4. SYSTEM PERFORMANCE

When the Dock Transfer Lines leak detection system was initially tested and put into operation, lower leak detection limits or "thresholds" were in place and had to be modified, and continue to be modified on an ongoing basis. As the system was operated, various problems occurred which had not been encountered previously which created false alarms, and the thresholds were widened to provide more stable operation. As time went on and additional run data was acquired to allow additional fine tuning or "optimization", the thresholds are carefully being tightened as much as is possible without creating excessive false alarms. The performance limits listed here should be considered to be the worst case, that is to say they are the least sensitive settings that have been or will be used during operation of this system. Note that these limits, even at worst case, are considerably tighter than what is required by the state regulations. These performance limits have recently been tightened from what is listed here, and appear to be working quite well at much lower limits. The worst case detection limits are listed here in the interest of being conservative, and not overstating the capability of the system, yet the ongoing process of fine tuning will continue until the best achievable performance is attained.

The worst case detection capability can be summarized as follows:

Main 30" Crude Oil Line

6% of maximum flow leak rate detected in 1 minute
5% of maximum flow leak rate detected in 5 minutes
4% of maximum flow leak rate detected in 15 minutes

All Other Lines

4% of maximum flow leak rate detected in 1 minute
3% of maximum flow leak rate detected in 5 minutes
2.5% of maximum flow leak rate detected in 15 minutes

2.5. SUMMARY OF MILESTONE DATES

The following is a brief summary of events/dates which took place during the design, installation, startup and testing of the system. Engineering activities began in June of 1994, shortly after finalization of the state regulations. A great deal of initial investigation work was performed to determine the best possible system available that would meet or exceed the regulations, and provide good stability with minimum false alarms, while providing additional benefits to plant operations if possible. Previous investigations done by Texaco in 1991/1992 were reviewed, and the latest improvements that had occurred since then were looked into. Bids were solicited from numerous possible suppliers, and were narrowed down to the three best candidates, which were reviewed in detail with the engineering, operations, and maintenance departments. The proposal selected was unanimously agreed upon by all departments, and was reviewed with management and finally submitted for funding. This is a rather involved process which is somewhat time consuming, but is required on a major project such as this to ensure a successful installation.

June 6, 1994	Engineering personnel assigned, initial investigation phase

June - Aug., 1994	Prepare Scope of Work Documents, Site Surveys by suppliers, Solicitation of bids, engineering review
Sept. 16, 1994	Initial internal submittal for funding
Sept. 21, 1994	Issue Letter of Intent to Controlotron, schedule manufacturing of equipment
Sept. 26, 1994	Start of preparation of Electrical Engineering Package
Oct. 18, 1994	Final internal submittal for funding
Nov. 15, 1994	Issue Purchase Order to Controlotron
Nov. 18, 1994	Issue Electrical Installation Package for bids
Dec. 14, 1994	Issue Electrical Installation Contract
Jan. - April, 1995	System Installation
April 17, 1995	Initial Power applied to system, communications established, remote phone link to Controlotron established
April - July	Ongoing "Optimization" or fine tuning of the system
May 9-10, 1995	I&E Technician Maintenance Training
May 16-17, 1995	A&B Teams Operator Training (16 operators)
May 19	C&D Teams Operator Training (16 operators)
May 18-June 2, 1995	Leak Testing
June 2, 1995	System placed into service

3. SYSTEM TESTING

3.1. DESCRIPTION OF TEST PROCEDURES

Testing of the system was started on May 18, 1995, and the last tests were performed on June 2, 1995. Testing was performed both to verify operation to meet the state regulations, and to verify the performance estimates provided by Controlotron, which are considerably more stringent than those specified by the state regulations.

As show on P&ID drawing 22-DA-0020, Fr. 5, a group of 4" takeoff valves exist at the "A" Anchor location. These valves, although very

rarely used, can be used to drain the lines into a vacuum truck if necessary. "A" Anchor is the location where the dock transfer lines come back to the shore, and then continue from there on-shore to the plant. This location is approximately halfway between the end of the dock and the plant.

"A" Anchor was the location chosen for leak testing, as there is both the 4" takeoffs as well as ready access for a vacuum truck. Tests were performed by withdrawing product from each line from the 4" takeoff into a large vacuum truck where it was collected and returned to the plant. A Positive Displacement meter (Brooks Bi-rotor PD meter) was placed in the line so that the flow rates and totals could be confirmed. This meter was supplied by Camcal Inc.. Texaco Marketing has a long standing contract with Camcal for third party calibration verification of the metering used on the Puget Sound Plant truck loading rack. The meter supplied by Camcal was independently calibrated and certified by Camcal, and a Camcal technician was present to assist during the testing. Tests were performed both under actual flowing conditions with a ship loading/unloading (or by circulating product down to the dock and back to the plant), and in the static condition with no product transfer taking place.

As described above, the Controlotron 990LD system measures the difference between the flow in and out of a protected segment. The system integrates the flow difference over four time periods, 1, 5, 15, and 60 minutes, with increasingly smaller leak rates detected over the longer integration periods. For example, assume a line with a 2000 bph (barrels per hour) flow rate where the detection limits are as follows:

1 min.	2%
5 min.	1.5%
15 min.	1.0%
60 min.	0.75%

The instantaneous leak rate detected for each of these detection limits would be:

1 min.	2% x 2000 bph = 40 bph or .666 barrels per minute
5 min.	1.5% x 2000 bph = 30 bph or .5 barrels per minute
15 min.	1.0% x 2000 bph = 20 bph or .333 barrels per minute

60 min. 0.75% x 2000 bph = 15 bph or .25 barrels per minute

Since the leak rate is integrated over the time period, the total leak size required to trigger the alarm at each of these limits would then be:

1 min. 1 min. x .666 barrels/min = .666 barrels
5 min. 5 min. x .5 barrels/min = 2.5 barrels
15 min. 15 min. x .333 barrels/min = 5 barrels
60 min. 60 min. x .25 barrels/min = 15 barrels

As can be seen from this example, the larger the size of the leak, the more quickly it will be detected, while the very small leaks have to continue for some time before they are detected. This is handled this way as there is a degree of fluctuation in the flow readings and other uncertainties that are impossible to totally eliminate, but that uncertainty tends to go in both directions, alternating positive and then negative, and tends to cancel itself out over longer time periods. It cannot be totally canceled out, so even over the longer integration periods there is a limit to how sensitive the system can be set.

Tests were performed to verify the 1 and 5 minute detection limits only. As described above, the longer time periods are used to detect increasingly smaller sized leak rates, but over longer periods of time. The total amount of product and the amount of time involved to test these longer limits is a prohibiting factor. Also, verifying the shorter detection limits, due to the nature of the system, verifies that the metering is reporting accurately, with the metering reporting accurately, it is assured that the longer time limits will respond as programmed. Also note that once the accuracy of the metering is verified, the programmed limits can be changed as required and the accuracy will not be affected, just the size of the leak that is detected. With this system, when a leak event occurs, as long as the meters are reporting accurately, the total size of the leak can be accurately reported and documented.

During the fine tuning and optimizing stage of the project, the very detailed custody transfer records kept by both the plant and the ships personnel were sent to Controlotron and the metering was adjusted to match the shipping records as accurately as possible, which assures that leak volumes would be reported accurately.

The testing performed then basically verified that leak sizes were being accurately reported, and that alarms were triggered after removal of the anticipated amount of product. A leak flow rate was established which was just slightly in excess of the alarm limit, and was held to verify that the appropriate alarm condition was reported. Testing of both the 1 and 5 minute limits was combined, that is to say a leak flow rate slightly in excess of the 5 minute alarm rate was held until the alarm was indicated, then the leak flow rate was increased to just above the 1 minute rate, and the 1 minute alarm was verified. Note that the system polls once a minute, so the reporting of alarms at times was delayed somewhat based on how close to the beginning of a poll cycle the test was started. Running such tests is dynamic in that the leak flow rate had at times to be adjusted based on occurrences in the process, so at times minor flow rate variations affected the test results. At times, it took one or two minutes to stabilize the flow at the desired rate, which makes it appear that the system did not respond as quickly as it should. Please note this when reviewing the test results.

A Positive Displacement meter was used to verify the leak flow rates as it is a different type of meter than the ultrasonic meters, and was certified by a third party calibration. Positive Displacement meters are extremely reliable and accurate (0.25%), but are sensitive to solids mixed with the liquids. This became a problem when testing crude oil as it was being unloaded from the ships, as it was found that a considerable amount of solids flowed with the liquid, and as it turned out it was too much for the PD meter used during the test, even when various strainers and filter arrangements were attempted. The amount of liquid involved with this line was also greater than the other lines as this is a large line with a high maximum flow rate. Although it was attempted, it turned out that using a PD meter for testing was not feasible for the 30" Crude Line, although it worked well for all other lines. The vacuum truck level indicating gauge was used to verify the crude oil removal volume which worked reasonably well, although it was not as accurate as using the metering.

TABLE 1 - CONTROLOTRON LEAK DETECTION SYSTEM PERFORMANCE SPECIFICATIONS

Crude Oil Line

1 Minute	2.0% of Maximum* flow rate
5 Minute	1.5% of Maximum* flow rate
15 Minute	1.0% of Maximum* flow rate
60 Minute	0.75% of Maximum* flow rate

All Other Lines

1 Minute	3.0% of Maximum* flow rate
5 Minute	2.0% of Maximum* flow rate
15 Minute	1.5% of Maximum* flow rate
60 Minute	1.0% of Maximum* flow rate

Based on this, the following table lists the leak rates and volumes for each detection threshold:

LINE	MAXIMUM FLOW RATE *	1 MINUTE DETECTION LIMIT	5 MINUTE DETECTION LIMIT		15 MINUTE DETECTION LIMIT		60 MINUTE DETECTION LIMIT	
	BPH	Total Barrels	Barrels/Min	Total Barrels	Barrels/Min	Total Barrels	Barrels/Min	Total Barrels
Crude Oil	30,000 bph	10	7.5	37.5	5	75	3.75	225
Crude Flushing	8,000 bph	4	2.66	13.3	2.0	30.0	1.33	79.8
Bunker Fuel Oil	4,500 bph	2.25	1.5	7.5	1.125	16.875	0.75	45
Av Jet 1	2,000 bph	1	0.66	3.3	0.5	7.5	0.33	19.8
Av Jet 2	2,000 bph	1	0.66	3.3	0.5	7.5	0.33	19.8
Leaded Regular	7,000 bph	3.5	2.33	11.65	1.75	26.25	1.167	70
Lead Free Regular	7,000 bph	3.5	2.33	11.65	1.75	26.25	1.167	70
Lead Free Premium	7,000 bph	3.5	2.33	11.65	1.75	26.25	1.167	70
Diesel 1	2,500 bph	1.25	0.833	4.17	0.625	9.375	0.42	25
Diesel 2	2,500 bph	1.25	0.833	4.17	0.625	9.375	0.42	25
Diesel 3	2,500 bph	1.25	0.833	4.17	0.625	9.375	0.42	25
Ballast	8,000 bph	4	2.66	13.3	2.0	30.0	1.33	79.8

* Maximum flow rate given to Controlotron during preparation of topology files.

Table 1 lists all the normal maximum flow rates for each line, and leak rates for each line and each detection limit. The 1 and 5 minute limits listed here are the values used during testing. Note that the detection limits listed are the limits estimated as possible by Controlotron prior to installation of the system. At the time the tests were performed, the system was still fairly new and limited run data was available. The system performed very well at these limits at that time and the testing was performed successfully, but later it was decided to raise the limits somewhat to allow more time for fine tuning so that all false alarm conditions which could occur could be seen and a method to handle them worked out. The nature of the testing performed verified that the system reported the leak sizes accurately, and therefore changing the programmed limits does not negate the test results in any way. For most lines, the current operating limits have recently been returned to these values, but this is an ongoing process and is subject to change as required. The limits listed in section 2.4 are, as previously stated, the worst case that will be used, as even under the most adverse conditions, operation has been found to be false alarm free and stable in this realm, and they are considerably better than the state requirements. The ongoing process of optimization will continue until the best sensitivity possible is achieved for all lines.

3.2. TEST RESULT PRINTOUTS

Attached to this report are printouts of graphic screens from the Controlotron Master Station which show the results of the tests for each line tested. The Controlotron Master Station provides numerous display screens to display data, and this data could be presented in quite a variety of ways. This particular screen was set up specifically to show as simply as possible at a glance the results of the tests. The upper graph, shows the total flow rate for the line reported by each of the meters during the tests. Below this are graphs showing the 1, 5 and 15 minute deltas (the delta is the flow difference between the two meters). When delta exceeds the threshold, shown in red, an alarm is reported. Note that the delta graphs each have four traces. The green trace is the uncompensated flow delta. This is primarily used as a diagnostic tool, and shows the "raw" data being received from the meter. The magenta trace is described as the warning line. This trace shows the data after correction for various factors such as temperature, Reynolds number, and other factors used to modify the flow signal. The red lines are the Threshold (delta) limits. The blue trace, is the trace that shows the actual flow difference used by the system to determine the alarm condition. It is the same data as the warning trace, but is further corrected by the system for operational factors such as line packing, aeration in the line, and other various internal correction factors used by the

software to determine if the flow difference is caused by some other operating parameter other than a leak. When the blue alarm trace exceeds the red threshold line, a leak alarm is issued by the system. Note that at the simplest level, the operator receives a simple alarm/no alarm indication from the system, and displays such as this are diagnostic tools to assist the operator in understanding the event in greater detail.

3.3. SUMMARY OF DETAILED TEST RESULTS

Note that the test setup used for these test worked very well, but that manual control of the leak flow rate was not always extremely precise. Some minor errors occurred due to difficulty in maintaining the desired flow rate due to the nature of the test setup and ongoing changes in the process conditions which required dynamic manual correction. Actually, when reviewing the test results, the more common cause of the minor deviations from the expected values is related to this instability.

Also please note that during the first tests performed, the 1 and 5 minute deltas were verified in separate test runs. All subsequent tests combined these into a single test run with two different flow rates. It was found that this method allowed for better control of the flow rates and of the testing in general.

The flow rate and total values are listed here in GPM and Gallons. These units are used as the meter used during testing was calibrated in those units. The values listed in Table 1 are converted to Gallons by multiplying barrels times 42.

3.3.1. HIGH SULFUR DIESEL LINE #1 (HSD#1)

TEST #1 - LINE FLOWING, 5 MINUTE DELTA ALARM

Test Date	: 5/18/95
Start Time	: 11:03 AM
5 min. Delta Rate	: 35 GPM
5 min. Delta Total	: 175 Gallons

Total flow after:

1 min.	33 gallons
2 min.	72 gallons
3 min.	111 gallons
4 min.	149 gallons
5 min.	189 gallons

5 minute delta alarm received at 5 min., 15 seconds into test, total flow was 199 gallons

TEST #2 - LINE FLOWING, 1 MINUTE DELTA ALARM

Test Date	: 5/18/95
Start Time	: 11:21 AM
1 min. Delta Rate/Total	: 52.5 GPM/Gallons

Total flow after:

1 min.	45.7 gallons
2 min.	99.7 gallons

1 minute delta alarm received at 2 min., 20 seconds into test, total flow was 115 gallons

Note: This test was restarted after initially opening the valve too fast with too high of a flow rate, which produced an alarm 40 seconds into the test. After restarting, the flow rate during the first minute was too low to produce an alarm, and was increased to the correct level during the second minute, with the correct results.

TEST #3 - LINE STATIC, COMBINED 1 & 5 MINUTE DELTA ALARMS

Test Date	: 5/18/95
Start Time	: 11:42 AM
1 Min. Delta Rate/Total	: 52.5 GPM/Gallons
5 Minute Delta Rate	: 35 GPM
5 Minute Delta Total	: 175 Gallons

Total flow after:

1 min.	40 gallons
2 min.	87 gallons
3 min.	131 gallons
4 min.	149 gallons
5 min.	220 gallons

5 minute delta alarm received at 5 min., 20 seconds into test, total flow was 235 gallons

Increased flow rate at 6 minutes into test to 1 minute delta rate

Total flow after:

6 min.	260 gallons
7 min.	330 gallons

1 minute delta alarm received at 7 min., 20 seconds into test, total flow was 367 gallons

3.3.2. LOW SULFUR DIESEL LINE #2 (LSD#2)

TEST #1 - LINE FLOWING, COMBINED 1 & 5 MINUTE DELTA ALARMS

Test Date	: 5/18/95
Start Time	: 13:40 PM
1 Min. Delta Rate/Total	: 52.5 GPM/Gallons
5 Minute Delta Rate	: 35 GPM
5 Minute Delta Total	: 175 Gallons

Total flow after:

1 min.	46 Gallons
2 min.	88 Gallons
3 min.	129 Gallons
4 min.	170 Gallons
5 min.	212 Gallons
6 min.	250 Gallons

5 minute delta alarm received at 6 min., 10 seconds into test, total flow was 265 gallons

Increased flow rate at 9 minutes into test to 1 minute delta rate

Total flow after:

9 min.	400 Gallons
10 min.	455 Gallons
11 min.	514 Gallons
12 min.	573 Gallons

1 minute delta alarm received at 12 min., 30 seconds into test, total flow was 603 Gallons

TEST #2 - LINE STATIC, COMBINED 1 & 5 MINUTE DELTA ALARMS

Test Date	: 5/18/95
Start Time	: 14:40 PM
1 Min. Delta Rate/Total	: 52.5 GPM/Gallons
5 Minute Delta Rate	: 35 GPM
5 Minute Delta Total	: 175 Gallons

Total flow after:

1 min.	65 gallons
2 min.	120 gallons
3 min.	155 gallons
4 min.	200 gallons
5 min.	249 gallons
6 min.	295 gallons

5 minute delta alarm received at 6 min., 30 seconds into test, total flow was 320 gallons

Increased flow rate at 6 minutes, 30 seconds into test to 1 minute delta rate

Total flow after:

6 min. 30 sec.	320
7 min.	355

1 minute delta alarm received at 7 min., 45 seconds into test, total flow was 400 gallons

Note: As can be seen from these test results, an inaccuracy in the metering was noted during these tests. Initially, the flow rates were set at the desired rates, but had to be increased slightly to trigger the alarms. Initially this rate was set at about 55 GPM, just slightly higher than the expected 52.5 GPM. For the 1 minute delta alarms, the flow rate had to be increased to approx. 60 GPM to trigger this alarm. This is a minor error which was due to an imbalance between the meters (note that just prior to the start of the test a small offset away from zero in the negative direction can be observed on the 5 and 15 minute delta graphs). To put this error into perspective, the 1 minute leak rate of 52.5 GPM or 1.25 BPM is 3.0% of the normal maximum flow rate for this line. 60 GPM or 1.43 BPM is 3.4% of the normal maximum flow rate for this line, the error being approximately 0.4%. This metering error was subsequently corrected as a result of this testing after additional run time was acquired, which allowed further optimization of the Reynolds correction curves for this line.

3.3.3. LOW SULFUR DIESEL LINE #3 (LSD#3)

TEST #1 - LINE STATIC, COMBINED 1 & 5 MINUTE DELTA ALARMS

Test Date : 5/18/95

Start Time : 15:35 PM
1 Min. Delta Rate/Total : 52.5 GPM/Gallons
5 Minute Delta Rate : 35 GPM
5 Minute Delta Total : 175 Gallons

Total flow after:
1 min. 36 Gallons
2 min. 85 Gallons
3 min. 125 Gallons
4 min. 170 Gallons
5 min. 216 Gallons

5 minute delta alarm received at 5 min., 40 seconds into test, total flow was 245 gallons

Increased flow rate at 6 minutes into test to 1 minute delta rate

Total flow after:
6 min. 260 Gallons
7 min. 317 Gallons
8 min. 374 Gallons

1 minute delta alarm received at 8 min., 0 seconds into test, total flow was 374 Gallons

TEST #2 - LINE FLOWING, COMBINED 1 & 5 MINUTE DELTA ALARMS

Test Date : 5/18/95
Start Time : 17:38 PM
1 Min. Delta Rate/Total : 52.5 GPM/Gallons
5 Minute Delta Rate : 35 GPM
5 Minute Delta Total : 175 Gallons

Total flow after:
1 min. 36 gallons
2 min. 85 gallons
3 min. 125 gallons
4 min. 170 gallons
5 min. 215 gallons

5 minute delta alarm received at 5 min., 30 seconds into test, total flow was 238 gallons

Increased flow rate at 6 minutes, into test to 1 minute delta rate

Total flow after:
6 min. 260
7 min. 316

1 minute delta alarm received at 7 min., 15 seconds into test, total flow was 335 gallons

3.3.4. LEAD FREE REGULAR LINE (LFR)

TEST #1 - LINE FLOWING, COMBINED 1 & 5 MINUTE DELTA ALARMS

Test Date : 5/23/95
Start Time : 11:28 AM
1 Min. Delta Rate/Total : 147 GPM/Gallons
5 Minute Delta Rate : 97.8 GPM
5 Minute Delta Total : 489 Gallons

Total flow after:
1 min. 108 Gallons
2 min. 216 Gallons
3 min. 335 Gallons
4 min. 480 Gallons
5 min. 630 Gallons

5 minute delta alarm received at 5 min., 40 seconds into test, total flow was 720 gallons

1 minute delta alarm received at 5 min., 40 seconds into test, total flow was 720 gallons

TEST #2 - LINE STATIC, COMBINED 1 & 5 MINUTE DELTA ALARMS

Test Date : 5/23/95
Start Time : 13:19 PM
1 Min. Delta Rate/Total : 147 GPM/Gallons
5 Minute Delta Rate : 97.8 GPM
5 Minute Delta Total : 489 Gallons

Total flow after:
1 min. 150 gallons
2 min. 305 gallons
3 min. 423 gallons
4 min. 537 gallons

5 min. 650 gallons

5 minute delta alarm received at 5 min., 10 seconds into test, total flow was 660 gallons

Increased flow rate at 6 minutes into test to 1 minute delta rate

Total flow after:
6 min. 807 Gallons
7 min. 1000 Gallons

1 minute delta alarm received at 7 min., 0 seconds into test, total flow was 1000 gallons

3.3.5. AVIATION JET FUEL LINE #2 (AV_JET2)

TEST #1 - LINE FLOWING, COMBINED 1 & 5 MINUTE DELTA ALARMS

Test Date	: 5/23/95
Start Time	: 15:13 PM
1 Min. Delta Rate/Total	: 42 GPM/Gallons
5 Minute Delta Rate	: 28 GPM
5 Minute Delta Total	: 140 Gallons

Total flow after:
1 min. 27 Gallons
2 min. 64 Gallons
3 min. 101 Gallons
4 min. 138 Gallons
5 min. 176 Gallons

5 minute delta alarm received at 5 min., 0 seconds into test, total flow was 176 gallons

Increased flow rate at 6 minutes into test to 1 minute delta rate

Total flow after:
6 min. 219 Gallons
7 min. 269 Gallons
8 min. 334 Gallons
9 min. 410 Gallons

1 minute delta alarm received at 9 min., 0 seconds into test, total flow was 410 Gallons

TEST #2 - LINE STATIC, COMBINED 1 & 5 MINUTE DELTA ALARMS

Test Date	: 5/23/95
Start Time	: 15:30 PM
1 Min. Delta Rate/Total	: 42 GPM/Gallons
5 Minute Delta Rate	: 28 GPM
5 Minute Delta Total	: 140 Gallons

Total flow after:

1 min.	36 gallons
2 min.	78 gallons
3 min.	120 gallons
4 min.	162 gallons
5 min.	175 gallons

5 minute delta alarm received at 5 min., 0 seconds into test, total flow was 175 gallons

1 minute delta alarm received at 2 min., 30 seconds into test, total flow was 100 gallons (no need to increase flow rate)

3.3.6. AVIATION JET FUEL LINE #1 (AV_JET1)

TEST #1 - LINE FLOWING, COMBINED 1 & 5 MINUTE DELTA ALARM

Test Date	: 5/23/95
Start Time	: 15:58 PM
1 Min. Delta Rate/Total	: 42 GPM/Gallons
5 Minute Delta Rate	: 28 GPM
5 Minute Delta Total	: 140 Gallons

Total flow after:

1 min.	26 Gallons
2 min.	60 Gallons
3 min.	92 Gallons
4 min.	132 Gallons
5 min.	171 Gallons
6 min.	213 Gallons

5 minute delta alarm received at 6 min., 10 seconds into test, total flow was 225 gallons

Increased flow rate at 7 minutes into test to 1 minute delta rate

Total flow after:
7 min. 263 Gallons
8 min. 328 Gallons

1 minute delta alarm received at 8 min., 0 seconds into test, total flow was 328 Gallons

TEST #2 - LINE STATIC, COMBINED 1 & 5 MINUTE DELTA ALARMS

Test Date : 5/23/95
Start Time : 16:14 PM
1 Min. Delta Rate/Total : 42 GPM/Gallons
5 Minute Delta Rate : 28 GPM
5 Minute Delta Total : 140 Gallons

Total flow after:
1 min. 38 gallons
2 min. 73 gallons
3 min. 106 gallons
4 min. 140 gallons
5 min. 189 gallons

5 minute delta alarm received at 4 min., 0 seconds into test, total flow was 140 gallons

1 minute delta alarm received at 5 min., 0 seconds into test, total flow was 189 gallons

3.3.7. LEAD FREE PREMIUM LINE (LFP)

TEST #1 - LINE FLOWING, COMBINED 1 & 5 MINUTE DELTA ALARM

Test Date : 5/26/95
Start Time : 9:28 AM
1 Min. Delta Rate/Total : 147 GPM/Gallons
5 Minute Delta Rate : 97.8 GPM
5 Minute Delta Total : 489 Gallons

Total flow after:
1 min. 47 Gallons
2 min. 114 Gallons
3 min. 211 Gallons
4 min. 340 Gallons
5 min. 480 Gallons

6 min. 623 Gallons

5 minute delta alarm received at 6 min., 50 seconds into test, total flow was 720 gallons

Increased flow rate at 7 minutes into test to 1 minute delta rate

Total flow after:
7 min. 760 Gallons
8 min. 940 Gallons

1 minute delta alarm received at 8 min., 50 seconds into test, total flow was 1100 gallons

TEST #2 - LINE STATIC, COMBINED 1 & 5 MINUTE DELTA ALARMS

Test Date	: 5/26/95
Start Time	: 9:53 PM
1 Min. Delta Rate/Total	: 147 GPM/Gallons
5 Minute Delta Rate	: 97.8 GPM
5 Minute Delta Total	: 489 Gallons

Total flow after:
1 min. 105 gallons
2 min. 217 gallons
3 min. 328 gallons
4 min. 438 gallons
5 min. 550 gallons

5 minute delta alarm received at 5 min., 45 seconds into test, total flow was 630 gallons

Increased flow rate at 6 minutes into test to 1 minute delta rate

Total flow after:
6 min. 660 Gallons
7 min. 806 Gallons

1 minute delta alarm received at 7 min., 40 seconds into test, total flow was 930 gallons

3.3.8. LEADED REGULAR GASOLINE LINE (LR)

Note: This line is not in service at this time

TEST #1 - LINE FLOWING, COMBINED 1 & 5 MINUTE DELTA ALARM

Test Date	: 5/26/95
Start Time	: 11:22 AM
1 Min. Delta Rate/Total	: 147 GPM/Gallons
5 Minute Delta Rate	: 97.8 GPM
5 Minute Delta Total	: 489 Gallons

Total flow after:

1 min.	92 Gallons
2 min.	202 Gallons
3 min.	302 Gallons
4 min.	409 Gallons
5 min.	521 Gallons
6 min.	635 Gallons
7 min.	753 Gallons
8 min.	871 Gallons

5 minute delta alarm received at 8 min., 20 seconds into test, total flow was 916 gallons

Increased flow rate at 9 minutes into test to 1 minute delta rate

Total flow after:

9 min.	1008 Gallons
10 min.	1177 Gallons

1 minute delta alarm received at 10 min., 10 seconds into test, total flow was 1200 gallons

TEST #2 - LINE STATIC, COMBINED 1 & 5 MINUTE DELTA ALARMS

Test Date	: 5/26/95
Start Time	: 11:41 AM
1 Min. Delta Rate/Total	: 147 GPM/Gallons
5 Minute Delta Rate	: 97.8 GPM
5 Minute Delta Total	: 489 Gallons

Total flow after:

1 min.	85 gallons
2 min.	186 gallons
3 min.	303 gallons
4 min.	418 gallons
5 min.	536 gallons
6 min.	651 gallons

5 minute delta alarm received at 6 min., 50 seconds into test, total flow was 740 gallons

Increased flow rate at 7 minutes into test to 1 minute delta rate

Total flow after:
7 min. 767 Gallons
8 min. 904 Gallons
9 min. 1074 Gallons

1 minute delta alarm received at 9 min., 0 seconds into test, total flow was 1074 gallons

3.3.9. BUNKER FUEL OIL LINE (BUNKER_FO)

TEST #1 - LINE FLOWING, COMBINED 1 & 5 MINUTE DELTA ALARM

Test Date	: 5/26/95
Start Time	: 14:23 PM
1 Min. Delta Rate/Total	: 94.5 GPM/Gallons
5 Minute Delta Rate	: 63 GPM
5 Minute Delta Total	: 315 Gallons

Total flow after:
1 min. 77 Gallons
2 min. 152 Gallons
3 min. 242 Gallons
4 min. 347 Gallons
5 min. 452 Gallons
6 min. 557 Gallons

5 minute delta alarm received at 6 min., 10 seconds into test, total flow was 575 gallons

Increased flow rate at 7 minutes into test to 1 minute delta rate

Total flow after:
7 min. 667 Gallons
8 min. 827 Gallons

1 minute delta alarm received at 8 min., 45 seconds into test, total flow was 962 gallons

TEST #2 - LINE STATIC, COMBINED 1 & 5 MINUTE DELTA ALARMS

Test Date	: 5/26/95
Start Time	: 14:56 PM
1 Min. Delta Rate/Total	: 94.5 GPM/Gallons
5 Minute Delta Rate	: 63 GPM
5 Minute Delta Total	: 315 Gallons

Total flow after:

1 min.	95 gallons
2 min.	150 gallons
3 min.	210 gallons
4 min.	273 gallons

5 minute delta alarm received at 4 min., 45 seconds into test, total flow was 323 gallons

Increased flow rate at 6 minutes into test to 1 minute delta rate

Total flow after:

6 min.	420 Gallons
7 min.	517 Gallons

1 minute delta alarm received at 7 min., 45 seconds into test, total flow was 617 gallons

3.3.10. CRUDE FLUSHING LINE (CRUDE_FLUSH)

TEST #1 - LINE FLOWING, COMBINED 1 & 5 MINUTE DELTA ALARM

Test Date	: 5/31/95
Start Time	: 11:09 AM
1 Min. Delta Rate/Total	: 168 GPM/Gallons
5 Minute Delta Rate	: 111.7 GPM
5 Minute Delta Total	: 558.6 Gallons

Total flow after:

1 min.	260 Gallons
2 min.	360 Gallons
3 min.	490 Gallons
4 min.	670 Gallons
5 min.	830 Gallons

5 minute delta alarm received at 5 min., 0 seconds into test, total flow was 830 gallons

1 minute delta alarm received at 5 min., 0 seconds into test, total flow was 830 gallons

TEST #2 - LINE STATIC, COMBINED 1 & 5 MINUTE DELTA ALARMS

Test Date	: 5/31/95
Start Time	: 11:28 AM
1 Min. Delta Rate/Total	: 168 GPM/Gallons
5 Minute Delta Rate	: 111.7 GPM
5 Minute Delta Total	: 558.6 Gallons

Total flow after:

1 min.	151 gallons
2 min.	242 gallons
3 min.	350 gallons
4 min.	460 gallons
5 min.	590 gallons
6 min.	720 gallons

5 minute delta alarm received at 6 min., 10 seconds into test, total flow was 740 gallons

Increased flow rate at 7 minutes into test to 1 minute delta rate

Total flow after:

7 min.	890 Gallons
8 min.	1110 Gallons

1 minute delta alarm received at 8 min., 10 seconds into test, total flow was 1135 gallons

3.3.11. 30" CRUDE OIL LINE (CRUDE_OIL)

Note: 1 minute delta tests only were performed on the 30" Crude Oil Line due to the large flow rates and volume of crude oil required to trigger the 5 minute delta alarm. The vacuum truck level gauge was used to calculate crude oil volume during this testing due to the high solids content which caused problems with the metering.

TEST #1 - LINE FLOWING, 1 MINUTE DELTA ALARM

Test Date	: 6/2/95
Start Time	: 12:25 PM
1 Min. Delta Rate/Total	: 420 GPM/Gallons
5 Minute Delta Rate	: 315 GPM
5 Minute Delta Total	: 1575 Gallons

Total flow after:
1 min. 380 Gallons
2 min. 830 Gallons

1 minute delta alarm received at 2 min., 30 seconds into test, total flow was 1055 gallons

TEST #2 - LINE STATIC, 1 MINUTE DELTA ALARM

Test Date	: 6/2/95
Start Time	: 13:56 PM
1 Min. Delta Rate/Total	: 420 GPM/Gallons
5 Minute Delta Rate	: 315 GPM
5 Minute Delta Total	: 1575 Gallons

Total flow after:
1 min. 350 gallons
2 min. 770 gallons
3 min. 1220 gallons

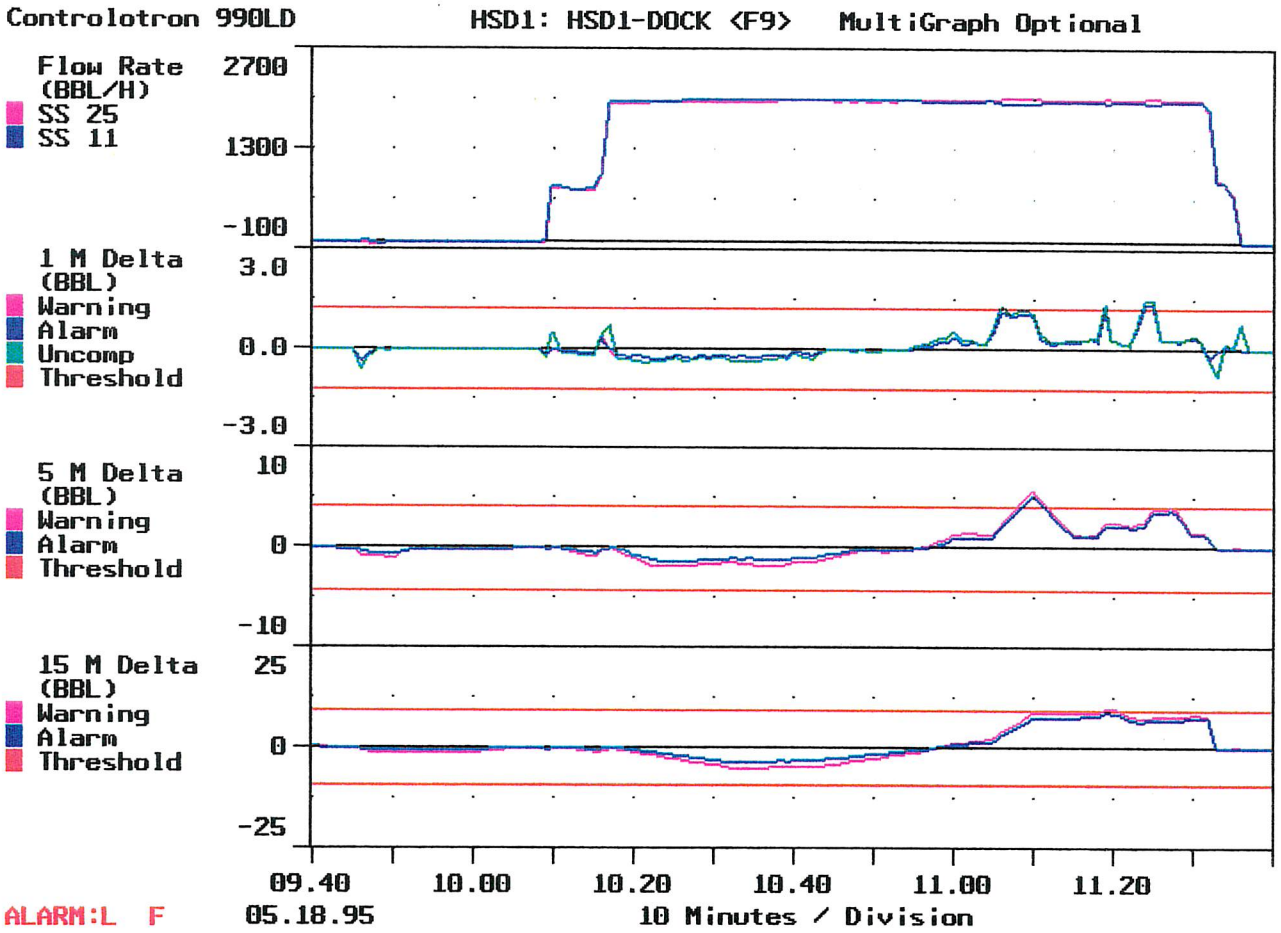
1 minute delta alarm received at 3 min., 40 seconds into test, total flow was 1500 gallons

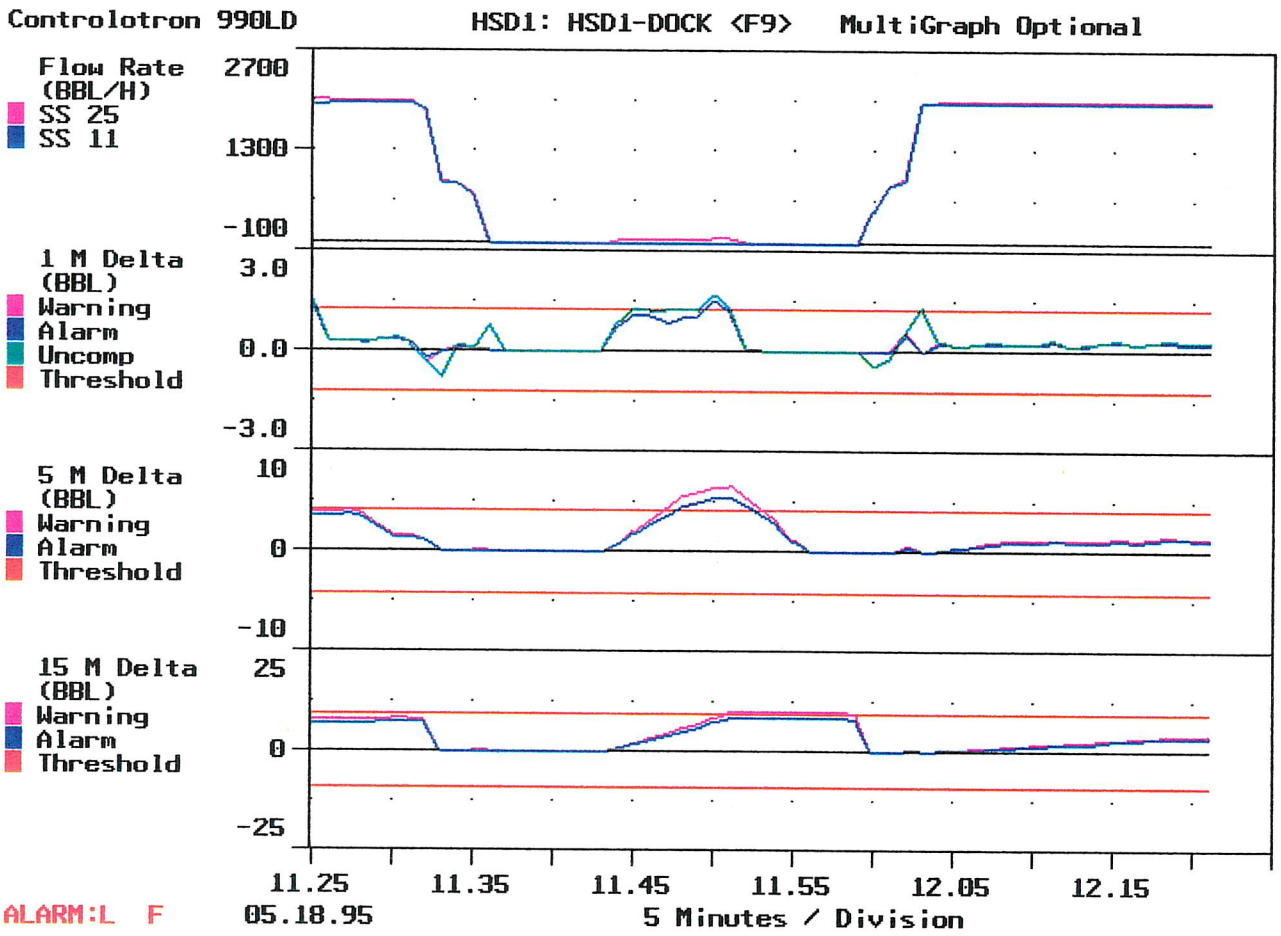
Note: During both test for this line the initial flow rate was to low to trigger the alarm, flow rate was increased after the first minute to the correct flow rate.

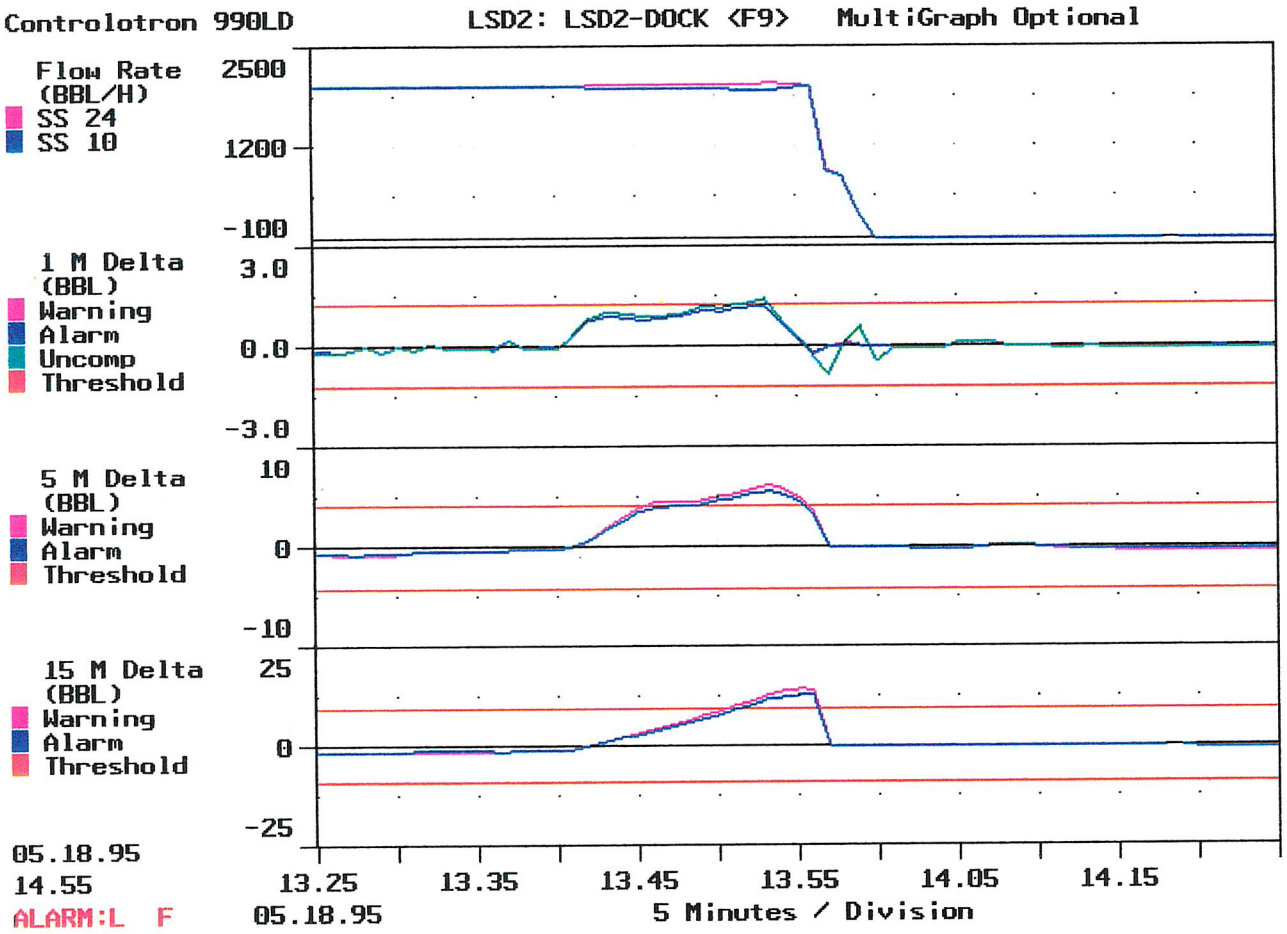
3.3.12. BALLAST LINE

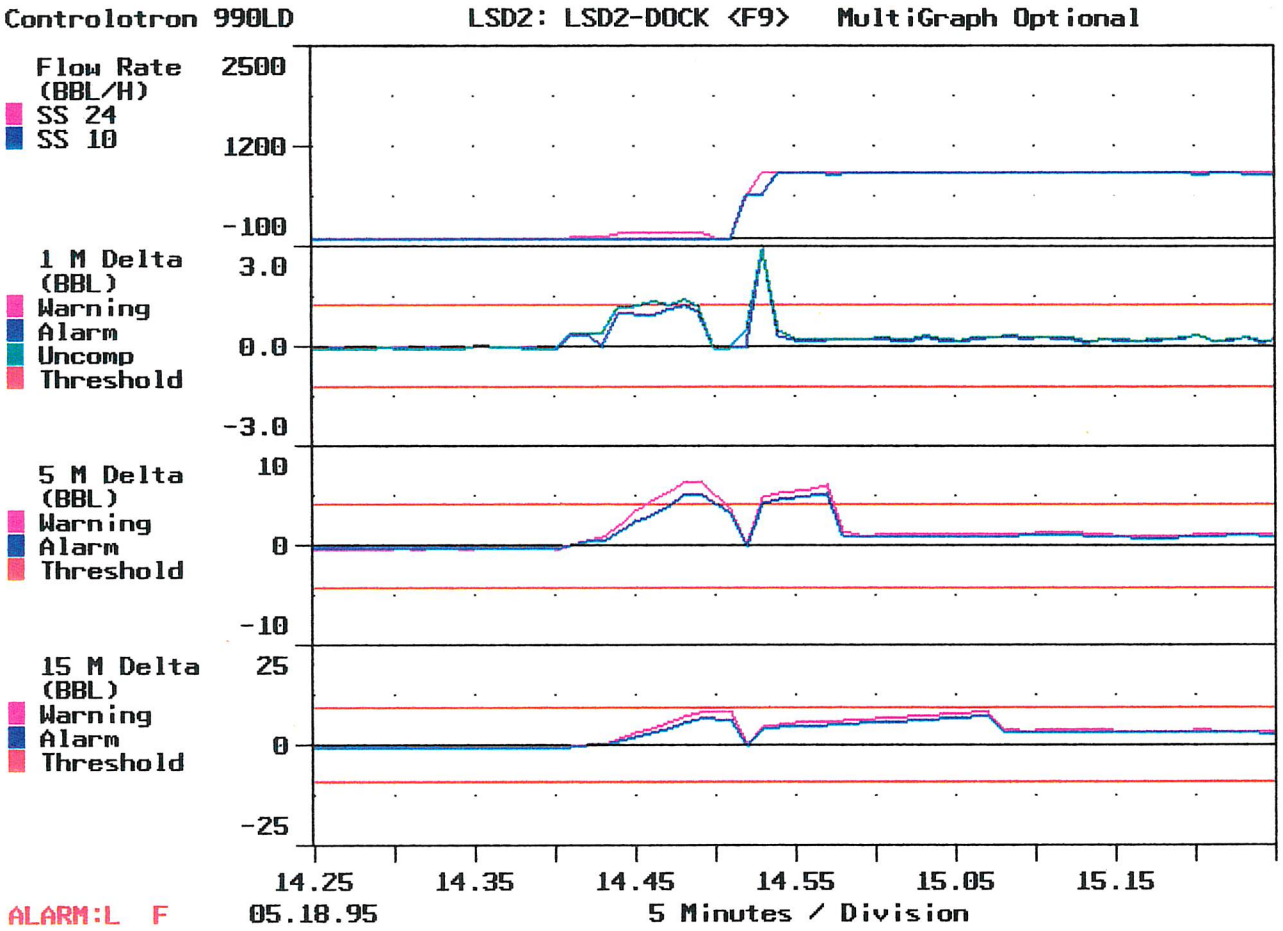
Testing on the Ballast Line is not complete as of the date of this report. Implementation of the Ballast line leak detection required some piping work, as the pipe is an older style concrete lined pipe. This required that a non-line spool piece be added to the line for metering purposes. This work could not be performed during the winter months due to the need to circulate to prevent freezing. As a result, this line is somewhat behind all others. All equipment is installed for this line, and the initial optimization is being performed. It is expected that testing on this line will occur by August 15, 1995.

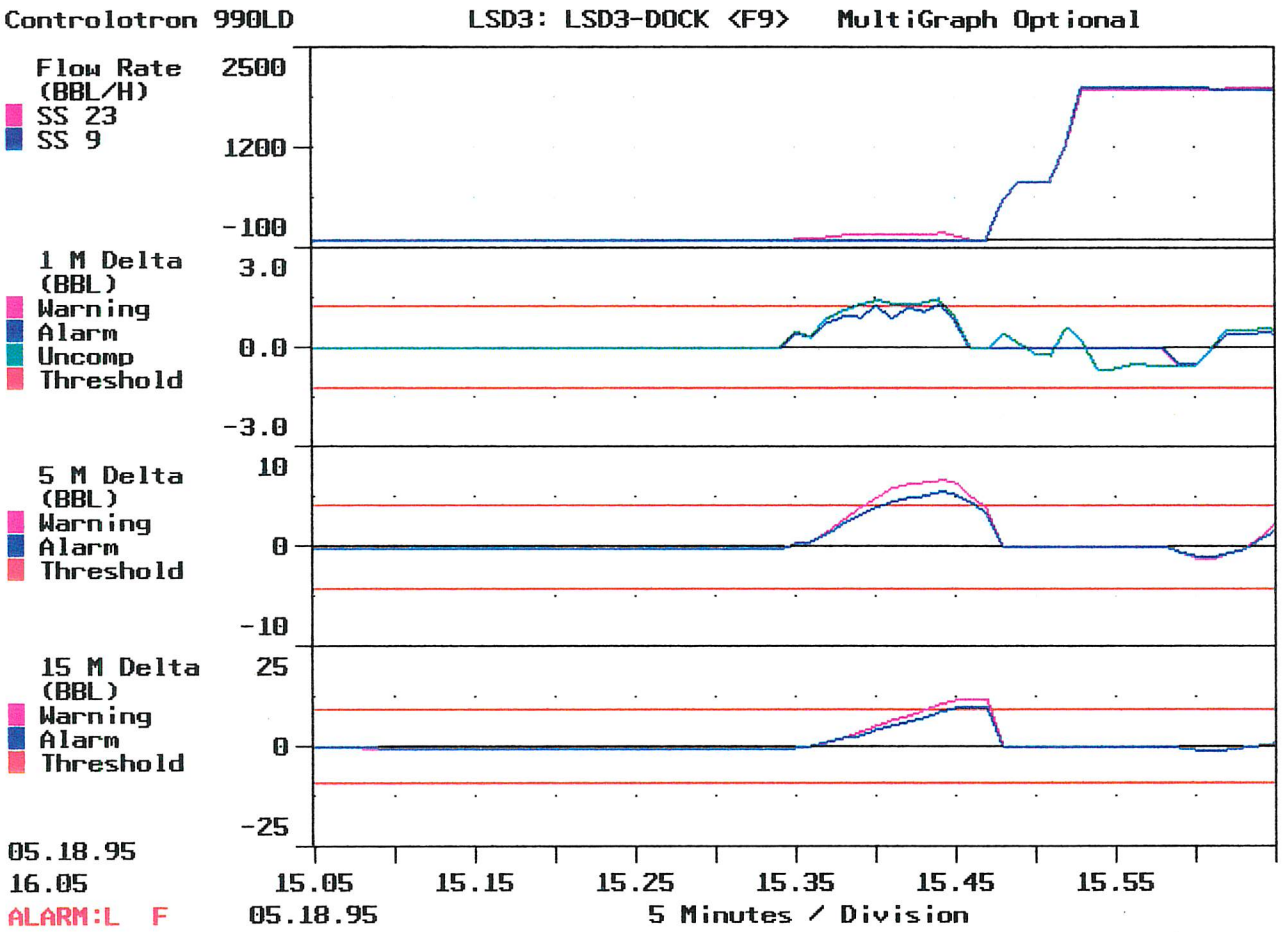
4. APPENDIX A - TEST RESULT PRINTOUTS

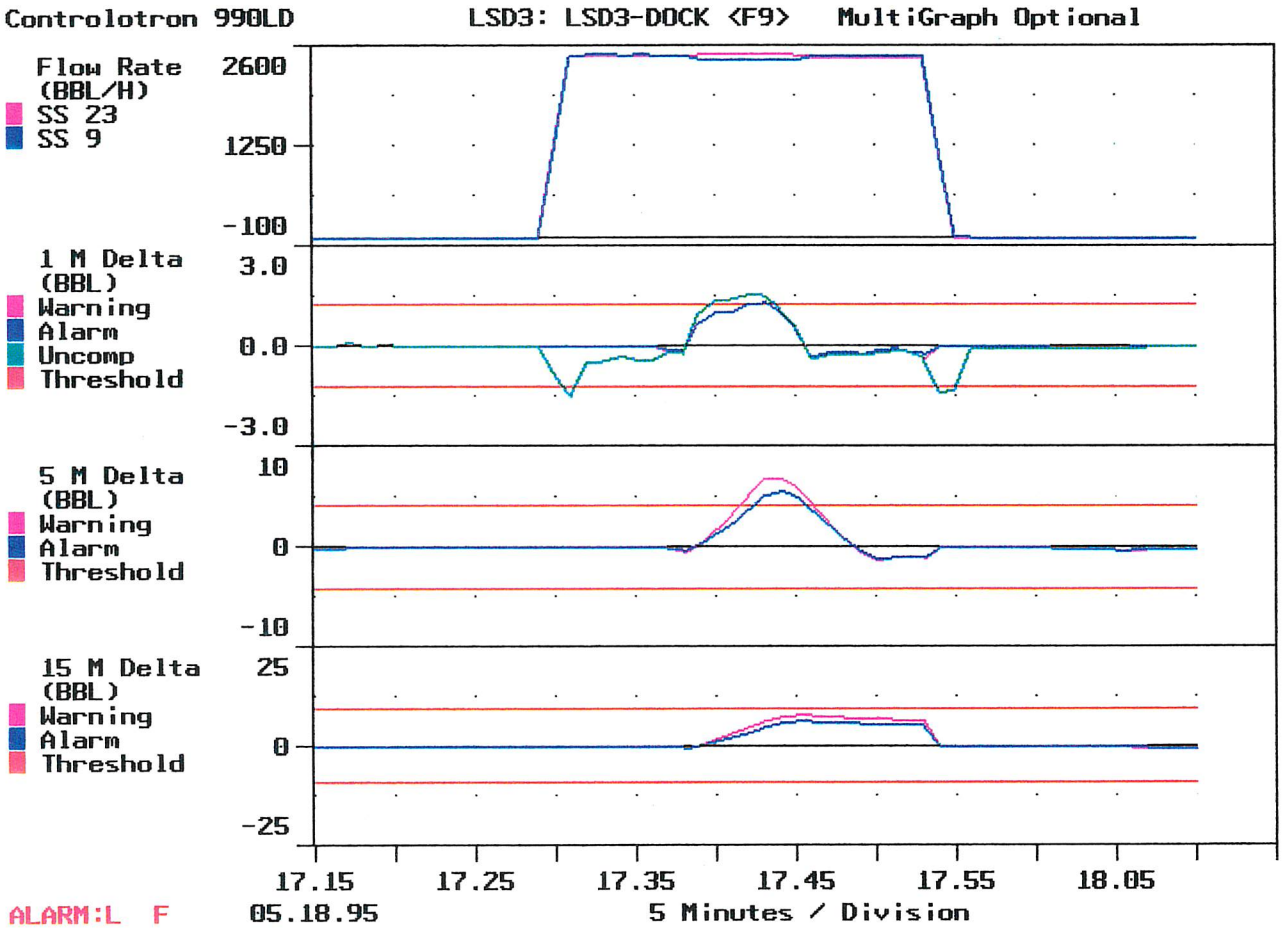

Controlotron 990LD
HSD1: HSD1-DOCK <F9> MultiGraph Optional
Flow Rate (BBL/H)
SS 25
SS 11
2700
1300
-100
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
3.0
0.0
-3.0
5 M Delta (BBL)
Warning
Alarm
Threshold
10
0
-10
15 M Delta (BBL)
Warning
Alarm
Threshold
25
0
-25
09.40
10.00
10.20
10.40
11.00
11.20
ALARM:L F
05.18.95
10 Minutes / Division

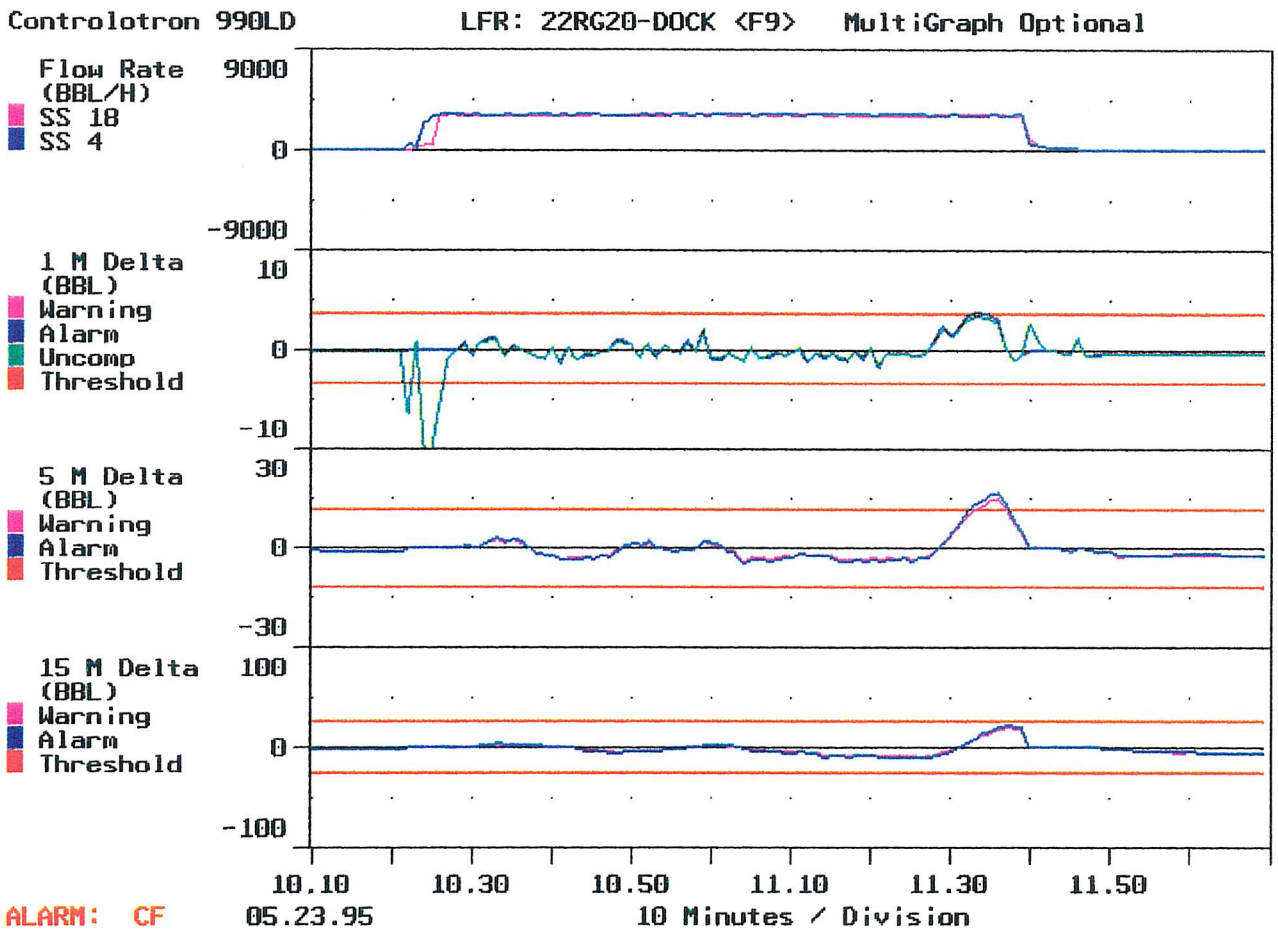

Controlotron 990LD
HSD1: HSD1-DOCK <F9>
MultiGraph Optional
Flow Rate (BBL/H)
SS 25
SS 11
2700
1300
-100
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
3.0
0.0
-3.0
5 M Delta (BBL)
Warning
Alarm
Threshold
10
0
-10
15 M Delta (BBL)
Warning
Alarm
Threshold
25
0
-25
11.25
11.35
11.45
11.55
12.05
12.15
ALARM:L F
05.18.95
5 Minutes / Division

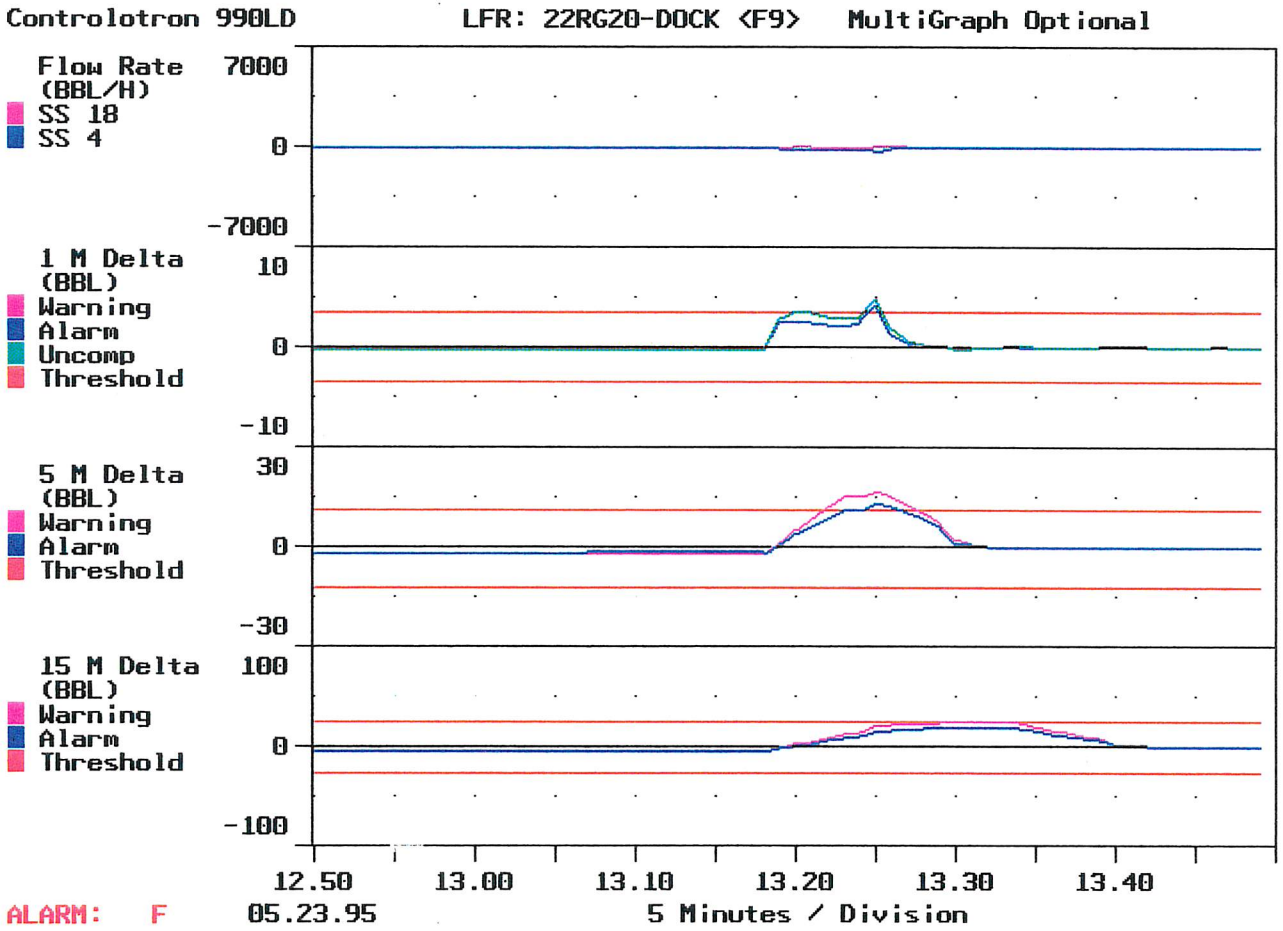

Controlotron 990LD
LSD2: LSD2-DOCK <F9>
MultiGraph Optional
Flow Rate (BBL/H)
SS 24
SS 10
2500
1200
-100
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
3.0
0.0
-3.0
5 M Delta (BBL)
Warning
Alarm
Threshold
10
0
-10
15 M Delta (BBL)
Warning
Alarm
Threshold
25
0
-25
05.18.95
14.55
ALARM:L F
13.25
13.35
13.45
13.55
14.05
14.15
05.18.95
5 Minutes / Division

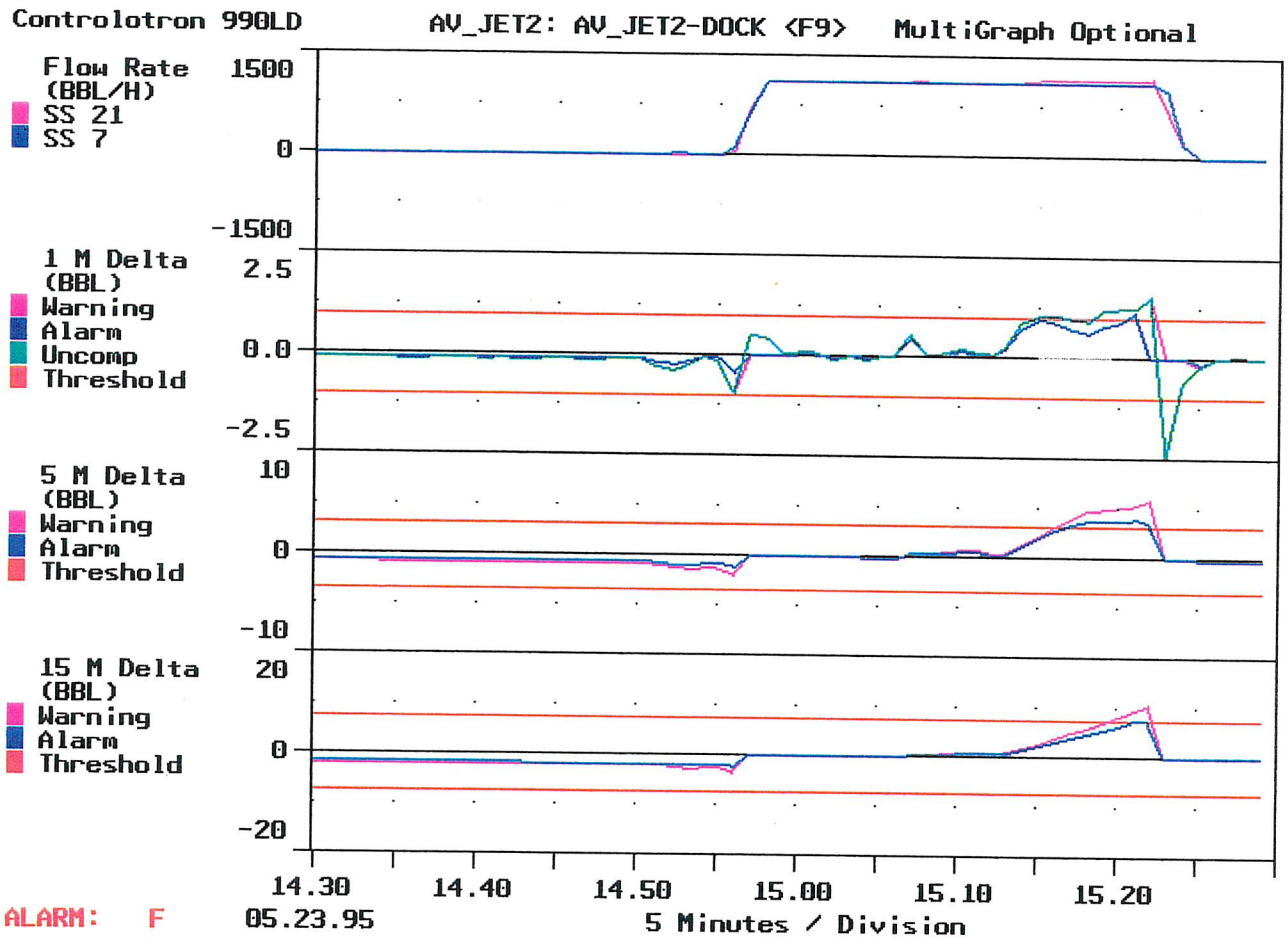

Controlotron 990LD
LSD2: LSD2-DOCK <F9>
MultiGraph Optional
Flow Rate (BBL/H)
SS 24
SS 10
2500
1200
-100
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
3.0
0.0
-3.0
5 M Delta (BBL)
Warning
Alarm
Threshold
10
0
-10
15 M Delta (BBL)
Warning
Alarm
Threshold
25
0
-25
14.25
14.35
14.45
14.55
15.05
15.15
ALARM:L F
05.18.95
5 Minutes / Division

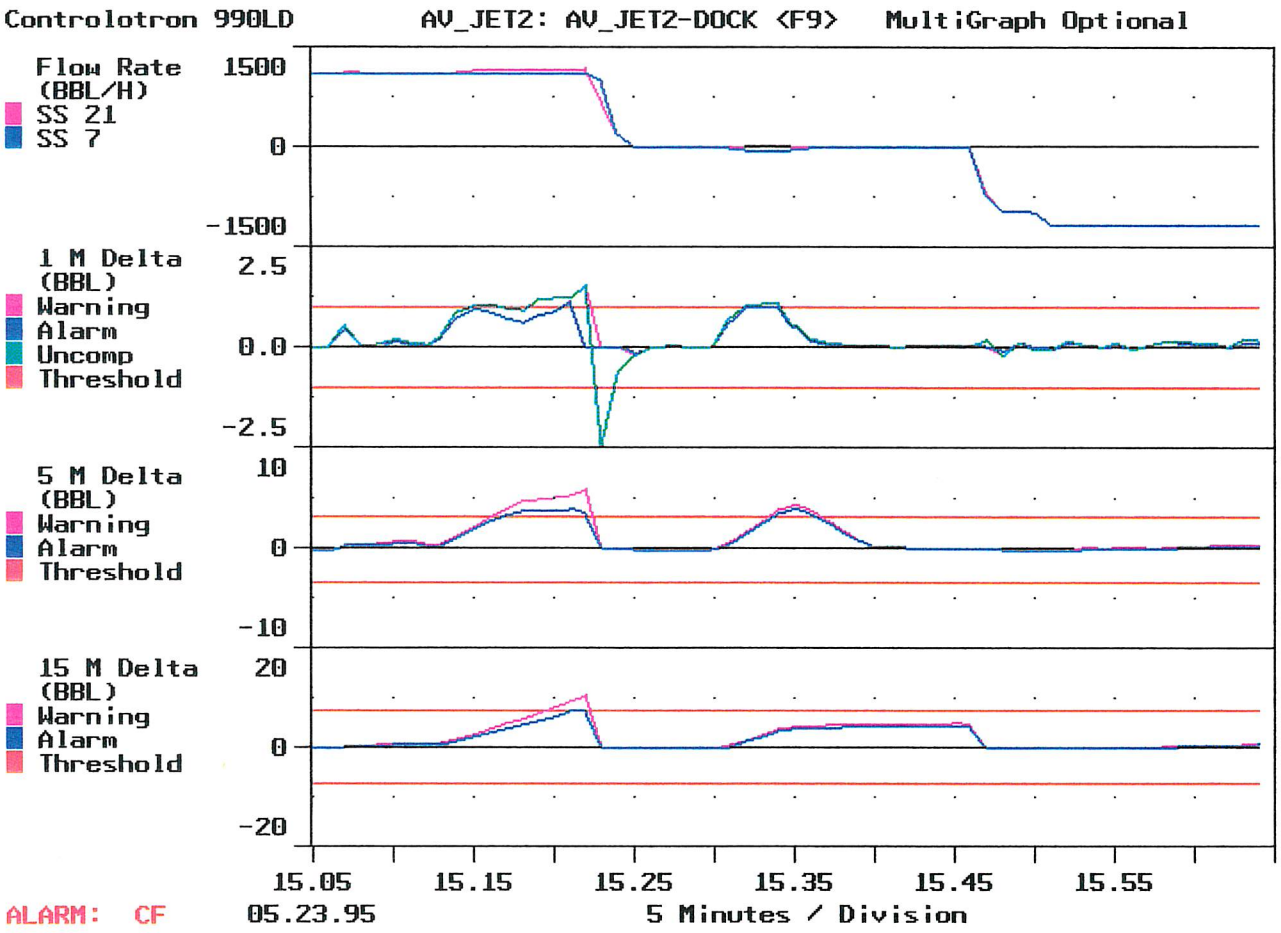

Controlotron 990LD
LSD3: LSD3-DOCK <F9>
MultiGraph Optional
Flow Rate (BBL/H)
SS 23
SS 9
2500
1200
-100
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
3.0
0.0
-3.0
5 M Delta (BBL)
Warning
Alarm
Threshold
10
0
-10
15 M Delta (BBL)
Warning
Alarm
Threshold
25
0
-25
05.18.95
16.05
ALARM:L F
15.05
15.15
15.25
15.35
15.45
15.55
05.18.95
5 Minutes / Division

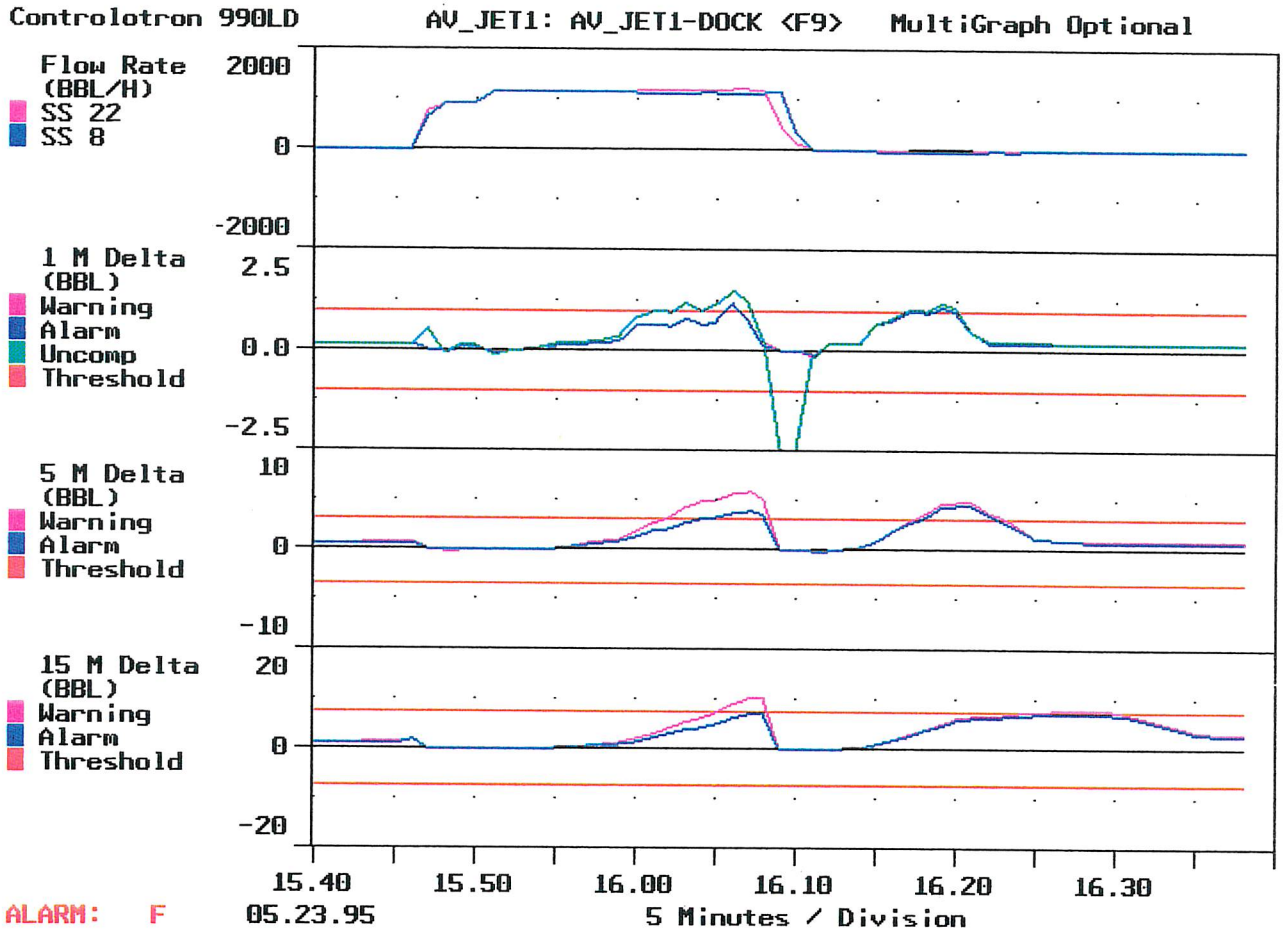

Controlotron 990LD
LSD3: LSD3-DOCK <F9> MultiGraph Optional
Flow Rate (BBL/H)
SS 23
SS 9
2600
1250
-100
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
3.0
0.0
-3.0
5 M Delta (BBL)
Warning
Alarm
Threshold
10
0
-10
15 M Delta (BBL)
Warning
Alarm
Threshold
25
0
-25
17.15
17.25
17.35
17.45
17.55
18.05
ALARM:L F
05.18.95
5 Minutes / Division

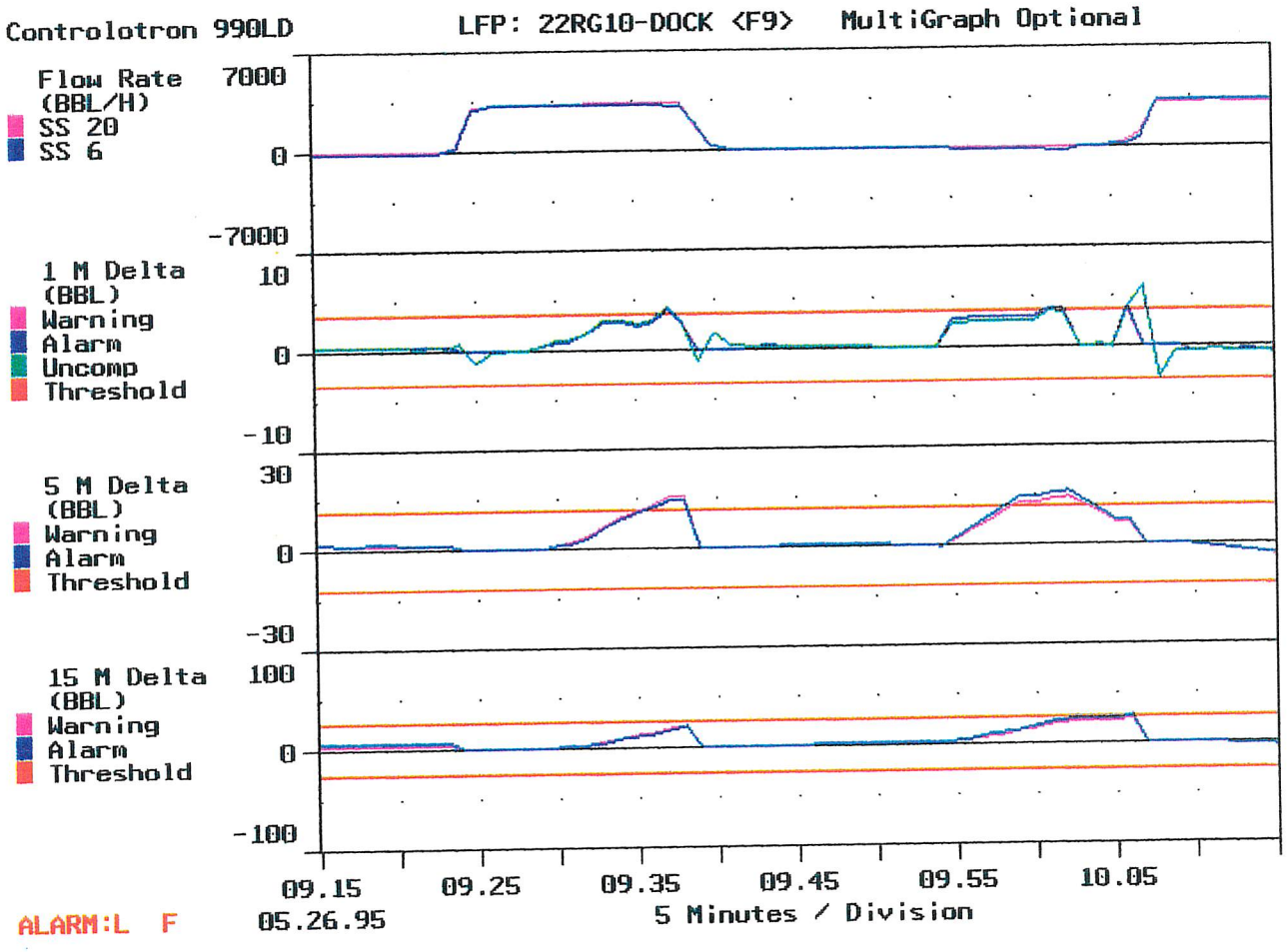

Controlotron 990LD
LFR: 22RG20-DOCK <F9>
MultiGraph Optional
Flow Rate (BBL/H)
SS 18
SS 4
9000
0
-9000
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
10
0
-10
5 M Delta (BBL)
Warning
Alarm
Threshold
30
0
-30
15 M Delta (BBL)
Warning
Alarm
Threshold
100
0
-100
10.10
10.30
10.50
11.10
11.30
11.50
ALARM: CF
05.23.95
10 Minutes / Division

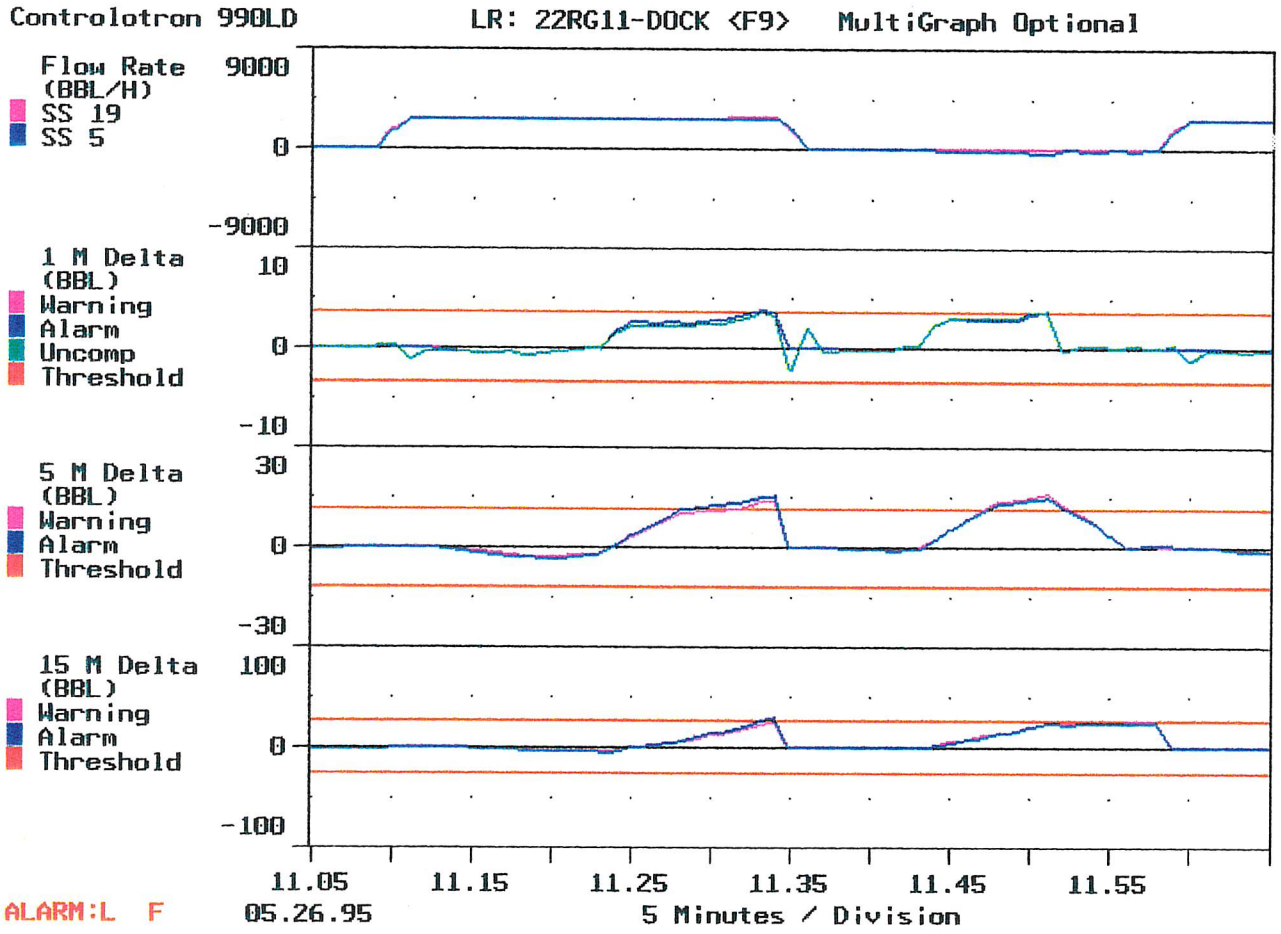

Controlotron 990LD
LFR: 22RG20-DOCK <F9>
MultiGraph Optional
Flow Rate (BBL/H)
SS 18
SS 4
7000
0
-7000
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
10
0
-10
5 M Delta (BBL)
Warning
Alarm
Threshold
30
0
-30
15 M Delta (BBL)
Warning
Alarm
Threshold
100
0
-100
12.50
13.00
13.10
13.20
13.30
13.40
ALARM: F
05.23.95
5 Minutes / Division

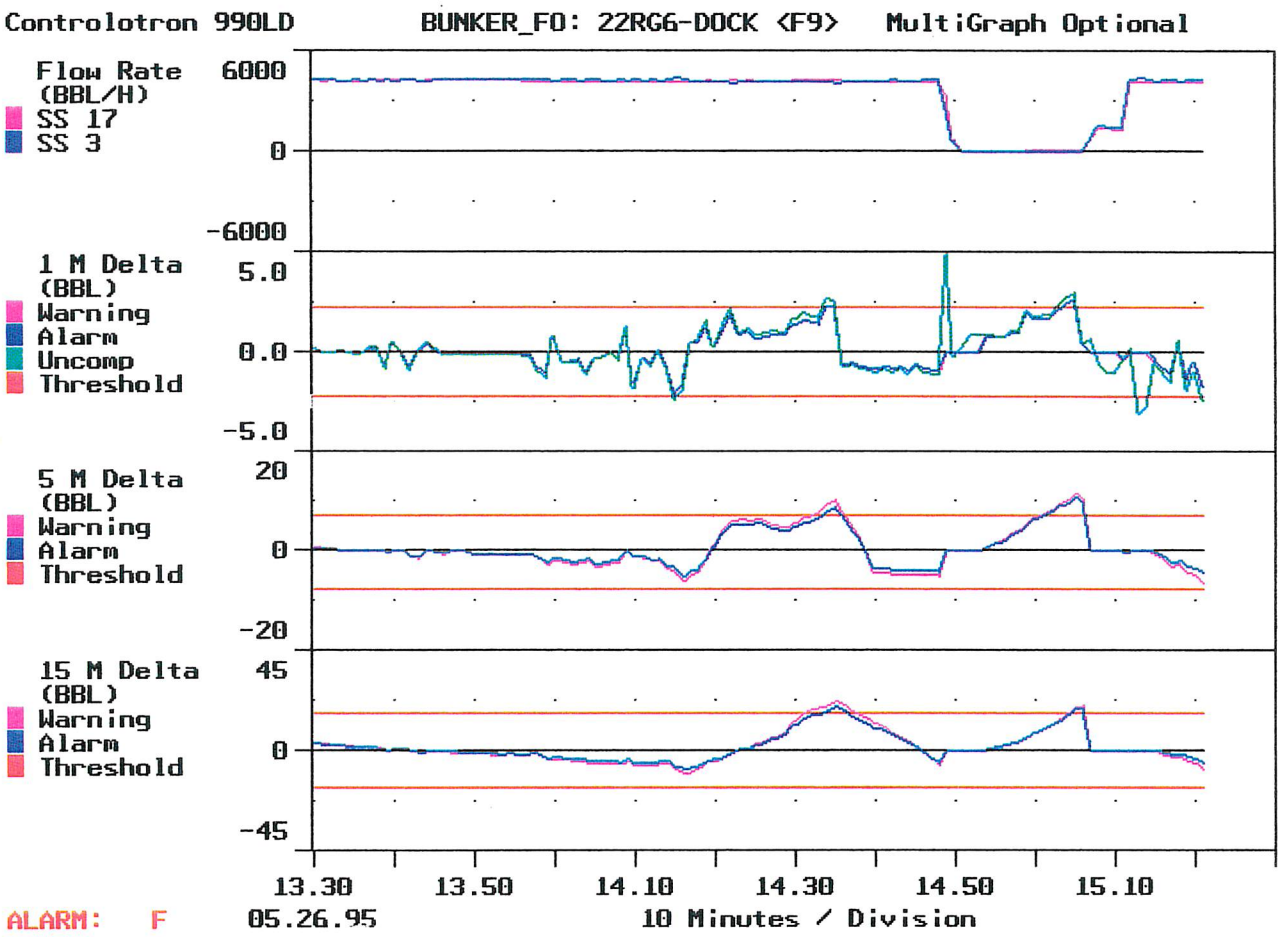

Controlotron 990LD
AV_JET2: AV_JET2-DOCK <F9> MultiGraph Optional
Flow Rate (BBL/H)
SS 21
SS 7
1500
0
-1500
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
2.5
0.0
-2.5
5 M Delta (BBL)
Warning
Alarm
Threshold
10
0
-10
15 M Delta (BBL)
Warning
Alarm
Threshold
20
0
-20
14.30
14.40
14.50
15.00
15.10
15.20
ALARM: F
05.23.95
5 Minutes / Division

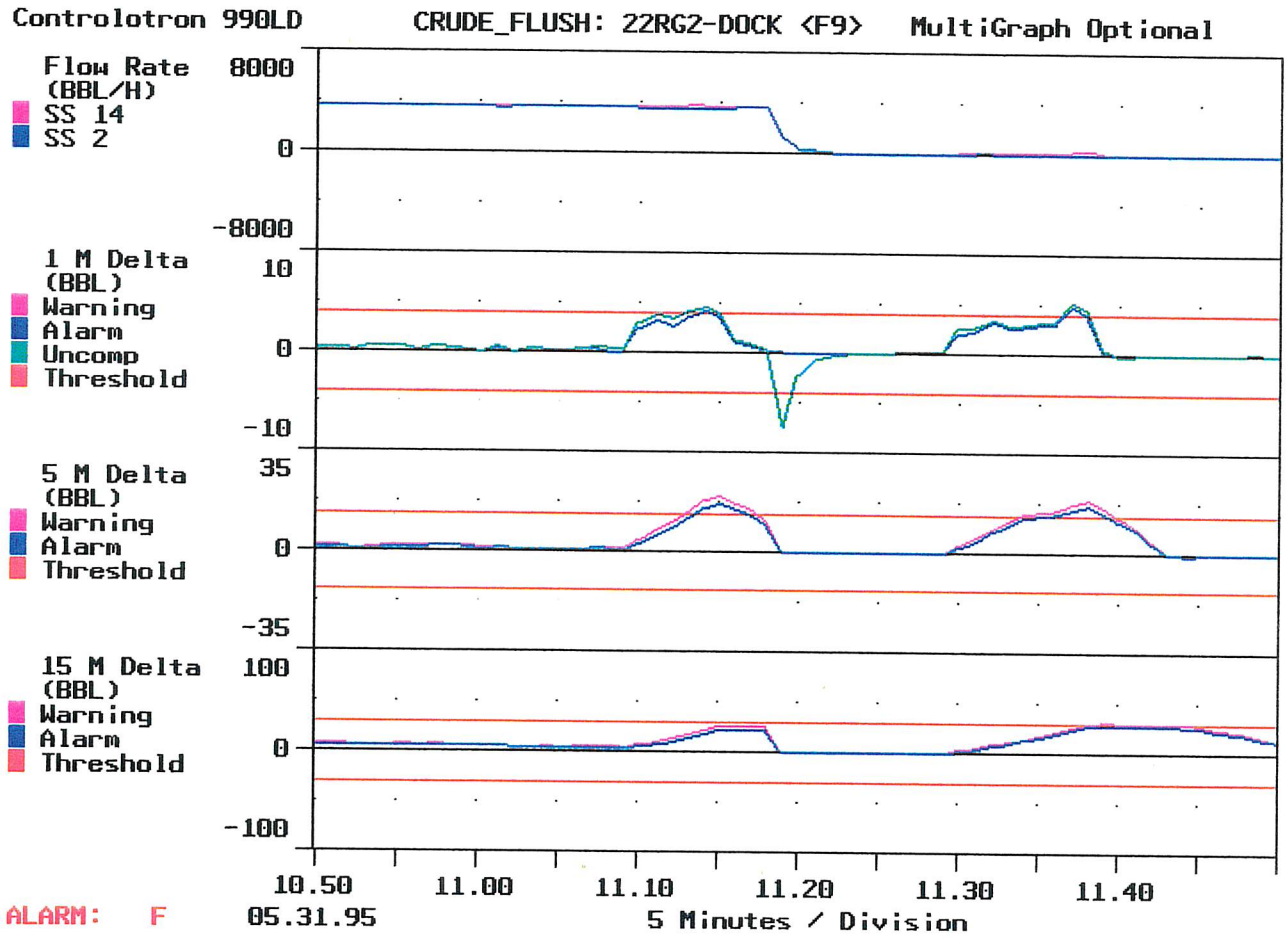

Controlotron 990LD
AV_JET2: AV_JET2-DOCK <F9>
MultiGraph Optional
Flow Rate (BBL/H)
SS 21
SS 7
1500
0
-1500
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
2.5
0.0
-2.5
5 M Delta (BBL)
Warning
Alarm
Threshold
10
0
-10
15 M Delta (BBL)
Warning
Alarm
Threshold
20
0
-20
15.05
15.15
15.25
15.35
15.45
15.55
ALARM: CF
05.23.95
5 Minutes / Division

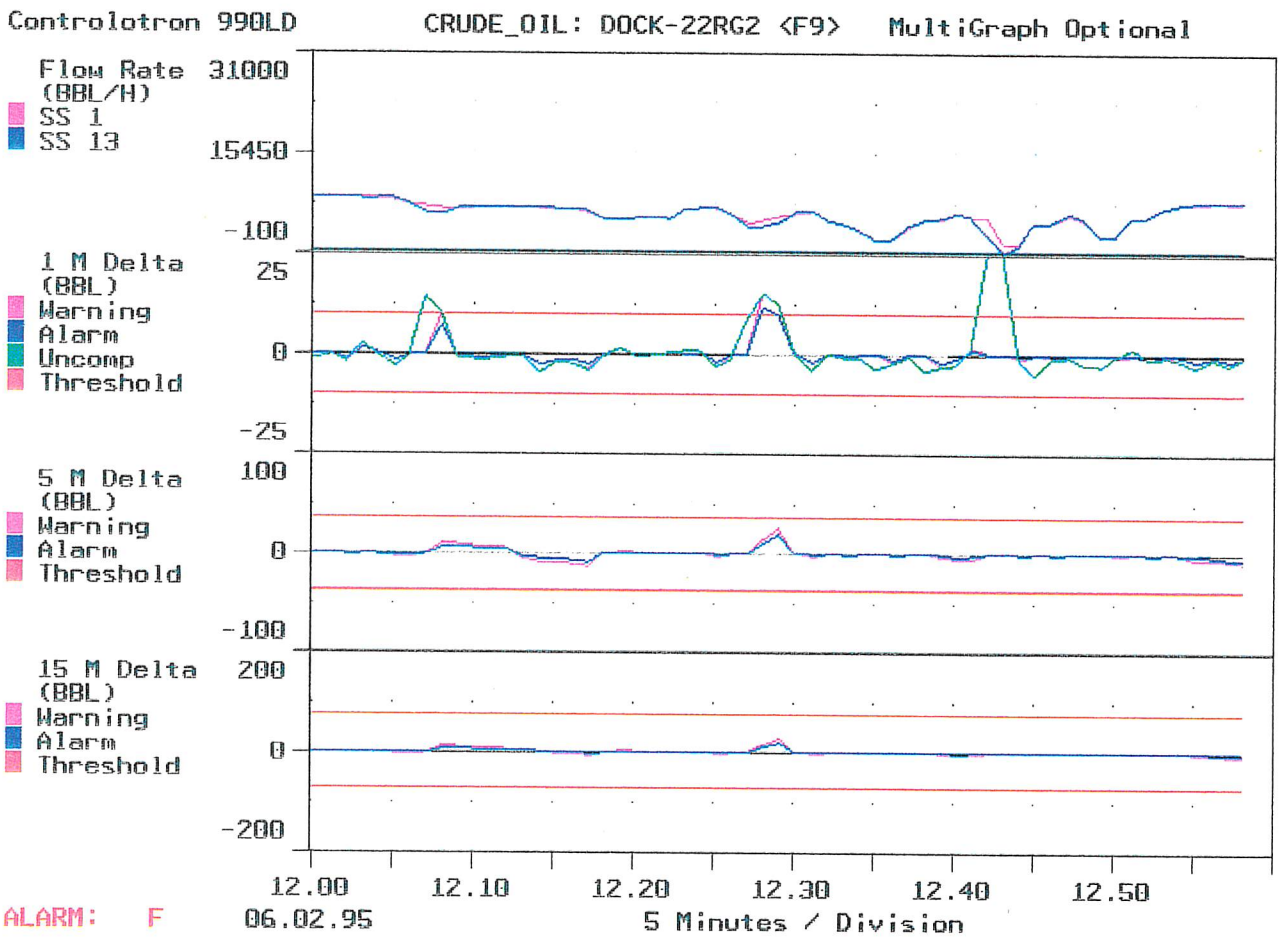

Controlotron 990LD
AV_JET1: AV_JET1-DOCK <F9> MultiGraph Optional
Flow Rate (BBL/H)
SS 22
SS 8
2000
0
-2000
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
2.5
0.0
-2.5
5 M Delta (BBL)
Warning
Alarm
Threshold
10
0
-10
15 M Delta (BBL)
Warning
Alarm
Threshold
20
0
-20
15.40
15.50
16.00
16.10
16.20
16.30
ALARM: F
05.23.95
5 Minutes / Division

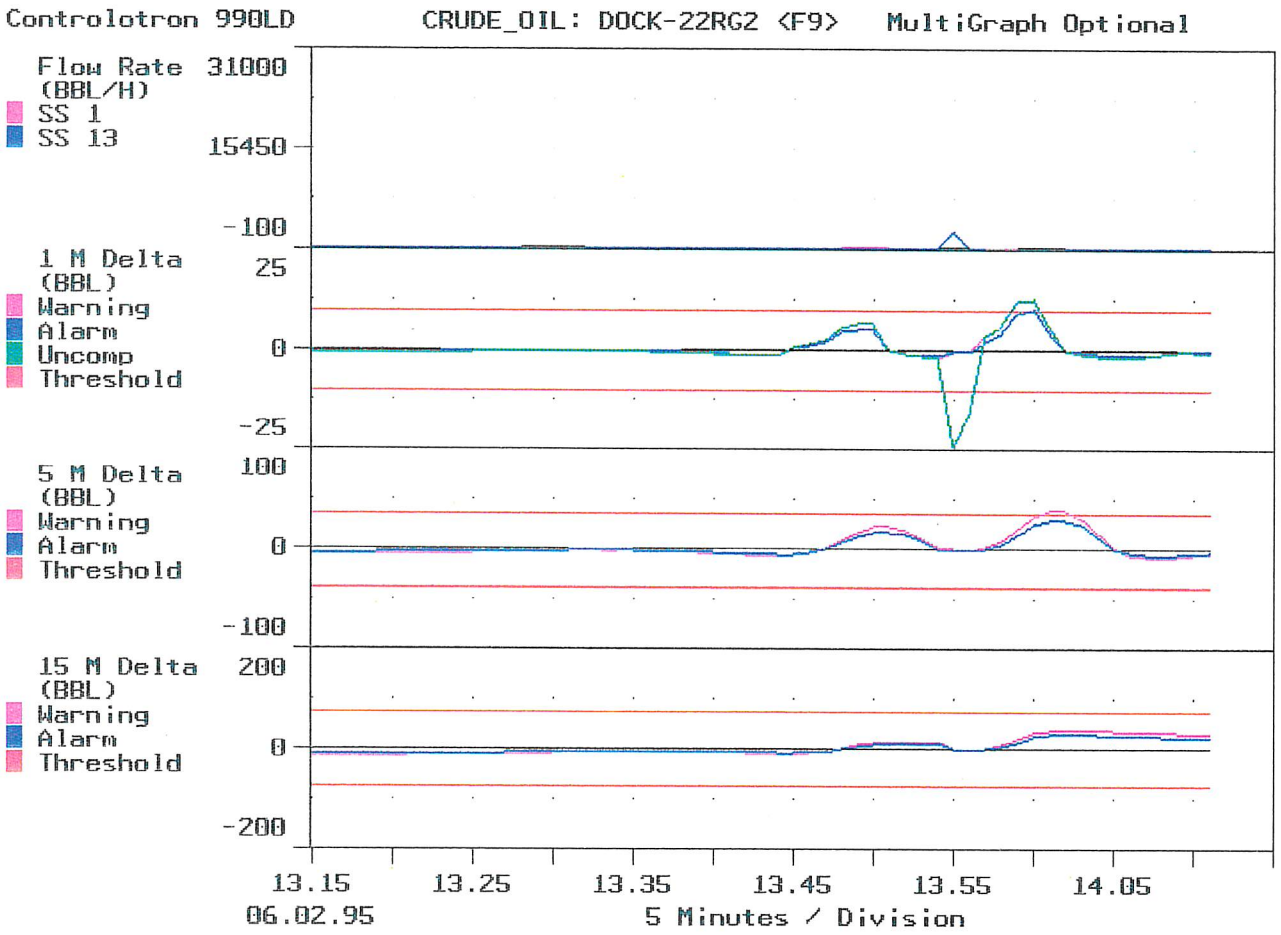

Controlotron 990LD
LFP: 22RG10-DOCK <F9>
MultiGraph Optional
Flow Rate (BBL/H)
SS 20
SS 6
7000
0
-7000
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
10
0
-10
5 M Delta (BBL)
Warning
Alarm
Threshold
30
0
-30
15 M Delta (BBL)
Warning
Alarm
Threshold
100
0
-100
09.15
09.25
09.35
09.45
09.55
10.05
ALARM:L F
05.26.95
5 Minutes / Division


Controlotron 990LD
LR: 22RG11-DOCK <F9>
MultiGraph Optional
Flow Rate (BBL/H)
SS 19
SS 5
9000
0
-9000
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
10
0
-10
5 M Delta (BBL)
Warning
Alarm
Threshold
30
0
-30
15 M Delta (BBL)
Warning
Alarm
Threshold
100
0
-100
11.05
11.15
11.25
11.35
11.45
11.55
ALARM:L F
05.26.95
5 Minutes / Division


Controlotron 990LD
BUNKER_FO: 22RG6-DOCK <F9>
MultiGraph Optional
Flow Rate (BBL/H)
SS 17
SS 3
6000
0
-6000
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
5.0
0.0
-5.0
5 M Delta (BBL)
Warning
Alarm
Threshold
20
0
-20
15 M Delta (BBL)
Warning
Alarm
Threshold
45
0
-45
13.30
13.50
14.10
14.30
14.50
15.10
ALARM: F
05.26.95
10 Minutes / Division


Controlotron 990LD
CRUDE_FLUSH: 22RG2-DOCK <F9>
MultiGraph Optional
Flow Rate (BBL/H)
SS 14
SS 2
8000
0
-8000
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
10
0
-10
5 M Delta (BBL)
Warning
Alarm
Threshold
35
0
-35
15 M Delta (BBL)
Warning
Alarm
Threshold
100
0
-100
10.50
11.00
11.10
11.20
11.30
11.40
ALARM: F
05.31.95
5 Minutes / Division


Controlotron 990LD
CRUDE_OIL: DOCK-22RG2 <F9>
MultiGraph Optional
Flow Rate (BBL/H)
SS 1
SS 13
31000
15450
-100
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
25
0
-25
5 M Delta (BBL)
Warning
Alarm
Threshold
100
0
-100
15 M Delta (BBL)
Warning
Alarm
Threshold
200
0
-200
12.00
12.10
12.20
12.30
12.40
12.50
ALARM: F
06.02.95
5 Minutes / Division


Controlotron 990LD
CRUDE_OIL: DOCK-22RG2 <F9>
MultiGraph Optional
Flow Rate (BBL/H)
SS 1
SS 13
31000
15450
-100
1 M Delta (BBL)
Warning
Alarm
Uncomp
Threshold
25
0
-25
5 M Delta (BBL)
Warning
Alarm
Threshold
100
0
-100
15 M Delta (BBL)
Warning
Alarm
Threshold
200
0
-200
13.15
13.25
13.35
13.45
13.55
14.05
06.02.95
5 Minutes / Division

TEXACO: Puget Sound Plant DEPARTMENT: RP&S STANDING ORDERS: General	**Leak Detection and Monitoring of the Dock Transfer Lines**	Code: GSO098 Number: 98 Version No.: 1 Date: 8/2/95 Page : 1 of 3

Leak Detection Policy

Regulatory Requirements:

The purpose of the state regulation, "Facility Oil Handling Operations and Design Standards, Chapter 173-180A WAC," is to establish facility operations and design standards that, when followed will:

1) Prevent oil and petroleum spills from occurring;
2) Ensure that facilities are designed and operated in a manner which will provide the best achievable protection of the public health and the environment;
3) Provide improved protection of Washington waters and natural resources from the impacts of oil spills caused by improper oil handling equipment design and operations.

Section 100 (8) further requires that:

Facilities shall have the capability of detecting a transfer pipeline leak equal to eight percent of the maximum design flow rate within fifteen minutes for transfer pipelines connected to tank vessels. Leak detection capability shall be determined by the facility using best engineering judgment. Deficiencies with leak detection systems such as false alarms must be addressed and accounted for by the facility. Facilities may meet these requirements by:

(a) Visual inspection provided the entire pipeline is visible and inspected every fifteen minutes; or

(b) Instrumentation; or

(c) Completely containing the entire circumference of the pipeline provided that a leak can be detected within fifteen minutes; or

(d) Conducting an acceptable hydrotest of the pipeline immediately before the oil transfer with visual surveillance of the exposed pipeline every fifteen minutes; or

(e) A combination of the above strategies; or

(f) A method approved by the department which meets the standard identified in this section.

Leak detection system operation and operator response must be described in the facility operations manual.

Means of Leak Detection:

The following means are used to monitor and detect leaks on the dock transfer lines:

1. Instrument Leak Detection System (ILDS) - Controlotron 990LD

   Is a Compensated Volume Balance System utilizing clamp-on transit time flow metering, to establish flow differences (deltas) and line pack differences to determine if there is a potential line leak between the meter sites.

The area of coverage that the ILDS system monitors is from the meter site just north of the Fire Protection building on the dock to the crude booster pump area to just west of Tank 36 for the 30 inch Crude line and the Crude Flushing line. The product lines are covered from the meter site just north of the Dock Shipping Pumps discharge to the meter site just north of the Fire Protection building. The Ballast line is covered from the meter site just north of the Fire Protection building to just north of the Ballast Tank (Tank 60) at the Effluent Plant.

2. Dock Operator Local Inspection

   The Dock Operator maintains local inspection and monitoring of the Dock Transfer lines, from the east end of the dock wharf (LDS meter site) to the west end of the dock wharf. The dock wharf is manned 7 days a week 24 hours a day.

3. Remote Visual Monitoring System

   Uses cameras to monitor key sensitive remote sites, (Crude Booster & A Anchor, TTLR & Gasoline Blender). The sites are then monitored remotely by the blending plant operator.

4. Local Visual Inspections

   Daily routine inspection rounds of the dock lines by the RP&S Operators. Daily routine and specific inspection duty rounds of the dock lines both in and outside of the plant, by the plant security forces.

Instrument Leak Detection System Operation Requirements

1. The Instrument Leak Detection System is to be in a fully operable mode to maintain capability to detect leaks at both full design flow and at static conditions at all times.

2. When the ILDS system is either partially or fully off-line, the dock transfer lines will be visually inspected and monitored on a continuous basis until the ILDS system is fully on-line.

3. All records for leak & site alarms will be maintained for a minimum of three years. Including the Dock Tranfer Lines - Leak Alarm Log Sheet, Leak and Site Alarm Inspection Form, Alarm Summary Pages, Alarm Graphic Display, etc.
   - WAC 173-180A-120 Record Keeping. Records required by this rule shall be maintained and available for a minimum of three years. Storage tank and Pipeline records shall be maintained for the life of the equipment. Records shall be available to the department (DOE) for inspection or photocopying upon request.

Required Responses to Instrument Leak Detection System Leak & Site Alarms:

1. The RP&S Operators will respond to all ILDS generated Leak Alarms (1,5,15,60 & pack delta's) & Site Alarms (failed site communications with the master station), by acknowledging, determining and verifying all leak & site alarms, by using the above listed means.

2. The RP&S Operators & Plant Security Forces, will inspect all effected dock transfer lines, with local visual inspection rounds.

3. The RP&S Operators will record, document and maintain files on all leak & site alarms, (false or real alarms).

4. The RP&S Supervision will ensure, that all real leak event data is archived, to disk format, from the ILDS (Controlotron Master Station). (To be maintained with the leak file, at EH&S).

5. The RP&S Operators will maintain all records within the Leak Alarm Log Book. The RP&S Supervisors will pull all of the monthly log sheets and inspection forms for review and then to forward all records to EH&S - attention Craig Ginnett for filing.

Required Response to Leak Detection System Failures:

1. The RP&S Operators will notify the RP&S Foreman or Night Foreman of the system failure.

2. The RP&S Foreman or Night Foreman will ensure that the LDS system is as expeditiously repaired as possible by notifying:
   - The on-shift unit I & E personnel; or
   - The on-shift I & E plant coverage personnel; or
   - The maintenance planner to callout I & E personnel

3. The RP&S Foreman or Night Foreman will ensure that all means are used to assure that the lines are monitored and inspected on a continuous basis through out the time period that the ILDS system is in a partial or full system failure. i.e.;
   - Increased operator awareness of affected operations
   - Increased operator and security inspection rounds of the dock transfer lines
   - Supplement the work force as necessary

Boyd L Wells

TEXACO Puget Sound Plant	**Monitoring the Dock Transfer Lines for Leaks**	'FM 'CB 'DW RPSBSO.002 VERSION # 1 VER. DATE: 8/2/95 Page 1 of 5
AUTHORIZED BY:_____		DATE: _____

SCOPE

This procedure describes the steps necessary to monitor the dock transfer lines for the potential of leaks.

RESPONSIBILITIES

RP&S (Receiving, Pumping, and Shipping) Operators are responsible for this procedure.

REQUIREMENTS

The Dock Transfer Lines will be monitored on a continuous basis using the Leak Detection System - Contolotron 990LD, Remote Visual Monitoring - Cameras, Local Visual Inspection - Operators and Security Forces and the Dock Operator Local Visual Inspection of the Dock Wharf.

The Dock Transfer Lines at the wharf that are not instrument monitored for leaks, will be visually inspected daily and documented as of their status. Records to be forwarded to the RP&S Foremans office for filling.

The plant security forces to perform drive by inspections of the dock transfer lines both in and outside of the plant during their routine duties and per specific inspection duties that require documentation of the transfer lines status.

All leak & site alarms must be documented.

All records dealing with leak & site alarms and inspection, must be kept for three years.

RELEVANT DOCUMENTS

RP&S General Standing Order No. 98 - Leak Detection & Monitoring of the Dock Transfer Lines.
WAC Chapter 173-180A-100-(8) - Transfer Pipeline Requirements.
WAC Chapter 173-180A-120 - Record Keeping.
Contolotron - Master Station Field Manual
Monitoring & Acknowldging the Controlotron 990LD Leak Detection Syste for Leak Alarms - Procedure, RPSB SO 001.

MATERIALS/EQUIPMENT

Leak Detection System - Controlotron 990LD.
Remote Visual Monitoring System.

PROCESS CONTROL

N/A

SAFETY and HEALTH

N/A.

QUALITY

There are no special quality concerns that apply to this procedure.

1.0 Monitor the Dock Transfer Pipelines.

1.1 View the System Alarm Status Screen, on the Controlotron 990LD Leak Detection system, for operating conditions, on a continuous basis.

1.2 Make remote visual inspections of the dock lines, using the Remote Visual Monitor Cameras, on a continuous basis.

1.3 Make local visual inspections of all segments of dock lines not instrument covered, on a continuous basis.

1.4 Make local visual inspections of all dock wharf lines that are not instrument monitored, on a continuous basis.

1.5 Inspect and record all dock lines and surronding waters on the Dock Area & Surrounding Water's Inspection Form, once a day.

2.0 Acknowledge the Leak Detection Systems, line and site warnings and alarms.

NOTE

Refer to the "Monitoring & Acknowledging the Controlotron 990LD Leak Detection System for Leak Alarms", procedure.

NOTE

Segment warnings are when the raw or uncompensated deltas exceed the threshold. **Segment alarms** are when the compensated or AppCon, (application condition) deltas exceed the threshold.

Site warnings are when the site can not get a reading. **Site alarms** are when the site fails to communicate with the master station.

3.0 Verify that there are no leaks.

3.1 Determine the cause of the alarm, by reviewing the appropriate screens on the Controlotron 990LD Leak detection system.

3.2 Make remote visual observation of all dock lines using the Leak detection Monitoring Cameras.

3.3 Make local visual inspections of the dock line in alarm.

3.4 Notify the RP&S Foreman or Night Foreman, of the condition.

4.0 Document the leak & site alarms.

4.1 Record the following information on the Leak Alarm Log Sheet, for leak & site alarms:

- Line/Site
- Alarm Type, Time, & Date
- Alarm Acknowledged Time
- Alarm Acknowledged By
- Remarks

4.2 Record the following information on the Dock Transfer Lines Leak Alarm Inspection Form, for leak alarms:

- Line
- Time
- Date
- Alarm delta type
- Local site verification
- Remote site verification
- Remarks - alarm cause, appropriate actions taken to correct

4.3 Attach all leak alarm graphic displays and alarm summary print outs, to the Dock Transfer Lines Leak Alarm Inspection Form, maintain the records in the RP&S Dock Transfer Lines Leak & Site Log Book.

TEXACO Puget Sound Plant	**Monitoring & Acknowledging the Controlotron 990LD Leak Detection System for Leak Alarms**	'FM 'CB 'DW RPSBSO.001 VERSION # 1 VER. DATE: 8/1/95 Page 1 of 7
AUTHORIZED BY:_____		DATE: _____

SCOPE

This procedure describes the steps necessary to monitor the 990LD Controlotron Leak Detection system and acknowledge and respond to Leak Detection Leak Alarms and System Fault Alarms on the system for the Dock Transfer Lines.

RESPONSIBILITIES

RP&S (Receiving, Pumping, and Shipping) Operators are responsible for this procedure.

REQUIREMENTS

Monitor the 990LD system during all product movements and periodically when lines are not in use for possible leaks.

Respond to all alarms as expeditiously as possible.

RELEVANT DOCUMENTS

Contolotron - Master Station Field Manual

MATERIALS/EQUIPMENT

There are no special materials or equipment required for this procedure.

PROCESS CONTROL

Refer to Appendix A for a summary of the consequences of deviating from the operating limits described in this procedure, and the steps to recover from deviation.

SAFETY and HEALTH

Refer to Appendix B for a summary of chemical properties and hazards. Observe all plant safety and health rules when performing this procedure.

QUALITY

There are no special quality concerns that apply to this procedure.

1.0 Monitoring the Controlotron 990LD System's Master Station for leaks.

1.1 Check the status levels for each line segment and site station.

> **NOTE**
>
> Refer to the System Alarm Status screen (F1) on the Controlotron Master Station and TDC Groups 61 & 62.

2.0 Acknowledge and respond to leak alarms on the Controlotron 990LD Master Station and TDC.

2.1 Acknowledge the Leak Detection Common alarm, 22FA300A and any individual site flow alarms on the TDC.

> **NOTE**
>
> Acknowledging this alarm, clears it only from the TDC not the 990LD Master Station.

2.2 Determine the line segment in alarm, call up the System Alarm Status screen, by pressing **F1** on the 990LD Master Station.

NOTE

The segment in alarm will be flashing in red, on the System Alarm status screen. The other segment designations are as follows:
Green = Ok, Red = Leak/Pack, Blue = Anti Leak (Blinking) = Unacknowledged Alarm

2.3 Determine the alarm type, move the cursor to the desired alarming segment, press **A**.

NOTE

The alarm types that can be noted here are 1, 5, 15, 60 minute Flow Delta's and Pack Delta Alarms.

2.4 Record the appropiate alarm data on the Dock Transfer Lines - Leak Alarm Log Sheet.

2.5 Acknowledge the alarm, press **ENTER**.

NOTE

Moving to another screen by pushing a Hot Key, will leave the alarm **unacknowledged.**

NOTE

Pressing the **Enter** key twice will call up a screen that lists all of the available screens and their associated Hot Keys for veiwing the screens.

2.6 Determine, if the specific alarm is due to operational demands and conditions or if it is a possible leak, by bringing up the desired screen for the designated alarm.

NOTE

For Delta Flow Alarms call up the Segment Status screen, (F2), for the current numeric data or the MultiGraph Delta screen (F5).

For Pack Delta Alarms call up the Line Pack screen, (CF7), or the Pack Delta screen, (CF8).

For a comparison of the 1 minute delta to flow, liquident and temperature, call up the Multigraph Data screen, (F6), or the Segment Status screen, (F2), for numeric data of the same.

NOTE

When the appcon delta for the one minute delta excedes the threshold on a continous basis, this is a strong indication of a major leak.

When the appcon delta excedes the one minute delta only momentarily, this is a indication that it may be operational conditions that are the cause.

3.0 Acknowledge and respond to system faults on the Controlotron 990LD Master Station.

3.1 Acknowledge the Leak Detection System Fault alarm, 22QA300 on the TDC.

NOTE

Acknowledging this alarm, clears it only from the TDC not the 990LD Master Station.

3.2 Determine the site in alarm, call up the System Alarm Status screen, by pressing **F1** on the 990LD Master Station.

NOTE

The site in alarm will be flashing in red, on the System Alarm status screen. The other site designations are as follows:
Green = Ok, Yellow = Empty @ Site not able to get reading, Red = FLT/MEM - Fault, (Blinking) Red = Unacknowledged Alarm

3.3 Determine the alarm type, move the cursor to the desired alarming segment, press **A**.

3.4 Acknowledge the alarm, press **ENTER**.

NOTE

Moving to another screen by pushing a Hot Key, will leave the alarm **unacknowledged.**

NOTE

Pressing the **Enter** key twice will call up a screen that lists all of the available screens and their associated Hot Keys for veiwing the screens.

3.5 Determine, if the specific warning or alarm condition is due to operational demands and/or system communication problems, by bringing up the site data screen (alpha numeric) F3, to compare the data between the two differnt sites on the affected segment.

NOTE

When the site is in the **Yellow Warning** condition, this is probally due to operational conditions such as a void in the line or product solidified, etc., causing the site transducers to not being able to get a reading.

When the site is in the **Red Alarm** condition, this is probally due to the leak detection system and equipment failing to communicate.

3.6 Notify the RP&S Foreman or Night Foreman to notify the I & E department for repairs.

NOTE

Refer to RP&S General Standing Order No. 98 - Leak Detection and Monitoring of the Dock Transfer Lines.

DOCK TRANSFER LINES

Leak and Site Alarm Inspection Form

Line: _____ **Time:** _____ **Date:** _____

Delta & Site Alarms Check the Appropiate Alarm(s)			
1 Minute		5 Minute	
15 Minute		60 Minute	
Pack		Site	

Local Line Segment Verification				
Site	Who	Time	Date	Remarks
Segment 1:				
Segment 2:				
Segment 3:				
Segment 4:				
Segment 5:				

Remote Line Verification				
	Who	Time	Date	Remarks
990LD				
Camera 1				
Camera 2				
Camera 3				
Camera 4				
Camera 5				

Remarks	
Alarm Cause	Appropriate Action(s) Taken to Correct

Print and Attach the Appropiate Alarm Graphics and Alarm Summary Printouts to this Form

Form to be forwarded to the EH&S Department - Attention Craig Ginnett, for filing

Segment - Area Definitions:

Segment 1: Dock Warf to Dock Cause Way.
Segment 2: Dock Cause Way to Dock Gate Office
Segment 3: Dock Gate Office to Crude Booster.
Segment 4: Crude Booster to Tankage
Segment 5: Crude Booster to Dock Shipping Pumps

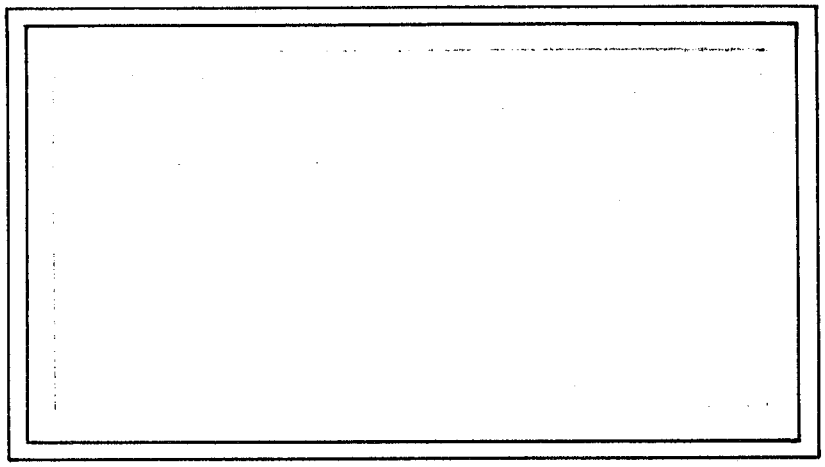
Remote Visual Monitoring:

Camera 1: Crude Booster
Camera 2: A Anchor
Camera 3: TTLR - Blend Control
Camera 4: TTLR - Security Control
Camera 5: Gasoline Blender

DOCK TRANSFER LINES
Leak Alarm Log Sheet

Line Segment or Site Station	Alarm Information			Acknowledgment		Remarks
	Type	Time	Date	Time	Who	Record Actions Used to Investigate and Verify Alarm Status

Form to be forwarded to the EH&S Department - Attention Craig Ginnett, for filing



CONTROLOTRON

Industrial and Aerospace Control Systems

December, 1993

CONTROLOTRON
MASTER STATION FIELD MANUAL
FOR
SYSTEM 990LD
PIPELINE LEAK DETECTOR

FOR TECHNICAL ASSISTANCE
PLEASE CALL, WRITE OR FAX:
TECHNICAL SERVICES DEPT.
CONTROLOTRON CORPORATION
155 PLANT AVENUE
HAUPPAUGE, NEW YORK, 11788, U.S.A.
PHONE: 516-231-3600
1-800-275-8480 (Outside New York State)
FAX: 516-231-3334
TELEX: 961-447
EASYLINK: 62819160

TABLE OF CONTENTS

FIGURES

DRAWINGS (E.W.O. 1876)

SECTION 1
INTRODUCTION

This manual describes the functions, features, and construction of the Controlotron 990LD Leak Detecton System. It describes what the system does, and points out certain limitations. It provides an overview of Installation, Start-up, Operation, Optimization and Maintenance activities.

System 990LD is quite simple to operate. However, it is important that Operators attend the Indoctrination and Training Courses provided by Controlotron. These courses offer operating details and text material beyond the scope of this manual. Learning about System 990LD, and following the its simple operating and maintenance procedures, will permit early detection of small and catastrophic leaks in petroleum and chemical pipelines. Operators will also become familiar with a variety of unique 990LD functions that are useful for general pipeline operations.

Additional information on the functions, features and performance of System 990LD can be obtained from the 990LD Bulletin, 990LDBUL, and the 990LD System Description, 990LDSYS.

System 990LD is designed to be extremely user friendly. Users should come up to speed in its operation very quickly. However, post start-up Controlotron services are always available to assist in all aspects of System Operation, Optimization and Maintenance. Where desired, Controlotron staff may be assigned to provide continuing support for operations, especially in System Optimization.

System 990LD is much more than a Leak Detection system. The unique additional information that 990LD provides will improve the effectivity of pipeline operation and maintenance not possible in any other way. Among the functions available, depending on the particular model obtained, are:

- ☐ Leak Detection
- ☐ Leak Location
- ☐ Custody Transfer
- ☐ Interface Detection
- ☐ Product Type Identification
- ☐ Batch Tracking
- ☐ Pig Detection
- ☐ Gas/Water Detection
- ☐ Aeration Detection
- ☐ Liquid Non-homogeneity
- ☐ Line Pack Detection
- ☐ Product Quality Control

System 990LD's primary purpose, Leak Detection, is a high priority in the transportation of valuable and/or hazardous liquids. This is especially true when pipelines pass through high risk environmentally vulnerable terrain. For decades, many attempts were made to design an effective Leak Detection system. However, until the introduction of System 990LD, the reliable and timely detection of small and catastrophic leaks remained unachievable.

The prior failure to detect pipeline leaks reliably, is due in part to the difficulty of the problem. The volume of product in most pipelines is enormous when compared to the small leak size that must be detected to avoid health hazards or environmental damage. Flow rates and flow direction frequently vary unpredictably. Environmental conditions change along the large distances occupied by many pipelines. The volume of product in the pipeline changes due to expansion or contraction with changes in temperature. The location of the actual interface between products in the pipeline becomes uncertain as the liquid travels over vast distances.

SECTION 2
BRIEF REVIEW OF CLAMP-ON FLOWMETERING THEORY

Since Controlotron provides several comprehensive descriptions of clamp-on transit-time flowmetering theory, this manual includes only a brief review.

Both leak detection and custody transfer requires continuous, exquisitely sensitive and accurate flow measurement and liquid type identification within the pipe. Systems 990LD and 990CX accomplishes this using exclusive Controlotron technology, developed from over 20 years experience as leader in the field of clamp-on transit-time ultrasonic flowmetering.

System 990 clamp-on transit-time ultrasonic flowmeters use patented Wide Beam technology. As shown, single or dual beams are generated by clamp-on 990 transducers. These induce an axial sonic wave in the pipe wall. As it travels down the pipe, it "rains" sonic energy into the liquid in the form of a Wide Beam. This wide beam entirely covers the receive transducer, assuring that it cannot be interrupted by bubbles, or lost due to a change in refraction angle as liquid types vary.

System 990 transmits alternately *upstream* and *downstream*. Flow makes the *upstream* beam take longer to traverse the liquid, and the *downstream* beam to take less time. System 990 measures the time difference, which is proportional to flow, and computes the flow rate in user-selected units. Since there is no energy taken from the stream, flow detection is extremely sensitive (0.0003 M/s), entirely linear, bidirectional, and operates at any flow rate, (0 to +/- 40 Ft/s).

Controlotron's proprietary LiquIdent™ Sonic Signature function positively indentifies the liquid type. It is a measure of a liquid's density in relation to its viscosity. System 990LD computes the LiquIdent™ from the liquid's sonic propagation velocity and its temperature. System 990 determines the liquid transit-time by measuring the actual travel time of the sonic beam through the known liquid path length. Temperature is measured by a high precision clamp-on RTD manufactured by Controlotron. After computing the LiquIdent™ value, System 990 computes the liquid density and viscosity based on the Master Station's liquid parameters.

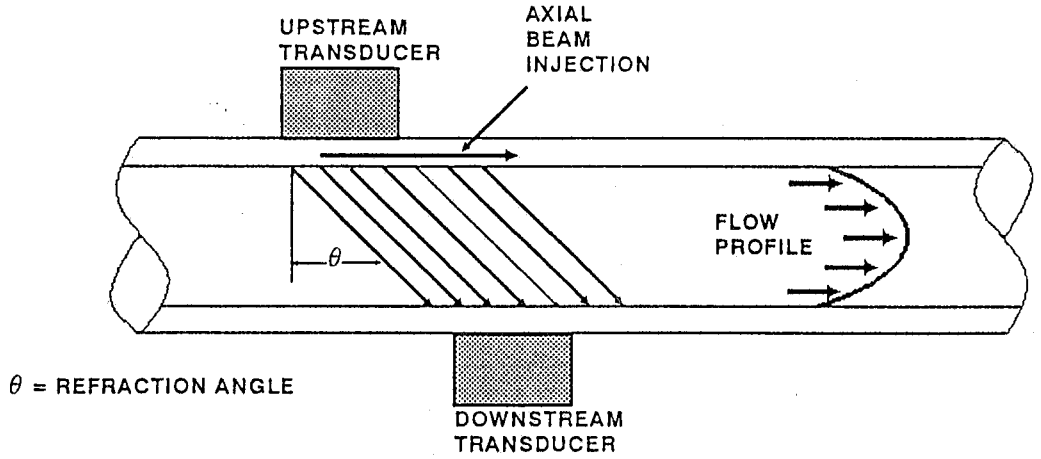


Figure 2-1: Wide Beam Ultrasonic Transmission

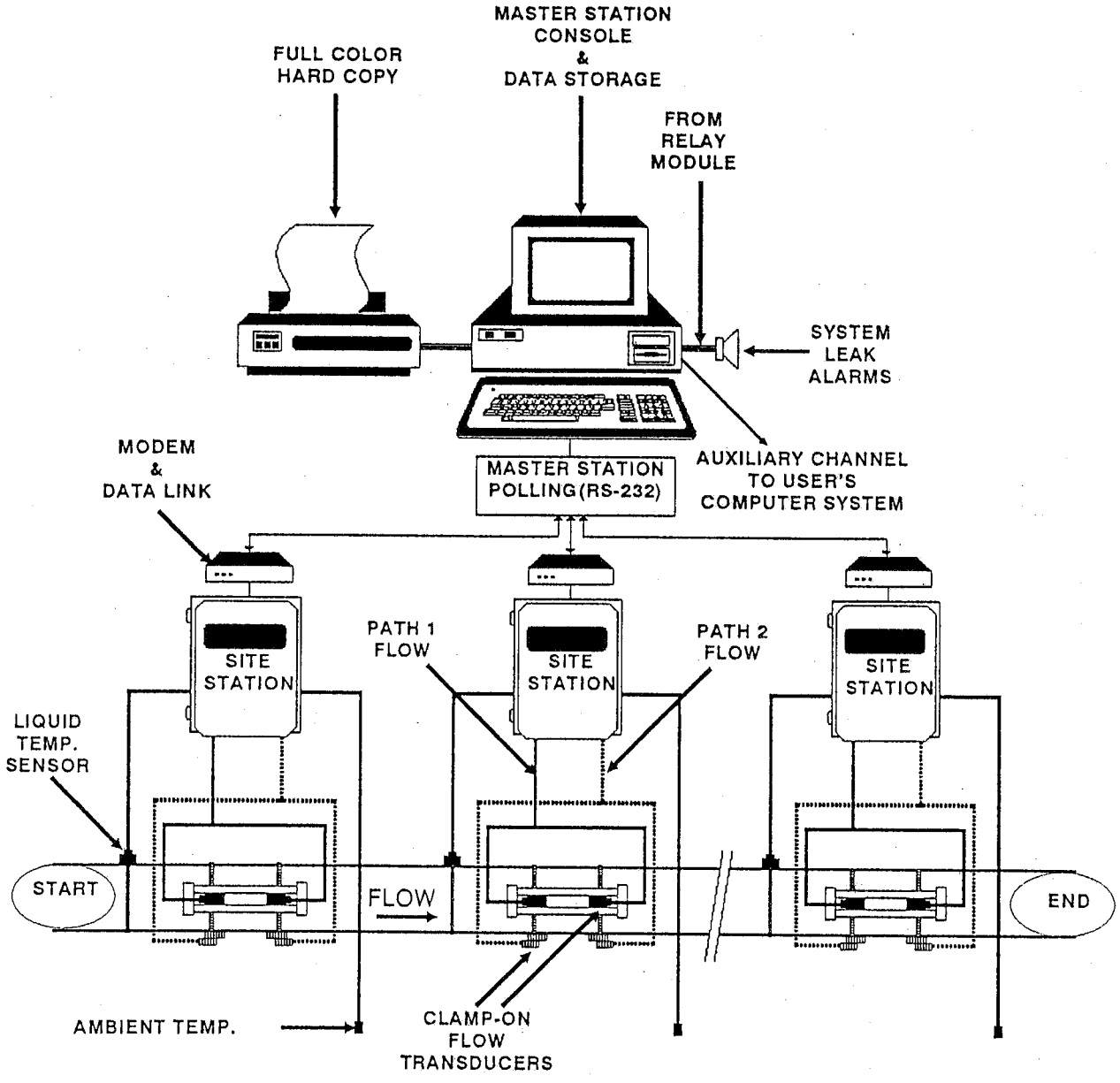


Figure 3-1: Typical 990LD System Configuration

Screens are also provided to assist in the operation of the pipeline, such as Interface detection and liquid type identification etc.. This section describes the data provided by the Site Station and the data processed by the Master Station.

Each Site Station, depending on its system type, collects various parameters every 1/10 second:

1) Flow Rate
2) Liquid Temperature
3) Ambient Temperature
4) Liquid Sonic Properties
   - Sonic Propagation Velocity, Vs
   - Sonic Signal Strength, Valc
   - Liquid Aeration, Vaer
   - Timed Maximum Rate of Change of Sonic Propagation Velocity
5) Site Station Diagnostic Data
   - Empty Alarm
   - Flow Direction
   - Operation Fault
   - Aeration Alarm

Typically once per minute, the 990LD Master Station collects date and time stamped data from all Site Stations simultaneously. Often, data is transmitted through the users installed communication system. This is decided jointly by the user and Controlotron staff engineers during the initial system planning phase.

Once per minute, the 990LD Master Station receives, processes and archives Site Station data. It displays the processed data, either numerically or graphically, using a specified scale and time base. The displayed data covers the previous 1, 2, 4, 8, 16, 24, 48 or 72 hours. It provides the operating staff with comprehensive information to disclose the existence of a leak. It also provides information about general pipeline operations. It displays the selection of any of the following processed data, for any Segment of any pipeline installed on the 990LD Master Station:

Segment Alarm Screen	This screen provides a graphic overview of all Site Stations and the pipeline segments that they monitor. The color of the Site Stations and segments (Green, Yellow, Blue or Red as defined in Section 5) shows their condition. It is the *first alert* screen, normally displayed when in background operation mode.
Segment Status Screen	This screen shows the numeric data for any selected segment of any installed pipeline. The operator can evaluate the exact conditions, relative to confirming the existence of a leak.
Site Station Data Screen	This screen shows the condition of the two Site Stations that border any selected segment. The operator can clearly observe their condition. This will help the operator to decide if a leak exists.
Batch Tracking Data Screen	This screen shows the current content of the pipeline, where the interfaces of the various batches are, and when the interfaces are expected to arrive at the next Site Station.

Segment Temperature Data Screen	This screen displays the *measured* liquid temperature, the *computed* liquid temperature, and the *measured* ambient temperature for each Site Station of a selected segment. This permits the operator to confirm the liquid volume expansion/contraction computation accuracy that is required for accurate leak detection.
Liquid Sonic Propagation Velocity (Vs) Screen	This screen displays the Sonic Propagation Velocities of both Site Stations bordering a selected segment. This is useful for checking liquid temperature measurement accuracy and identifying the liquid.
dVs/dt Screen	This screen shows the differential (rate of change) of Vs, the Sonic Propagation Velocity, of the liquid which is now in, and has recently passed, each Site Station of the selected Segment. This information is useful in determining Line Pack, Interface Passage and the pressure changes associated with catastrophic leak occurrence. It is also useful in Leak Location, in 990LD systems which incorporate that function.
Site Station Signal & Aeration Screen	The Site Station Diagnostic Screen displays the Signal Strength and Aeration of each Site Station of the selected Segment. The trend of this data permits operating staff to confirm proper operation of the Site Stations, as well as identify any non-homogeneous liquid condition inconsistent with the type of liquid being transported.
Segment Line Pack Screen	The Line Pack screen detects the presence of both Line Pack and Line Unpack, as well as the transition from one liquid type to another, as when an Interface passes either of the Site Stations of the selected Segment. It is useful to confirm the operation of the automatic Line Pack data conditioner, which prevents Line Pack from creating a false Leak Alarm.
Segment Pack Delta Screen	The Pack Delta screen shows the current volume of the Line Pack in each Segment during constant flow rate. During an acceleration or deceleration of flow rate, the screen shows the transient change in the value of line pack volume. In the event that a pipe bursts during this transient period, when the pipe may be undergoing the added pressure needed to accelerate liquid, a Leak Alarm will be announced if the added flow breaks a programmable Pack Delta threshold, visible on this screen.
Liquid Viscosity Screen	This screen shows the current computed viscosity, corrected for the current liquid temperature. It also shows the past viscosity trends of the liquids in the selected Segments Site Stations. If the 990LD is equipped with In-line viscometers, then the data shown is as measured.
Liquid Reynolds Number Screen	This screen shows the current computed Reynolds Number, and past trends, of the liquids passing through the selected Segments Site Stations. The Transition region between Turbulent and Laminar flow is indicated on the screen.

SECTION 4
SYSTEM 990LD INSTALLATION & START-UP

4.1 APPLICATION CONDITIONS & THEIR EFFECT ON PERFORMANCE

Every instrument is affected by the application conditions under which measurement is made. System 990LDs non-intrusive sensing principle is affected less than perhaps any other instrument in this regard. However, it is important for the user of System 990LD to understand what conditions can affect operation, to what extent, and what can be done to detect, and counteract, the presence of these conditions.

The performance specifications of System 990LD Clamp-on Transit-time flowmeters are given for nominal conditions. These call for:

- Full Pipe
- Homogeneous liquid conditions
- Minimal free gas, cavitation or aeration
- Reynolds Number outside of transition region
- Fully developed flow profile without crossflow
- Newtonian liquids

Controlotron's long experience in selection of the best installation sites is available to the user when Site Survey is conducted prior to installation. This is done by using Portable Clamp-on 990 flowmeters that enable the Controlotron Field Engineer to see into the pipe at all prospective Site Station locations to assess the internal conditions.

System 990LD contains a unique AppCon™ system, which uses the self diagnostic capability of the system to sense current application conditions. Automatic adjustment of the leak alarm data is implemented to avoid false leak detection alarms if there is a deterioration of application conditions. When System 990LD is first installed, leak detection thresholds are set for approximately twice the target values, and decreased as the Optimization process proceeds.

4.2 SITE SURVEY, TRAINING & OTHER PREPARATORY ACTIVITIES

Before either recommending or installing a 990LD System, trained Controlotron Field Engineers will have visited every prospective Site Station to determine the best possible installation location. This Site Survey also enables an estimate of the performance that can be achieved under the application conditions observed. Controlotron can then also recommend the most cost effective 990LD models needed to meet the users performance objectives.

Site Survey is accomplished with Portable 990 flowmeters, essentially identical to those that will be used in actual 990LD service. This gives User personnel an opportunity to become familiar with the 990LD Site Station equipment, and with the installation and operation of this equipment.

During Site Survey, all aspects of Site Station installation can be planned. This includes location of the 990LD Flow Computer and Communication equipment. All installation considerations, such as the location of power sources, etc, should be considered at this time. A review of the available User communication system is also recommended to assure fast and effective start-up of the communication link to the Master Station.

4.4.2 INITIAL SETTINGS

Master Stations are usually delivered with Leak Detection Warning and Alarm thresholds set somewhat above specified limits. This is done to prevent false alarms from developing until Preliminary Optimization is completed. At that time, operation at or close to final specification should be achieved. In cases of very difficult application conditions, final Alarm thresholds may not be determined until Final Optimization is completed.

4.4.3 PRELIMINARY OPTIMIZATION

As noted above, Master Stations may be installed and started before Preliminary Optimization data has been received. In such cases, or for Final Optimization, each Master Station archives each day of original Site Station data for up to eight days. This data can be transferred to Floppy Disk by Menu command. It is automatically named by the date, and Master Station registration number assigned to your Master Station, so that it can be stored in an Archived filing system.

Delivery of these data files to Controlotron will permit Preliminary Optimization, or Final Optimization at that point in the Installation sequence, if arrangements have been made for Controlotron Optimization responsibility. Those who wish to perform Optimization personally should obtain special Optimization training, available on appointment.

The process of Optimization is relatively simple, but benefits from prior experience. An outline of the phases of the process is presented in Section 6. However, it is the essential step in reduction of the Alarm Thresholds to the specified level, with minimum vulnerability to false alarm.

Optimization is not necessarily limited to two phases, Preliminary and Final. As more Archived data on actual pipeline operation is collected, it may be possible to improve system performance by further Optimization. The criteria is quite simple; Optimization enables reduction of the Alarm Threshold without proportional increase in the risk of False Alarm.

4.5 COMMUNICATION SYSTEM START-UP & CERTIFICATION

4.5.1 GENERAL

The 990LD Master Station uses data obtained from 990LD Site Stations distributed along the pipeline to determine whether or not liquid has been released. The Master Station's operating program acquires data by polling all Site Stations once per minute. The Master Station assures simultaneity of data reporting by first commanding all Site Stations to store a data report of flow and other conditions at a precise instant. Then, in a sequence partly determined by the nature of the communications facilities, this data is collected from each Site Station in turn. The Master Station uses the data to compute the Site Station information. It also archives the data collected to enable subsequent playback and optimization.

4.5.2. TYPES OF SERIAL COMMUNICATIONS NETWORKS SUPPORTED

The Master Station operating program can be configured to function over a wide variety of communications networks. These include radio modems, satellite networks, leased telephone lines, physical twisted pair lines owned by the customer and even dial-up. Each network type has unique characteristics. The operating program can exploit these characteristics to ensure that the communications link is used to maximum efficiency. The 990LD Master Station considers that it has permanent access to all Site Stations over the serial data link. The Master Station assumes that every message it issues is received by all Site Stations - whether it is addressed to them or not. Each Site Station has its own Network ID number. The Master Station includes this Network I.D. when it transmits commands. A Site Station will only respond to the Master Station when its Network I.D. matches the one contained in the Master Station message.

4.5.5 ACTIVATING THE NETWORK

Activating the 990LD Network is very simple. All Site Stations must be connected to the communications link. The Master Station modem should be similarly prepared. When the Master Station is turned on, the operating program will request the user to enter a password. After the password is entered, the Master Station begins its polling process. As previously mentioned, this sequence can be observed on the Trace Diagnostic Screen. After verifying that all stations have responded correctly, this screen is no longer useful for normal system operation. However, it is the only screen that allows the operator to examine the Valc and Status of each measurement path of a Site Station.

The Master Station only draws data traces when data exists. It is suggested that the 1 hour timebase be used on system initialization so that the data traces can be observed. As the traces build up, a longer timebase may be selected. If the Master Station is called in the middle of the day (between midnights), and an archived file exists for the earlier part of the day, the program will read this archive and fill in the day. In this way a coherent screen will be available even though Master Station operation may have been interrupted.

5.1.2.1 Display Select

This command presents the display screen selection menu (figure 5-1b). Move the cursor to the desired display screen, then press <ENTER>. The MS program will draw the selected display screen.

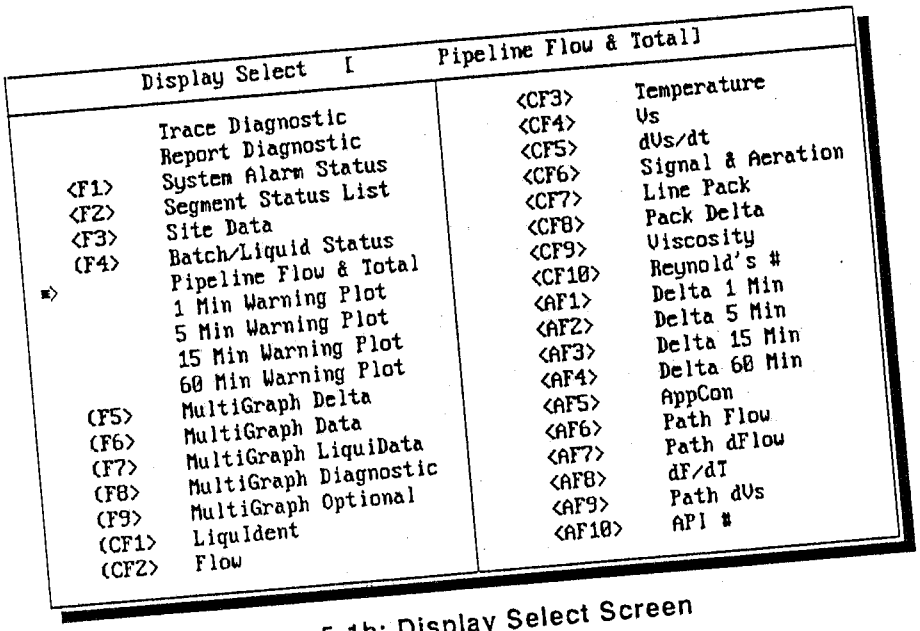


Figure 5-1b: Display Select Screen

5.1.2.2 X-Axis Select

This command selects the time resolution of the system screens (figure 5-1c). Current parameters are displayed in brackets next to the command. Selecting a longer timebase enables the user to observe earlier events. The Master Station only allows 'back scrolling' when it is operated in the Optimization mode. Since archived data files are stored as 24-hour blocks, the X-Axis Select should be set to 24-Hours, unless a more more recent event is of interest and greater detail is desired. Changing the system time-base does not permanently affect the amount of data to which the user has access.

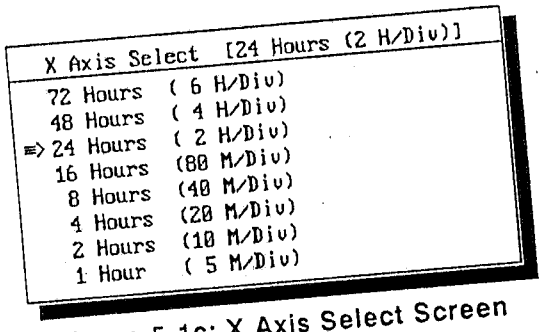


Figure 5-1c: X Axis Select Screen

5.1.2.3 Pipe Select *{If Applicable}*

This menu item will only appear if System 990LD is used on an application with more than one pipeline. It enables the selection of a pipeline for the screen display. The 990LD system always monitors every Segment of all pipelines. However, only the user-selected pipe and Segment data are displayed on the system screens. Of course the System Alarm Status screen always shows the current overall status of all pipes and Segments in the system. Note that this selection can also be conveniently made by using the cursor on the System Alarm Status <F1> screen.

primary responsibility operators with appropriate training. Menu items that alter the operating state of the Master Station possess password protection. Note that passwords are case-sensitive.
Mouse Control: This sub-menu is used to set the mouse horizontal and vertical resolution and button-click timing parameters.

5.1.2.8 Extract Archive Data

This item (Figure 5-1g) permits the user to download archived data files of the past seven days onto floppy disk for long-term storage or off-line analysis. These files contain application specific data including the liquid characteristics. Note that the first six digits of the topology file reflects the date of the archive. These files are stored in a compressed format to preserve storage space. A file expansion utility, NETCH.EXE, is provided to expand these files into a ASCII format for review. Since the Master Station only reserves eight archived files for such data, it is recommended that the system be archived on a weekly basis.

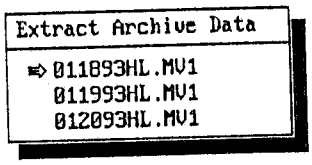


Figure 5-1h: Extract Archive Data Screen

5.1.2.9 Import Topology File

This item instructs the Master Station to look on the system floppy disk for an appropriately named topology file to upload. The data on this file will immediately replace the current system topology parameters. The system optimizer must be sure that this topology file is appropriate for the application, since it is not possible to exhaustively check for all possible error conditions.

5.1.2.10 Communications Setup

This item (Figure 5-1h) provides access to certain serial communications parameters. These should only be altered upon consultation with Controlotron engineering or the optimization team. Details concerning these items are available through the help screen.

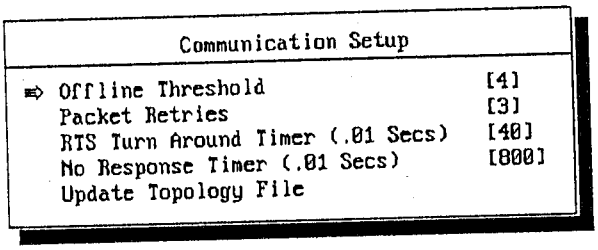


Figure 5-1i: Communication Setup Screen

5.1.2.11 Data Report Setup

This menu item (Figure 5-1i) commands the Master Station to output formatted ASCII data reports to its COM3 serial port, once per minute. A sub-menu allows selection of data formats.

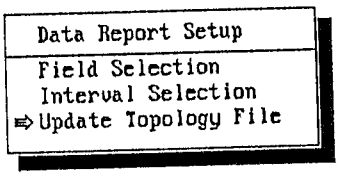


Figure 5-1j: Data Report Setup Screen

5.2 OVERVIEW OF SYSTEM 990LD OPERATION

As noted in Section 3 and with reference to Figure 5-2, the Master Station acquires time correlated Site Station digital flow and temperature data via the 990LD communication system once per minute. The Master Station processes this data to establish the possibility of a leak event from any Segment of the pipeline. the Master Station provides also other functions, such as Interface Detection and Batch Tracking.

Each Site Station forms one end of a pipeline Segment. Each Segment is bounded by an adjacent Site Station. Therefore, all Site Stations, except for the first and last, participate in monitoring flow in two pipeline Segments.

The system uses Volume Balance as the basic means of detecting a leak. The Master Station computes the Volume Balance using the difference in the volume entering and leaving the pipeline. Computation of the Site Station data occurs once per minute. Compensation is made for variations in volume due to liquid expansion or contraction caused by temperature changes in a pipeline Segment.

Each one minute difference in Segment volume is called the *one minute delta*. Three additional time integration registers receive this data. They operate on a rolling average basis of 5 Minutes, 15 Minutes and 60 Minutes. Shorter time integration periods show large leaks very quickly. Longer periods show smaller leaks before they become excessive. Each integration period has its own Alarm Threshold. This determines the leak volume that will trigger the audible and visible alerts.

Before the Master Station issues the *1 minute delta*, it must be corrected for two factors. One is the expansion or contraction of the liquid due to temperature changes (as mentioned previously). The second is the *line pack* effect. This produces a temporary difference in flow rate at the two Site Stations bordering a Segment whenever the pipeline flow rate increases or decreases.

Calculation of the liquid expansion or contraction within a pipeline Segment requires knowledge of the type of liquid flowing and temperature changes at all points within Segment. Since a Segment can often be over 25 miles long, it is physically and economically infeasible to measure the actual temperature at all of its points. Therefore it is necessary to compute this Temperature Profile - ideally for as many as 100 individual points along the Segment. This is computed once per minute from the ambient and liquid temperature measured at the Site Stations, and from the liquid flow rate.

Liquid type identifcation, LiquIdent™, is accomplished within each Segment by Site Station monitoring of the sonic propagation velocity (Vs), and temperature of the liquid entering each Segment. These two parameters define the liquid's *Sonic signature*. Site Stations report the liquid's *Sonic signature* to the Master Station, which positively identifies the liquid type currently flowing through each pipeline Segment. The Master Station includes data on the class of liquids flowing in the pipeline. Its topology file contains the identified liquid's physical parameters, such as Density and Viscosity. The Master Station corrects the parameters for temperature variables, and then downloads the data into its computation registers.

The Segment temperature profile is calculated once per minute using a Thermal Model of the Segment. This model incorporates the Master Station thermodynamic equations to compute the increase or decrease of temperature of the flowing liquid. The equations of this model require only that we know the temperature of the liquid entering and leaving the Segment, plus the measured temperature of the *ambient* at each Site Station, either air, water or soil. The Model uses the topological description of each Segment, i.e., the distance that it travels in air, water or soil. This data was stored in the Master Station's topological file at the time of system's manufacture.

The screens selected from the Display Select menu (including *Hot Key* codes):

Fn:	
F1 .... System Alarm Status	F6 ..... MultiGraph Data
F2 .... Segment Status List	F7 ..... MultiGraph LiquiData
F3 .... Site Data	F8 ..... MultiGraph Diagnostic
F4 .... Batch/Liquid Status	F9 ..... MultiGraph Optional
F5 .... MultiGraph Delta	F10 .... Print Screen (not listed on screen)
Ctrl + *Fn:*	
CF1 .. LiquIdent	CF6 ... Signal & Aeration
CF2 .. Flow	CF7 ... Segment Line Pack
CF3 .. Temperature	CF8 ... Segment Pack Delta
CF4 .. Vs	CF9 ... Liquid Viscosity
CF5 .. dVs/dt	CF10 .. Reynold's #
Alt + *Fn:*	
AF1 .. Delta 1 Minute	AF6 .... Path Flow
AF2 .. Delta 5 Minute	AF7 .... Path dFlowl
AF3 .. Delta 15 Minute	AF8 .... dFlow/dT
AF4 .. Delta 60 Minute	AF9 .... Path dVs
AF5 .. AppCon™	AF10 ... API #

Display Select Screens selected by cursor placement only:

⇒ + <Enter>	
Trace Diagnostic	1 Min Warning Plot
Report Diagnostic	5 Min Warning Plot
Pipeline Flow & Total	15 Min Warning Plot
	60 Min Warning Plot

The following sections provide illustrations and descriptions of these screens. Note that each screen can have any time base or allowable data scale assigned by the operator via the System Menu. When data is viewed on a 990LD Optimizer Computer, a Review mode is offered that permits scrolling back and forth in time. In Review mode, the system optimizer can utilize the various analytical computation tools provided.

5.3.1 SYSTEM ALARM SCREEN - *Hot Key F1*

It is recommended that, upon receiving an audible or visual Warning or Alarm, the operator view this screen as first. It instantly shows (by their display color) which pipeline's Segment(s) are responsible for the Alert. A Yellow (Warning), or Flashing Red (Alarm) will replace the normal Green color. *Anti-leak* is shown in Blue. If any of the Site Stations that border the Segment are in Fault, they will be displayed in Red, rather than the normal Green color.

Under one of the Segment's graphic is a movable Cursor, whose position is controlled by the Master Station keyboard Arrow Keys. The Operator moves the Cursor under any Segment of interest. This conditions the Hot Keys to assign its Screen to show data for the selected Segment, or its bordering Site Stations. Thus the operator can quickly identify any Segment which may be in a suspect Leak condition, and quickly view data to confirm or reject the suspicion.

5.3.3 SITE DATA SCREEN - *Hot Key F3*

This screen shows the current data sent from each of the selected Segment's Site Stations. This data includes Site Station Alarm conditions to confirm the validity of the data being sent to the Master Station. In the event of a Warning or Alarm, this screen should be viewed after the F2 Segment Status Screen to determine the validity of the alert. In particular, view the Site Station diagnostic Alarm codes. This screen also shows data relative to the communication system.

```
Controlotron 990LD     Segment : BRR-MTF <F3> Site Data

                    Site Data Input
BRR           SITE ID           MTF           SITE ID
10.15.92      DATE              10.15.92      DATE
08.57         TIME              08.57         TIME
-0.8205       KBLL3/H           -0.9375       KBBL3/H
1398.78       VS(M/S)           1443.95       VS(M/S)
72            S                 79            S
2             A                 1             A
----------    ALARMS            ----------    ALARMS
110.8         F (Liquid)        91.8          F (Liquid)
73.6               F (Ambient)        78.1          F (Ambient)

                    Processed Data
-782.9862     Flow (BBL/H)      -799.2584     Flow (BBL/H)
1513.1        Liquldent         1510.9        Liquldent
48.72         Viscosity (Cs)    81.88         Viscosity (Cs)
3313          Reynold's #       1773          Reynold's #

BRR           Id:01 TX:0 RX:538 NAK:0 TO:0 PF:0
MTF           Id:02 TX:0 RX:538 NAK:0 TO:0 PF:0
                                                      Pause
```

Figure 5-5: Site Station Data Screen

5.3.4 BATCH/LIQUID STATUS SCREEN - *Hot Key F4*

This screen is optional and is not provided on all 990LD systems. When provided, it shows the location of the leading interface of each different Batch of liquid currently in the pipeline. It also shows the estimated time of arrival (ETA) of the leading interface at the next Site Station. Some 990LD models identify the liquid Batch number and the Batch volume, in Standard Barrels.

```
Controlotron 990LD     : <F4> Batch/Liquid Tracking

Pipeline: MVP                Date/Time: 08.27.92 02.43

Batch Liquid      Start                          BBL Minutes  To
0019  DOMSWT      08.27.92  00.28       16910.45       913  PVR
0018  CSTLMIX     08.27.92  00.18        1255.86       903  PVR
0017  NIGRIAN     08.26.92  20.07       32259.49       643  PVR
0016  CSTLMIX     08.26.92  19.58        1173.22       634  PVR
0015  DOMSWT      08.26.92  05.48      108082.50         0  PVR
0014  CSTLMIX     08.26.92  05.25        2945.43       958  LIM
0013  NIGRIAN     08.26.92  01.30       29917.16       717  LIM
0012  CSTLMIX     08.26.92  00.05       10852.30       630  LIM
0011  DOMSWT      08.25.92  14.29       73099.49        42  LIM
0010  CSTLMIX     08.25.92  14.19        1271.58        31  LIM
0009  NIGRIAN     08.25.92  14.12         897.07        24  LIM
0008  EXTSOUR     08.25.92  10.17       29883.17         0  LIM
```

Figure 5-6: Batch/Liquid Status Screen

5.3.6 REALEAK™ SCREEN

The Display Select menu 1, 5, 15 or 60 Min Warning Plot shows a scatter plot of any user selected data, such as LiquIdent™ or flow acceleration, etc., versus the 1, 5, 15 or 60 minute Delta data. It should be used in cases where the Leak Alert, declared by anyof the Delta Integration periods, is not definitive enough for the operator to determine if the leak alert is real or false. The scatter plot emphasizes all Alarm data points so that the operator can see if they correlate with any clearly non-leak event, such as the arrival of a liquid Interface, or any other reported data condition.

If there is a correlation of the "leak" event with a specific value of the selected data, the user can determine if this is the cause of the alert. If a non-leak event correlates with the alert, it is less likely that the alert is caused by a true leak. Conversely, failing to find any correlation makes it more likely that the reported Leak Alert is real. Thus fast action to remedy the reported leak can be taken with confidence that it is a real condition. In the event that the alert is deemed to be false, the ReaLeak™ screen identifies the application condition responsible, and makes it simpler to Optimize the system to minimize or prevent the reoccurrence of false alerts in the future.

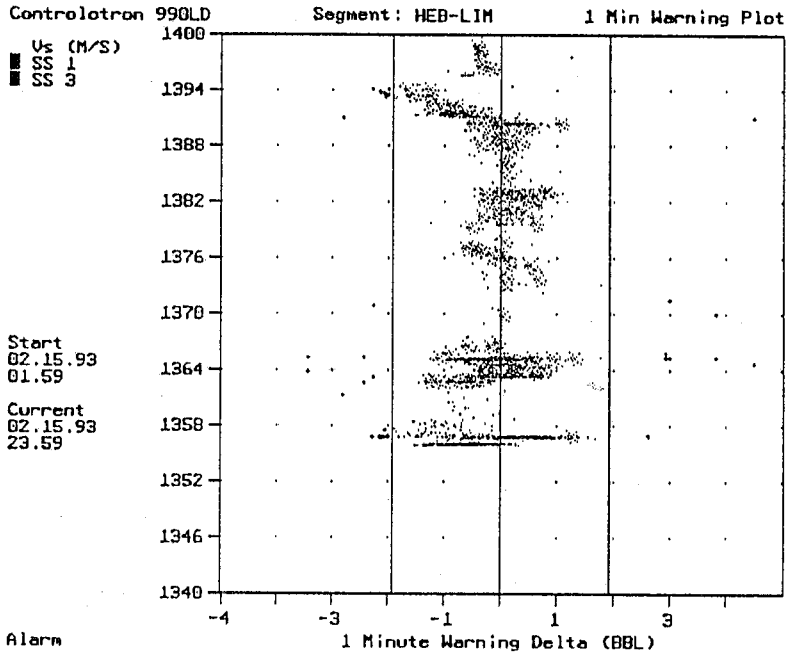


Figure 5-8: ReaLeak™ Scatter Plot

5.3.7 MULTIGRAPH DATA SCREEN - *Hot Key F6*

This MultiGraph™ screen is primarily used to determine the validity of an Alert condition. It simultaneously shows the current value, and past trends, of these four parameter categories:

- Flow Rate for both of the selected Segment's Site Stations
- The Segment's 1 Minute Delta
- The LiquIdent™ data for each of the Segment's Site Stations
- The Measured and Computed Liquid temperature, and the measured Ambient temperature for each of the Segment's Site Stations.

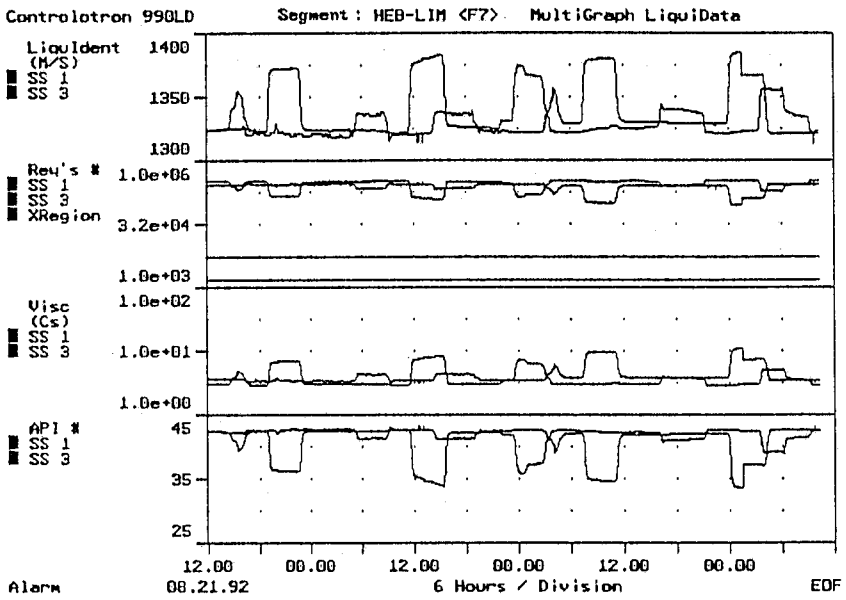


Figure 5-10: MultiGraph LiquiData Screen

5.3.9 MULTIGRAPH DIAGNOSTIC SCREEN - *Hot Key F8*

This MultiGraph screen shows the time correlated data relevant to the current and past condition of the selected Segment's Site Stations. This data includes:

- Path dFlow (Flow Difference Data), i.e., the difference in reported flow rates for each of the two individual paths. This is provided only for Dual Beam 990LD Site Stations. This is useful in confirming proper Site Station flow detection, and also in identifying adverse Site Station flow profile conditions.
- Path dVs (Sonic Velocity (Vs) Difference), i.e., the difference in liquid Sonic Propagation Velocity, as measured by each individual path of a Dual Beam 990LD Site Station. This is provided only for Dual Beam Site Stations. Conformance of both path's Vs is indicative of proper Site Station set-up and operation, and good liquid homogeneity.
- Signal and Aeration, showing viscosity related signal strength and homogeneity related "Aeration" level at each of the selected Segment's Site Stations. Low signal, or high aeration levels indicate need to investigate conditions at the identified Site Station, which have a bearing on the validity of a leak Alarm condition. Use the Trace Diagnostic screen to determine which path is responsible for signal quality deterioration.
- Line Pack. This signal identifies the existence of either a Line Pack (Magenta) or Line Unpack (Blue). Line Pack detection prevents current Leak data from triggering false 1 Minute Delta integration period alarms. It also prevents corruption of the 5, 15 and 60 minute integration period Warning and Alarm registers.

5.3.11 LIQUIDENT SCREEN - *Hot Key CNTRL F1*

LiquIdent™ is defined as the numeric value of a liquid's sonic propagation velocity (Vs) at a reference temperature of 60°F. This single display screen shows the current value and past trends of the selected Segment's Site Station LiquIdent™ value. This value is used in identifying the liquid in, or previously in, the Site Stations. The defined liquid's physical properties are then used for various purposes, such as density and viscosity determination, Line Pack Volume Computation, Thermal Compensation and Custody Transfer, where provided. It also helps in identifying the presence of spurious liquids, such as water.

LiquIdent™ also helps mark the exact time at which an Interface passes a Site Station. It is also essential for Batch Tracking. To assure accuracy, LiquIdent is compensated for either inferred or measured line pressure.

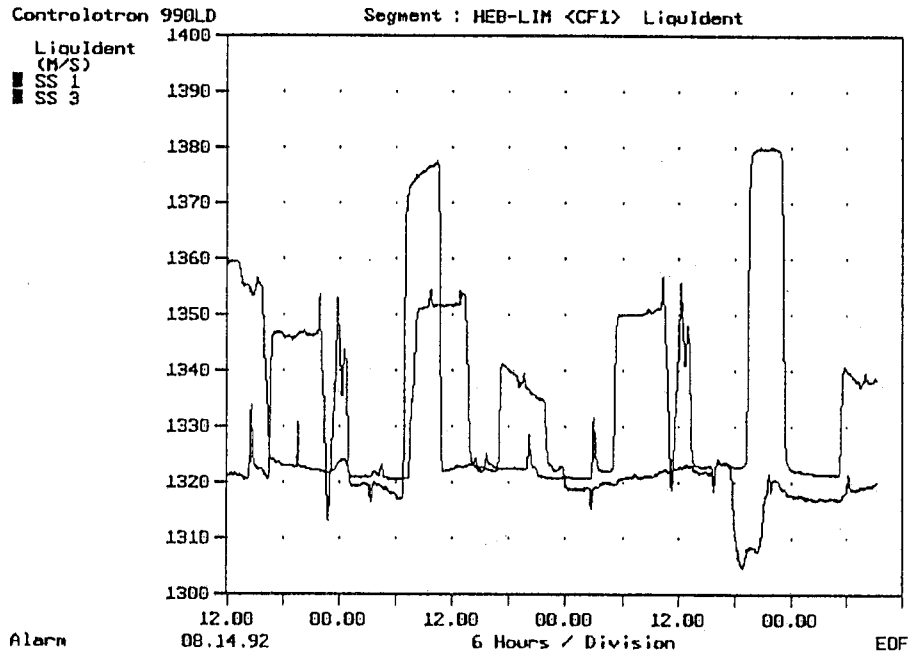


Figure 5-13: LiquIdent™ Screen

5.3.14 Vs *(sonic velocity)* SCREEN - *Hot Key CNTRL F4*

This single display screen shows the current and prior sonic propagation velocities (Vs) for the selected Segment's Site Stations. While the LiquIdent™ screen is more useful in determining liquid properties, Vs may be of interest from time to time, especially in determining that the Site Stations are reporting this basic information accurately.

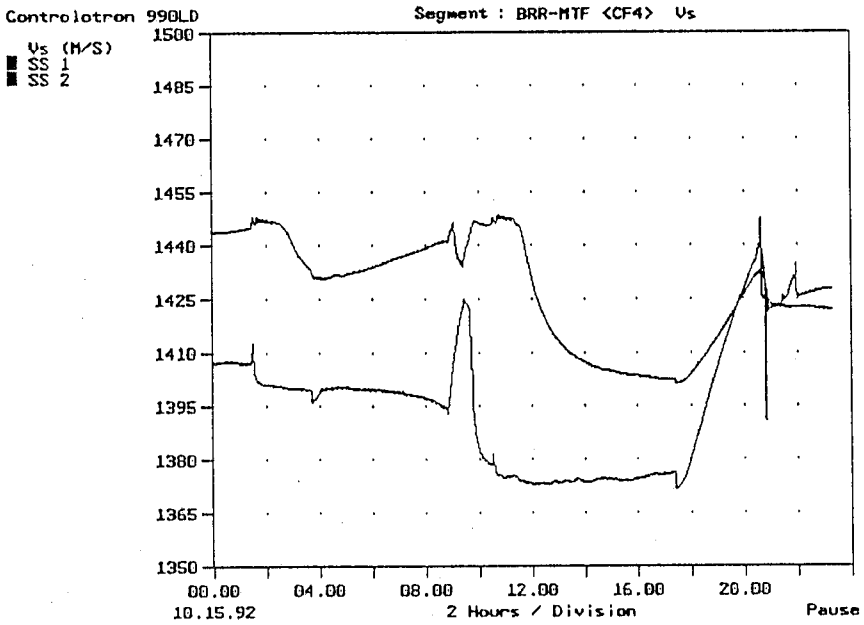


Figure 5-16: Vs Screen

5.3.15 dVs/dt - *Hot Key CNTRL F5 (Sonic Velocity Differential)*

This Single Display screen shows the time differential of Vs, the Sonic Propagation Velocity of the liquids in the selected Segment's Site Stations. This information may be useful, in some cases, in determining the possible location of a catastrophic rupture in a pipeline. This parameter is a sensitive indicator of pump and valve manipulations. Also, the peak values of dVs/dt during liquid interfaces generally correspond to the "middle" of the interface, when Vs is changing rapidly.

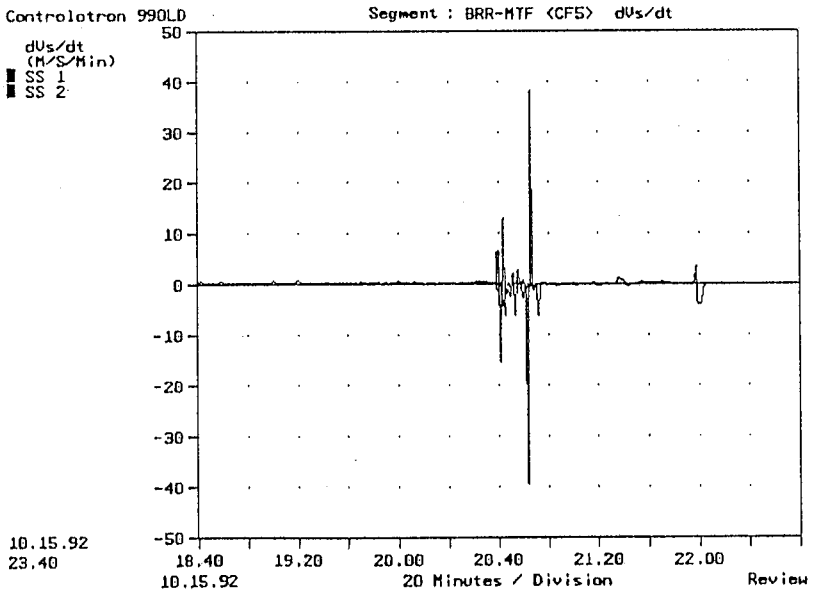


Figure 5-17: dVs/dt Screen

5.3.18 PACK DELTA SCREEN - *Hot Key CNTRL F8*
This single display screen shows the current volume of liquid that is packed into the selected Segment at the current flow rate. When the flow rate is changing, as indicated by a Line Pack or Unpack per the CF7 screen, the Pack Delta screen will dynamically show the change in the amount of liquid packed into the Segment.

In addition, Pack Delta integrates the volume of liquid being packed. If this volume exceeds the established normal value for any given flow rate, exceeding the screen's visible Alarm Threshold, the Leak Alarm will be triggered. Thus the Pack Delta screen serves to detect catastrophic leaks that could occur when pumps are first turned on.

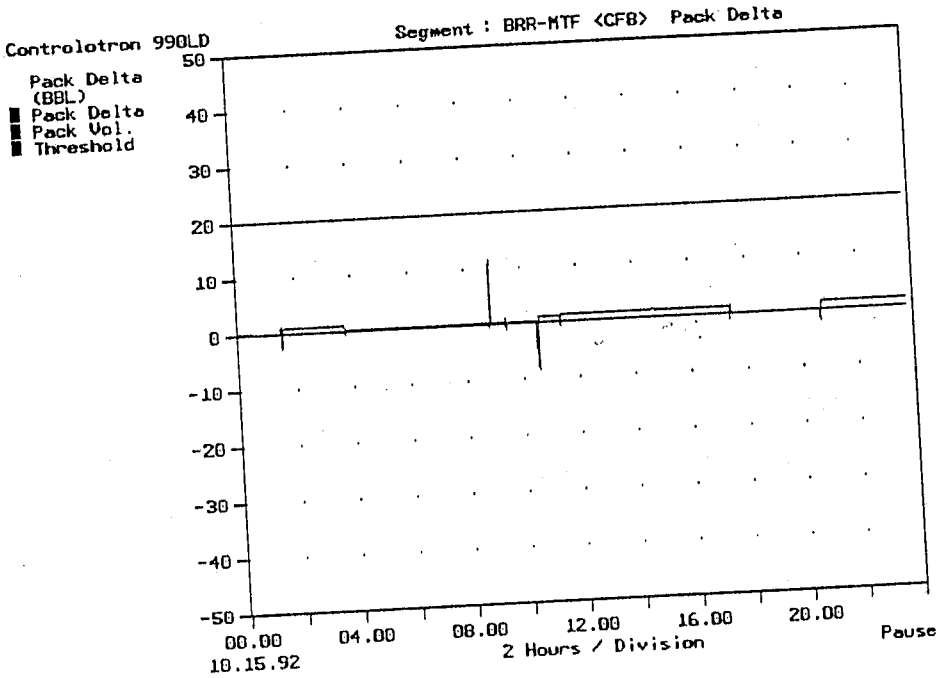


Figure 5-20: Pack Delta Screen

5.3.19 VISCOSITY SCREEN - *Hot Key CNTRL F9*
This single display screen shows the current and past viscosity values of the liquids that are now at each Site Station. The viscosity is derived from data in the Master Station topology file, for the current LiquIdent™ value (corrected for the liquid temperature when the data was recorded).

In the event that the system is equipped with an In-line Viscometer, the values shown will be as derived from that instrument.

5.3.21 INDIVIDUAL DELTA SCREENS - *Hot Keys ALT F1 to F4*
Viewing the individual Integration Period Deltas on their individual display screens, as opposed to the MultiGraph (Hot Key F4) screen, permits greater display resolution than available on the MultiGraph Delta screen.

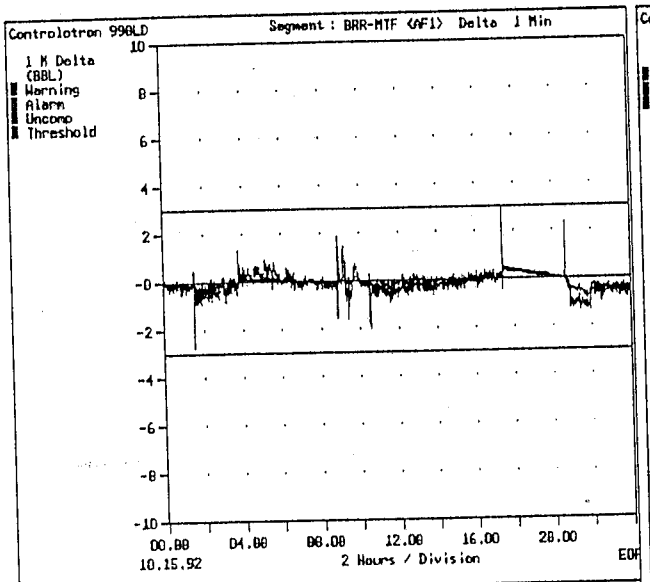


Figure 5-23a: Delta 1 Min [ALT-F1]

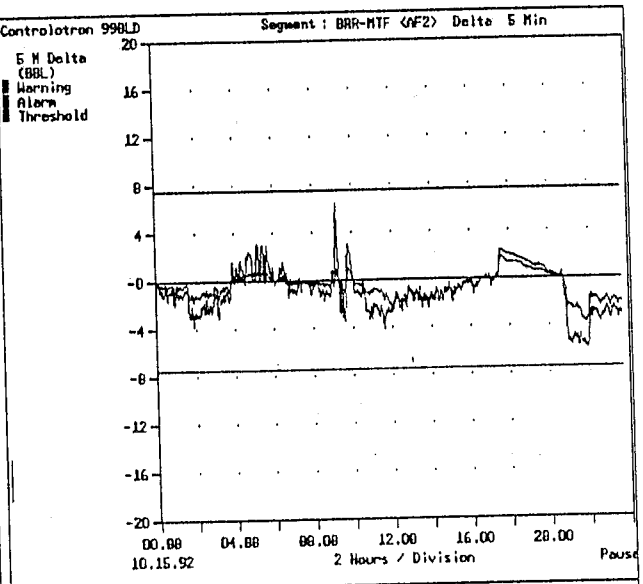


Figure 5-23b: Delta 5 Min [ALT-F2]

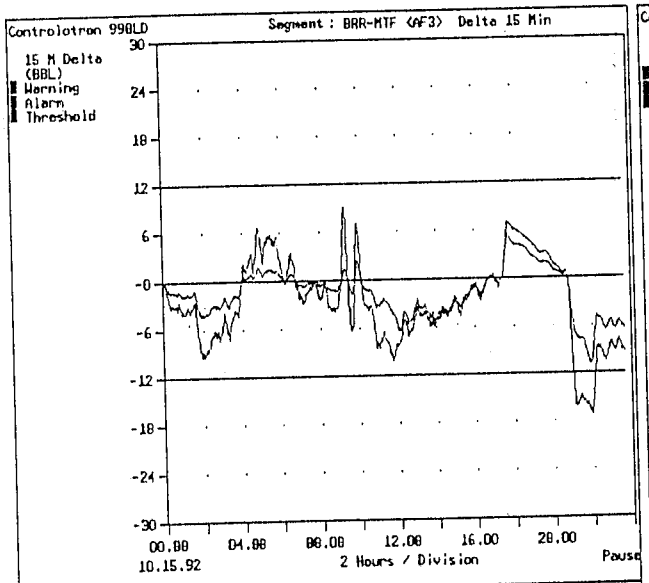


Figure 5-23c: Delta 15 Min [ALT-F3]

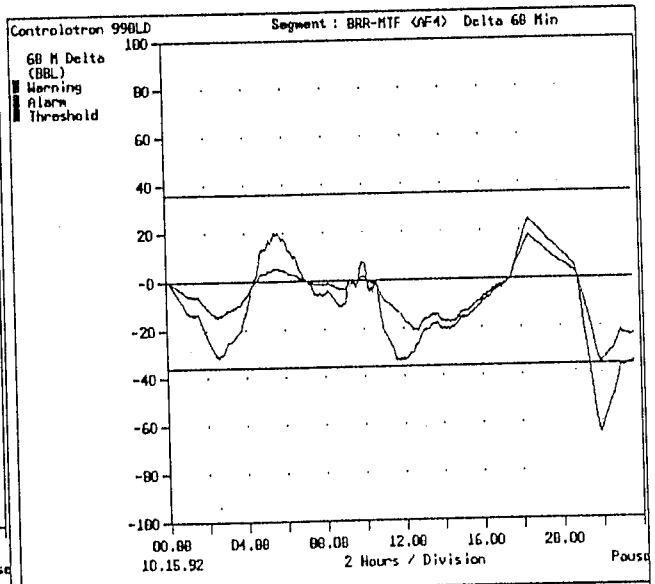


Figure 5-23d: Delta 60 Min [ALT-F4]

5.3.23 PATH FLOW SCREEN - *Hot Key ALT F6*
This single display screen shows the flow rate of the each of the two paths of both of the selected Segment's Site Stations. This information is useful in detecting any condition which affects the flow profile. It also indicates any Site Station flow detection abnormality. Note that Path Flow data is not subject to either Master Station Zero control, Kc Slope correction, or Flow Profile (Reynold's number) correction.

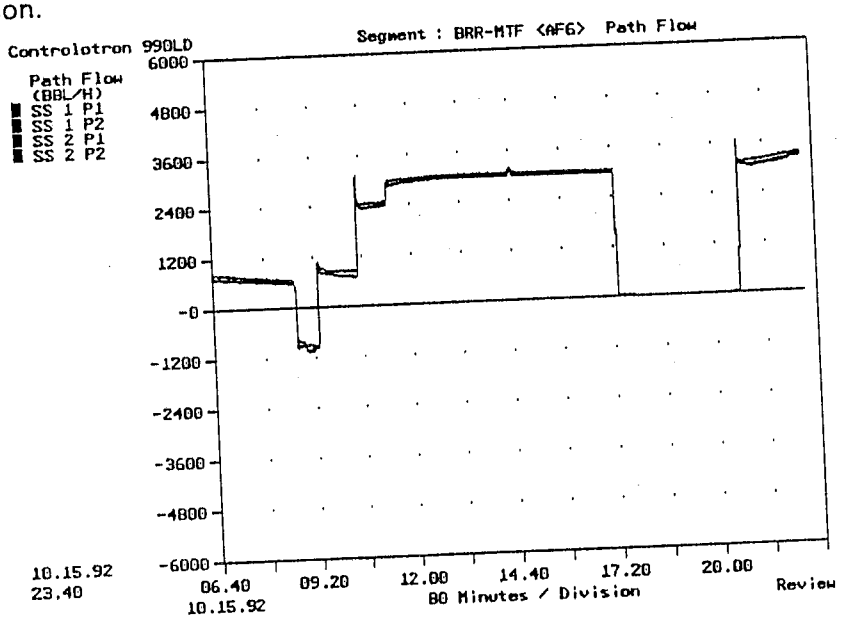


Figure 5-25: Path Flow Screen

5.3.24 PATH dVS *(flow rate differential)* **SCREEN** - *Hot Key ALT F7*
This single display screen shows the difference in flow rate of the two paths of each of the selected Segment's Site Stations. This screen can be expanded to show small differences in path flow, which are usually due to flow profile distortion. This screen serves the same purpose as that of Path Flow, per Figure 5-25, with the convenience that the screen scaling will not have to change with each change in absolute flow rate.

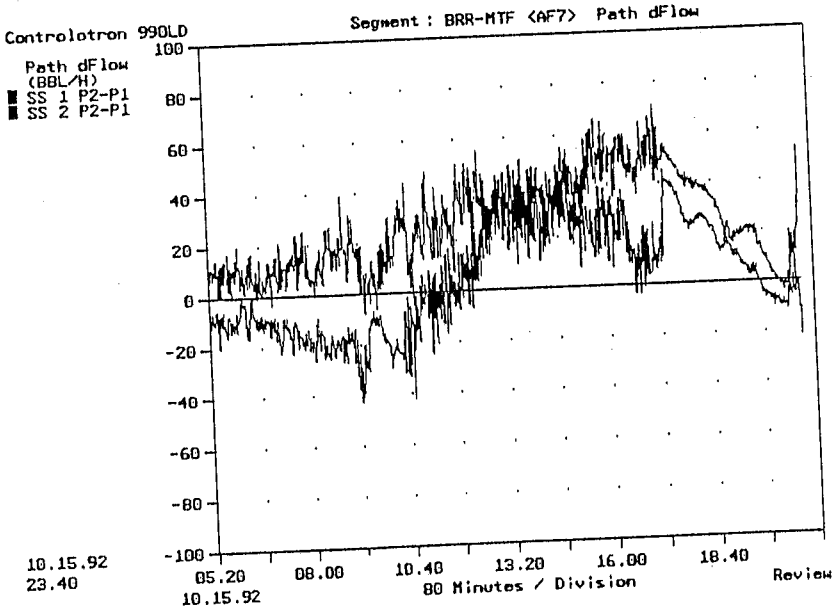


Figure 5-26: Path dFlow Screen

5.3.27 TRACE DIAGNOSTIC SCREEN - *No Hot Key - (Menu Access)*

This screen shows the incoming data for the selected Segment's Site Stations. This screen is used to confirm the condition of the 990LD communication system, and to view a Dual Beam's individual path Signal data.

```
01.29.93 11.07 0100 Sys Stop
/H  29.916    KBBL 3   1407.57  1406.64 1407.11 VS(M/S) 71 73 72 S 2 A
--------- --------- --------- 105.1   69.6 F
MTF       10.15.92 00.01  0.6875  KBBL 3/H 0.6961 0.6758 0.6859 KBBL 3/H 3
2.557     KBBL 3   1439.67  1447.89  1443.78 VS(M/S) 79 79 79   S 2 A -----
--------- --------- --------- 89.1   69.7 F
BBR       10.15.92 00.02  0.6296  KBBL 3/H 0.6274 0.6451 0.6393  KBBL 3/H 29
.927     KBBL 3   1407.38  1406.40  1406.89 VS(M/S) 71 73 72  S  1 A -----
--------- --------- --------- 105.1   69.6 F
MTF       10.15.92 00.02  0.6971  KBBL 3/H 0.6853 0.6637 0.6745  KBBL 3/H 3
2.568     KBBL 3   1439.61  1447.84  1443.72 VS(M/S) 79 79 79   S 1 A -----
                                                                    Pause
```

Figure 5-29: Trace Diagnostic Screen

5.3.28 REPORT DIAGNOSTIC SCREEN - *No Hot Key - (Menu Access)*

The Report Diagnostic Screen shows Segment Diagnostic Data that is sent from the Master Station's Auxiliary port to a user SCADA system, etc..

```
                    Controlotron 990LD          Report Diagnostic

10.18.93 02.57 MTF-BBR   -0.014   -0.011      1.500 BBL  84 AC --------


                                                                Pause
```

Figure 5-30: Report Diagnostic Screen

5.3.29 PIPELINE FLOW & TOTAL SCREEN - *No Hot Key - (Menu Access)*

The Pipeline Flow & Total Screen shows the Segment Flow rate at the time of the report request and the flow total of the previous 24 hours.

```
                    Controlotron  990LD          Pipeline Flow & Total

Pipeline: Pipe 2              Date/Time:  02.19.93 00.33

                          Flow        Day Total
Site:                     BBL/H           BBL
BBR                     22.8841            12
MTF                    -72.7614           -41



Alarm                                                           Pause
```

Figure 5-31: Pipeline Flow & Total Screen

5.6 DATA ARCHIVING & INTER-COMPUTER COMMUNICATION

All Site Station data, and the Audit Trail noted in Para. 5.4, is automatically archived, and will be retained on the System 990LD Hard Disk for a period of eight days. It is recommended that responsibility be assigned for transfer of such data to the User data archives for permanent storage. Provision for automatic transfer of such data to the User's Main Computer can be provided, but at the cost of some processing speed.

5.7 CREATING OPTIMIZATION DATA FILES

As noted previously, each System 990LD contains a topology file that has been set up to provide the Master Station with a description of each pipeline Segment. Included is its length, the type of terrain it passes through, i.e., air, soil or water, and the estimated thermal parameters that determine the exchange of heat with the environment. This is especially important in long pipelines. These parameters determine the computation of the expansion and contraction of liquid needed to detect very small leaks.

There are differences in the actual thermal parameters between pipelines, and even between different Segments on the same pipeline. For that reason it might be noted that Segment Volume Balance, (Delta), variations may not always precisely represent actual conditions. This could lead to possible false alarms, or failure to detect small leaks, if not corrected. However, these events contain the information needed to Optimize the topology file parameters. Upgrading these parameters results in improvement of System 990LD leak detection sensitivity and accuracy.

The process of upgrading the topology file parameters is called Optimization. It is not done on the Master Station, which must always remain "on-line". It is done at a separate computer called an Optimizer. This is a PC of designated capacity that is loaded with a special Controlotron Optimization program. This makes control of the topology file parameters available to authorized personnel. It "plays back" Archived data to determine how much Optimized Topology parameters have improved System 990LD performance.

Controlotron provides an Optimization service, which is recommended for Users who have only recently begun to utilize System 990LD. Since Optimization is a specialized and skilled activity, it is recommended that Users who wish to perform their own Optimization utilize available Controlotron Optimization training courses to qualify their staff for this purpose. A video providing an introduction to this process is available.

Fortunately, System 990LD does not need to increase leak detection thresholds to accommodate for the most adverse application conditions. Rather, System 990LD has Leak Detection thresholds for its 1, 5, 15 and 60 minute integration periods that are set dependent on the normal flow rate, segment volume and normal application conditions, as determined at Site Survey. This is because System 990LD has a means of detecting the Site Station application conditions and uses the related AppCon™ factor to adjust the leak detection sensitivity only when conditions deteriorate. This preserves the best sensitivity during normal conditions, and minimizes or prevents false alarms only if application conditions deteriorate.

6.2 Site Station Optimization

Site Station Optimization is the process of ensuring that the data provided to the Master Station by the Site Stations is in itself as free of aberration as possible. Among factors that are controllable at the Site Station are:

- Optimal Transducer Installation
- Correct calibration at Zero flow
- Correct Site Station flow calibration
- Correct indication of Sonic Propagation Velocity, Vs
- Correct Sonic Propagation Velocity range
- Correct Site Station Registration
- Proper location & calibration of Temperature sensors

Most of these factors can be Optimized at the Master Station on a temporary basis, until it is convenient to visit a Site Station to Optimize its operating parameters, if needed.

6.3 Master Station Optimization

The Master Station has provision for Optimization of the following parameters:

- Site Station Zero flow calibration
- Segment's Site Station flow calibration ratio
- Segment Sonic Propagation Velocity ratio
- Segment Thermal Model Parameters

In addition, by the use of the off-line Optimization program, Optimization of the following factors may be implemented:

- Thermal Model Parameters
- AppCon Factors
- Absolute Pipeline flow calibration (for Custody Transfer models)
- Segment Flow Calibration Balance
- Site Station Zero Setting
- Sonic Propagation Velocity Normalization
- Site Specific Reynold's Compensation

SECTION 7
990LD MAINTENANCE

System 990LD, like any instrument on which critical dependence is placed, must be observed to determine its condition on a regular basis. This assures that no event has taken place that would affect its operation. For this purpose, each Site Station has a Diagnostic Menu, accessible via its 995T hand-held terminal, to report on its current condition. Some of this information is available over the 990LD communication system, and is visible on the Master Station screen. A Fault Alarm in any Site Station will cause the Segment Status Alarm screen to show that Site Station symbol in Red. However the user is instructed to be alert to other indications that the 990LD system is not performing in a normal way, such as the failure to provide fresh data reports once per minute.

Controlotron provides instruction in all aspects of System 990LD Operation Evaluation, Diagnosis, and Maintenance procedures. It is expected that the User will assign responsible staff for various functions, such as System Operation and Maintenance, and arrange for their attendance at Controlotron In-house or Field training exercises.

7.1 SITE STATION DIAGNOSTIC MENU & MAINTENANCE

990LD Site Stations are among the most reliable of all flow and temperature sensing instruments since they have no moving parts, and contain circuits that are primarily digital in design. However, it is, as is any instrument, subject to failure of an electronic component, or damage to the flow or temperature transducers by internal or external influences. Therefore it is important to periodically monitor the condition of each Site Station.

Fortunately, it is not necessary to visit the sometimes remote location of a Site Station to examine its condition. Most of the Site Station's diagnostic parameters are reported to the Master Station once per minute via the 990LD communication network. This makes it a relatively simple matter to diagnose its condition. Simple training sessions are available, either at Controlotron's facility, or in the field, in all aspects of Diagnosis and Maintenance.

Maintenance of System 990LD Site Stations is much simpler than any conventional intrusive flowmeter. This is because it is never necessary to stop flow, or open the pipe, to service this instrument. In addition, all computer modules are of interchangeable plug-in design. Both Flow and Temperature transducers are of Clamp-on construction, and may be quickly replaced if necessary. Very little skill is needed in finding and replacing any defective module. This is based on either the Diagnostic menu indications, or by the very quick "sequential interchange" method.

It is recommended that, rather than maintain individual spare parts, one spare operational Site Station be maintained in your instrument maintenance facility. As such, it permits staff training, and the testing of modules obtained from a defective Site Station to determine their condition. In addition, users may obtain a Portable Clamp-on 990LD Site Station. This may be used to confirm the condition of a suspected defective Site Station, or to temporarily maintain operation of the system during maintenance.

7.3.2 SPECIAL CONSIDERATIONS

Certain network configurations such as satellite links and dial-up facilities present special debugging problems that are beyond the scope of this manual. Data communications networks provided by the customer or contractees cannot be altered or repaired by Controlotron staff. Of course, networks that are part of turnkey systems are fully installed, set-up, commissioned and maintained by Controlotron.

INDEX

TEXACO REFINING & MARKETING INC.
PUGET SOUND PLANT
ANACORTES, WASHINGTON

PLANT 22 – WHARF
LEAK DETECTION SYSTEM
BLOCK DIAGRAM

INITIALS	DATE	SCALE
		NONE
DWN. BY DEH	10/3/94	CAD FILE NO. 220J0015
CKD. BY TML		DRAWING NUMBER
CHK'. ENGR.		

REVISIONS						
DESCRIPTION	BY	DATE	APPROVED BY	DATE	SYMBOL	
ISSUED FOR CONSTRUCTION	DEH	10/3/94				
AS-BUILT LEAK DETECTION EQUIP.	DEH	7/31/95				1

JOB			
ESTIMATE	B.M.		
PSP543			
PSP543			

APPROVED		
BY	DATE	
JAC	8/2/95	
JAG		

22–DJ–34 | 1

THIS DRAWING HAS NOT BEEN PUBLISHED. IT IS THE SOLE PROPERTY OF TEXACO REFINING AND MARKETING INC. IT IS LENT TO THE RECIPIENT FOR HIS CONFIDENTIAL USE ONLY, AND UPON THE CONDITION AND AGREEMENT FOLLOWING: BY CONSIDERATION OF THE LOAN OF THIS DRAWING THE RECIPIENT PROMISES AND AGREES TO RETURN IT UPON RECORDAL AND THAT IT SHALL NOT BE REPRODUCED, COPIED, LENT OR DISCLOSED DIRECTLY OR INDIRECTLY WITHOUT WRITTEN CONSENT.

JEFFREY A. CURTIS — STATE OF WASHINGTON — 19443 — REGISTERED PROFESSIONAL ENGINEER
8/2/95 REV 1
EXPIRES 10-31-95

TO 3K-60, BALLAST WATER HEATING TANK

LOC. AT EFFLUENT R.T. (TANK 60)

SITE STATION J12B (FT, TT, FE, TE)

RS-232 DIGITAL COMM. TO/FROM MASTER STATION (NOTE 4)

SITE STATION J11B (FT, TT, FE, TE)
SITE STATION J10B (FT, TT, FE, TE)
SITE STATION J09B (FT, TT, FE, TE)
SITE STATION J08B (FT, TT, FE, TE)
SITE STATION J07B (FT, TT, FE, TE)
SITE STATION J06B (FT, TT, FE, TE)
SITE STATION J05B (FT, TT, FE, TE)
SITE STATION J04B (FT, TT, FE, TE)
SITE STATION J03B (FT, TT, FE, TE)
SITE STATION ENCLOSURE

(NOTE 2 – TYP.)

LOCATED IN NEW BUILDING ON 6TH ST. ACROSS FROM OPERATIONS CONSTRUCTION OFFICE

RS-232 DIGITAL COMM. TO/FROM MASTER STATION (NOTE 4)

SITE STATION J01C (FT, TT, FE, TE)
SITE STATION J02C (FT, TT, FE, TE)

LOC. IN LOAD CENTER 20–J BLDG. AT "B" & 8TH ST.

(NOTE 2)

FROM CRUDE STORAGE TANKS

TO CRUDE STORAGE TANKS

SECONDARY CONTAINMENT

FROM PRODUCT PUMPS

SITE STATION J01B (FT, TT, FE, TE)
SITE STATION J02B (FT, TT, FE, TE)
SITE STATION J03B (FT, TT, FE, TE)
SITE STATION J04B (FT, TT, FE, TE)
SITE STATION J05B (FT, TT, FE, TE)
SITE STATION J06B (FT, TT, FE, TE)
SITE STATION J06B1 J06B2 (FT, TT, FE, TE)
SITE STATION J07B (FT, TT, FE, TE)
SITE STATION J08B (FT, TT, FE, TE)
SITE STATION J09B (FT, TT, FE, TE)
SITE STATION J10B (FT, TT, FE, TE)
SITE STATION J11B (FT, TT, FE, TE)
SITE STATION J12B (FT, TT, FE, TE)

LOC. IN COMMUNICATIONS JUNCTION BLDG.

RS-232 DIGITAL COMM. TO/FROM SITE STATIONS (NOTE 4)

SITE STATION J01B (FT, TT, FE, TE)
SITE STATION J02B (FT, TT, FE, TE)

CRUDE BOOSTER PUMP 22P-G2 (EXISTING)

MOV 121 (EXISTING)
MOV 122 (EXISTING)
MOV 22-2 (EXISTING)

30"-22-O-2 CRUDE OIL
12"-22-O-89 CRUDE FLUSHING

RS-232 DIGITAL COMM. TO/FROM SITE STATIONS (NOTE 4)

MASTER STATION (LOC. IN RP&S CONTROL RM.)

NOTE 5

FA J01A, J01B, J02A, J02B, J03A, J03B, J04A, J04B, J05A, J05B, J06A, J06B, J07A, J07B, J08A, J08B, J09A, J09B, J10A, J10B, J11A, J11B, J12A, J12B

FROM LOADING/UNLOADING BERTHS

30"-22-O-1 CRUDE OIL

12"-22-O-115 MTBE/FLUSHING CRUDE OIL

TO PIG TRAP

(NOTE 2 – TYP.)

12"-22-O-18 BUNKER FUEL OIL

TO LOADING/UNLOADING BERTHS (TYPICAL – ALL PRODUCT LINES)

14"-22-O-120 LEAD FREE GASOLINE

14"-22-O-6 MTBE/REGULAR GASOLINE

14"-22-O-4 LEAD FREE PREMIUM GASOLINE

8"-22-O-8 AV JET (LINE #2)

8"-22-O-10 AV JET (LINE #1)

8"-22-O-16 LOW SULFUR DIESEL (LINE #3)

8"-22-O-14 HIGH SULFUR DIESEL (LINE #2)

8"-22-O-12 HIGH SULFUR DIESEL (LINE #1)

16"-22-SW-4 BALLAST

BALLAST WATER FROM LOADING/UNLOADING BERTHS

SITE STATION J01A (FT, TT, FE, TE)
SITE STATION J02A (FT, TT, FE, TE)
SITE STATION J03A (FT, TT, FE, TE)
SITE STATION J04A (FT, TT, FE, TE)
SITE STATION J05A (FT, TT, FE, TE)
SITE STATION J06A (FT, TT, FE, TE)
SITE STATION J07A (FT, TT, FE, TE)
SITE STATION J08A (FT, TT, FE, TE)
SITE STATION J09A (FT, TT, FE, TE)
SITE STATION J10A (FT, TT, FE, TE)
SITE STATION J11A (FT, TT, FE, TE)
SITE STATION J12A (FT, TT, FE, TE)
SITE STATION ENCLOSURE

LOCATED IN FIRE PROTECTION BUILDING AT THE DOCK

RS-232 DIGITAL COMM. TO/FROM MASTER STATION (NOTE 4)

FLOW DIRECTIONS SHOWN ARE TYPICAL. ALL LINES MAY BE USED BI-DIRECTIONALLY.

EACH PE REQUIRES 2 CABLES, SUPPLIED BY THE MANUFACTURER (REFER TO CONTROLOTRON DWG. 992QNS–10 FOR CABLE DETAILS). EACH 'TE' REQUIRES A SINGLE CABLE, SUPPLIED BY THE MANUFACTURER (CONTROLOTRON DWG. 991TSS–8 FOR DETAILS). EACH GROUP OF CABLES RELATED TO EACH SITE STATION TO BE RUN IN A SEPARATE ISOLATED CONDUIT (REFER TO TYPICAL INSTALLATION DETAIL DWG. #SK02894).

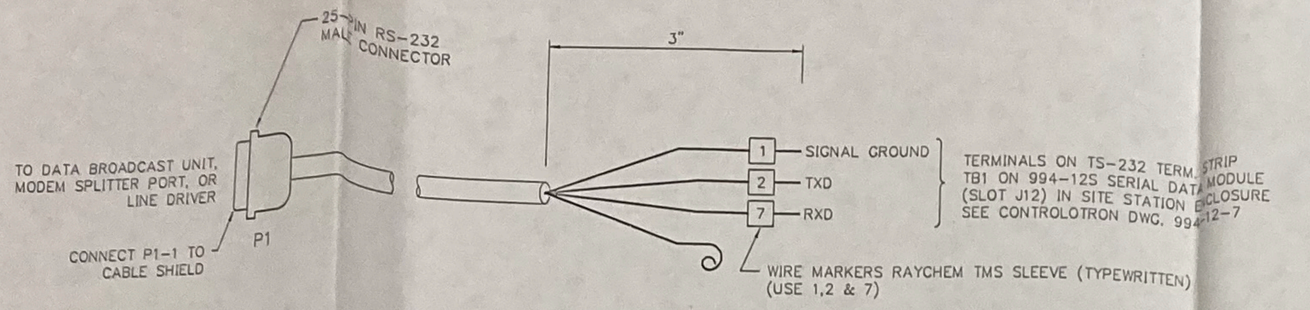
SITE STATION ELECTRONICS ASSEMBLIES ARE LOCATED IN NON–CLASSIFIED AREAS. ALL TRANSDUCERS ARE LOCATED IN CLASS I, DIV. II AREAS.

REFER TO DWG. 22–DJ–35 FOR ADDITIONAL DETAIL ON COMMUNICATION SYSTEM

EACH SITE STATIONS REPORT TO THE MASTER STATION (IBM COMPATIBLE PC). EACH COMPARES FLOW IN VS. FLOW OUT FOR EACH SEGMENT. IF AN ABNORMAL IMBALANCE IS DETECTED, THE FLOW ALARM (FA) FOR THAT SEGMENT IS ACTIVATED AND IS RECEIVED BY AND DISPLAYED ON THE TDC SYSTEM.

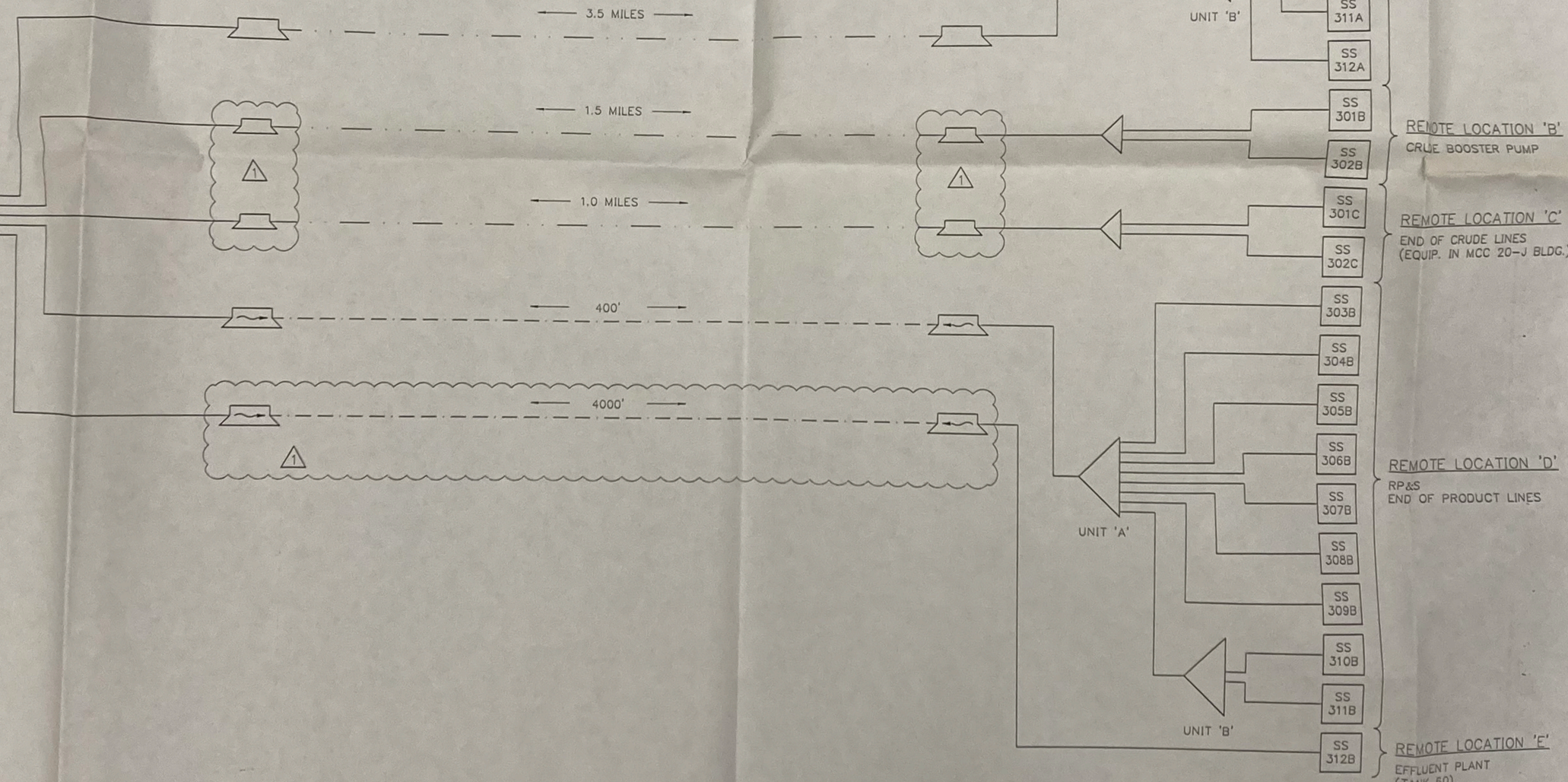
(FROM) P1		(TO) CRIMP LUGS	
FUNCTION	PIN	FUNCTION	PIN
GND	1	–	N/C
TXD	2	TXD	2
RXD	3	RXD	7
RTS	4	RTS	N/C
CTS	5	CTS	N/C
DSR	6	DSR	N/C
SIG GND	7	SIG GND	1
DCD	8	DCD	N/C
DTR	20	DTR	N/C

NOTE: SPARE WIRES TO BE COILED & TAPED AT SITE STATION.



DETAIL A

RS-232 CONNECTION TO SITE STATIONS
NOT TO SCALE



LEGEND

- SS XXX — CONTROLOTRON SITE STATION
- DATA BROADCAST UNIT BLACK BOX TL158-R2
- MODEM SPLITTER (3 PORT) BLACK BOX TL073A
- LINE DRIVER (COPPER) BLACK BOX ME760A
- MINI-LINE DRIVER (COPPER) BLACK BOX ME762A
- LINE DRIVER (FIBER OPTIC) BLACK BOX MD940A
- RS-232 PRE-FABRICATED CABLE
- COMMUNICATIONS CABLE – 2 PAIR COPPER DEDICATED TELEPHONE CABLE
- COMMUNICATIONS CABLE – 2 FIBER OPTIC CABLES

NOTES

1. ALL COMMUNICATIONS DEVICES, LINE DRIVERS, ETC. ARE SUPPLIED BY TEXACO.
2. ALL PRE-FABRICATED RS-232 CABLES ARE SUPPLIED BY TEXACO.
3. ALL PRIMARY COMMUNICATIONS CABLES ARE EXISTING TO MAIN PATCH PANELS. THE INSTALLATION CONTRACTOR IS RESPONSIBLE FOR WIRING & TERMINATIONS FROM PATCH PANELS TO THE LINE DRIVERS.

JEFFREY A. CURTIS
STATE OF WASHINGTON
19445
REGISTERED
PROFESSIONAL ENGINEER
8/2/95
REV 1

EXPIRES 10-31-95

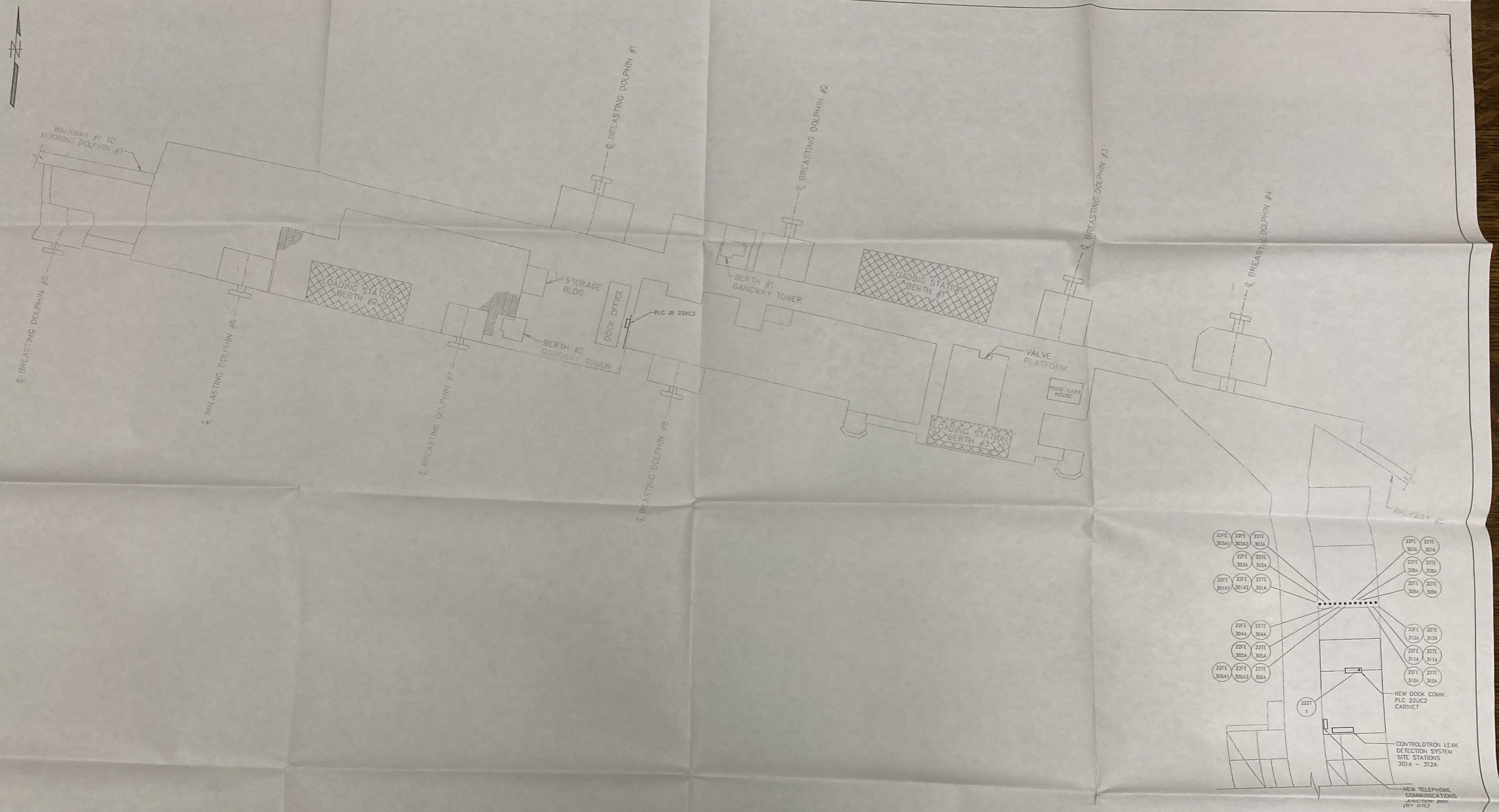
TEXACO REFINING & MARKETING INC.
PUGET SOUND PLANT
ANACORTES, WASHINGTON

PLANT 22 – WHARF LEAK DETECTION SYSTEM COMMUNICATION BLOCK DIAGRAM

BY	DATE	ESTIMATE	B.M.	BY	DATE	DESCRIPTION	SYMBOL
APPROVED		JOB		REVISIONS			
IAC	8/2/95	PSP543		DEH	7/27/95	AS-BUILT	1
		PSP543		DEH	10/3/94	ISSUED FOR CONSTRUCTION	Δ

INITIALS–		DATE	
DWN. BY	DEH	10/3/94	
CKD. BY	TML		
APP'D BY			
CHF. ENGR.			

SCALE NONE
CAD FILE NO. 22DJ0016
DRAWING NUMBER 22-DJ-35
REV NO 1



JEFFREY A. CURTIS
STATE OF WASHINGTON
13485
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES 10/31/95

8/2/95
REV 0

TEXACO REFINING & MARKETING INC.
PUGET SOUND PLANT
ANACORTES, WASHINGTON

WHARF AND LOADING FACILITIES INSTRUMENT LOCATION PLAN

									INITIALS–	DATE
JAC	8/2/95	PSP-543		DEH	4/10/95	ADD PLC 22UC2 EQUIP. PER W.O. 9416384	1		DWN. BY EW	10/1/94
BY	DATE	ESTIMATE	B.M.	EW	10/1/94	DOCK TRANSFER LINES LEAK DETECTION	⚠		CKD. BY	
APPROVED		JOB		BY	DATE	DESCRIPTION	SYMBOL		APP'D BY	
				REVISIONS					CHF. ENGR.	

SCALE 1"=20'
CAD FILE NO. 22EJ0013
DRAWING NUMBER 22–EJ–32
REV. NO 1

DRAWING LIMIT

NORTH TEXAS ROAD

N. 13249.06

E. 7770.00

SWITCH GEAR

CONTROLOTRON LEAK DETECTION SYSTEM SITE STATIONS 301B & 302B

COMMUNICATIONS CABLING JUNCTION BUILDING

SWITCH GEAR

RETAINING WALL

CRUDE OIL BOOSTER PUMPS

22TE 302B

22FE 302B

22TE 301B

22FE 301B1

22FE 301B2

9TH STREET

DRAIN TO THE BAY

HOUSE

HOUSE

WEST MARCHES POINT ROAD

ACCESS ROAD

HOUSE

SUMP PUMP

PIPEWAY

DRAINAGE BASIN

ACCESS ROAD

TRESTLE

TO ANACORTES

HOUSE

DRAIN TO THE BAY

DRAWING LIMIT

DRAWING LIMIT

DRAWING LIMIT

N. 12570.00

E. 7770.00

THIS DRAWING HAS NOT BEEN PUBLISHED. IT IS THE SOLE PROPERTY OF TEXACO REFINING AND MARKETING INC. IT IS LENT TO THE RECIPIENT FOR HIS CONFIDENTIAL USE ONLY, AND UPON THE CONDITION AND AGREEMENTS FOLLOWING. IN CONSIDERATION OF THE LOAN OF THIS DRAWING THE RECIPIENT PROMISES AND AGREES TO RETURN IT UPON REQUEST, AND THAT IT SHALL NOT BE REPRODUCED, COPIED, LENT OR OTHERWISE DISPOSED OF DIRECTLY OR INDIRECTLY WITHOUT WRITTEN CONSENT.

JEFFREY A. CURTIS — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER

8/2/95

EXPIRES 10-31-95

TEXACO REFINING & MARKETING INC.
PUGET SOUND PLANT
ANACORTES, WASHINGTON

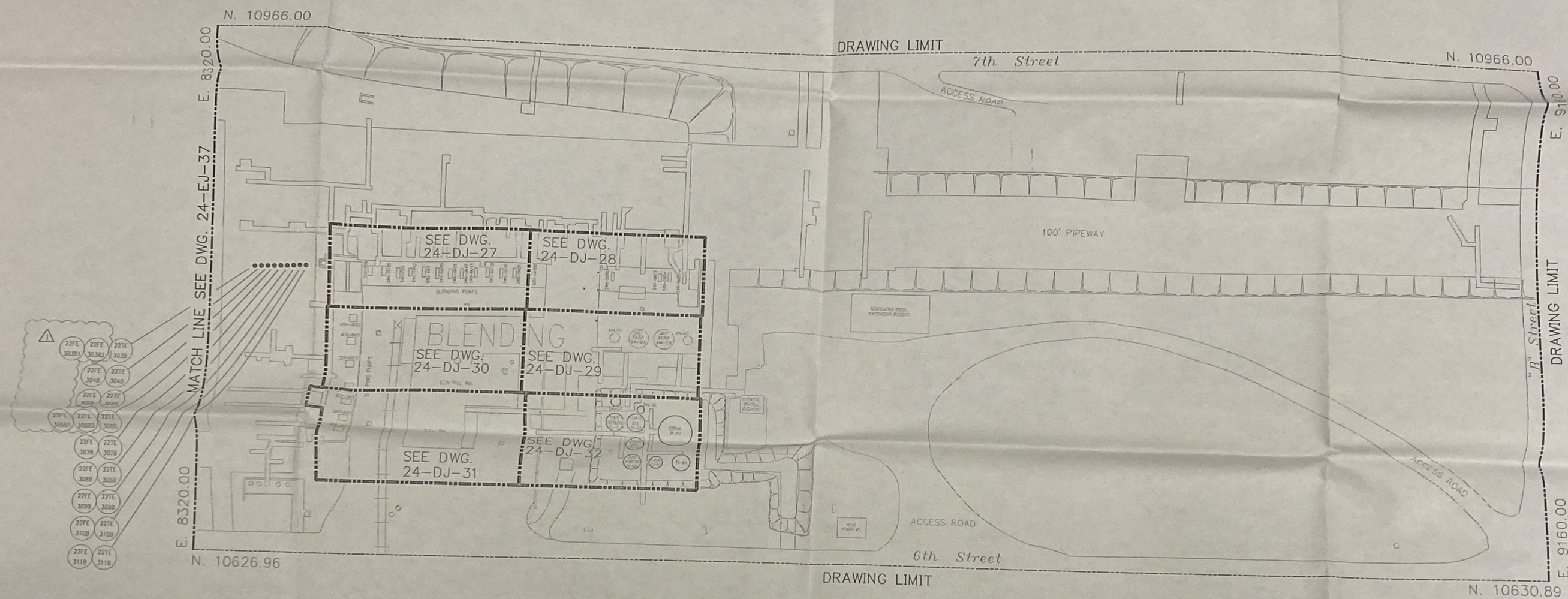
N.W. CRUDE OIL BOOSTER PUMPS INSTRUMENT LOCATION PLAN

BY	DATE	ESTIMATE	B.M.
JAC	8/2/95	PSP-543	
APPROVED		JOB	

BY	DATE	SYMBOL	DESCRIPTION
EW	10/3/94	4	ADDED LEAK DETECTION EQUIPMENT

REVISIONS

INITIALS	DATE	SCALE 1"=30'
DWN. BY EW	10/3/94	CAD FILE NO. 22EJ0014
CKD. BY		DRAWING NUMBER 22-E.I-33
APP'D BY		REV. NO 0
SUP. ENGR		



JEFFREY A. CURTIS
STATE OF WASHINGTON
REGISTERED
PROFESSIONAL ENGINEER
1980

8/2/95 REV1

EXPIRES 10/21/95

TEXACO REFINING & MARKETING INC.
PUGET SOUND PLANT
ANACORTES, WASHINGTON

BLENDING PLANT INSTRUMENT LOCATION PLAN

BY	DATE	ESTIMATE	B.M.	BY	DATE	DESCRIPTION	SYMBOL
APPROVED		JOB		REVISIONS			
JLC	8/7/95	PSP-543		DEH	7/27/95	AS-BUILT LEAK DETECTION EQUIP.	1
		PSP-543		EW	10/11/94	ADDED LEAK DETECTION EQUIPMENT	⚠

INITIALS– DATE SCALE 1"=30'
DWN. BY EW 10/11/94 CAD FILE NO. 24EJ0072
CKD. BY
APP'D BY
CHF. ENGR

DRAWING NUMBER 24-EJ-17 REV NO 1

N. 11170.00

DRAWING LIMIT

N. 11170.00

E. 7776.33

E. 8320.00

MATCHLINE SEE DWG. 23-EJ-13

ACCESS ROAD

CASCADE NATURAL GAS CO.

PIPEWAY

GRAVEL ACCESS ROAD

MATCHLINE SEE DWG. 24-EJ-17

SHIPPING AND OFFTEST PUMPS

PIPEWAY

10' GRAVEL ACCESS ROAD

PIPEWAY

CONTROLOTRON LEAK DETECTION SYSTEM SITE STATIONS 3030 - 3110

RP&S LEAK DETECTION EQUIPMENT BUILDING

E. 7691.02

E. 8320.00

6th Street

N. 10625.20

DRAWING LIMIT

N. 10626.96

JEFFREY A. CURTIS — STATE OF WASHINGTON — 9908 — REGISTERED PROFESSIONAL ENGINEER

EXPIRES 10/31/95

8/2/95 REV 0

THIS DRAWING HAS NOT BEEN PUBLISHED. IT IS THE SOLE PROPERTY OF TEXACO REFINING AND MARKETING INC. IT IS LOAN TO THE RECIPIENT FOR HIS CONFIDENTIAL USE ONLY, AND UPON THE CONDITIONS AND AGREEMENTS FOLLOWING. BY ACCEPTANCE AND USE OF THIS DRAWING THE RECIPIENT PROMISES AND AGREES TO RETURN IT UPON INTIMATE REQUEST AND THAT IT SHALL NOT BE REPRODUCED, COPIED, LENT OR OTHERWISE DISPOSED OF DIRECTLY OR INDIRECTLY WITHOUT WRITTEN CONSENT.

TEXACO REFINING & MARKETING INC.
PUGET SOUND PLANT
ANACORTES, WASHINGTON

OFFPLOT - W. BLENDING PLANT
INSTRUMENT LOCATION PLAN

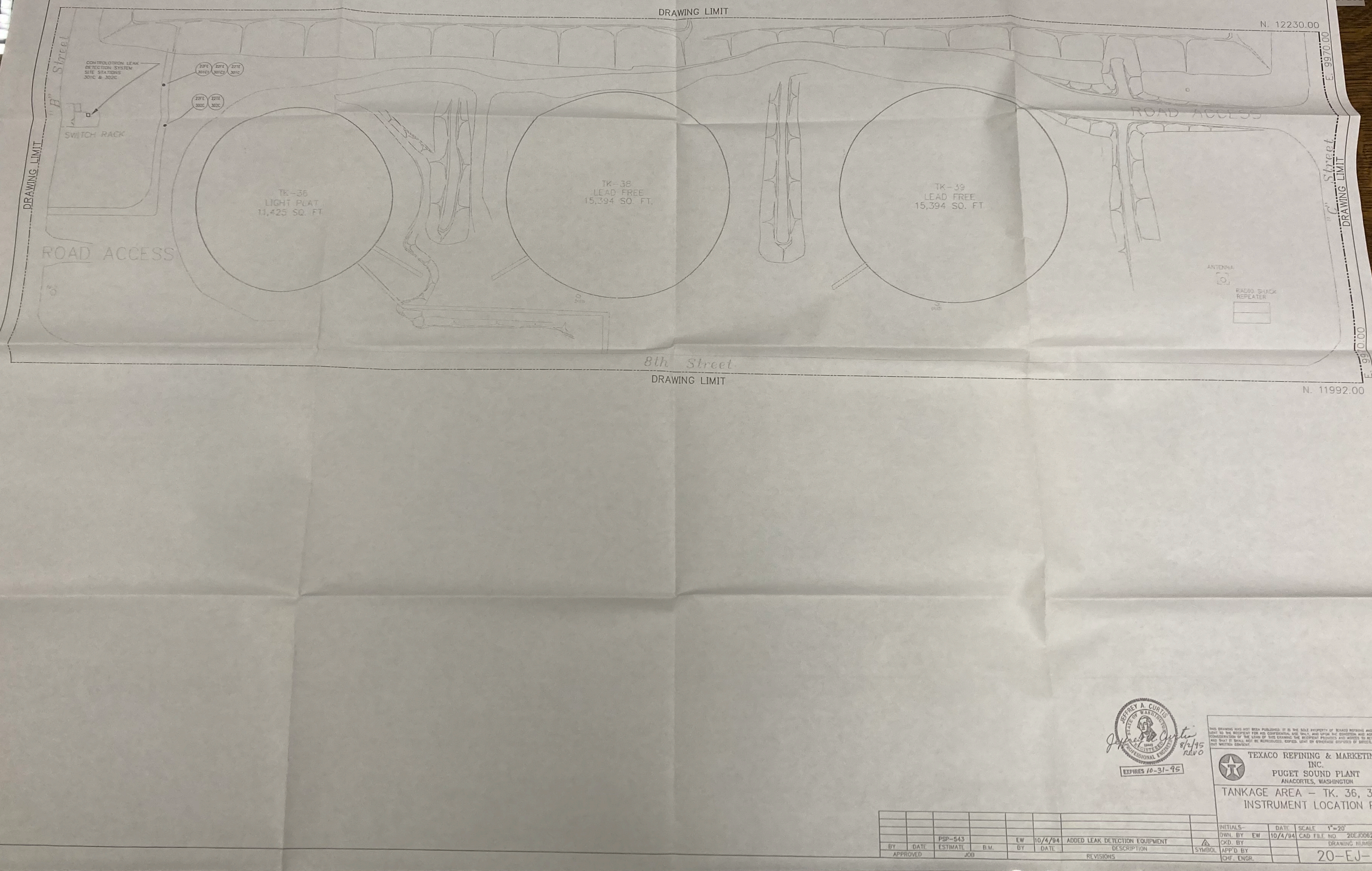
BY	DATE	APPROVED
JAC	8/2/95	
		ESTIMATE
PSP-543		JOB
		B.M.
EW	10/4/94	
		DATE

REVISIONS

SYMBOL	DESCRIPTION	BY	DATE
1	ADDED LEAK DETECTION EQUIPMENT	EW	10/4/94

	INITIALS	DATE
DRN. BY	EW	10/4/94
CKD. BY		
APP'D BY		
CHF. ENGR.		

SCALE 1"=20'
CAD FILE NO. 24EJ037I
DRAWING NUMBER 24-EJ-37
REV NO 0



JEFFREY A. CURTIS
STATE OF WASHINGTON
10445
REGISTERED PROFESSIONAL ENGINEER

8/1/95
REV 0

EXPIRES 10-31-95

TEXACO REFINING & MARKETING INC.
PUGET SOUND PLANT
ANACORTES, WASHINGTON

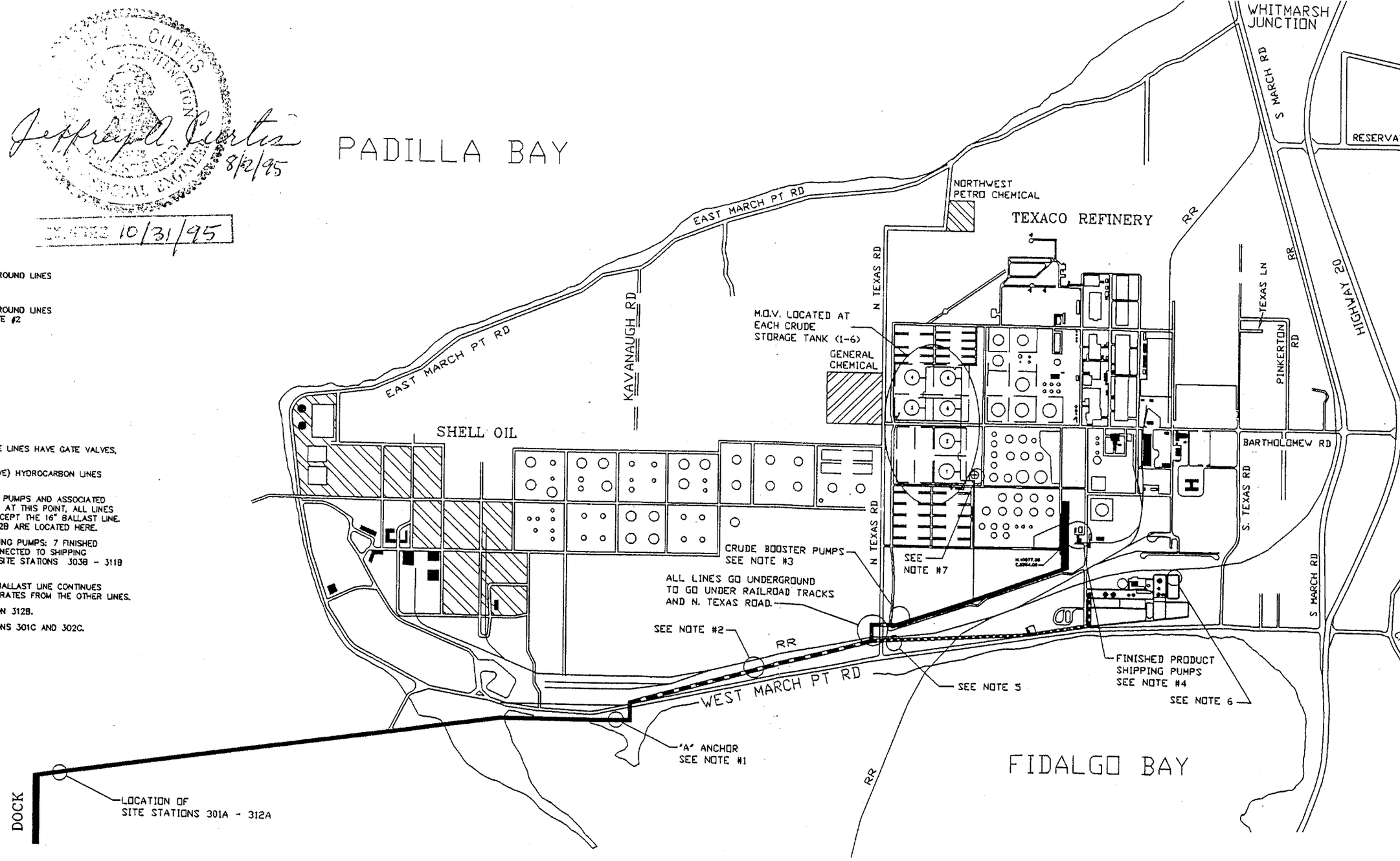
TANKAGE AREA – TK. 36, 38, & 39 INSTRUMENT LOCATION PLAN

BY	DATE	APPROVED
		PSP-543
		ESTIMATE
		B.M.
		JOB

BY	DATE	DESCRIPTION	SYMBOL
EW	10/4/94	ADDED LEAK DETECTION EQUIPMENT	1

REVISIONS

INITIALS–	DATE	SCALE 1"=20'
DWN. BY EW	10/4/94	CAD FILE NO 20EJ0062
CKD. BY		DRAWING NUMBER 20-EJ-32
APP'D BY		REV NO 0
CHF. ENGR.		



Jeffrey A. Curtis 8/2/95

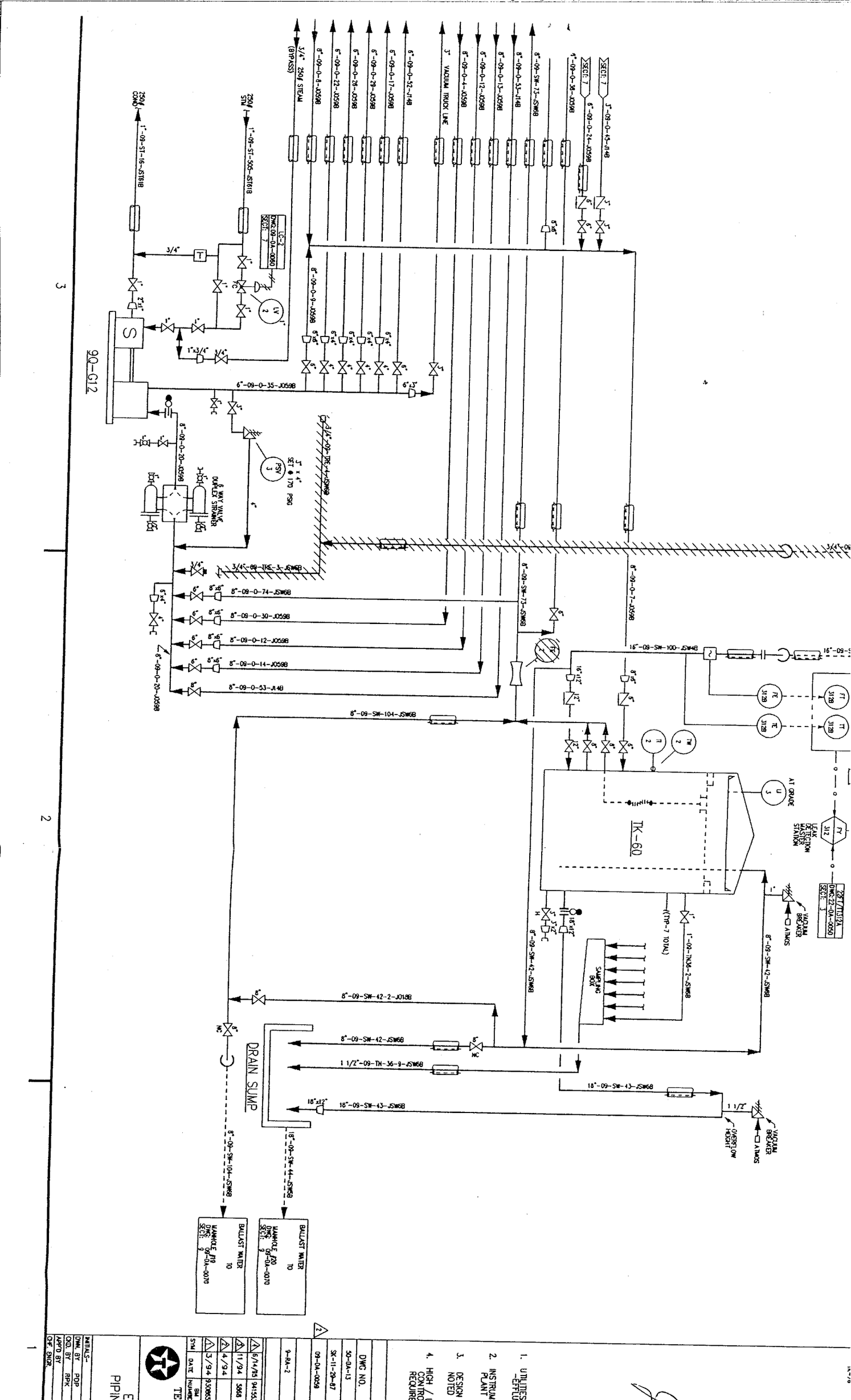
EXPIRES 10/31/95

LEGEND:

- ABOVEGROUND LINES
- UNDERGROUND LINES SEE NOTE #2

NOTES:

1. "A" ANCHOR. ALL OF THE LINES HAVE GATE VALVES, EXCEPT 30" CRUDE LINE.
2. AT THIS POINT 12 (TWELVE) HYDROCARBON LINES RUN UNDERGROUND.
3. SITE OF CRUDE BOOSTER PUMPS AND ASSOCIATED MOVs AND CHECK VALVE. AT THIS POINT, ALL LINES COME ABOVE GROUND EXCEPT THE 16" BALLAST LINE. SITE STATION 301B & 302B ARE LOCATED HERE.
4. FINISHED PRODUCT SHIPPING PUMPS: 7 FINISHED PRODUCT LINES ARE CONNECTED TO SHIPPING PUMPS AT THIS POINT. SITE STATIONS 303B - 311B ARE LOCATED HERE.
5. AT THIS POINT THE 16" BALLAST LINE CONTINUES UNDERGROUND AND SEPARATES FROM THE OTHER LINES.
6. LOCATION OF SITE STATION 312B.
7. LOCATION OF SITE STATIONS 301C AND 302C.



1. UTILITIES -EFFLU
2. INSTRUM PLANT
3. DESIGN NOTED
4. HIGH / CONTRO REQUIRE

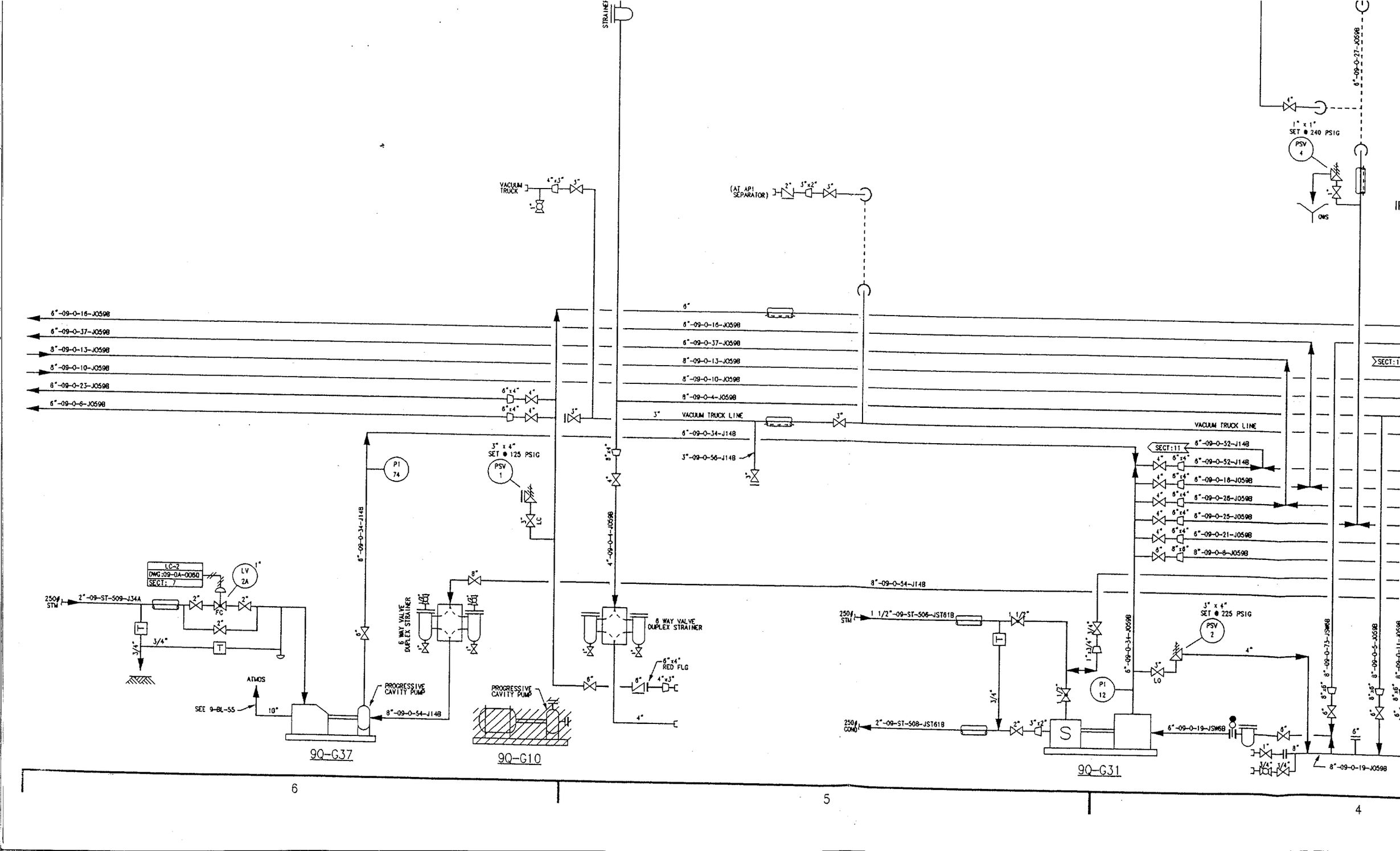
DWG NO.
09-0A-0059
50-0A-13
SK-11-29-87
9-RA-2

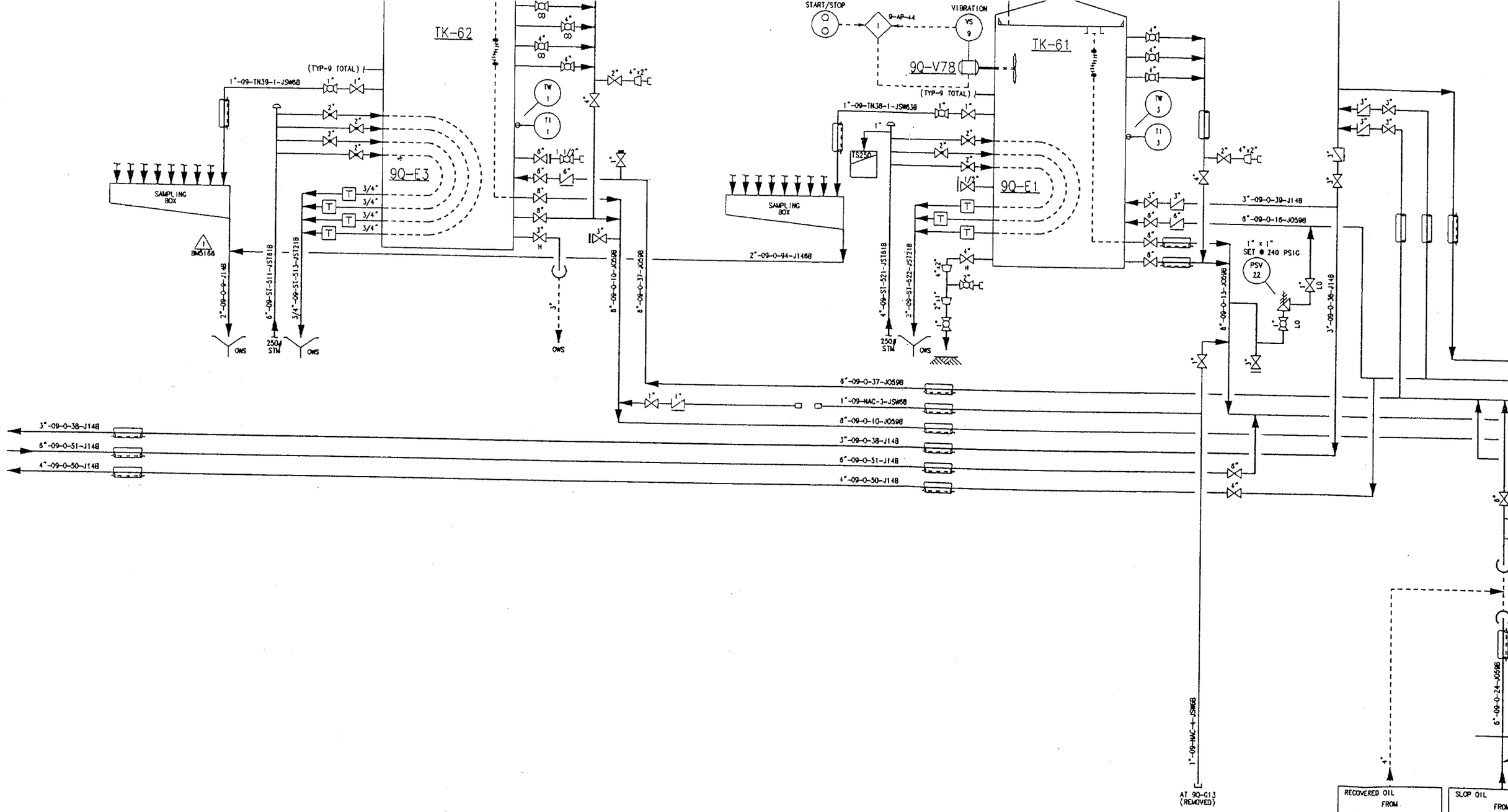
NO.	DATE	NUMBER	BM
1	6/14/95	94135	SMB
2	11/94	5868	
3	4/94		
4	3/94	93-0065	

MATERIALS-
DWN. BY PDP
CKD. BY
APP'D. BY RPK
CHF. ENGR.

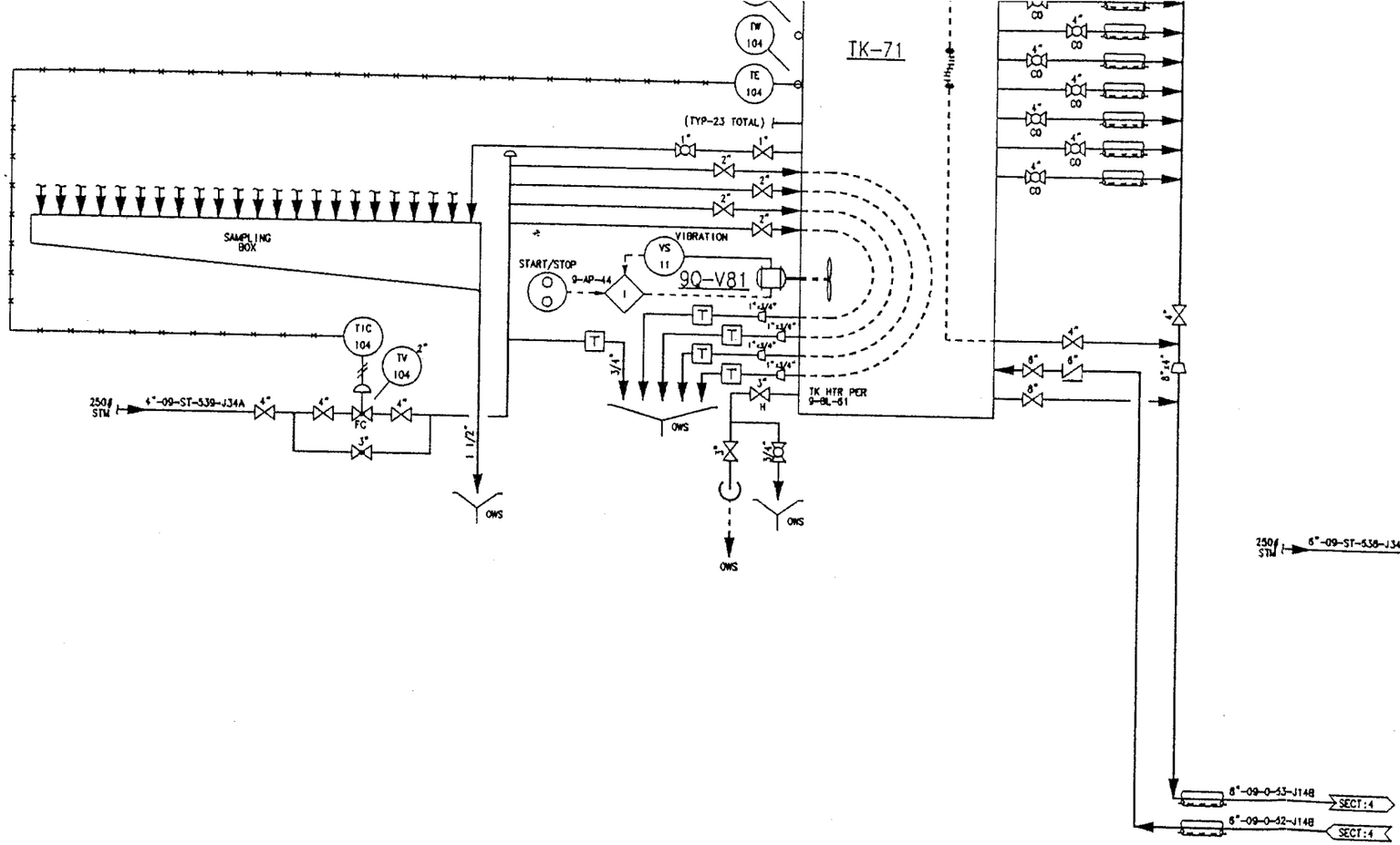
TE

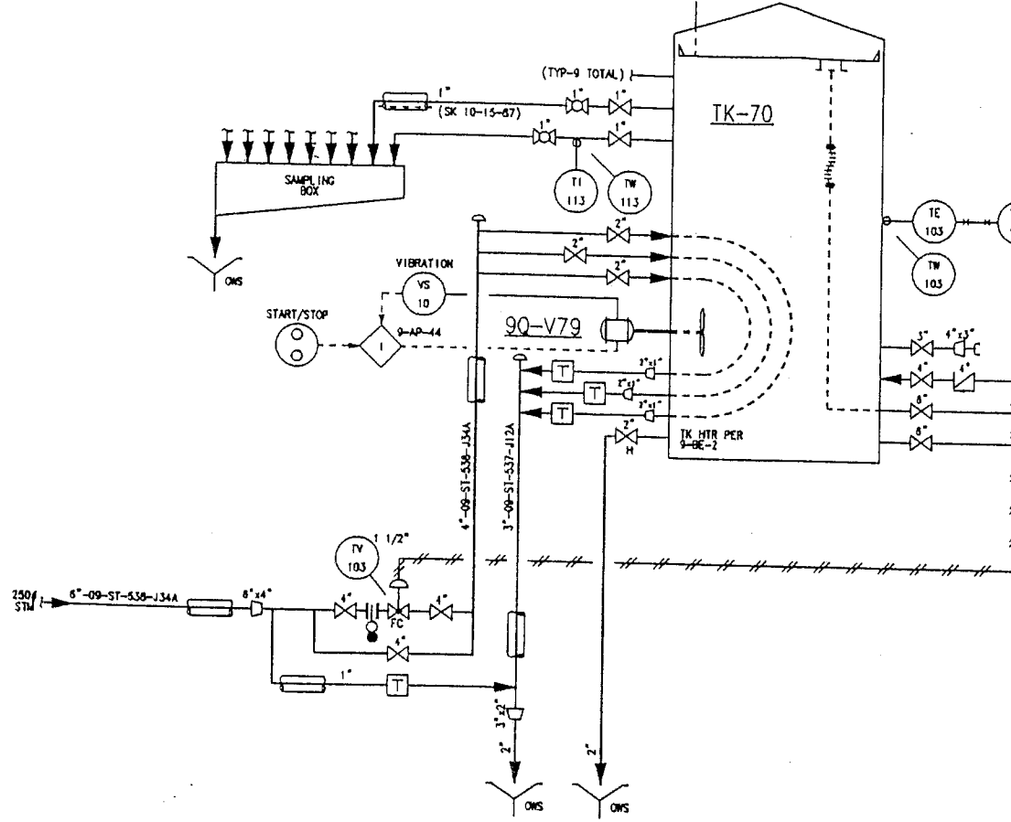
PIPIN

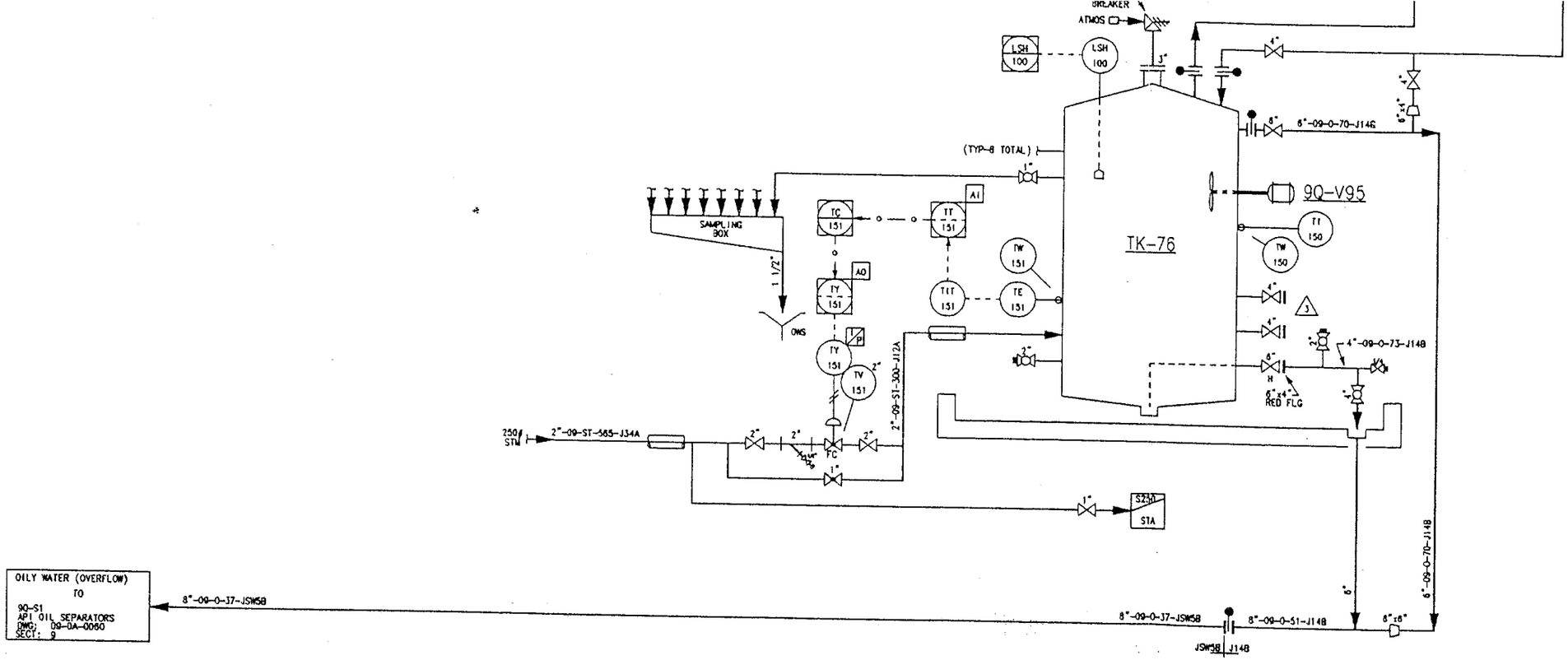

VACUUM TRUCK
(AT API SEPARATOR)
STRAINER
6"-09-O-16-J059B
6"-09-O-37-J059B
8"-09-O-13-J059B
8"-09-O-10-J059B
8"-09-O-23-J059B
6"-09-O-6-J059B
6"-09-O-27-J059B
1" x 1" SET @ 240 PSIG
PSV 4
OWS
6"
8"-09-O-4-J059B
3" VACUUM TRUCK LINE
6"-09-O-34-J14B
3"-09-O-56-J14B
VACUUM TRUCK LINE
SECT:11
6"-09-O-52-J14B
6"-09-O-28-J059B
6"-09-O-25-J059B
6"-09-O-21-J059B
8"-09-O-8-J059B
3" x 4" SET @ 125 PSIG
PSV 1
PI 74
LC
8"-09-O-34-J14B
4"-09-O-4-J059B
8"-09-O-54-J14B
LC-2
DWG:09-0A-0060
SECT: 7
LV 2A
250# STM
2"-09-ST-509-J34A
FC
3/4"
ATMOS
SEE 9-BL-55
10"
PROGRESSIVE CAVITY PUMP
8"-09-O-54-J14B
6 WAY VALVE DUPLEX STRAINER
6"x4" RED FLG
4"x3"
9Q-G37
9Q-G10
250# STM
1 1/2"-09-ST-506-JST61B
PI 12
3" x 4" SET @ 225 PSIG
PSV 2
LO
6"-09-O-34-J059B
6"-09-O-7-J059B
6"-09-O-5-J059B
6"-09-O-11-J059B
250# COND
2"-09-ST-508-JST61B
6"-09-O-19-JSW6B
8"-09-O-19-J059B
9Q-G31
6
5
4

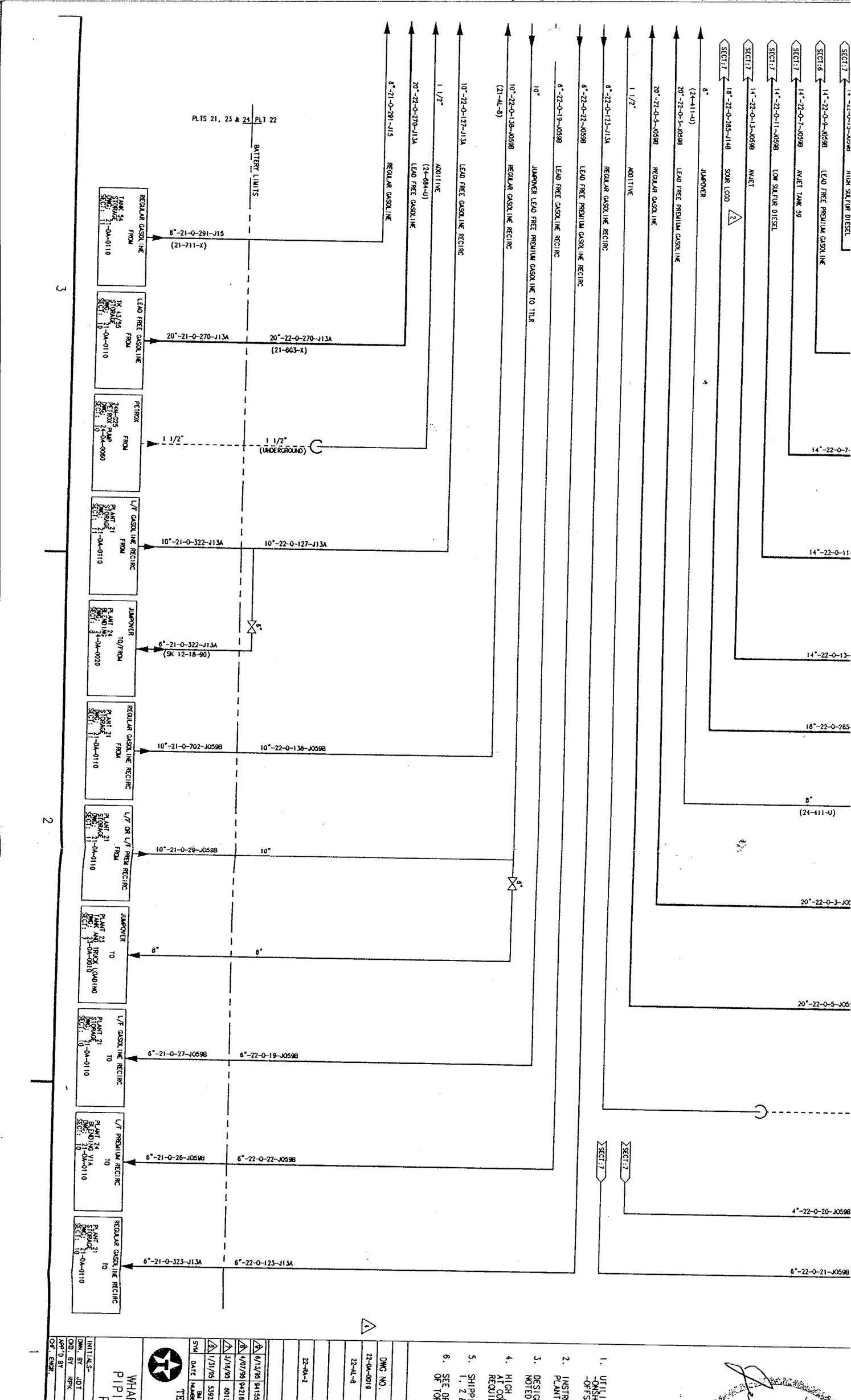

TK-62
TK-61
90-E3
90-E1
90-V78
(TYP-9 TOTAL)
1"-09-TN39-1-JSW68
1"-09-TN38-1-JSW68
SAMPLING BOX
START/STOP
VIBRATION
9-AP-44
TS250
TW 1
TI 1
TW 3
TI 3
PSV 22
1" x 1" SET @ 240 PSIG
LO
2"-09-0-9-J14B
6"-09-SI-511-JST61B
3/4"-09-SI-513-JST21B
2"-09-0-94-J146B
4"-09-SI-521-JS161B
2"-09-SI-522-JST21B
8"-09-0-10-JO59B
8"-09-0-37-JO59B
3"-09-0-39-J14B
6"-09-0-16-JO59B
8"-09-0-13-JO59B
3"-09-0-38-J14B
1"-09-HAC-4-JSW68
AT 90-C13 (REMOVED)
RECOVERED OIL FROM
90-C8/C8A THICKENED SLUDGE PUMPS
DWG: 09-0A-0120
SECT: 1
SLOP OIL FROM
PLANT 21 DISTRIBUTION
DWG: 35-0A-
SECT: 12
250# STM
OWS

9 8 7


TK-71
TW 104
TE 104
(TYP-23 TOTAL)
SAMPLING BOX
VIBRATION
VS 11
START/STOP
9-AP-44
90-V81
TIC 104
TV 104
250# STM
4"-09-ST-539-J34A
FC
1 1/2"
OWS
TK HTR PER 9-BL-61
8"-09-0-53-J14B
SECT:4
8"-09-0-52-J14B
SECT:4


TK-70
(TYP-9 TOTAL)
(SK 10-15-87)
TI 113
TW 113
SAMPLING BOX
VIBRATION
VS 10
START/STOP
9-AP-44
90-V79
TE 103
TW 103
TK HTR PER 9-BE-2
4"-09-ST-538-J34A
3"-09-ST-537-J12A
TV 103
1 1/2"
250# STM
6"-09-ST-536-J34A
FC
OWS


BREAKER
ATMOS
LSH 100
LSH 100
3"
4"
6"
6"-09-0-70-J14G
(TYP-8 TOTAL)
1"
90-V95
TK-76
TT 150
TW 150
TW 151
TE 151
TIT 151
TC 151
TT 151
A1
AO
TY 151
P
TY 151
TV 151
2"
SAMPLING BOX
1 1/2"
OWS
4"-09-0-73-J14B
6"x4" RED FLG
2"-09-ST-300-J12A
250# STM
2"-09-ST-565-J34A
2"
FC
1"
S250 STA
6"-09-0-70-J14B
OILY WATER (OVERFLOW) TO 90-S1 API OIL SEPARATORS DWG: 09-0A-0060 SECT: 9
8"-09-0-37-JSW5B
8"-09-0-37-JSW5B
8"-09-0-51-J14B
8"±6"
JSW3B J14B



1. UTILI
-ONSH
-OFFS
2. INSTR
PLANT
3. DESIG
NOTED
4. HIGH
AT CO
REQUI
5. SHIPP
1, 2
6. SEE DR
OF TOR

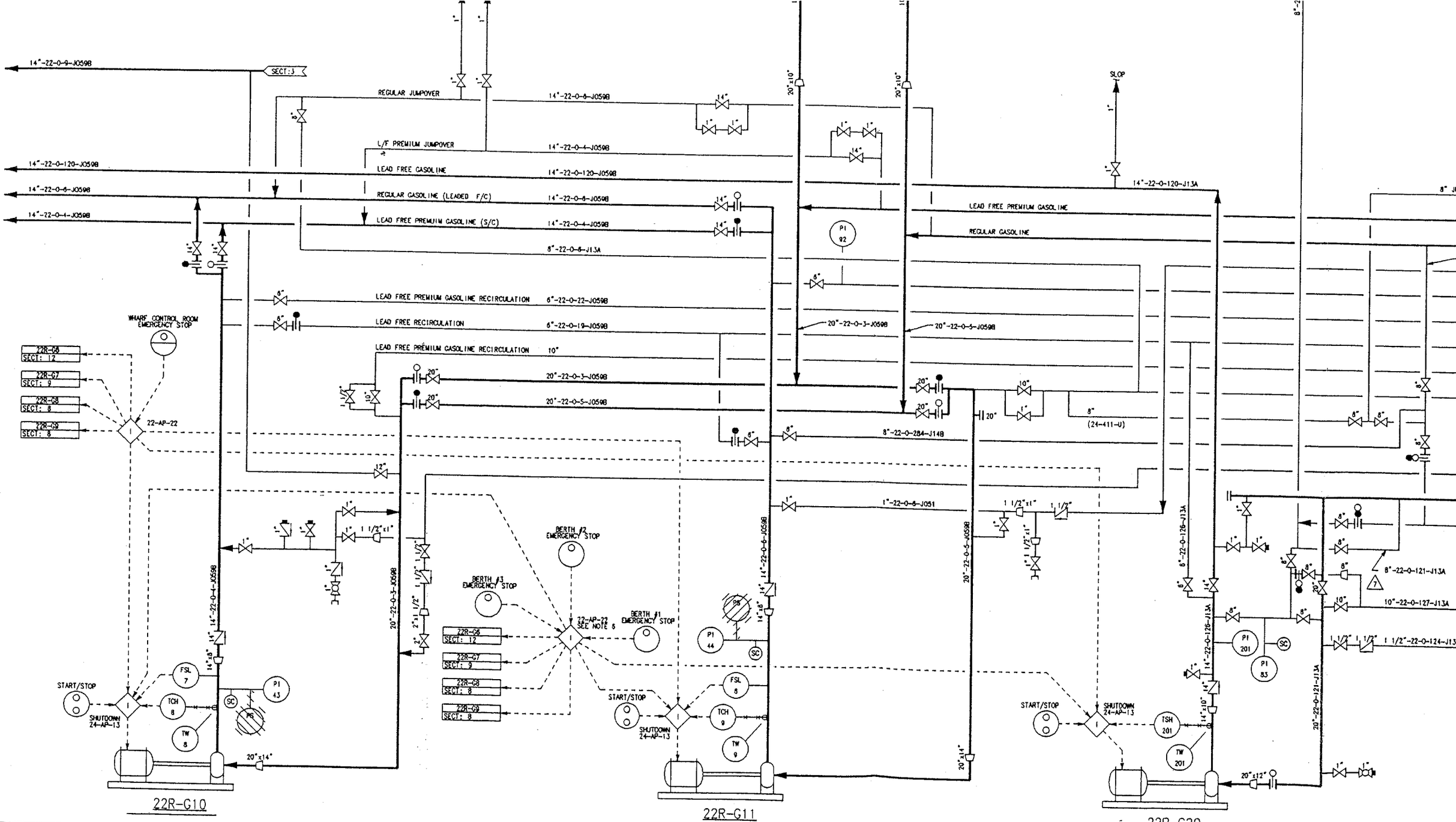
DWG NO.	
22-0A-0019	
22-AL-8	
22-RA-2	

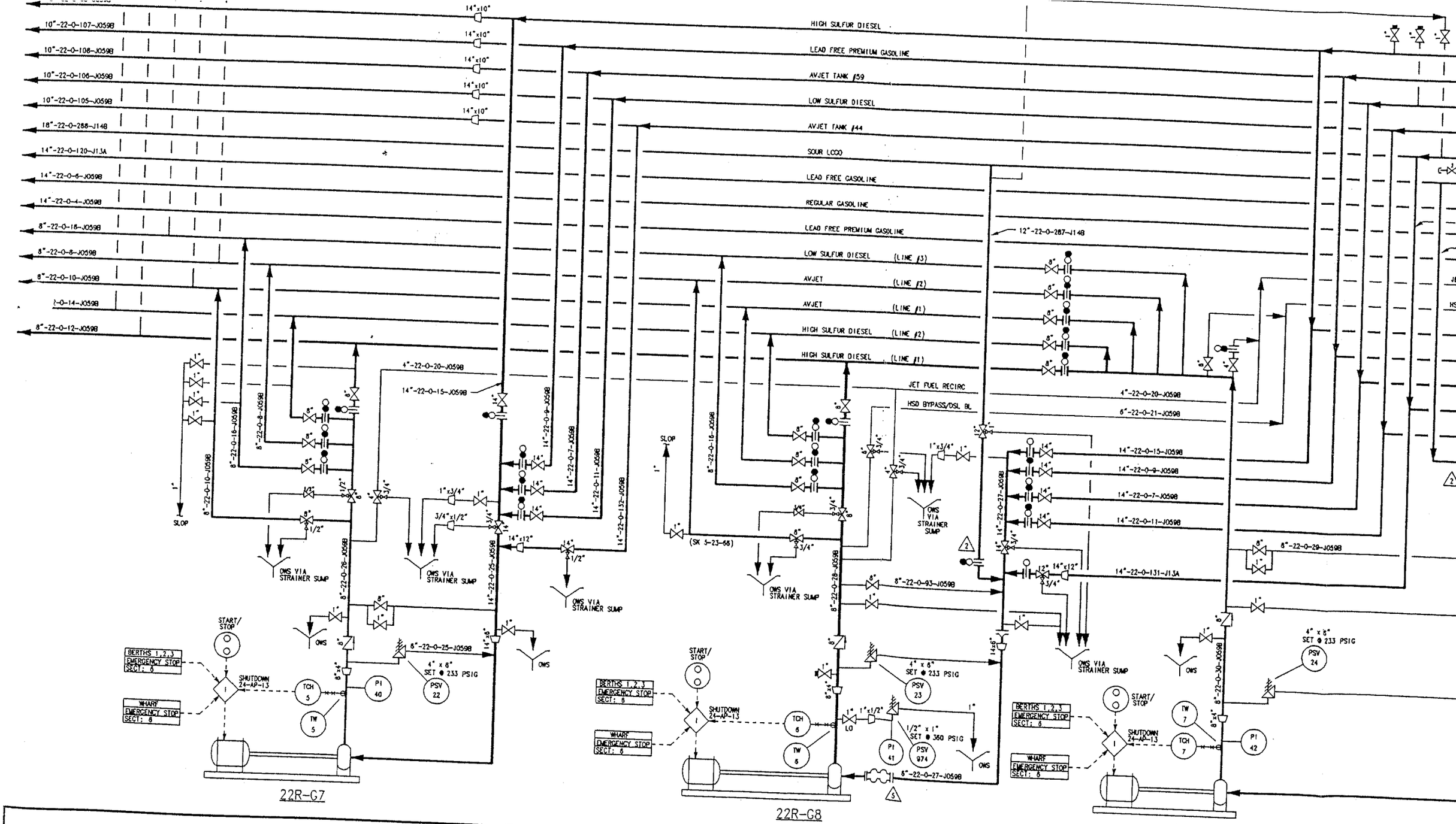
6	6/13/95	94155	
5	4/07/95	94218	
4	3/16/95	801	
3	1/31/95	5392	
SYM	DATE	MARK	

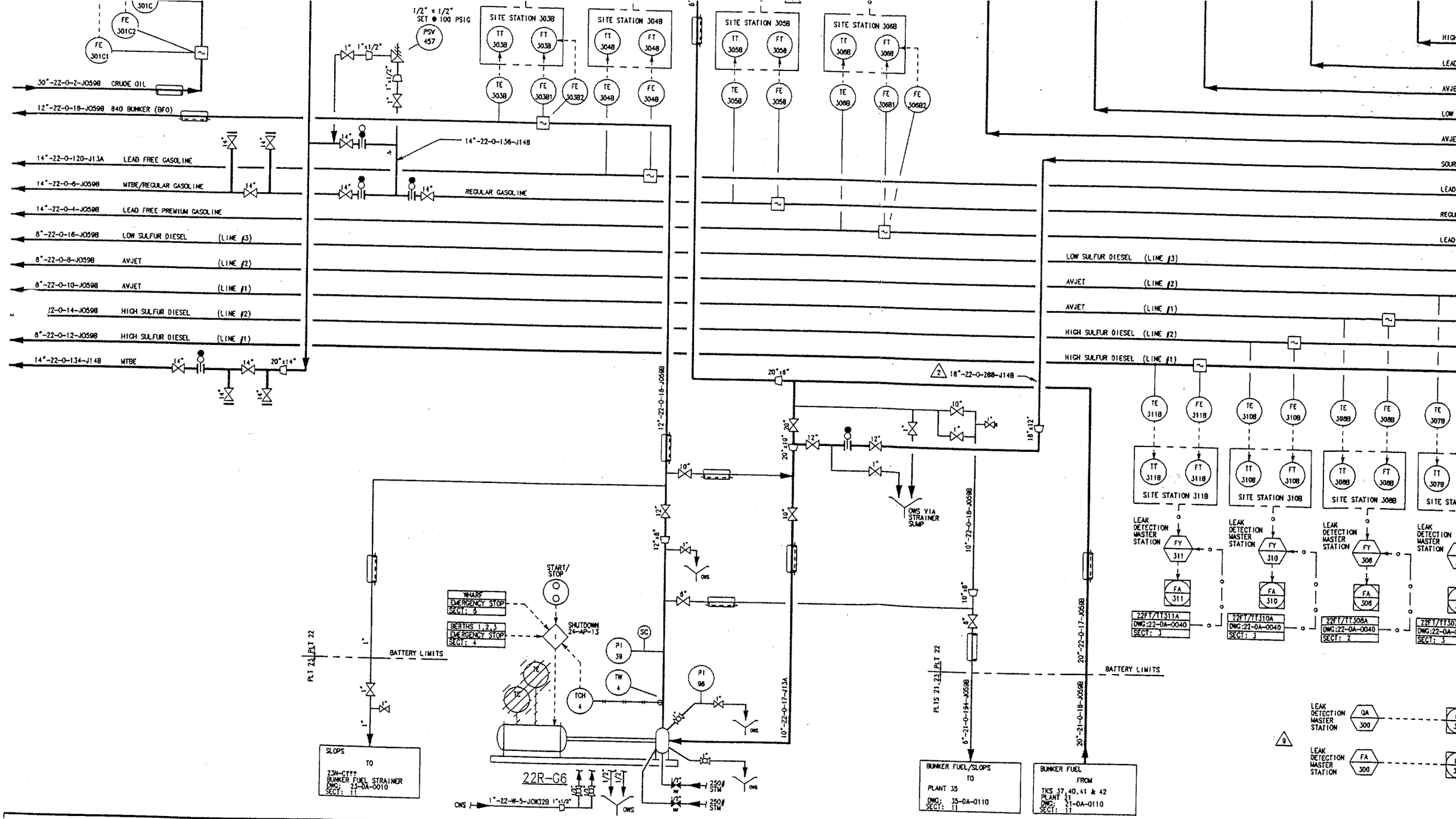
WHAR
PIP
F

TE

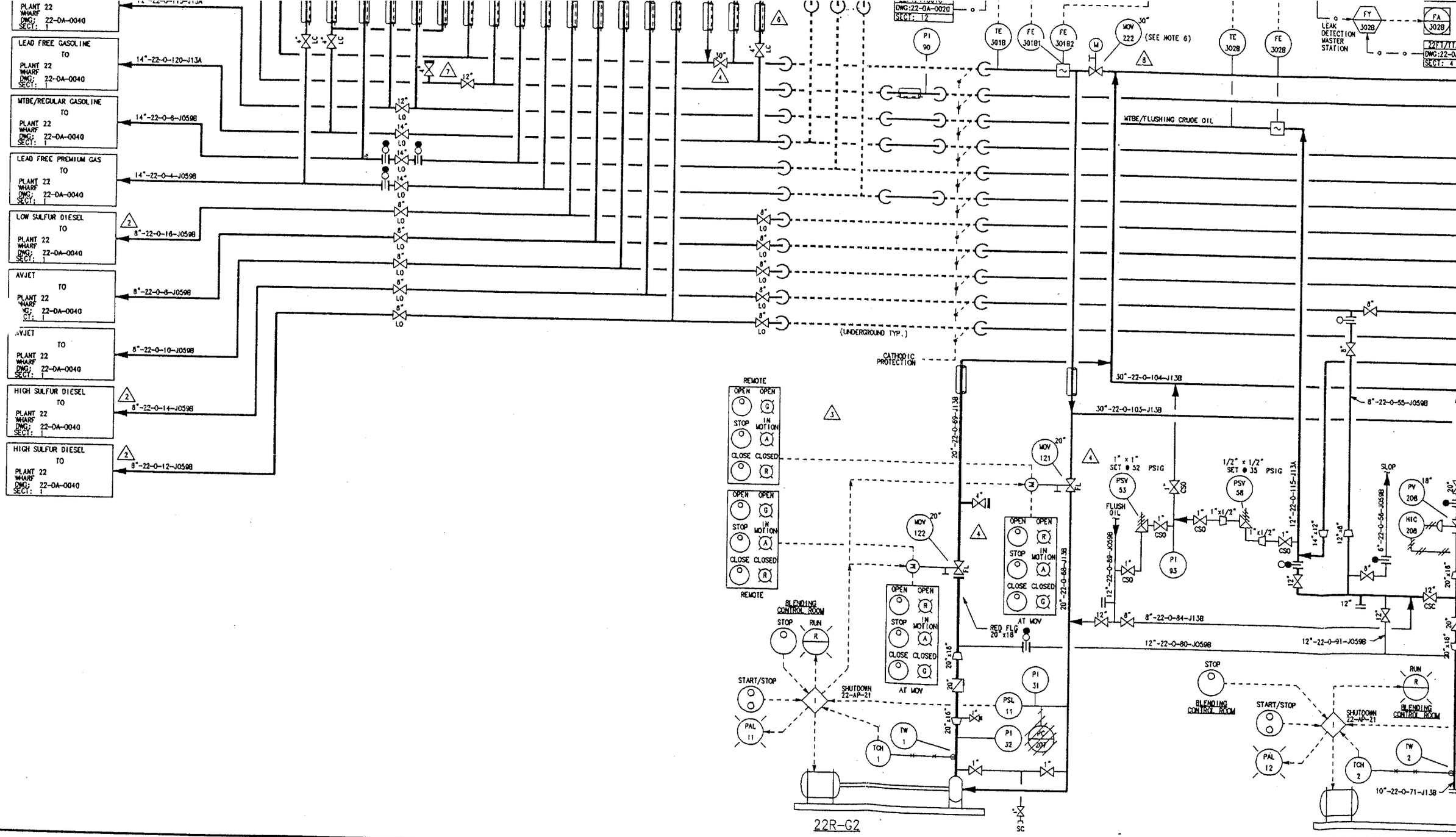
INITIALS-	
DWN. BY	JDT
CKD. BY	RPK
APP'D. BY	
CHF. ENGR.	


14"-22-0-9-J059B
SECT:3
REGULAR JUMPOVER
14"-22-0-8-J059B
L/F PREMIUM JUMPOVER
14"-22-0-4-J059B
14"-22-0-120-J059B
LEAD FREE GASOLINE
14"-22-0-8-J059B
REGULAR GASOLINE (LEADED F/C)
14"-22-0-4-J059B
LEAD FREE PREMIUM GASOLINE (S/C)
8"-22-0-8-J13A
LEAD FREE PREMIUM GASOLINE RECIRCULATION
6"-22-0-22-J059B
LEAD FREE RECIRCULATION
6"-22-0-19-J059B
LEAD FREE PREMIUM GASOLINE RECIRCULATION
10"
20"-22-0-3-J059B
20"-22-0-5-J059B
8"-22-0-284-J14B
1"-22-0-8-J051
WHARF CONTROL ROOM EMERGENCY STOP
22R-G6 SECT: 12
22R-G7 SECT: 9
22R-G8 SECT: 8
22R-G9 SECT: 8
22-AP-22
BERTH #2 EMERGENCY STOP
BERTH #3 EMERGENCY STOP
BERTH #1 EMERGENCY STOP
22-AP-22 SEE NOTE 5
START/STOP
SHUTDOWN 24-AP-13
FSL 7
TCH 8
TW 8
PI 43
FSL 8
TCH 9
TW 9
PI 44
PI 92
SLOP
14"-22-0-120-J13A
LEAD FREE PREMIUM GASOLINE
REGULAR GASOLINE
8" (24-411-U)
8"-22-0-126-J13A
8"-22-0-121-J13A
10"-22-0-127-J13A
1 1/2"-22-0-124-J13A
14"-22-0-126-J13A
20"-22-0-121-J13A
PI 201
PI 85
TSH 201
TW 201
20"x14"
20"x12"
22R-G10
22R-G11
22R-G20

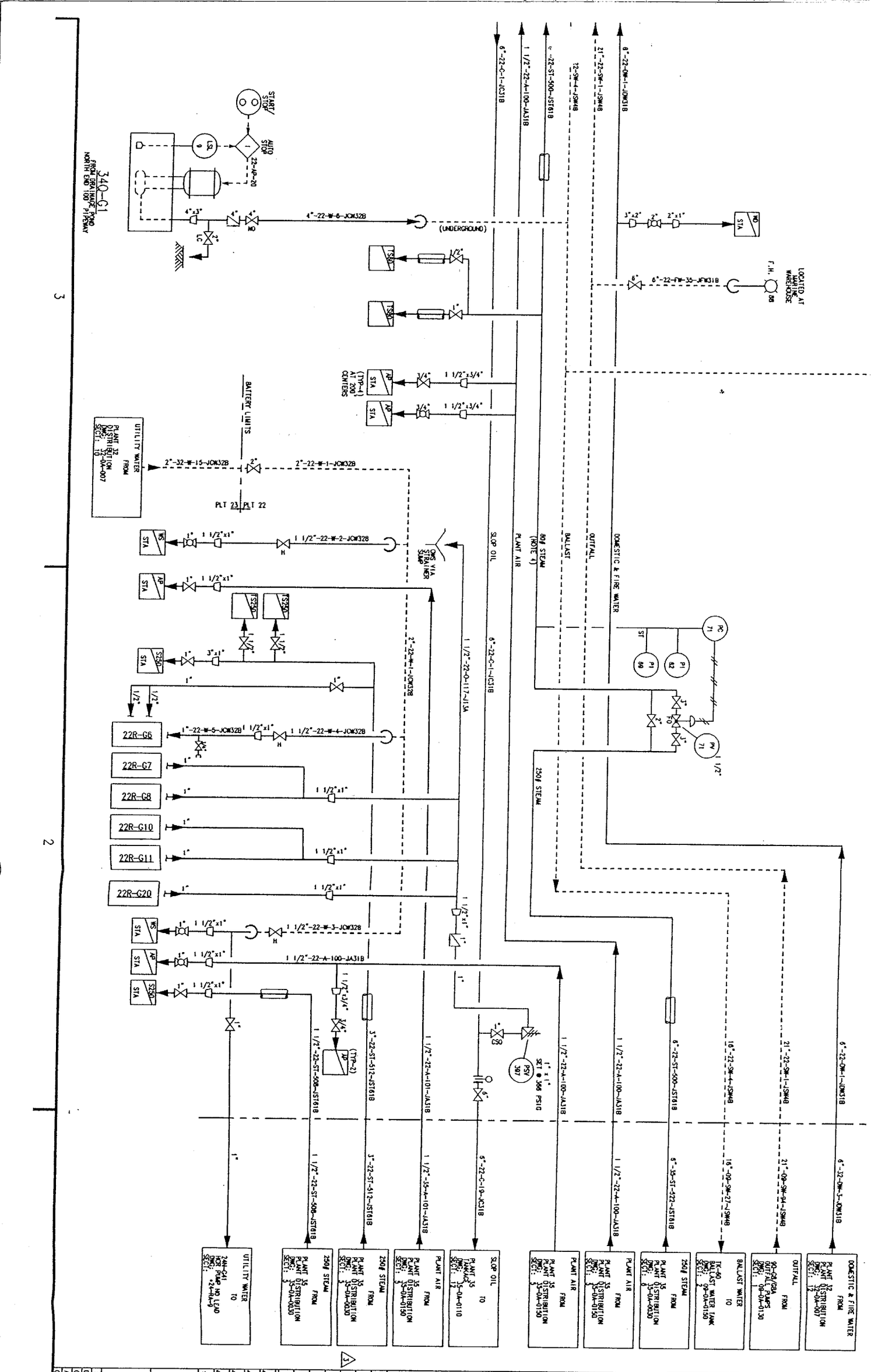

10"-22-0-107-J059B
10"-22-0-108-J059B
10"-22-0-106-J059B
10"-22-0-105-J059B
18"-22-0-288-J14B
14"-22-0-120-J13A
14"-22-0-6-J059B
14"-22-0-4-J059B
8"-22-0-18-J059B
8"-22-0-8-J059B
8"-22-0-10-J059B
8"-22-0-12-J059B
HIGH SULFUR DIESEL
LEAD FREE PREMIUM GASOLINE
AVJET TANK #59
LOW SULFUR DIESEL
AVJET TANK #44
SOUR LCCO
LEAD FREE GASOLINE
REGULAR GASOLINE
LEAD FREE PREMIUM GASOLINE
LOW SULFUR DIESEL (LINE #3)
AVJET (LINE #2)
AVJET (LINE #1)
HIGH SULFUR DIESEL (LINE #2)
HIGH SULFUR DIESEL (LINE #1)
JET FUEL RECIRC
HSD BYPASS/DSL BL
12"-22-0-287-J14B
4"-22-0-20-J059B
14"-22-0-15-J059B
8"-22-0-26-J059B
14"-22-0-25-J059B
8"-22-0-25-J059B
4" x 6" SET @ 233 PSIG
PSV 22
PI 40
TCH 5
TW 5
SHUTDOWN 24-AP-13
BERTHS 1,2,3 EMERGENCY STOP SECT: 6
WHARF EMERGENCY STOP SECT: 6
START/ STOP
OWS VIA STRAINER SUMP
OWS
SLOP
(SK 5-23-68)
8"-22-0-28-J059B
8"-22-0-93-J059B
PSV 23
PSV 974
PI 41
TCH 6
TW 6
LO
1/2" x 1" SET @ 360 PSIG
14"-22-0-27-J059B
14"-22-0-9-J059B
14"-22-0-7-J059B
14"-22-0-11-J059B
14"-22-0-131-J13A
8"-22-0-29-J059B
8"-22-0-30-J059B
PSV 24
PI 42
TCH 7
TW 7
22R-G7
22R-G8
22R-G9


30"-22-0-2-J0598 CRUDE OIL
12"-22-0-18-J0598 840 BUNKER (BFO)
14"-22-0-120-J13A LEAD FREE GASOLINE
14"-22-0-6-J0598 MTBE/REGULAR GASOLINE
14"-22-0-4-J0598 LEAD FREE PREMIUM GASOLINE
8"-22-0-16-J0598 LOW SULFUR DIESEL (LINE #3)
8"-22-0-8-J0598 AVJET (LINE #2)
8"-22-0-10-J0598 AVJET (LINE #1)
12-0-14-J0598 HIGH SULFUR DIESEL (LINE #2)
8"-22-0-12-J0598 HIGH SULFUR DIESEL (LINE #1)
14"-22-0-134-J14B MTBE
14"-22-0-136-J14B
REGULAR GASOLINE
1/2" x 1/2" SET @ 100 PSIG
PSV 457
SITE STATION 303B
SITE STATION 304B
SITE STATION 305B
SITE STATION 306B
SITE STATION 311B
SITE STATION 310B
SITE STATION 308B
LOW SULFUR DIESEL (LINE #3)
AVJET (LINE #2)
AVJET (LINE #1)
HIGH SULFUR DIESEL (LINE #2)
HIGH SULFUR DIESEL (LINE #1)
18"-22-0-288-J14B
12"-22-0-18-J0598
10"-22-0-18-J0598
20"-22-0-17-J0598
10"-22-0-17-J13A
OWS VIA STRAINER SUMP
START/ STOP
WHARF EMERGENCY STOP SECT: 5
BERTHS 1,2,3 EMERGENCY STOP SECT: 4
SHUTDOWN 24-AP-13
BATTERY LIMITS
PLT 23 PLT 22
SLOPS TO 23H-C??? BUNKER FUEL STRAINER DWG: 23-0A-0010 SECT: 11
22R-C6
1"-22-W-5-JCW328
LEAK DETECTION MASTER STATION
22FT/TT311A DWG:22-0A-0040 SECT: 3
22FT/TT310A DWG:22-0A-0040 SECT: 3
22FT/TT308A DWG:22-0A-0040 SECT: 2
PLTS 21,23 PLT 22
6"-21-0-194-J0598
20"-21-0-18-J0598
BUNKER FUEL/SLOPS TO PLANT 35 DWG: 35-0A-0110 SECT: 11
BUNKER FUEL FROM TKS 37,40,41 & 42 PLANT 21 DWG: 21-0A-0110 SECT: 11

12 11 10


PLANT 22 WHARF DWG: 22-0A-0040 SECT: 1
LEAD FREE GASOLINE TO PLANT 22 WHARF DWG: 22-0A-0040 SECT: 1
14"-22-0-120-J13A
MTBE/REGULAR GASOLINE TO PLANT 22 WHARF DWG: 22-0A-0040 SECT: 1
14"-22-0-8-J059B
LEAD FREE PREMIUM GAS TO PLANT 22 WHARF DWG: 22-0A-0040 SECT: 1
14"-22-0-4-J059B
LOW SULFUR DIESEL TO PLANT 22 WHARF DWG: 22-0A-0040 SECT: 1
8"-22-0-16-J059B
AVJET TO PLANT 22 WHARF DWG: 22-0A-0040 SECT: 1
8"-22-0-8-J059B
AVJET TO PLANT 22 WHARF DWG: 22-0A-0040 SECT: 1
8"-22-0-10-J059B
HIGH SULFUR DIESEL TO PLANT 22 WHARF DWG: 22-0A-0040 SECT: 1
8"-22-0-14-J059B
HIGH SULFUR DIESEL TO PLANT 22 WHARF DWG: 22-0A-0040 SECT: 1
8"-22-0-12-J059B
(UNDERGROUND TYP.)
CATHODIC PROTECTION
REMOTE
OPEN OPEN G
STOP IN MOTION A
CLOSE CLOSED R
REMOTE
BLENDING CONTROL ROOM
STOP RUN R
START/STOP
SHUTDOWN 22-AP-21
PAL 11
TW 1
TCH 1
PI 90
TE 3018
FE 30181
FE 30182
MOV 222
(SEE NOTE 6)
TE 3028
FE 3028
LEAK DETECTION MASTER STATION
FY 3028
FA 3028
WTBE/FLUSHING CRUDE OIL
30"-22-0-104-J13B
30"-22-0-103-J13B
8"-22-0-55-J059B
MOV 121
MOV 122
AT MOV
RED FLG 20"x18"
20"-22-0-69-J13B
20"-22-0-68-J13B
1" x 1" SET @ 52 PSIG
1/2" x 1/2" SET @ 35 PSIG
PSV 53
PSV 58
FLUSH OIL
PI 93
12"-22-0-115-J13A
12"-22-0-59-J059B
8"-22-0-84-J13B
12"-22-0-80-J059B
12"-22-0-91-J059B
6"-22-0-56-J059B
PV 208
HIC 208
SLOP
PSL 11
PI 31
PI 32
FC 201
TW 2
TCH 2
PAL 12
10"-22-0-71-J13B
22R-G2
22R-G3
SC

15 14 13



1. INSTRUMENTATION AND PLANT AIR PIPING NOT SHOWN.
2. DESIGN CONDITIONS NOTED ARE MAXIMUM.
3. HIGH/LOW POINT VENTS AT CONTRACTOR'S OPTION REQUIRED.
4. THE PRESSURE RATING OF BOILER STEAM PIPING AND THE PRESSURE

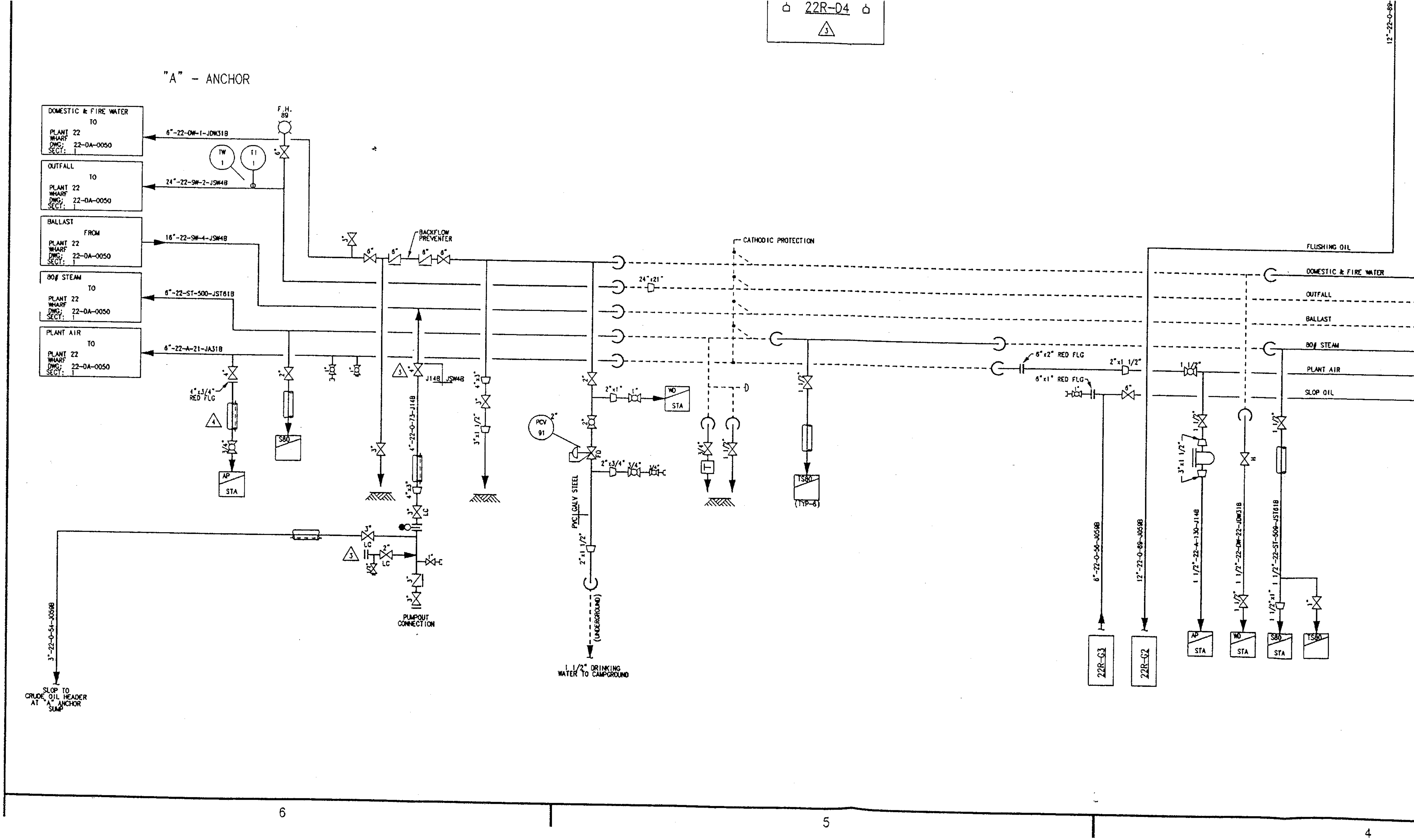
DWG NO.	
22-DA-0019	
50-DA-13	
22-DA-2	

NO.	DATE	MARKED	BY
1	1/31/95	5392	
2	9/19/93		
3	8/9/93		
4	1/13/94		

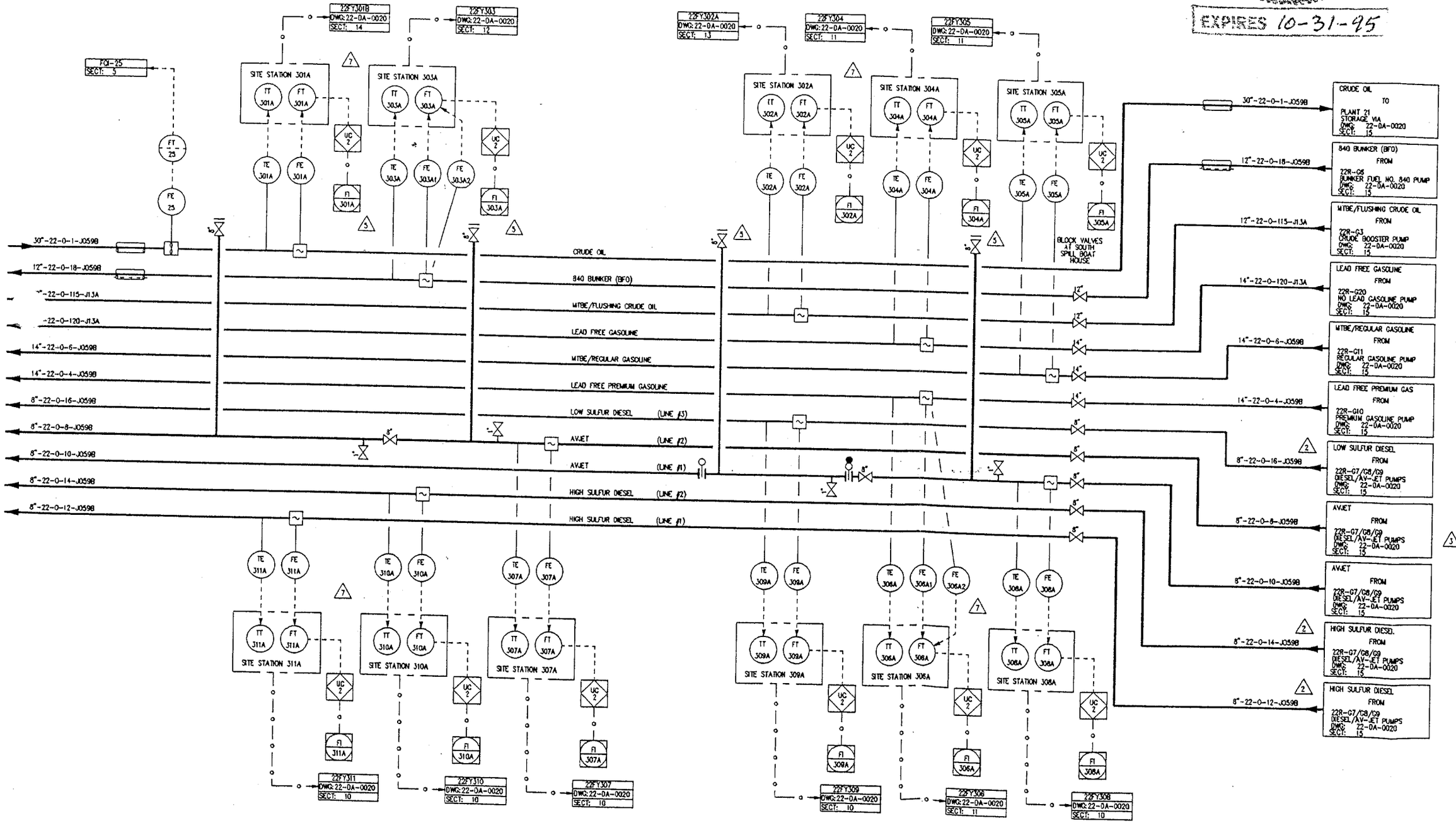
INITIALS-
DWN. BY JDT
CKD. BY
APP'D BY RPK
QA ENGR.

WHARF

TE



22R-D4
"A" - ANCHOR
DOMESTIC & FIRE WATER TO PLANT 22 WHARF DWG: 22-DA-0050 SECT: 1
OUTFALL TO PLANT 22 WHARF DWG: 22-DA-0050 SECT: 1
BALLAST FROM PLANT 22 WHARF DWG: 22-DA-0050 SECT: 1
80# STEAM TO PLANT 22 WHARF DWG: 22-DA-0050 SECT: 1
PLANT AIR TO PLANT 22 WHARF DWG: 22-DA-0050 SECT: 1
6"-22-DW-1-JDW31B
24"-22-SW-2-JSW4B
16"-22-SW-4-JSW4B
6"-22-ST-500-JST61B
6"-22-A-21-JA31B
F.H. 89
TW 1
TI 1
BACKFLOW PREVENTER
CATHODIC PROTECTION
4"x3/4" RED FLG
AP STA
S80
4"-22-0-73-J14B
J14B JSW4B
3"x1 1/2"
4"x3"
24"x21"
WD STA
PCV 91
FO
PVC GALV STEEL
2"x1 1/2"
(UNDERGROUND)
1 1/2" DRINKING WATER TO CAMPGROUND
PUMPOUT CONNECTION
LC
3"-22-0-54-J059B
SLOP TO CRUDE OIL HEADER AT "A" ANCHOR SUMP
TS80 (TYP-6)
6"x2" RED FLG
6"x1" RED FLG
FLUSHING OIL
DOMESTIC & FIRE WATER
OUTFALL
BALLAST
80# STEAM
PLANT AIR
SLOP OIL
6"-22-0-56-J059B
12"-22-0-89-J059B
1 1/2"-22-A-130-J14B
1 1/2"-22-DW-22-JDW31B
1 1/2"-22-ST-509-JST61B
22R-G3
22R-G2
AP STA
WD STA
S80 STA
TS80
12"-22-0-89-
6
5
4



1. UTILITIES A
-ONSHOR
-OFFSHO

2. INSTRUMEN
PLANT NU

3. DESIGN D
NOTED WH

4. HIGH / LO
VALVES A
VALVES R
POINT DRA

5. CONTROL S
(SECTION

DWG NO.
50-DA-13
FP-22-L5-1 THRU 80
FP-22-J16-6-1
FP-22-J16-6-2
22-DA-0019
22-RA-2
22-AL-201
22-AL-202

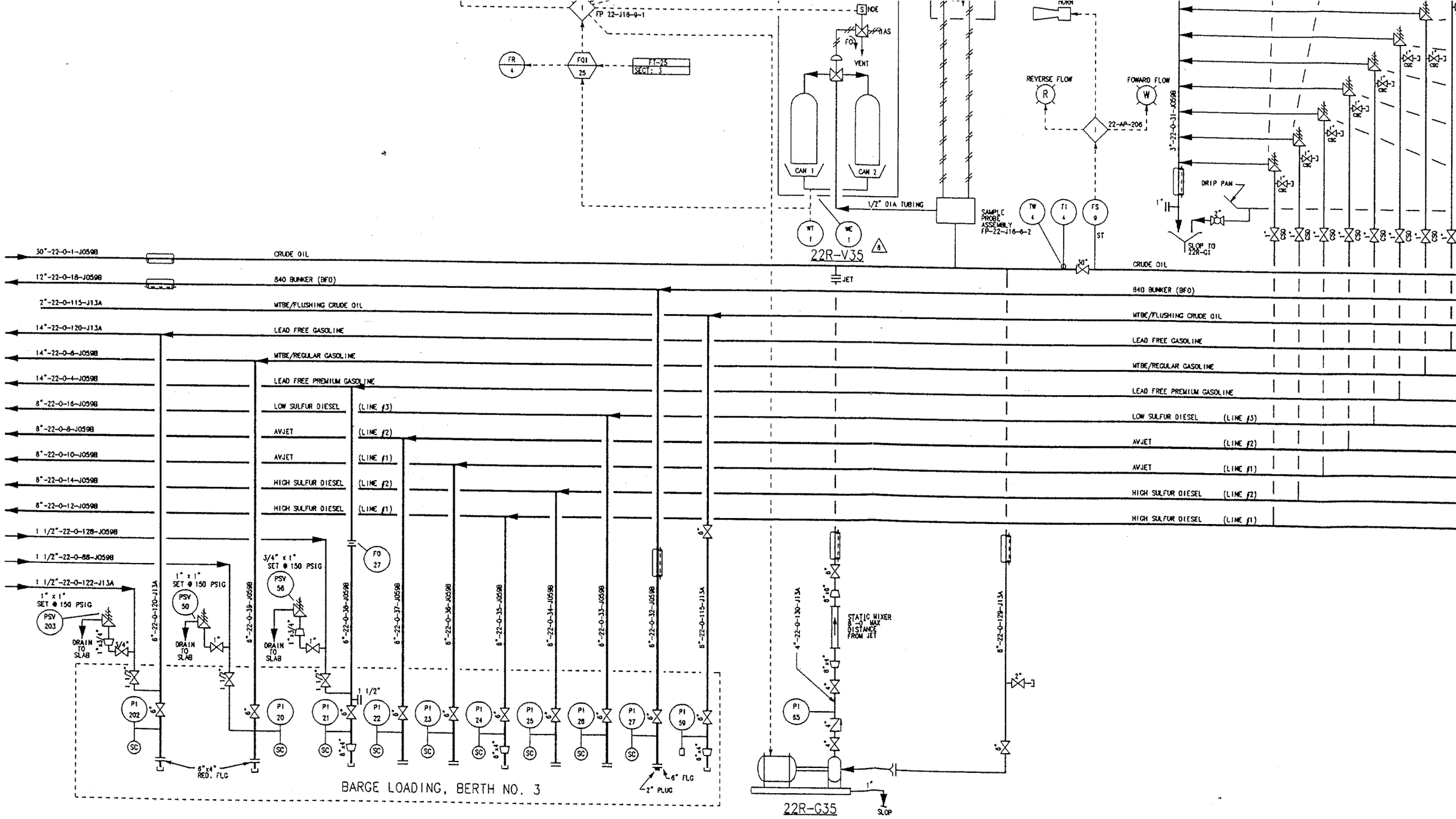
SYM	DATE	BM NUMBER
7	8/14/95	9415538
6	4/07/95	9421898
5	01/10/95	5772
4	9/23/94	

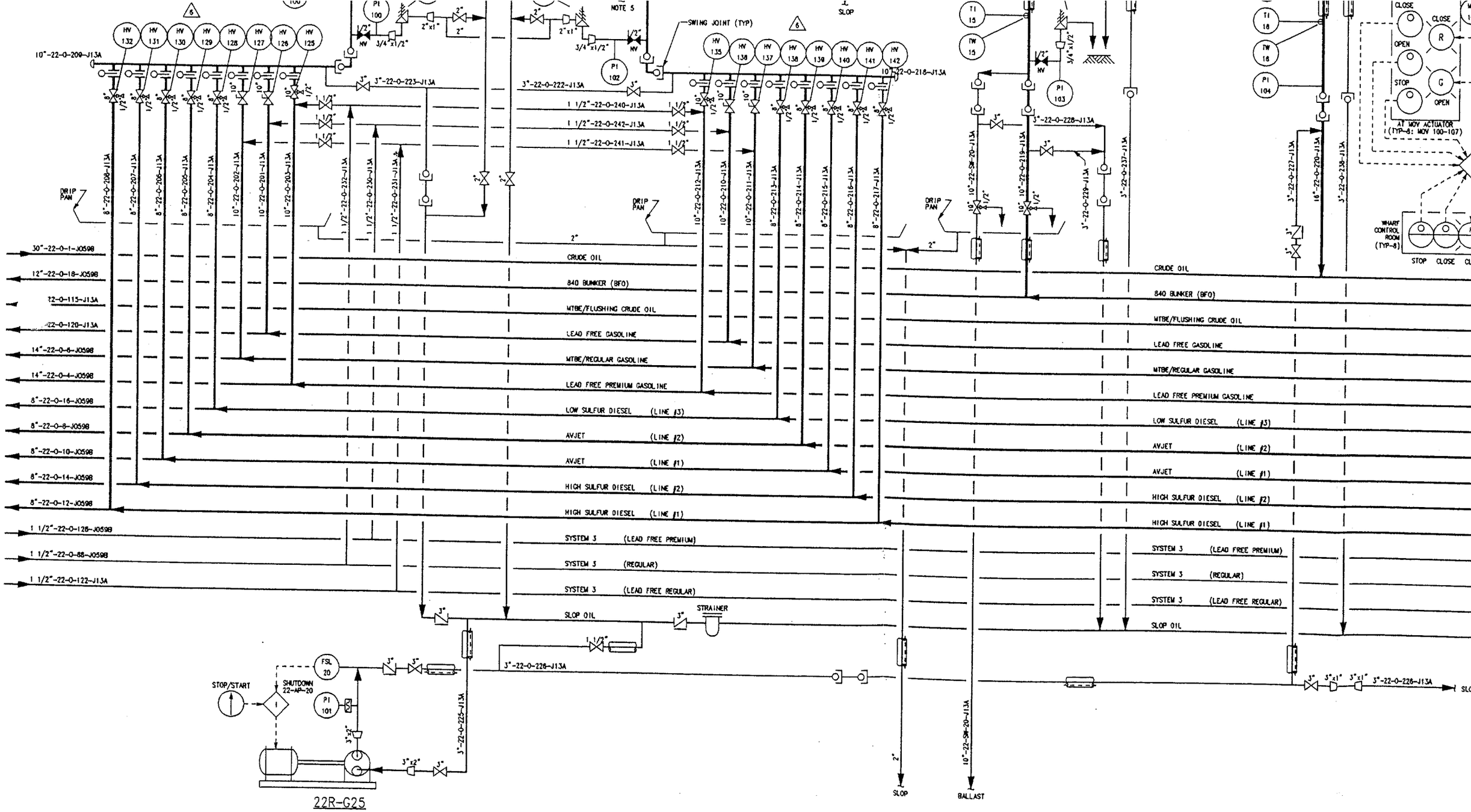
TEXA

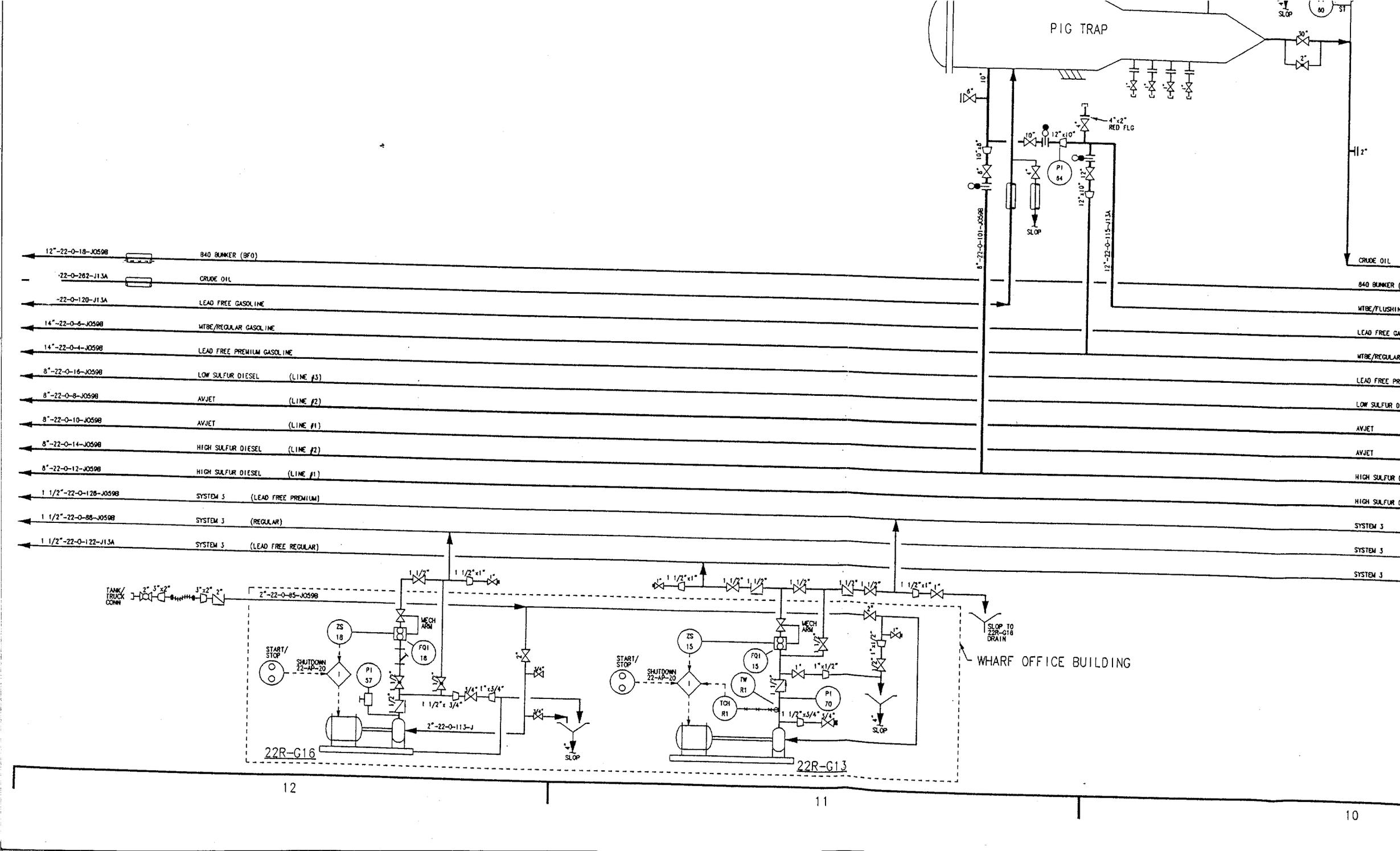
WHARF
PIPING
O

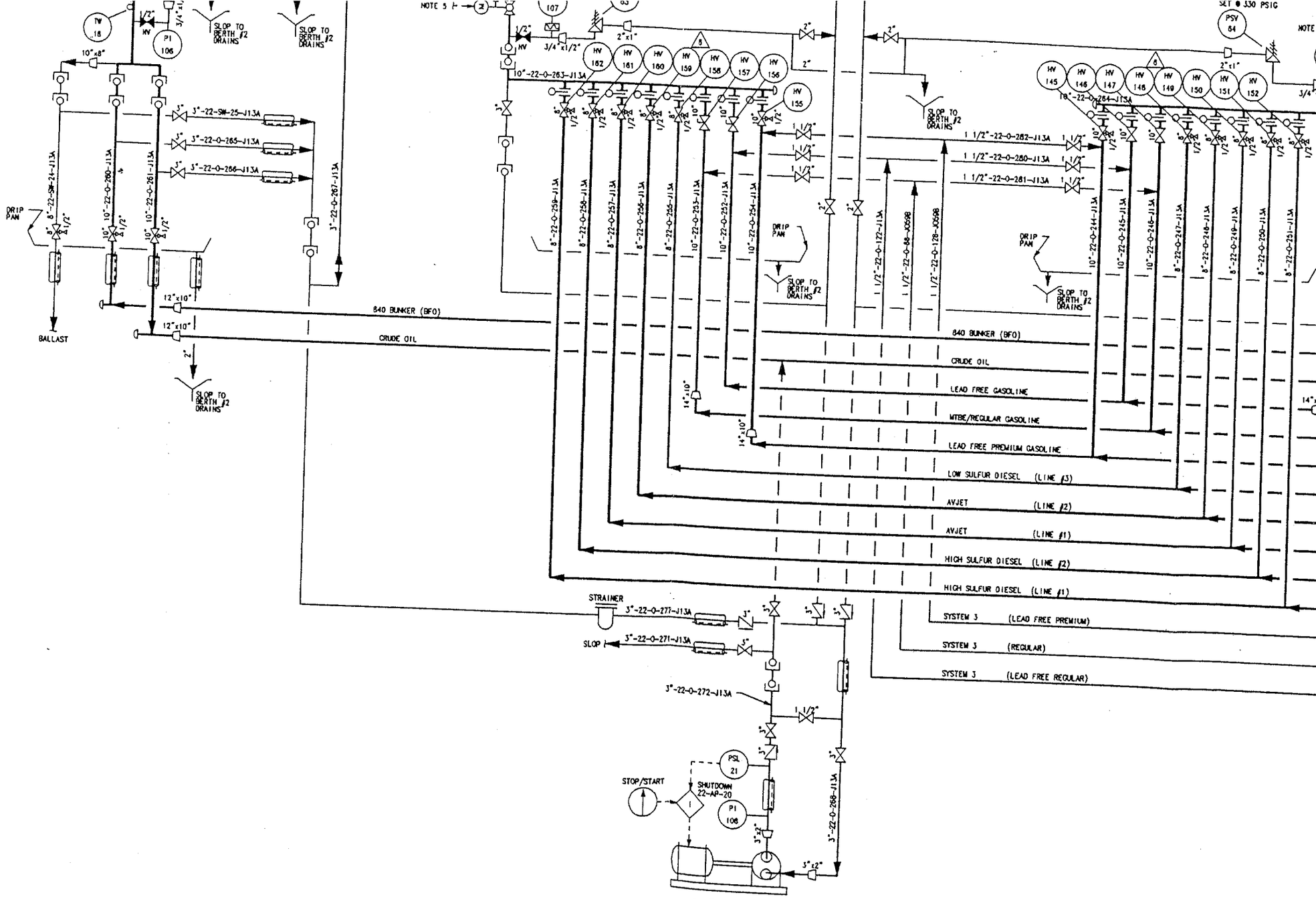
INITIALS-	
DWN. BY	JDT
CKD. BY	RPK
APP'D BY	
CHF. ENGR.	

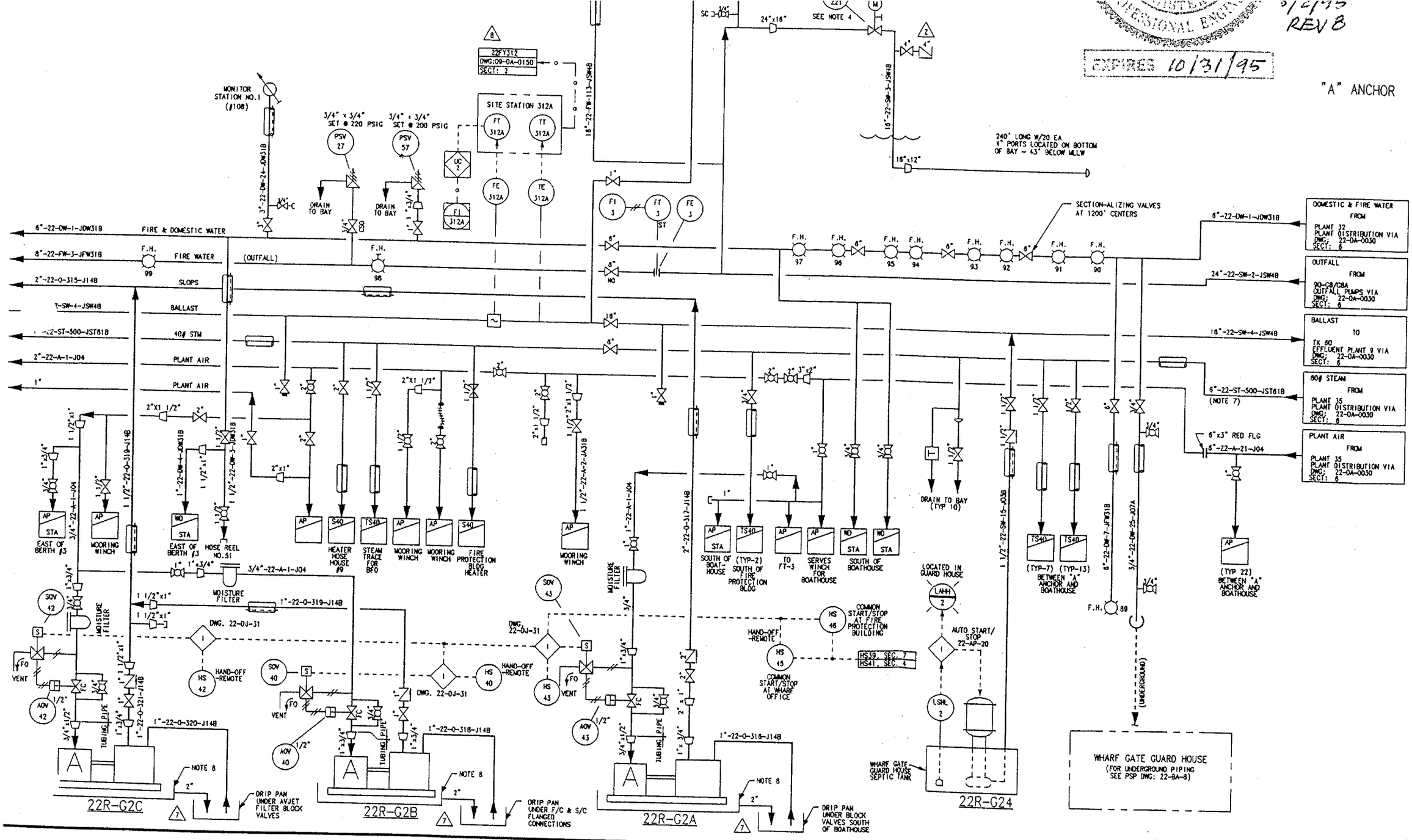
3 2 1

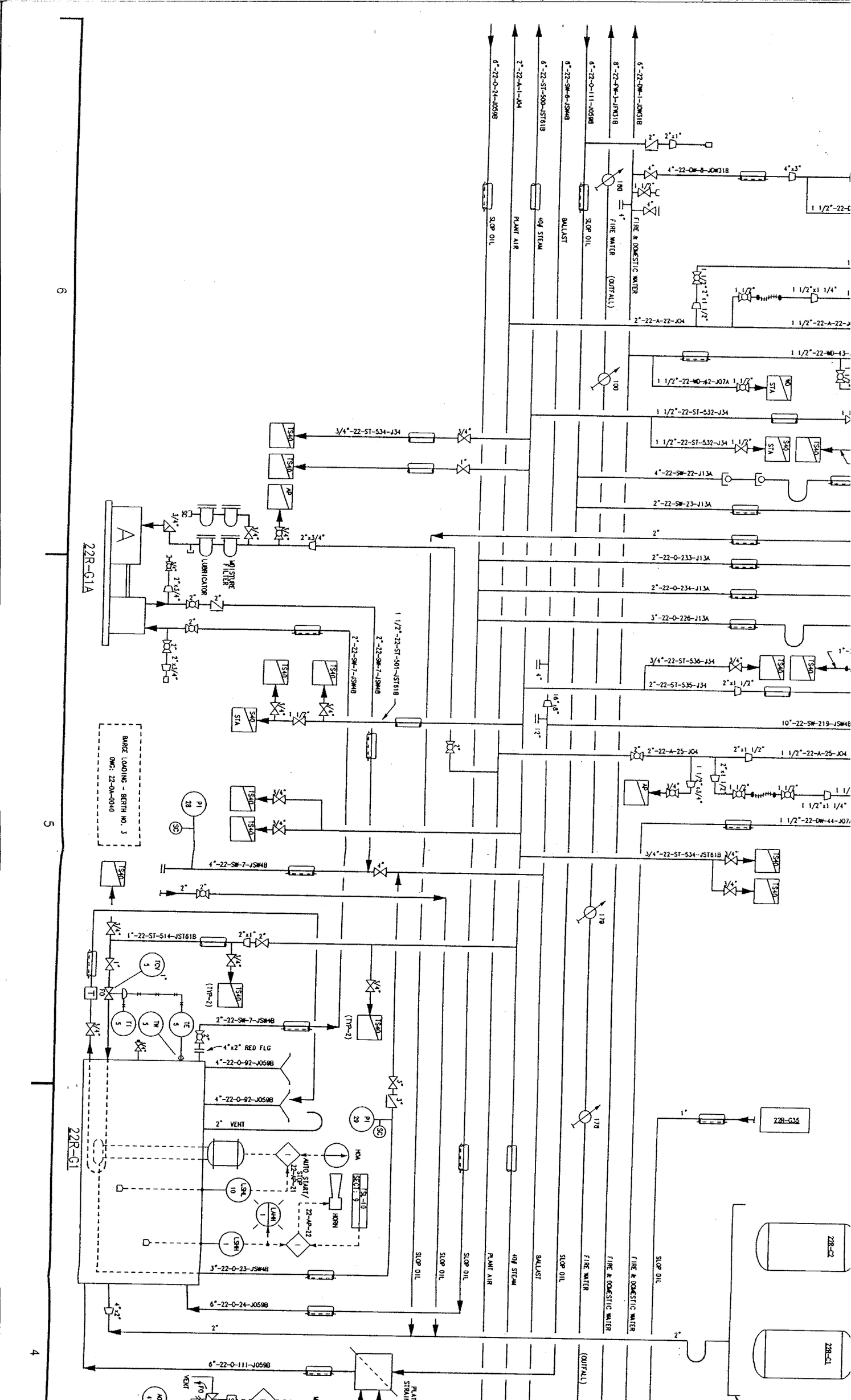

30"-22-0-1-J059B
CRUDE OIL
12"-22-0-18-J059B
840 BUNKER (BFO)
2"-22-0-115-J13A
MTBE/FLUSHING CRUDE OIL
14"-22-0-120-J13A
LEAD FREE GASOLINE
14"-22-0-6-J059B
MTBE/REGULAR GASOLINE
14"-22-0-4-J059B
LEAD FREE PREMIUM GASOLINE
8"-22-0-16-J059B
LOW SULFUR DIESEL (LINE #3)
8"-22-0-8-J059B
AVJET (LINE #2)
8"-22-0-10-J059B
AVJET (LINE #1)
8"-22-0-14-J059B
HIGH SULFUR DIESEL (LINE #2)
8"-22-0-12-J059B
HIGH SULFUR DIESEL (LINE #1)
1 1/2"-22-0-128-J059B
1 1/2"-22-0-88-J059B
1 1/2"-22-0-122-J13A
1" x 1" SET @ 150 PSIG
PSV 203
PSV 50
PSV 56
3/4" x 1" SET @ 150 PSIG
DRAIN TO SLAB
FO 27
PI 202
PI 20
PI 21
PI 22
PI 23
PI 24
PI 25
PI 26
PI 27
PI 59
PI 85
SC
6" x 4" RED. FLG
6" FLG
2" PLUG
BARGE LOADING, BERTH NO. 3
22R-V35
22R-G35
JET
VENT
CAN 1
CAN 2
1/2" DIA TUBING
WT 1
WE 1
SAMPLE PROBE ASSEMBLY FP-22-J16-6-2
TW 4
TI 4
FS 9
ST
REVERSE FLOW
FOWARD FLOW
22-AP-206
DRIP PAN
SLOP TO 22R-G1
STATIC MIXER 20 DIA MAX DISTANCE FROM JET
SLOP
FP 22-J16-6-1
FR 4
FQI 25
FT-25 SECT. 3
3"-22-0-31-J059B
4"-22-0-130-J13A
8"-22-0-129-J13A
6"-22-0-39-J059B
6"-22-0-38-J059B
6"-22-0-37-J059B
6"-22-0-36-J059B
6"-22-0-35-J059B
6"-22-0-34-J059B
6"-22-0-33-J059B
6"-22-0-32-J059B
6"-22-0-115-J13A

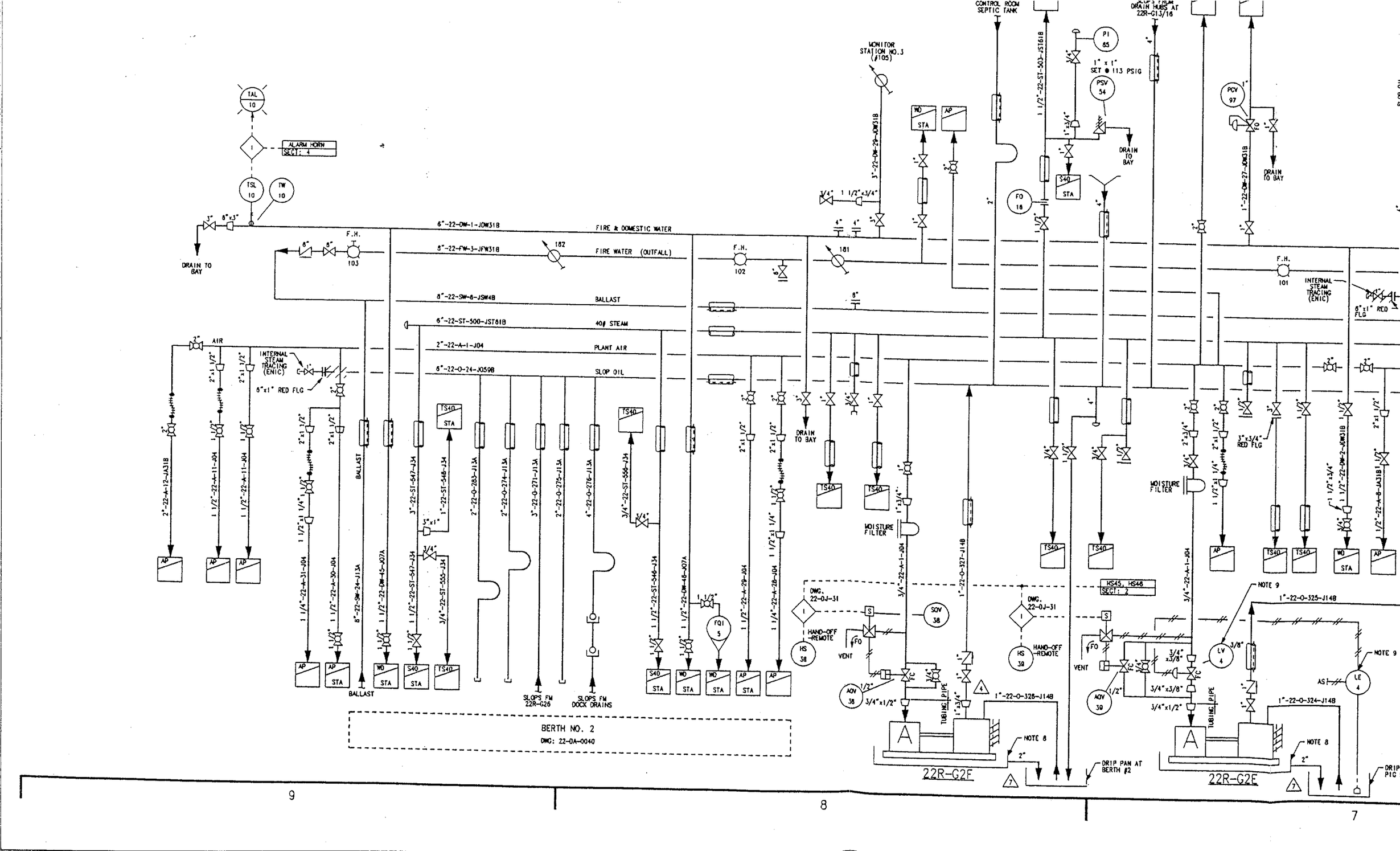

HV 132
HV 131
HV 130
HV 129
HV 128
HV 127
HV 126
HV 125
HV 135
HV 136
HV 137
HV 138
HV 139
HV 140
HV 141
HV 142
10"-22-0-209-J13A
10"-22-0-218-J13A
3"-22-0-223-J13A
3"-22-0-222-J13A
1 1/2"-22-0-240-J13A
1 1/2"-22-0-242-J13A
1 1/2"-22-0-241-J13A
SWING JOINT (TYP)
NOTE 5
SLOP
PI 100
PI 102
PI 103
PI 104
TI 15
TW 15
TI 16
TW 16
3"-22-0-228-J13A
3"-22-0-227-J13A
3"-22-0-229-J13A
3"-22-0-237-J13A
3"-22-0-238-J13A
16"-22-0-220-J13A
10"-22-SW-20-J13A
AT MOV ACTUATOR (TYP-8: MOV 100-107)
CLOSE
OPEN
STOP
R
C
WHARF CONTROL ROOM (TYP-8)
DRIP PAN
8"-22-0-208-J13A
8"-22-0-207-J13A
8"-22-0-206-J13A
8"-22-0-205-J13A
8"-22-0-204-J13A
10"-22-0-202-J13A
10"-22-0-201-J13A
10"-22-0-203-J13A
1 1/2"-22-0-232-J13A
1 1/2"-22-0-230-J13A
1 1/2"-22-0-231-J13A
10"-22-0-212-J13A
10"-22-0-210-J13A
10"-22-0-211-J13A
8"-22-0-213-J13A
8"-22-0-214-J13A
8"-22-0-215-J13A
8"-22-0-216-J13A
8"-22-0-217-J13A
30"-22-0-1-J0598
12"-22-0-18-J0598
22-0-115-J13A
22-0-120-J13A
14"-22-0-6-J0598
14"-22-0-4-J0598
8"-22-0-16-J0598
8"-22-0-8-J0598
8"-22-0-10-J0598
8"-22-0-14-J0598
8"-22-0-12-J0598
1 1/2"-22-0-126-J0598
1 1/2"-22-0-88-J0598
1 1/2"-22-0-122-J13A
CRUDE OIL
840 BUNKER (BFO)
MTBE/FLUSHING CRUDE OIL
LEAD FREE GASOLINE
MTBE/REGULAR GASOLINE
LEAD FREE PREMIUM GASOLINE
LOW SULFUR DIESEL (LINE #3)
AVJET (LINE #2)
AVJET (LINE #1)
HIGH SULFUR DIESEL (LINE #2)
HIGH SULFUR DIESEL (LINE #1)
SYSTEM 3 (LEAD FREE PREMIUM)
SYSTEM 3 (REGULAR)
SYSTEM 3 (LEAD FREE REGULAR)
SLOP OIL
STRAINER
3"-22-0-226-J13A
3"-22-0-225-J13A
FSL 20
PI 101
STOP/START
SHUTDOWN 22-AP-20
SLOP
BALLAST
22R-G25

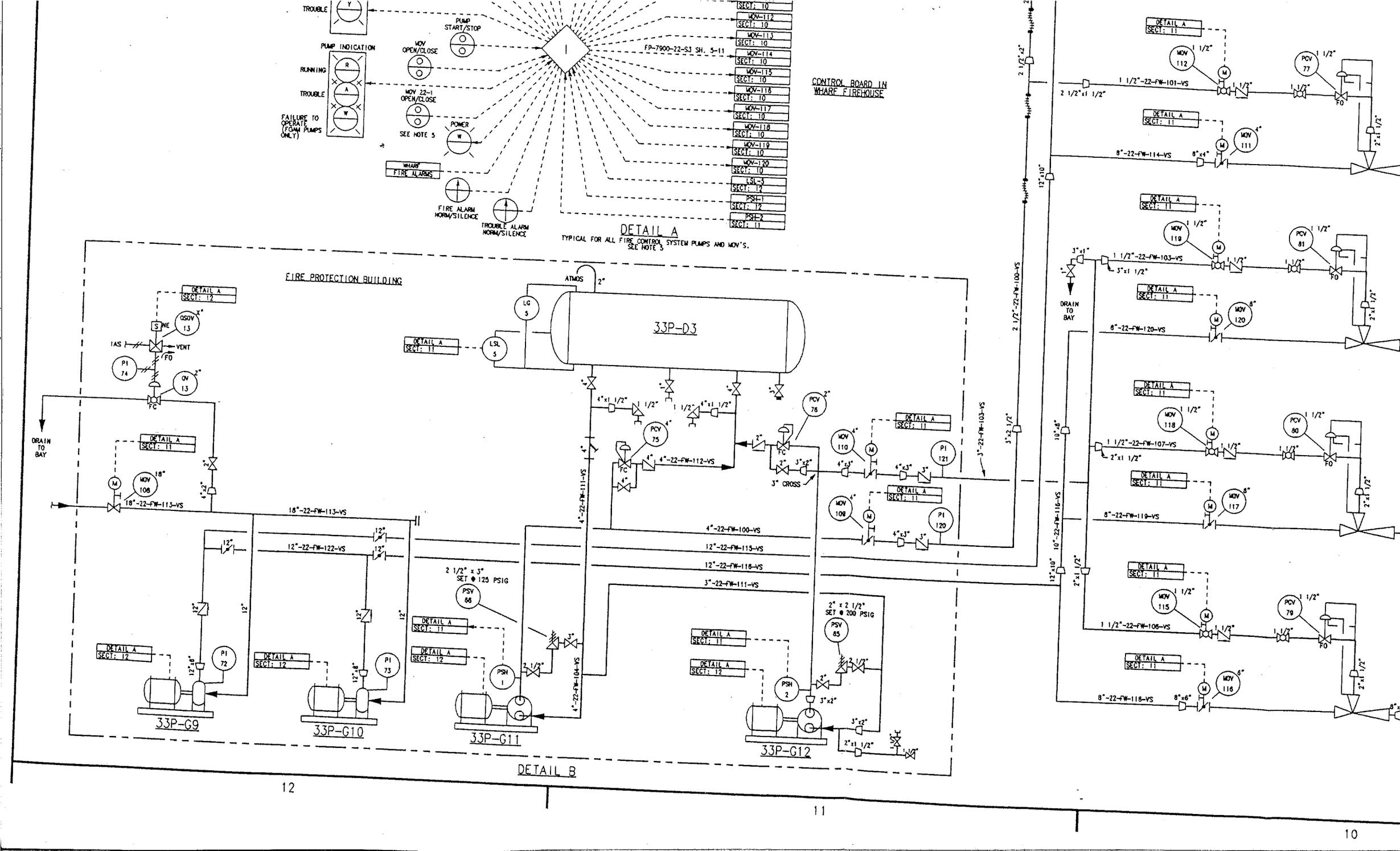

PIG TRAP
12"-22-0-18-J0598
840 BUNKER (BFO)
22-0-262-J13A
CRUDE OIL
22-0-120-J13A
LEAD FREE GASOLINE
14"-22-0-6-J0598
MTBE/REGULAR GASOLINE
14"-22-0-4-J0598
LEAD FREE PREMIUM GASOLINE
8"-22-0-16-J0598
LOW SULFUR DIESEL (LINE #3)
8"-22-0-8-J0598
AVJET (LINE #2)
8"-22-0-10-J0598
AVJET (LINE #1)
8"-22-0-14-J0598
HIGH SULFUR DIESEL (LINE #2)
8"-22-0-12-J0598
HIGH SULFUR DIESEL (LINE #1)
1 1/2"-22-0-126-J0598
SYSTEM 3 (LEAD FREE PREMIUM)
1 1/2"-22-0-88-J0598
SYSTEM 3 (REGULAR)
1 1/2"-22-0-122-J13A
SYSTEM 3 (LEAD FREE REGULAR)
8"-22-0-101-J0598
12"-22-0-115-J13A
4"x2" RED FLG
P1 84
SLOP
CRUDE OIL
840 BUNKER
MTBE/FLUSHIN
LEAD FREE GA
MTBE/REGULAR
LEAD FREE PR
LOW SULFUR D
AVJET
AVJET
HIGH SULFUR
HIGH SULFUR
SYSTEM 3
SYSTEM 3
SYSTEM 3
TANK/ TRUCK CONN
2"-22-0-85-J0598
ZS 18
MECH ARM
FQI 18
START/ STOP
SHUTDOWN 22-AP-20
P1 57
2"-22-0-113-J
22R-G16
ZS 15
FQI 15
TW R1
TCH R1
P1 70
22R-G13
SLOP TO 22R-G16 DRAIN
WHARF OFFICE BUILDING
12
11
10

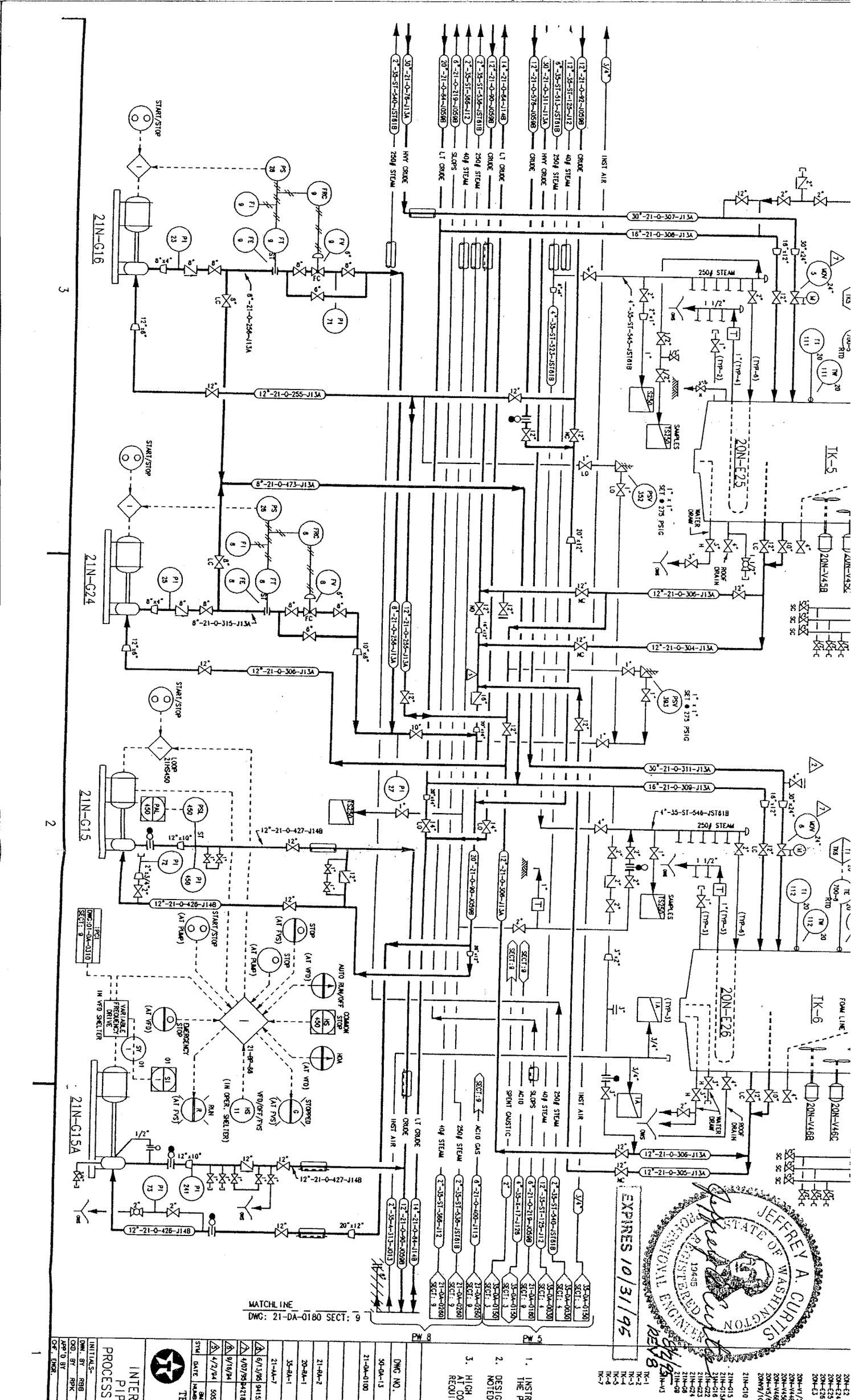

840 BUNKER (BFO)
CRUDE OIL
LEAD FREE GASOLINE
MTBE/REGULAR GASOLINE
LEAD FREE PREMIUM GASOLINE
LOW SULFUR DIESEL (LINE #3)
AVJET (LINE #2)
AVJET (LINE #1)
HIGH SULFUR DIESEL (LINE #2)
HIGH SULFUR DIESEL (LINE #1)
SYSTEM 3 (LEAD FREE PREMIUM)
SYSTEM 3 (REGULAR)
SYSTEM 3 (LEAD FREE REGULAR)
BALLAST
STRAINER
SLOP
STOP/START
SHUTDOWN 22-AP-20
DRIP PAN
SLOP TO BERTH #2 DRAINS
22R-G26

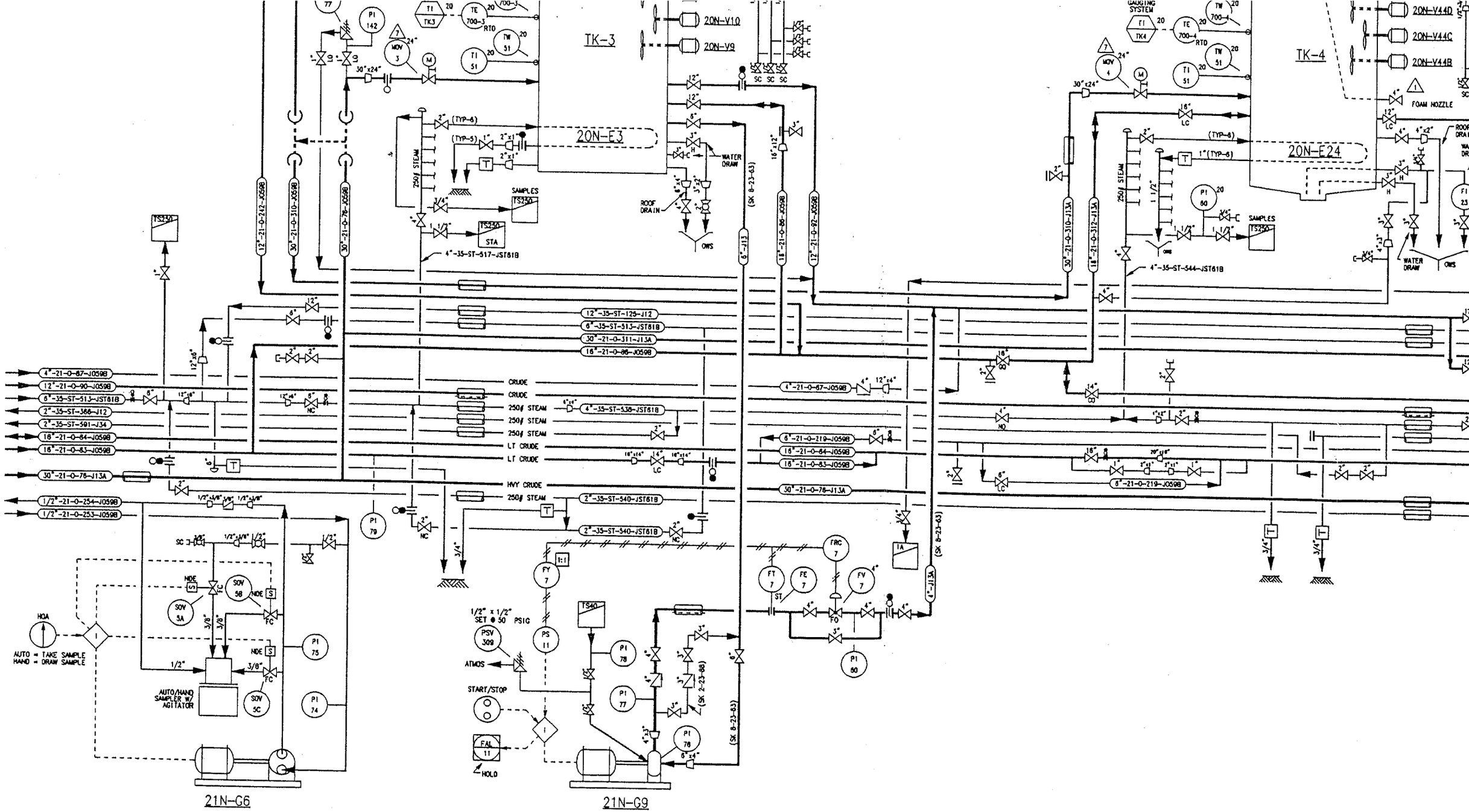

"A" ANCHOR
EXPIRES 10/31/95
REV 8
MONITOR STATION NO.1 (#108)
SITE STATION 312A
22FY312
DWG:09-0A-0150
SECT: 2
6"-22-DW-1-JDW31B
FIRE & DOMESTIC WATER
8"-22-FW-3-JFW31B
FIRE WATER
(OUTFALL)
2"-22-O-315-J14B
SLOPS
BALLAST
40# STM
2"-22-A-1-J04
PLANT AIR
1"
PLANT AIR
SECTION-ALIZING VALVES AT 1200' CENTERS
240' LONG W/20 EA 4" PORTS LOCATED ON BOTTOM OF BAY ~ 43' BELOW MLLW
DOMESTIC & FIRE WATER FROM PLANT 32 PLANT DISTRIBUTION VIA DWG: 22-0A-0030 SECT: 6
OUTFALL FROM 90-C8/C8A OUTFALL PUMPS VIA DWG: 22-0A-0030 SECT: 6
BALLAST TO TK 60 EFFLUENT PLANT 9 VIA DWG: 22-0A-0030 SECT: 6
80# STEAM FROM PLANT 35 PLANT DISTRIBUTION VIA DWG: 22-0A-0030 SECT: 6
PLANT AIR FROM PLANT 35 PLANT DISTRIBUTION VIA DWG: 22-0A-0030 SECT: 6
EAST OF BERTH #3
MOORING WINCH
HOSE REEL NO.51
HEATER HOSE HOUSE #9
STEAM TRACE FOR BFO
FIRE PROTECTION BLDG HEATER
SOUTH OF BOAT-HOUSE
(TYP-2) SOUTH OF FIRE PROTECTION BLDG
TO FT-3
SERVES WINCH FOR BOATHOUSE
SOUTH OF BOATHOUSE
DRAIN TO BAY (TYP 10)
(TYP-7) BETWEEN "A" ANCHOR AND BOATHOUSE
(TYP-13)
(TYP 22) BETWEEN "A" ANCHOR AND BOATHOUSE
MOISTURE FILTER
COMMON START/STOP AT FIRE PROTECTION BUILDING
COMMON START/STOP AT WHARF OFFICE
LOCATED IN GUARD HOUSE
AUTO START/STOP 22-AP-20
WHARF GATE GUARD HOUSE SEPTIC TANK
WHARF GATE GUARD HOUSE (FOR UNDERGROUND PIPING SEE PSP DWG: 22-BA-8)
(UNDERGROUND)
22R-G2C
22R-G2B
22R-G2A
22R-G24
DRIP PAN UNDER AVJET FILTER BLOCK VALVES
DRIP PAN UNDER F/C & S/C FLANGED CONNECTIONS
DRIP PAN UNDER BLOCK VALVES SOUTH OF BOATHOUSE
NOTE 8
HAND-OFF-REMOTE
DWG. 22-0J-31
1. INSTRU PLANT
2. DESIGN NOTED
3. HIGH / AT CON REQUIR
4. MOV 22 A) WHA C) WHA TRANSF MOV 22 THROUG
5. ONLY T OPERAT
6. "VS" I NO TEX
7. PIPE FR AT "A"
8. DRIP PA DECK LE 2" RETU
9. REUSE E 22LV4.
DWG NO.
22-0A-0019
50-0A-13
22-BA-8
22-AM-228
FP-7900-22-S3-14
FP-7900-22-S3-15
FP-7900-22-S3-16
22-RA-2
22-AL-201
22-AL-202
22-AL-210
22-BL-110
6 6/13/95 9415536
5 4/25/95 5678
4 4/07/95 9421898
3 4/18/94
SYM DATE BM NUMBER
INITIALS-
DWN. BY JDT
CKD. BY RPK
APP'D BY
CHF. ENGR.
3
2
1


6"-22-O-24-J059B
SLOP OIL
2"-22-A-1-J04
PLANT AIR
6"-22-ST-500-JST61B
40# STEAM
6"-22-SW-4-JSW4B
BALLAST
6"-22-O-111-J059B
SLOP OIL
8"-22-FW-1-JFW31B
FIRE WATER (OUTFALL)
6"-22-DW-1-JDW31B
FIRE & DOMESTIC WATER
4"-22-DW-8-JDW31B
2"-22-A-22-J04
1 1/2"-22-WD-43-
1 1/2"-22-WD-42-J07A
1 1/2"-22-ST-532-J34
3/4"-22-ST-534-J34
4"-22-SW-22-J13A
2"-22-SW-23-J13A
2"-22-O-233-J13A
2"-22-O-234-J13A
3"-22-O-226-J13A
3/4"-22-ST-536-J34
2"-22-ST-535-J34
1 1/2"-22-ST-501-JST61B
2"-22-SW-7-JSW4B
10"-22-SW-219-JSW4B
2"-22-A-25-J04
1 1/2"-22-A-25-J04
1 1/2"-22-DW-44-J07A
3/4"-22-ST-534-JST61B
4"-22-SW-7-JSW4B
1"-22-ST-514-JST61B
2"-22-SW-7-JSW4B
4"x2" RED FLG
4"-22-O-92-J059B
2" VENT
3"-22-O-23-JSW4B
6"-22-O-24-J059B
6"-22-O-111-J059B
22R-G1A
22R-G1
22R-G35
22R-G2
22R-G1
LUBRICATOR
MOISTURE FILTER
BARGE LOADING - BERTH NO. 3
DWG: 22-04-0040
AUTO START/ STOP 22-AP-21
22-AP-22
HORN
HOA
PLATE STRAINER
(OUTFALL)
(TYP-2)

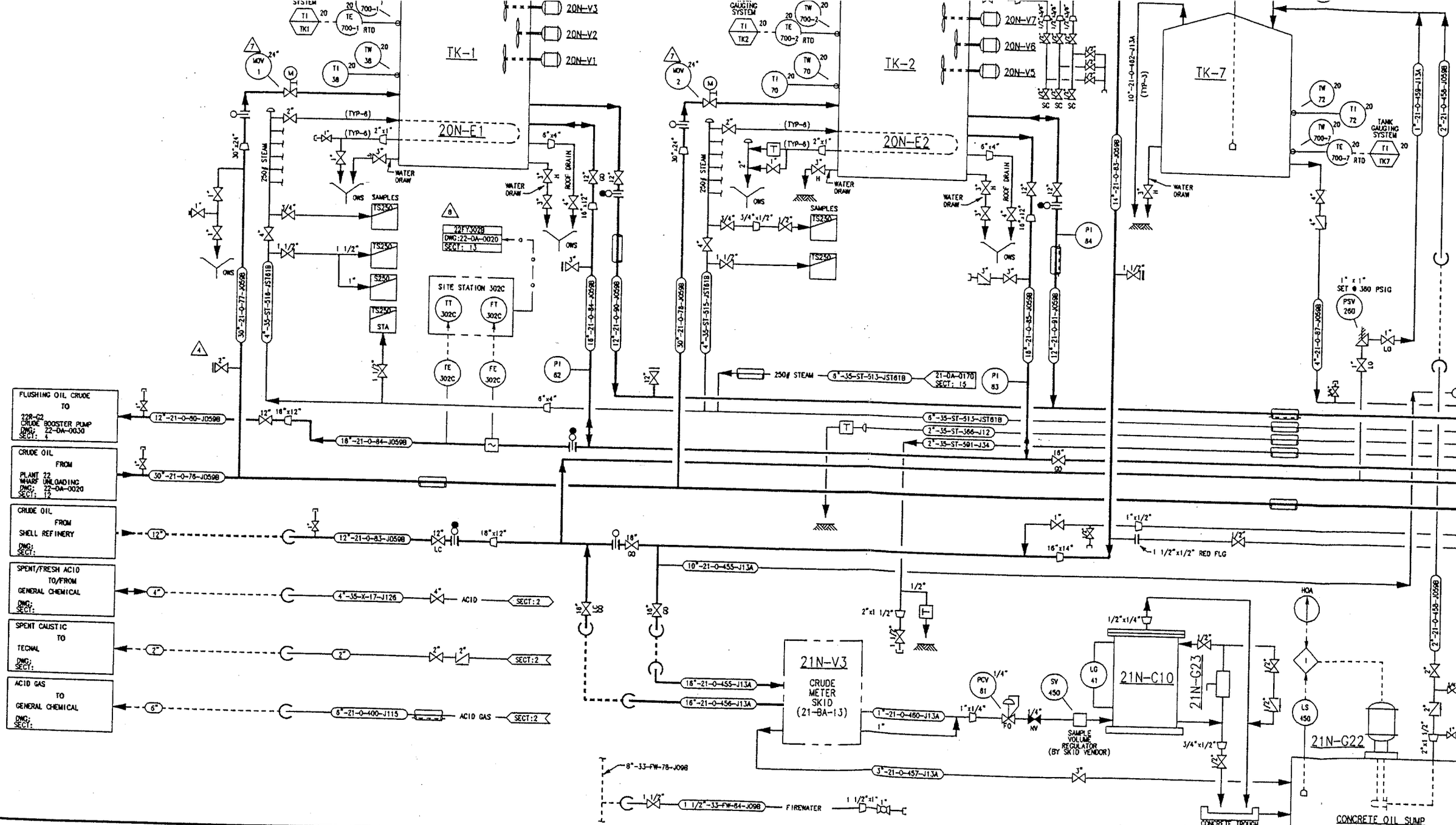

6"-22-OW-1-JOW31B
FIRE & DOMESTIC WATER
8"-22-FW-3-JFW31B
FIRE WATER (OUTFALL)
8"-22-SW-6-JSW4B
BALLAST
6"-22-ST-500-JST61B
40# STEAM
2"-22-A-1-J04
PLANT AIR
6"-22-O-24-JO59B
SLOP OIL
DRAIN TO BAY
F.H.
103
102
101
182
181
ALARM HORN
SECT: 4
TAL 10
TSL 10
TW 10
MONITOR STATION NO.3 (#105)
CONTROL ROOM SEPTIC TANK
DRAIN HUBS AT 22R-G13/16
PI 85
PSV 34
PCV 97
FO 18
1" x 1" SET @ 113 PSIG
INTERNAL STEAM TRACING (ENIC)
6"x1" RED FLG
3"x3/4" RED FLG
MOISTURE FILTER
BALLAST
SLOPS FM 22R-G26
SLOPS FM DOCK DRAINS
FQI 5
SOV 38
HS 38
HS 39
AOV 38
AOV 39
LV 4
LE 4
DWG. 22-0J-31
HAND-OFF -REMOTE
VENT
TUBING PIPE
HS45, HS46 SECT: 2
NOTE 8
NOTE 9
DRIP PAN AT BERTH #2
22R-G2F
22R-G2E
BERTH NO. 2
DWG: 22-0A-0040

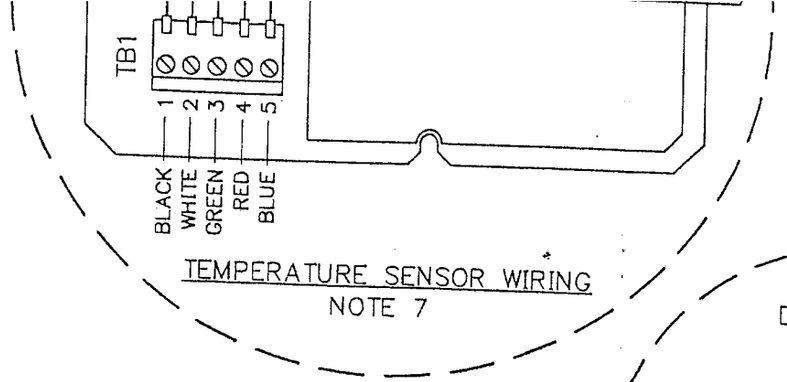

DETAIL A
TYPICAL FOR ALL FIRE CONTROL SYSTEM PUMPS AND MOV'S.
SEE NOTE 5
CONTROL BOARD IN WHARF FIREHOUSE
FIRE PROTECTION BUILDING
33P-D3
33P-G9
33P-G10
33P-G11
33P-G12
DETAIL B
DRAIN TO BAY
ATMOS
VENT
4"-22-FW-111-VS
18"-22-FW-113-VS
12"-22-FW-122-VS
4"-22-FW-100-VS
12"-22-FW-115-VS
12"-22-FW-116-VS
3"-22-FW-111-VS
4"-22-FW-112-VS
3"-22-FW-103-VS
2 1/2"-22-FW-100-VS
10"-22-FW-116-VS
1 1/2"-22-FW-101-VS
8"-22-FW-114-VS
1 1/2"-22-FW-103-VS
8"-22-FW-120-VS
1 1/2"-22-FW-107-VS
8"-22-FW-119-VS
1 1/2"-22-FW-106-VS
8"-22-FW-118-VS
2 1/2" x 3" SET @ 125 PSIG
2" x 2 1/2" SET @ 200 PSIG
3" CROSS
PUMP START/STOP
MOV OPEN/CLOSE
MOV 22-1 OPEN/CLOSE
POWER
TROUBLE
RUNNING
FAILURE TO OPERATE (FOAM PUMPS ONLY)
WHARF FIRE ALARMS
FIRE ALARM NORM/SILENCE
TROUBLE ALARM NORM/SILENCE
FP-7900-22-SJ SH. 5-11


21N-G16
21N-G24
21N-G15
21N-G15A
TK-5
TK-6
20N-E25
20N-E26
20N-V45B
20N-V46B
20N-V46C
START/STOP
12"-21-0-255-J13A
12"-21-0-306-J13A
12"-21-0-304-J13A
30"-21-0-311-J13A
16"-21-0-309-J13A
12"-21-0-427-J14B
12"-21-0-426-J14B
12"-21-0-305-J13A
250# STEAM
INST AIR
SAMPLES
WATER DRAW
ROOF DRAIN
MATCHLINE
DWG: 21-DA-0180 SECT: 9
PW 8
PW 5
EXPIRES 10/31/95
JEFFREY A. CURTIS
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER
19435

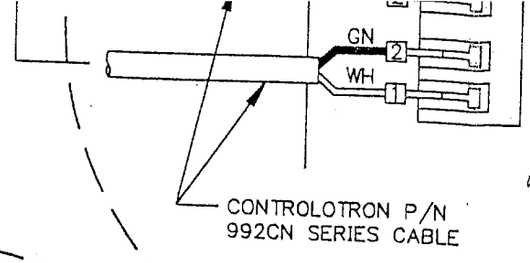

TK-3
TK-4
20N-E3
20N-E24
20N-V10
20N-V9
20N-V44D
20N-V44C
20N-V44B
FOAM NOZZLE
WATER DRAW
OWS
ROOF DRAIN
SAMPLES
TS250
STA
250# STEAM
12"-21-0-242-J0598
30"-21-0-310-J0598
30"-21-0-76-J0598
4"-35-ST-517-JST61B
18"-21-0-86-J0598
12"-21-0-92-J0598
30"-21-0-311-J13A
30"-21-0-312-J13A
4"-35-ST-544-JST61B
12"-35-ST-125-J12
6"-35-ST-513-JST61B
16"-21-0-86-J0598
4"-21-0-87-J0598
12"-21-0-90-J0598
2"-35-ST-366-J12
2"-35-ST-591-J34
16"-21-0-84-J0598
16"-21-0-83-J0598
30"-21-0-76-J13A
1/2"-21-0-254-J0598
1/2"-21-0-253-J0598
CRUDE
CRUDE
250# STEAM
250# STEAM
250# STEAM
LT CRUDE
LT CRUDE
HVY CRUDE
250# STEAM
4"-35-ST-538-JST61B
2"-35-ST-540-JST61B
2"-35-ST-540-JST61B
6"-21-0-219-J0598
16"-21-0-84-J0598
16"-21-0-83-J0598
30"-21-0-76-J13A
8"-21-0-219-J0598
4"-J13A
(SK 8-23-63)
(SK 2-23-88)
HOA
AUTO = TAKE SAMPLE
HAND = DRAW SAMPLE
AUTO/HAND SAMPLER W/ AGITATOR
SOV 5A
SOV 5B
SOV 5C
1/2" x 1/2" SET @ 50 PSIG
PSV 309
ATMOS
START/STOP
HOLD
21N-G6
21N-G9

6 5 4


TK-1
TK-2
TK-7
20N-E1
20N-E2
20N-V3
20N-V2
20N-V1
20N-V7
20N-V6
20N-V5
TANK GAUGING SYSTEM
SITE STATION 302C
250# STEAM
WATER DRAW
ROOF DRAIN
SAMPLES
OWS
FLUSHING OIL CRUDE TO 228-G2 CRUDE BOOSTER PUMP
CRUDE OIL FROM PLANT 22 WHARF UNLOADING
CRUDE OIL FROM SHELL REFINERY
SPENT/FRESH ACID TO/FROM GENERAL CHEMICAL
SPENT CAUSTIC TO TECNAL
ACID GAS TO GENERAL CHEMICAL
21N-V3
CRUDE METER SKID (21-BA-13)
21N-C10
21N-G23
21N-G22
SAMPLE VOLUME REGULATOR (BY SKID VENDOR)
FIREWATER
CONCRETE TROUGH
CONCRETE OIL SUMP
6'x6'x4' DEEP
1 1/2"x1/2" RED FLG
1" x 1" SET @ 360 PSIG

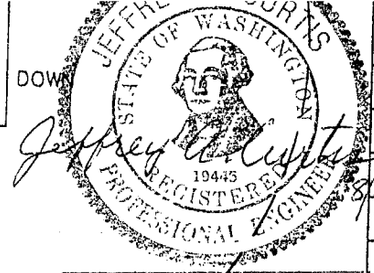


TEMPERATURE SENSOR WIRING
NOTE 7



CONTROLOTRON P/N
992CN SERIES CABLE

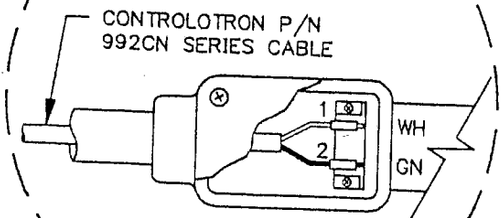
TRANSDUCER CABLE WIRING
NOTE 7



10/31/95

ITEM	QTY	DESC
1	A/R	CONDUIT, 1/2" LIQUIDTIGHT
9	4	CONDUIT FITTING, 1/2" LIQU
83	A/R	CONDUIT, 1" RIGID GALVANIZ
91	2	CONDUIT FITTING, 1" GROUND
211	A/R	CONDUIT, 1/2" RIGID GALVAN
229	1	CONDUIT FITTING, 1/2" GROU
260	4	CONDUIT FITTING, 1/2" GROU
A2	1	CONDUIT SEAL, 1" C-H #EYS
A3	1	ENCLOSURE, 6x6x4 SS NEMA

DETAIL 'C'

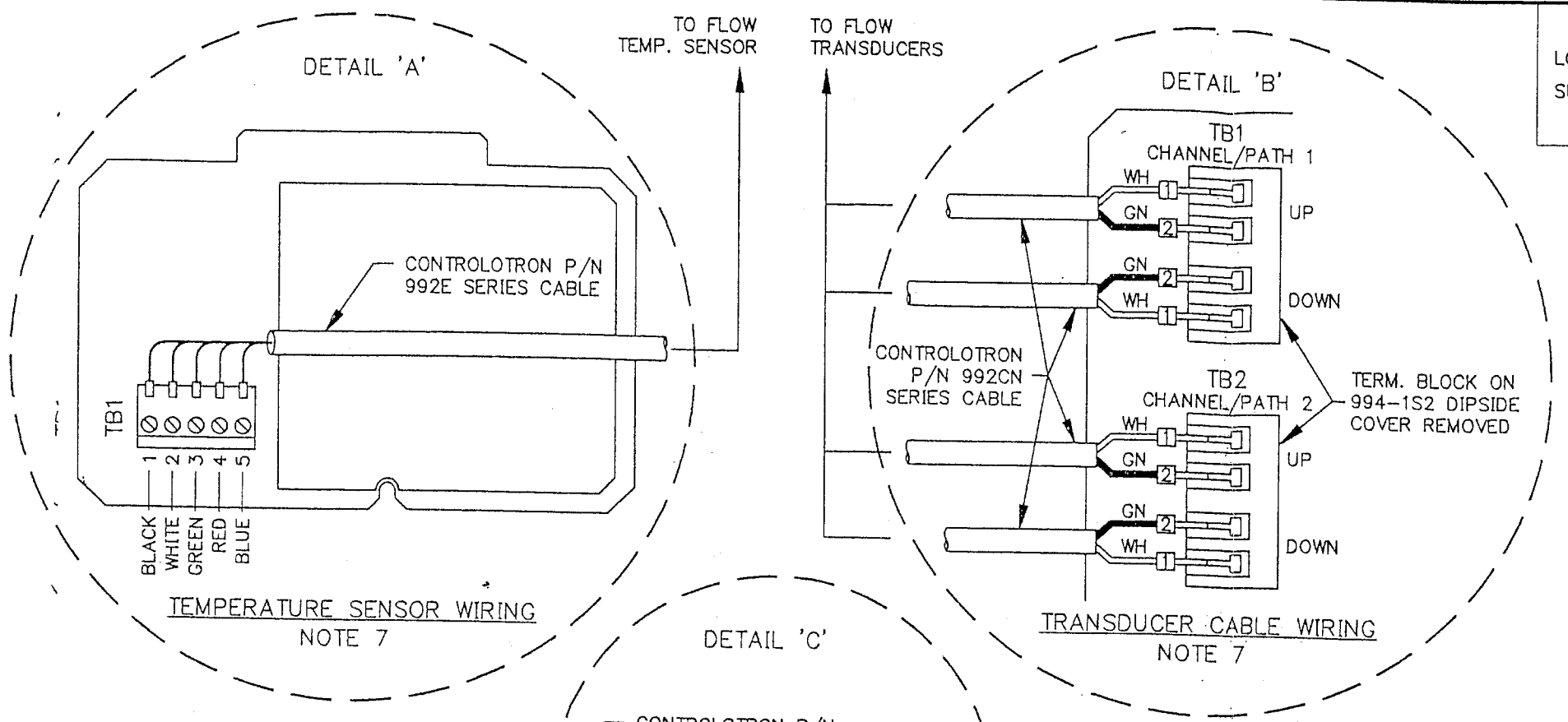


TRANSDUCER WIRING
NOTE 6

END VIEW

NOTES:

1. QUANTITIES SHOWN ARE FOR ONE
2. INSTALL CONDUIT DRAIN(S) AT LOW
3. FLEX CONDUIT IS TO BE OF SUFFIC
FOR EASY REMOVAL OF THE TRANS
WITH TEXACO PRIOR TO INSTALLAT
4. PERMANENTLY LABEL WIRES WITH
USING RAYCHEM TMS SLEEVE SYST
TEXACO APPROVED EQUAL.
5. ALL CABLES ARE SUPPLIED BY OTH
992CN SERIES CABLES TO BE INST
FUTURE TRANSDUCERS. ALLOW SPA
EQUAL TO THAT OF OTHER CABLES
CABLES IN FIELD ENCLOSURE.
6. SEE CONTROLOTRON DWG. 990THND
TERMINATIONS AT TRANSDUCER.
7. SEE CONTROLOTRON DWGS. 994LDVM
ADDITIONAL INFORMATION ON FLOW
TRANSDUCER WIRING. SEE CONTROL
FOR ADDITIONAL DETAIL ON FLOW T
8. TEMPERATURE SENSOR JUNCTION BO
FITTINGS SUPPLIED BY OTHERS. TEM
SUPPLIED WITH 24" WIRING PIGTAIL
JUNCTION BOX (DO NOT RUN IN CO
DWG. 991TS5-8 FOR ADDITIONAL DE
SENSOR CABLING.
9. SEAL FITTING TO BE INSTALLED AT
DIV. II AREA TO UNCLASSIFIED AREA



LOCATION PLANT 22 – WHARF BM NO. PSP543
SUBJECT LEAK DETECTION SITE STATION
DUAL PATH FLOW TRANSDUCER INSTALL. DETAILS

SHT.NO. SK101094
DATE 10/10/94
BY DEH
CHKD. BY TML
APPVD. BY JAC
CHIEF ENGR.
FILE NO. 22BJ0019

LIST OF MATERIALS

ITEM	QTY	DESCRIPTION
1	A/R	CONDUIT, 1/2" LIQUIDTIGHT FLEXIBLE METAL
9	4	CONDUIT FITTING, 1/2" LIQUIDTITE STR. MALE CONN.,O-Z#4Q-50
83	A/R	CONDUIT, 1" RIGID GALVANIZED STEEL
91	2	FITTING, 1" GROUND HUB, MYERS #STG-3
211	A/R	CONDUIT, 1/2" RIGID GALVANIZED STEEL
229	1	FITTING, 1/2" GROUND HUB, MYERS #STG-[illegible]
260	4	CONDUIT FITTING, 1/2" GROUNDING BUSHING, O-Z/[illegible]50ES-4BC
A1	1	ENCLOSURE, 6x4x4 SS NEMA 4X, HOFFMAN #A-6044CHNFSS
A2	1	CONDUIT SEAL, 1" C-H #EYS31

JEFFREY A. CURTIS — STATE OF WASHINGTON — 19445 — REGISTERED PROFESSIONAL ENGINEER — 8/24/95
Jeffrey A. Curtis
EXPIRES 10/31/95

NOTES:

1. QUANTITIES SHOWN ARE FOR ONE INSTALLATION ONLY.
2. INSTALL CONDUIT DRAIN(S) AT LOW POINTS IN CONDUIT RUN.
3. FLEX CONDUIT IS TO BE OF SUFFICIENT LENGTH TO ALLOW FOR EASY REMOVAL OF THE TRANSDUCER. (CONFIRM LENGTH WITH TEXACO PRIOR TO INSTALLATION.)
4. PERMANENTLY LABEL WIRES WITH THE ELEMENT TAG NUMBER USING RAYCHEM TMS SLEEVE SYSTEM (TYPEWRITTEN) OR TEXACO APPROVED EQUAL.
5. ALL CABLES ARE SUPPLIED BY OTHERS.
6. SEE CONTROLOTRON DWG. 990THNDBM-7 FOR CABLE TERMINATIONS AT TRANSDUCER.
7. SEE CONTROLOTRON DWGS. 994LDVN-7 SHTS. 1 & 2 FOR ADDITIONAL INFORMATION ON FLOW AND TEMPERATURE TRANSDUCER WIRING. SEE CONTROLOTRON DWG. 992CNS-10 FOR ADDITIONAL DETAIL ON FLOW TRANSDUCER CABLE.
8. TEMPERATURE SENSOR JUNCTION BOX AND ASSOCIATED FITTINGS SUPPLIED BY OTHERS. TEMPERATURE SENSOR SUPPLIED WITH 24" WIRING PIGTAIL FOR CONNECTION TO JUNCTION BOX (DO NOT RUN IN CONDUIT). SEE CONTROLOTRON DWG. 991TS5-8 FOR ADDITIONAL DETAIL ON TEMPERATURE SENSOR CABLING.
9. SEAL FITTING TO BE INSTALLED AT THE TRANSITION FROM DIV. II AREA TO UNCLASSIFIED AREA PER NEC REQUIREMENTS.