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MFN 420-77

November 4, 1977

U. S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, D.C. 20555

Attention: Mr. Victor Stello, Jr., Director
Division of Operating Reactors

Gentlemen:

SUBJECT: MARK I CONTAINMENT PROGRAM IN-PLANT SAFETY/RELIEF VALVE DISCHARGE LOAD TEST WITH A T-QUENCHER

Task 5.1.2 of the Mark I Containment Program consists of an in-plant safety/relief valve discharge load test with a T-Quencher to be performed at the Monticello Nuclear Generating Plant. During the Mark I Program status report meeting held in Bethesda on August 24 and 25, 1977, members of your staff requested a description of this test plan. Enclosed is a description of this test plan which is intended to respond to that request.

Sincerely,

L. H. Fraunhofer for

L. J. Sobon, Manager
BWR Containment Licensing

LJS:pat/11

Enclosure

cc: L. S. Gifford (GE, Bethesda)
J. C. Guibert (NRC)
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MONTICELLO IN-PLANT SAFETY/RELIEF VALVE TEST WITH T-QUENCHER

The inplant safety/relief valve discharge load testing with a new discharge device (called a T-quencher) is one of the major activities of the Mark I Long-Term Program.

The objective of the T-quencher is to reduce safety/relief valve (SRV) air-clearing loads and to discharge with stable condensation over the full operating range.

The objective of the Monticello T-quencher test is to provide the data necessary for developing the containment loads resulting from T-quencher discharge into the suppression pool. To provide data to meet this objective, instrumentation will be used to measure acceleration, strain, pressure, temperature, and water level.

The T-quencher installed on the Monticello safety/relief valve discharge line (SRVDL) is shown in Figure 1. The device consists of perforated arms attached to the discharge of a ramshead; the ramshead being similar to the device presently installed on the SRVDL. The T-quencher is designed to obtain a gradual discharge of air into the torus water during the air-clearing transient associated with SRV actuation, thereby reducing the hydrodynamic pressure transient. The quencher is supported at the ramshead and at the mid-span of the quencher arms as shown in Figures 2 and 3. These quencher supports are connected to a beam made from 14-inch Schedule 120 pipe, which is attached to the ring girders.

The long air-clearing times associated with the T-quencher results in lower decompression wave loads than are presently imposed on the SRVDL by the existing ramshead device. Higher peak pipe pressures are experienced within the T-quencher than within the existing ramshead device; however, these peak pressures and associated loads are well within design limits.

Pressure transducers located on the torus skin will provide measurements of surface pressure acting on the torus during the relief valve actuations. (The location of these sensors is shown in Figures 10 and 11). Special attention was given to epoxy mounting of sensors directly to the torus skin and protection of instrumentation lead wires by anchoring with stainless steel straps every 6 inches. Pressure transducers and temperature detectors in the relief valve discharge pipe will provide further data for the forcing function model.

An additional sophistication of these test measurements will be the recording of water level in the discharge piping to evaluate the effect of consecutive valve actuation. Until the discharge pipe vacuum breaker

admits sufficient air to the pipe following closure of the relief valve, the water level may be higher than normal. This higher water level would increase the bubble pressure during a subsequent valve reactuation although the effect may be partially offset by the smaller volume of air in the bubble (because of the partial vacuum). The consecutive valve actuation tests will further explore this phenomenon.

Pressure data at the torus skin will be utilized to confirm development of the analytical model for prediction of loads on the torus. Strain gage data from sensors on the torus skin will be utilized to determine the design margin of the torus for the full design life expectation of relief valve actuations. Strain gages will measure the response of the torus support columns.

Temperature sensors located in the torus pool will be monitored to evaluate mixing effects in the pool during relief valve actuation.

Strain gages will measure the response of the relief valve discharge piping, the quencher and their structural supports. Accelerometers will measure the response of the torus shell, the quencher and the quencher support.

The number of sensors of each type is tabulated in Table 1. Test instruments and their locations (except for the pool temperature sensors) are shown in attached Figures 4 through 12. Thirty-four (34) pool temperature sensors are installed in the torus pool at selected circumferential and vertical locations.

As shown in Figure 4, the torus bay designated as "D" (containing valve RV2-71A) is most heavily instrumented, and this "A" valve will be involved in all the tests. Each test, except the extended blowdown, will consist of manual actuation of the same relief valve for a period of approximately 5 seconds during which the instrumentation is actuated to record the response.

The test sequence is as follows:

1 valve cold pipe, normal water leg, full steam pressure

1 valve warm pipe, normal water leg, full steam pressure

1 valve hot pipe, normal water leg, full steam pressure

1 valve cold pipe, normal water leg, extended blowdown from full steam pressure.

After each test, the results will be evaluated before proceeding to the next test. The warm pipe and extended blowdown tests will be run once each. All other tests will be performed several times to assure repeatability of the data.

The above constitutes the test as presently planned. Considering that this testing is being performed on a production facility, the scope of tests is quite extensive. The number of relief valve actuations imposes a financial exposure due to power availability and potential maintenance outage considerations that may exceed the direct cost of performing the test. This is an extensive program capable of quantitatively defining the loads and structural responses of interest.

GGS:pat/99-101

TABLE 1

SENSOR TYPES, NUMBER AND GENERAL LOCATION

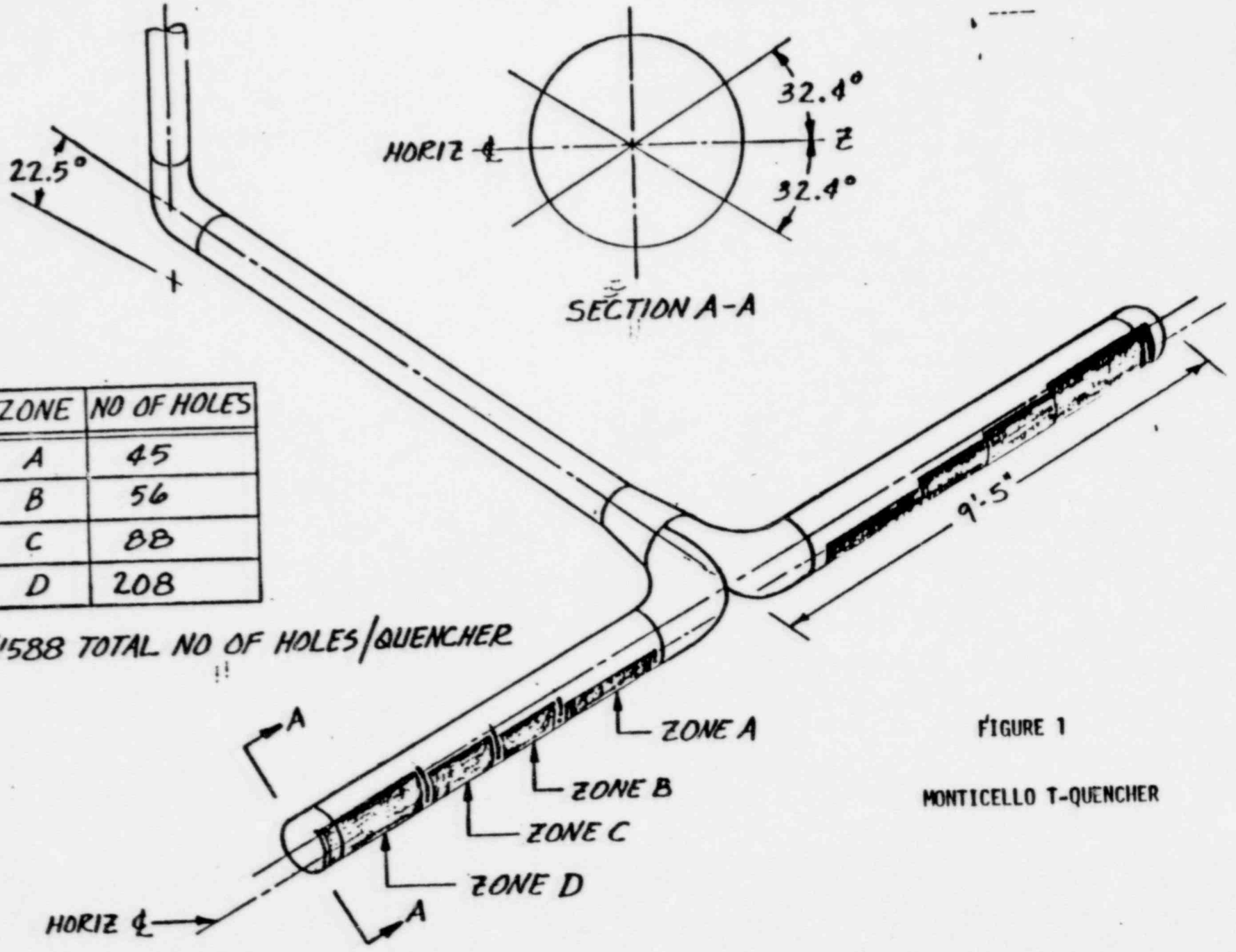
	Torus Region	Torus Pool	Torus Support	T-Quencher & Support	SRV Piping	Vacuum Breaker	Gauges/ Channels	Penetration (2)
Strain Gauges								
Single	10/10(1)	-	64/12	2/2	8/8	-	84/32	64
Rosette	40/120	-	-	7/21	3/9	-	50/150	234
Accelerometers								
Uni-axial	7/7	-	-	-	-	-	7/7	-
Bi-axial	-	-	-	2/4	-	-	2/4	8
Pressure Sensors	34/34	4/4	-	2/2	5/5	1/1	46/46	194
Water Leg Probes	-	-	-	-	2/2	-	2/2	6
Temperature Sensors (Resistance Temperature Detectors, RTD)	-	-	-	-	10/10	-	10/10	50
TOTALS	91/171	4/4	64/12	13/29	28/34	1/1	201/251 (3)	556
Other RTD (Not on PCM)	-	34/34	-	-	5/5	-	39/39 (4)	-

(1) No. of gauges/No. of channels.

(2) No. of penetrations through manway cover and drain flange on torus.

(3) Total number of gauges/channels connected to PCM recording system.

(4) Total number of gauges/channels connected to DS-83 Scan recorder.



ZONE	NO OF HOLES
A	45
B	56
C	88
D	208

1588 TOTAL NO OF HOLES/QUENCHER

FIGURE 1

MONTICELLO T-QUENCHER

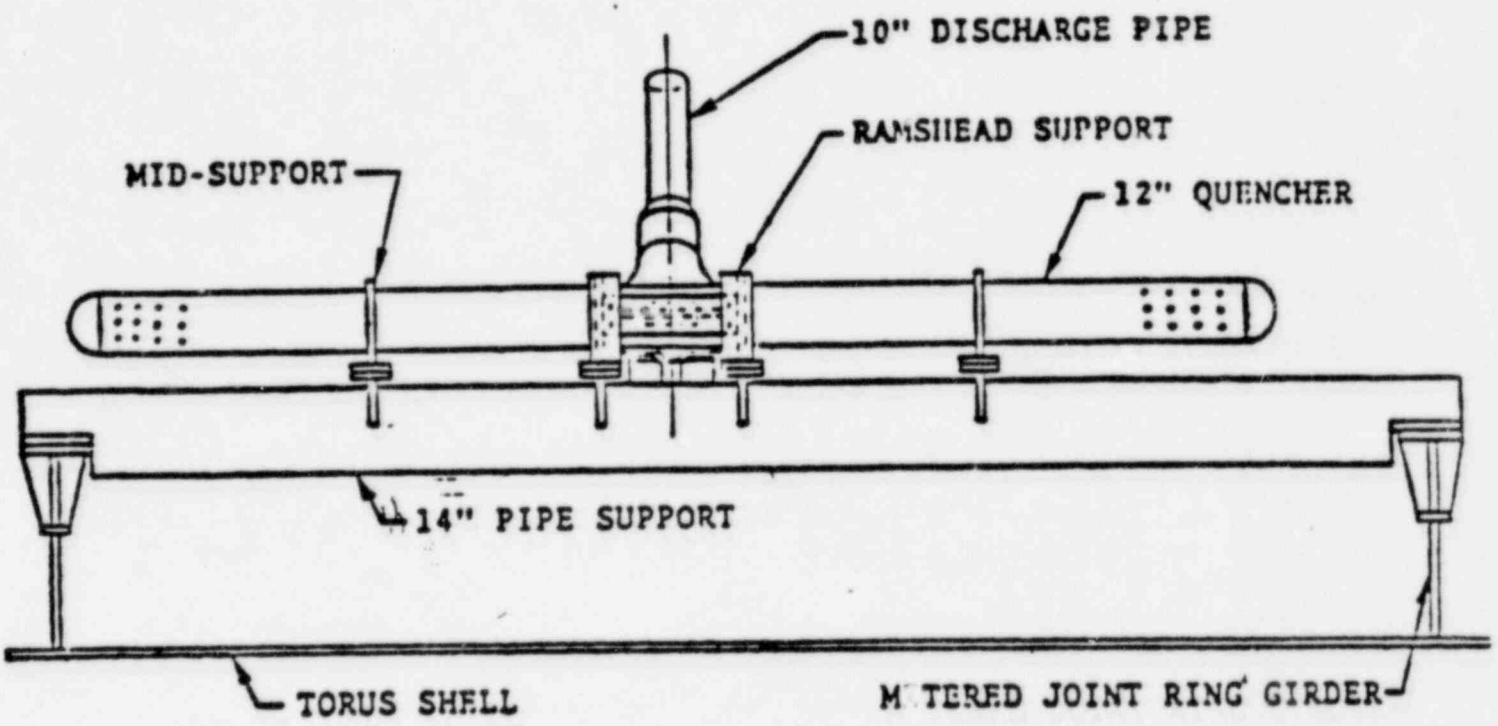


FIGURE 2

QUENCHER INSTALLATION

ELEVATION

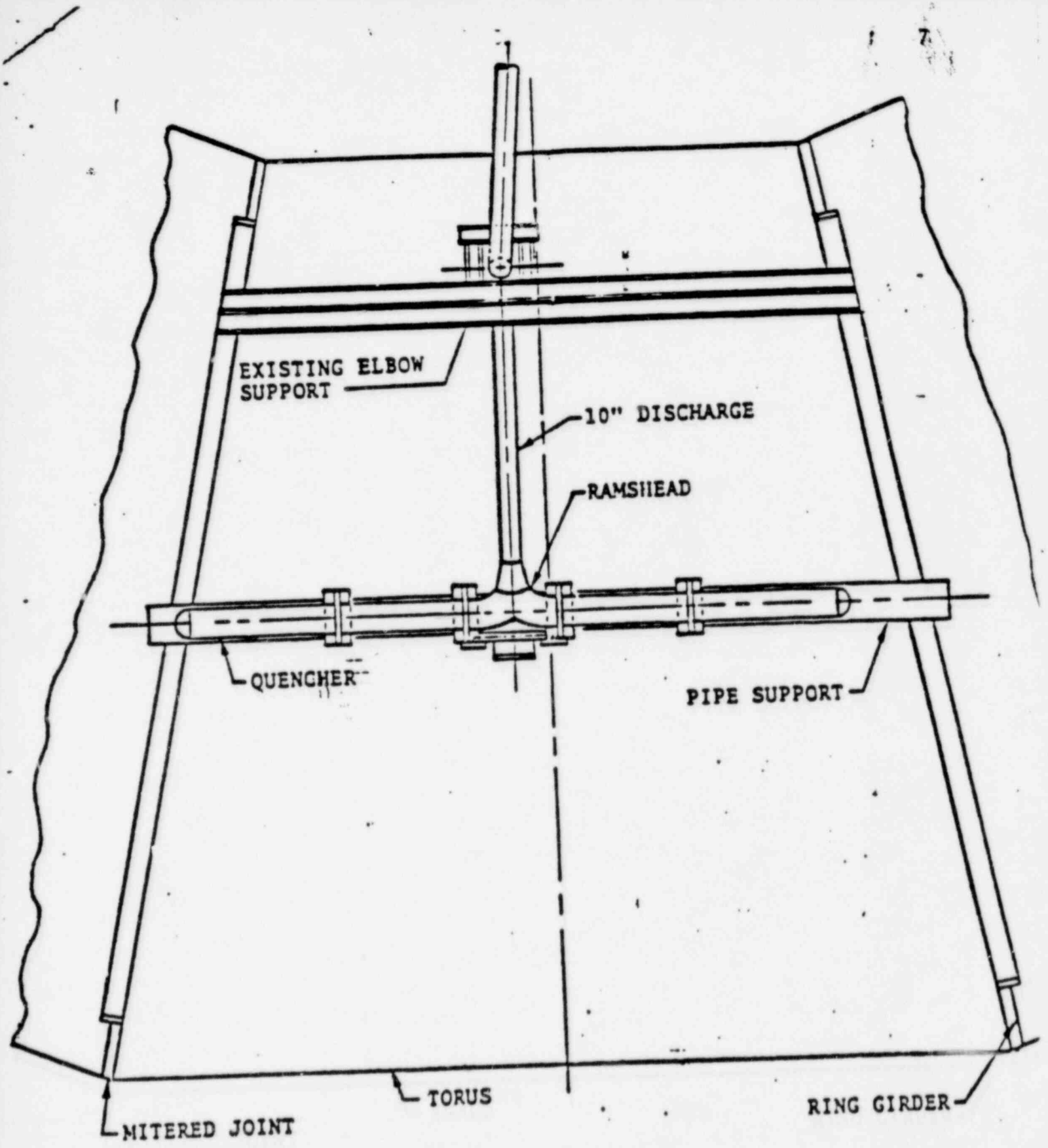
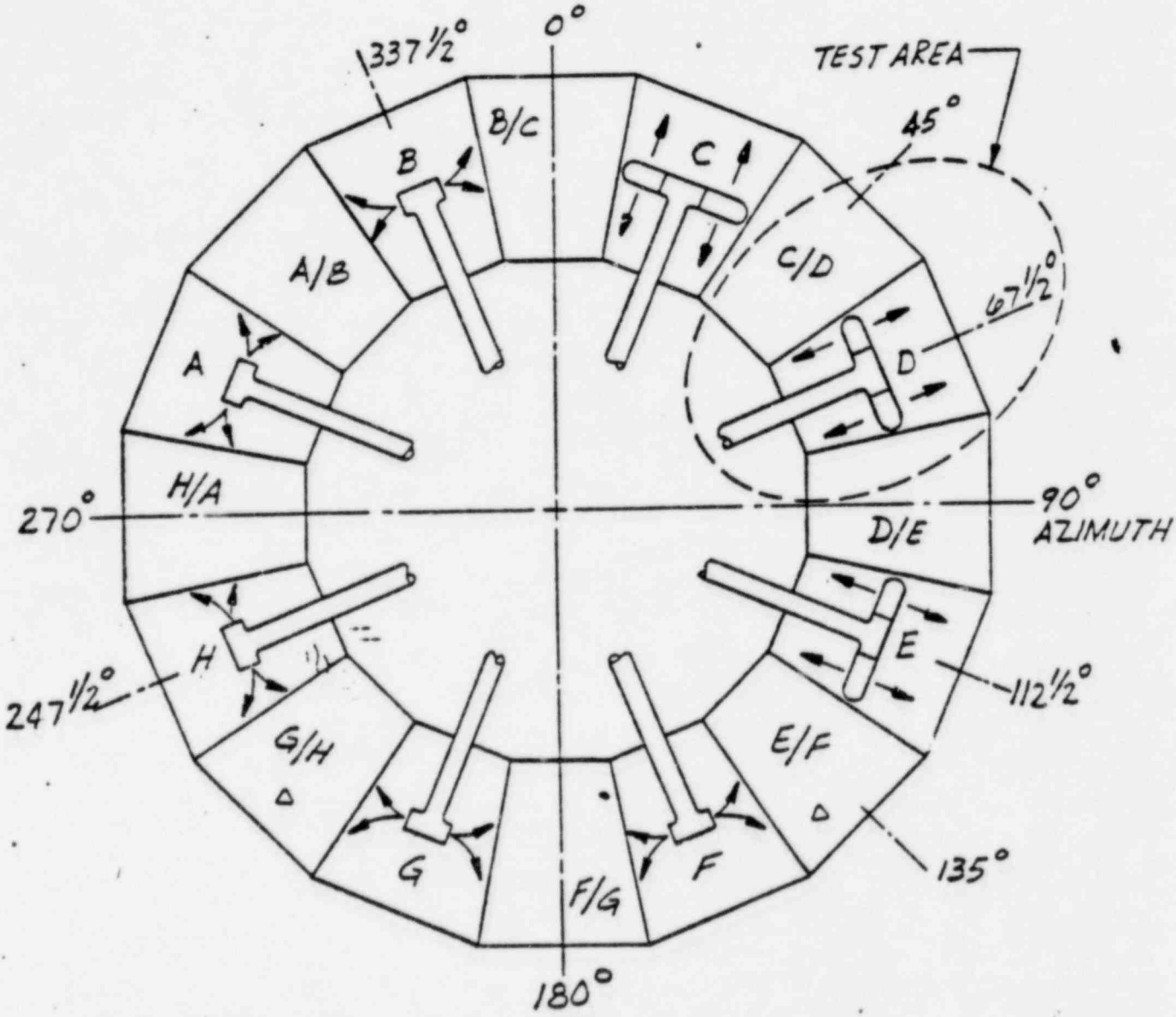


FIGURE 3

QUENCHER INSTALLATION

PLAN



BAY	S/R VALVE DESIGNATION	CATEGORY	AZIMUTH (DEGREE)	ACCESS LOCATION
A	RV2-71D		292-1/2	
B	RV2-71F		337-1/2	
C	RV2-71E		22-1/2	
D	RV2-71A	ADS	67-1/2	48-in MANWAY
E	RV2-71G		112-1/2	
F	RV2-71B	ADS	157-1/2	
G	RV2-71C	ADS	202-1/2	
H	RV2-71H		247-1/2	48-in MANWAY

△ PLANT POOL TEMPERATURE THERMOCOUPLES (EXISTING)

* ADS= AUTOMATIC DEPRESSURIZATION SYSTEM

FIGURE 4: ORIENTATION OF SAFETY/RELIEF VALVE DISCHARGES WITHIN MONTICELLO TORUS

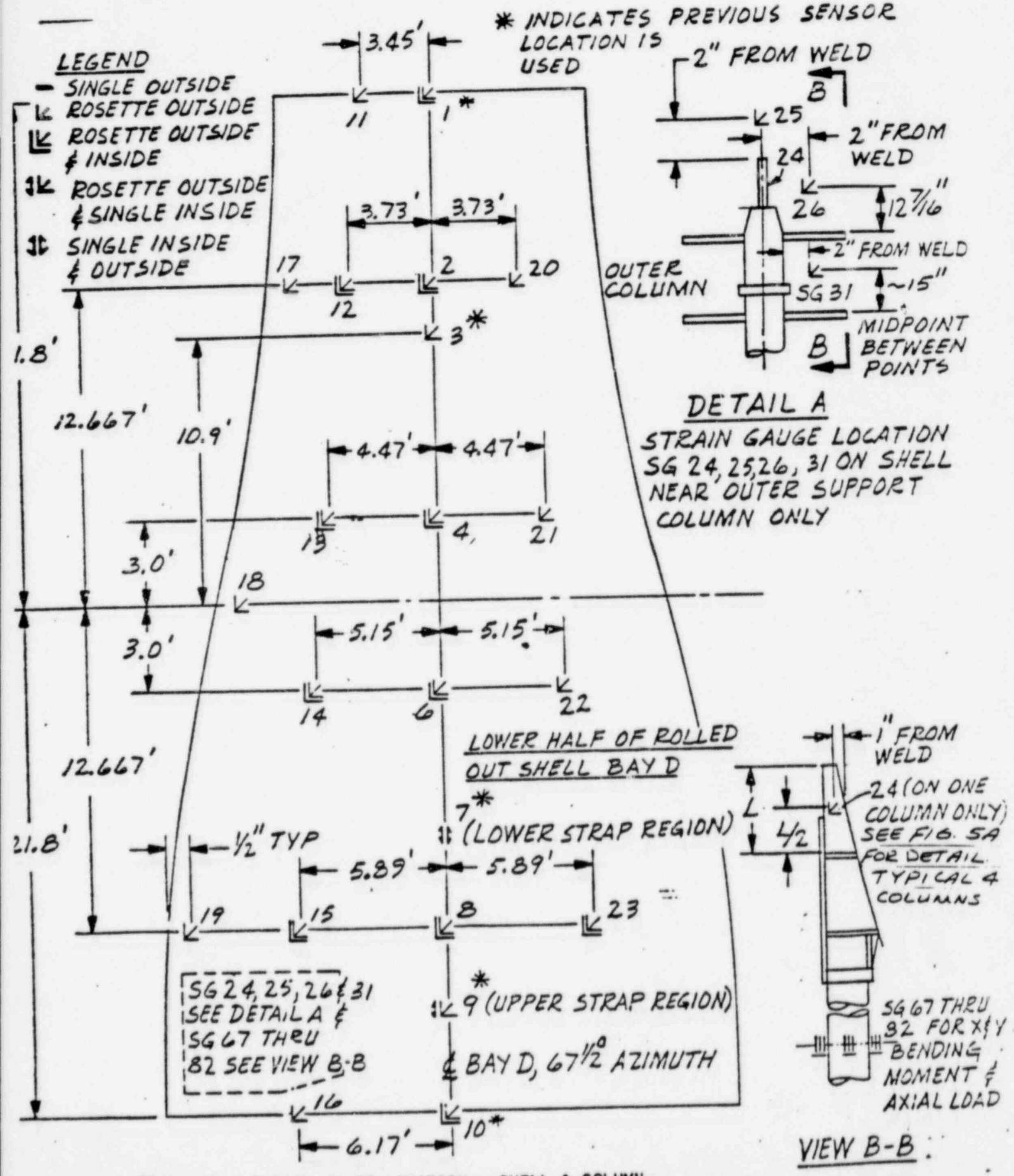


FIGURE 5: STRAIN GAUGE LOCATION - SHELL & COLUMN

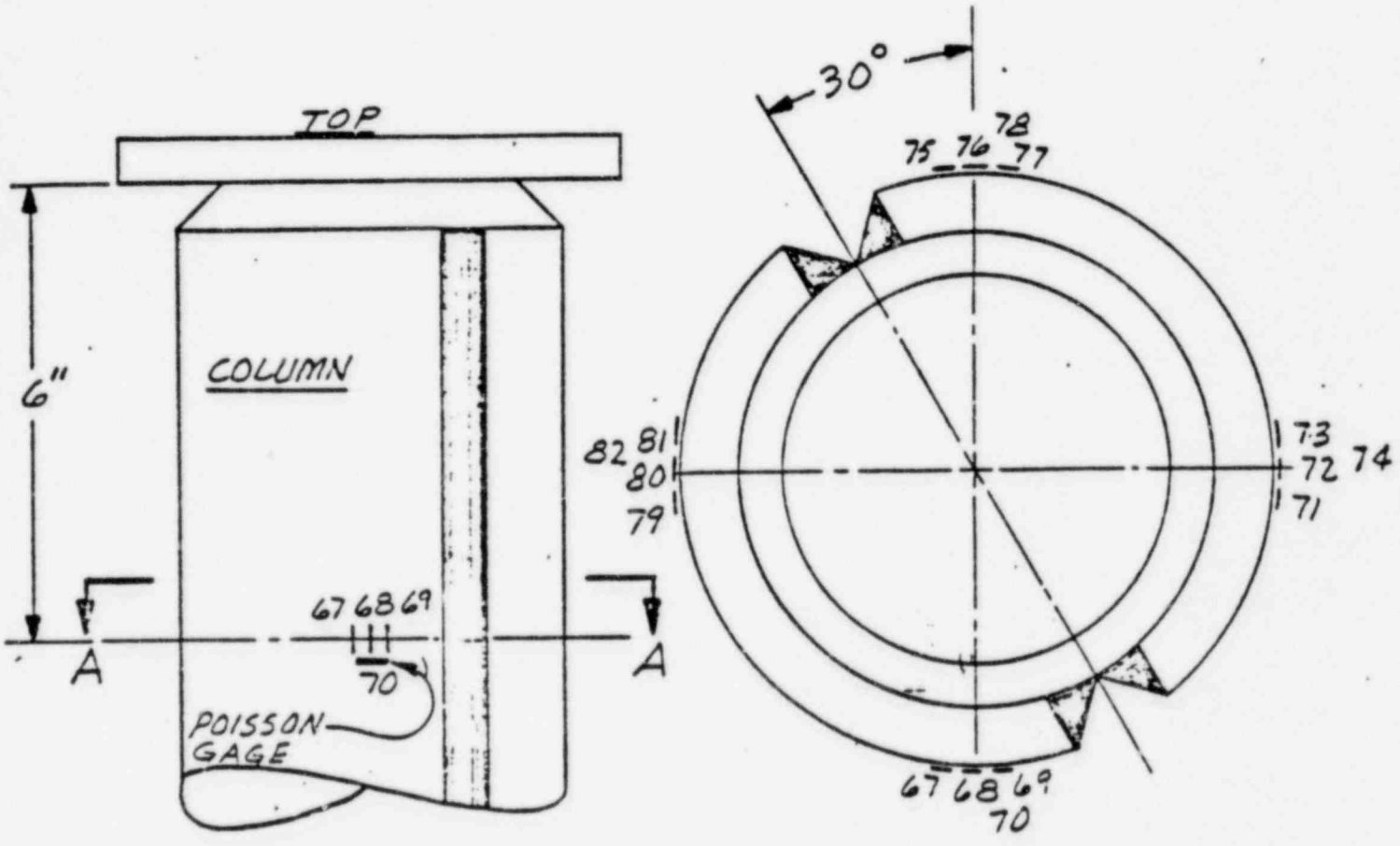


FIGURE 5A: STRAIN GAUGE LOCATION ON 4 SUPPORT COLUMNS-BAY D

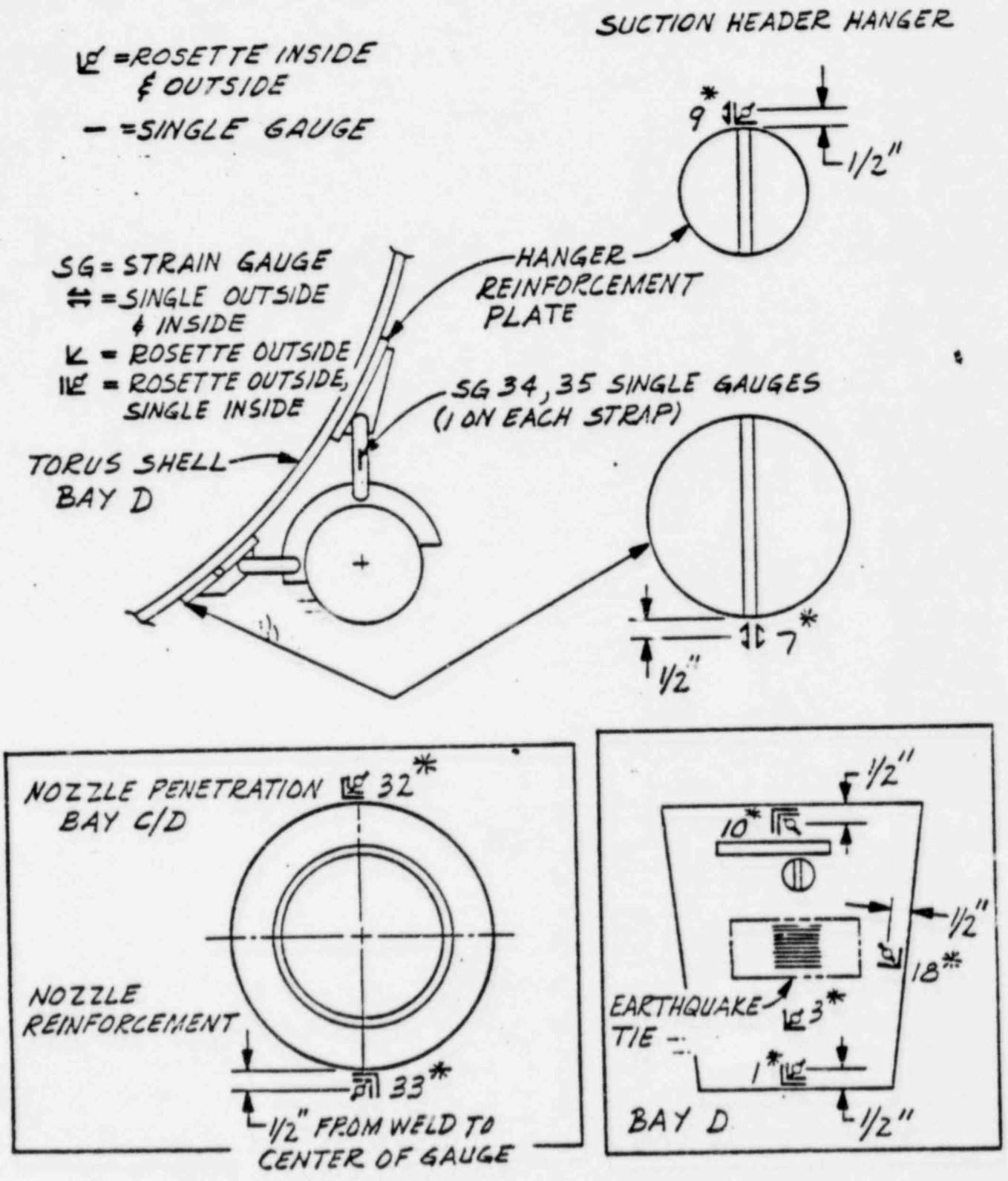
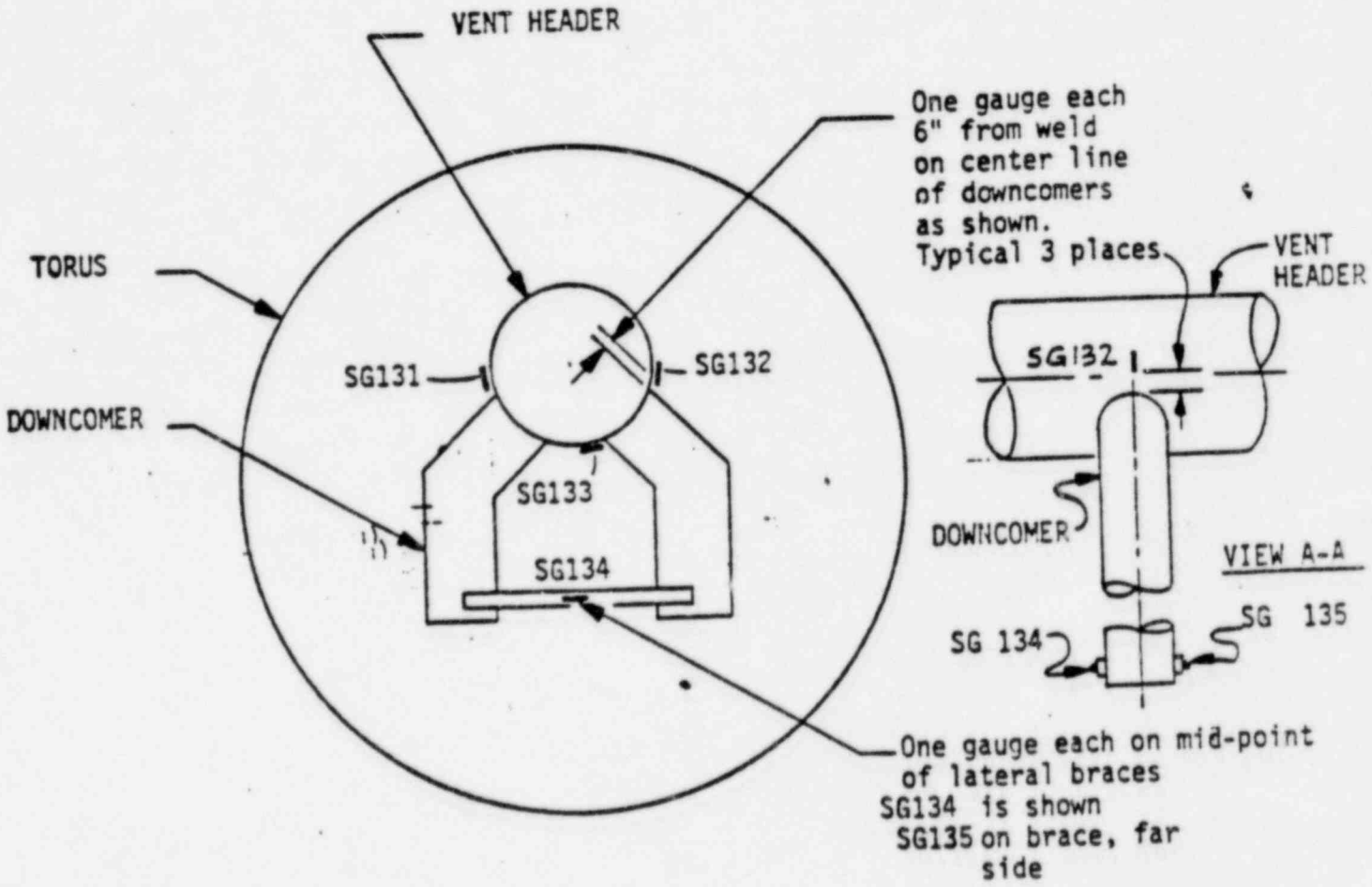


FIGURE 6: LOCATION OF STRAIN GAGES ON TORUS WALL AND SUCTION HEADER



5 UNI-AXIAL STRAIN GAUGES TOTAL:
SG131 through SG135

FIGURE 6A: STRAIN GAUGE LOCATION ON VENT HEADER AND DOWNCOMER BRACES---BAY D

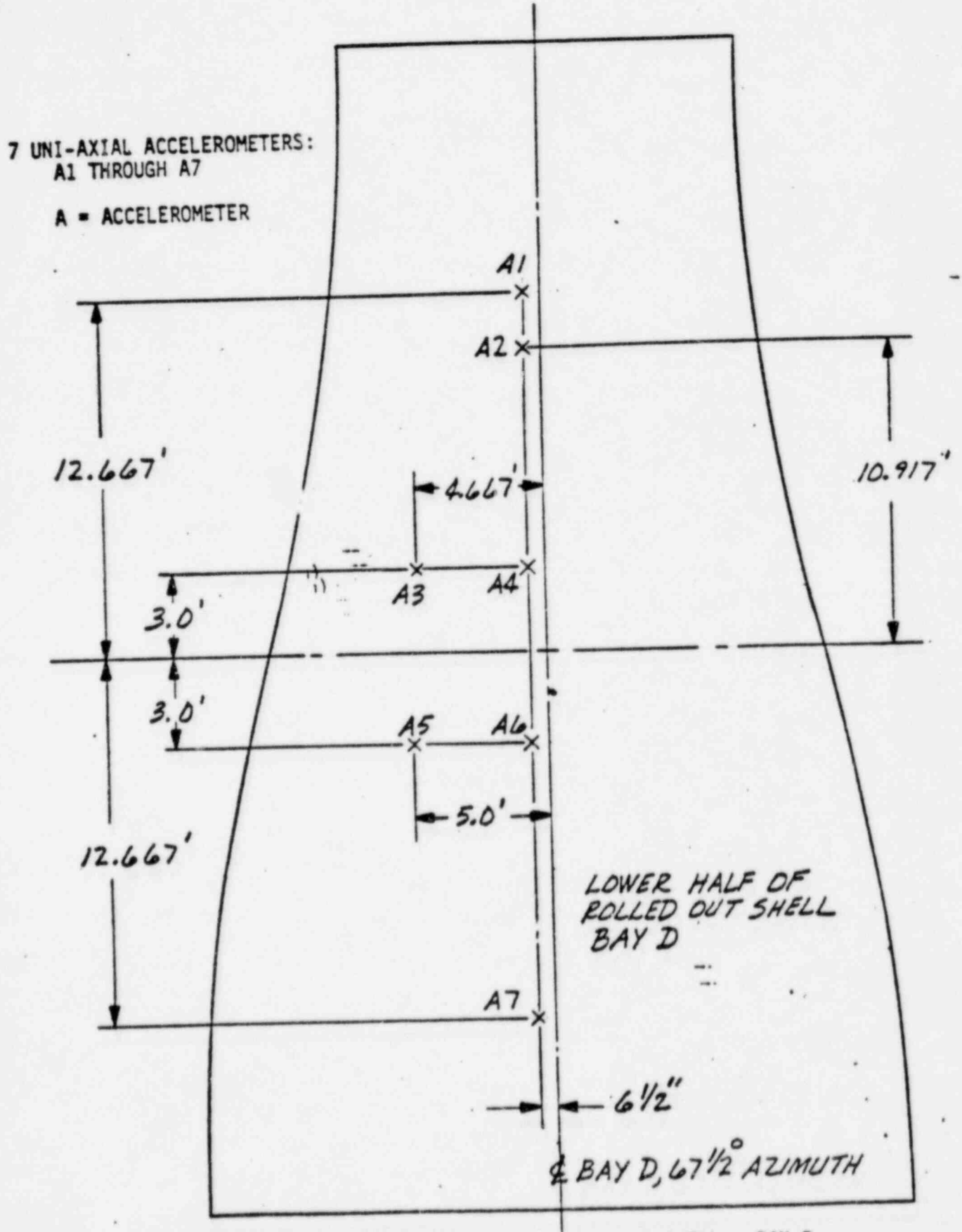


FIGURE 7: ACCELEROMETER LOCATION ON OUTSIDE SHELL---BAY D

*=INDICATES PREVIOUS SENSOR LOCATION IS USED
SG=STRAIN GAUGE

7 UNI-AXIAL STRAIN GAUGES SHOWN:

SG40 through SG46

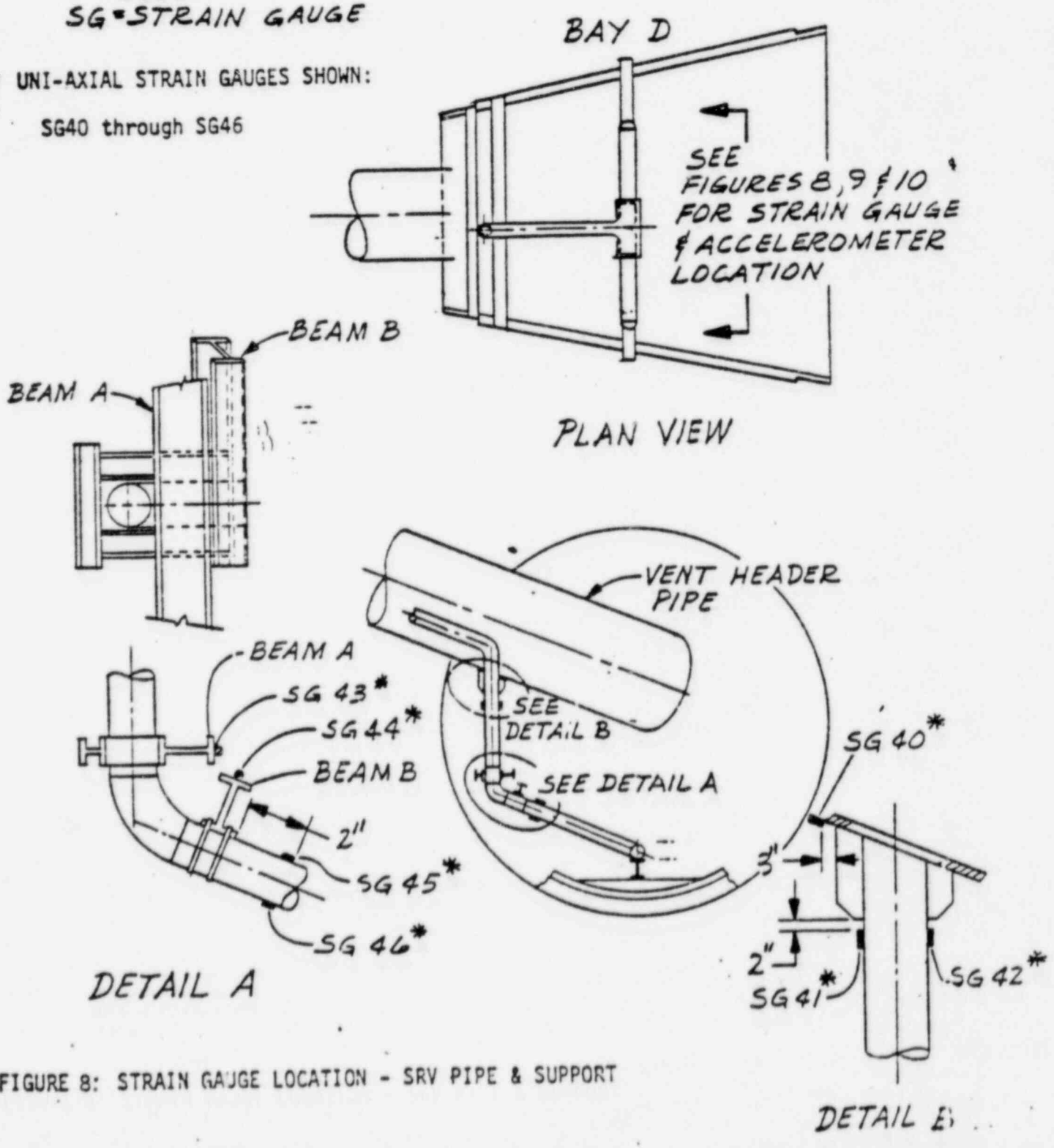
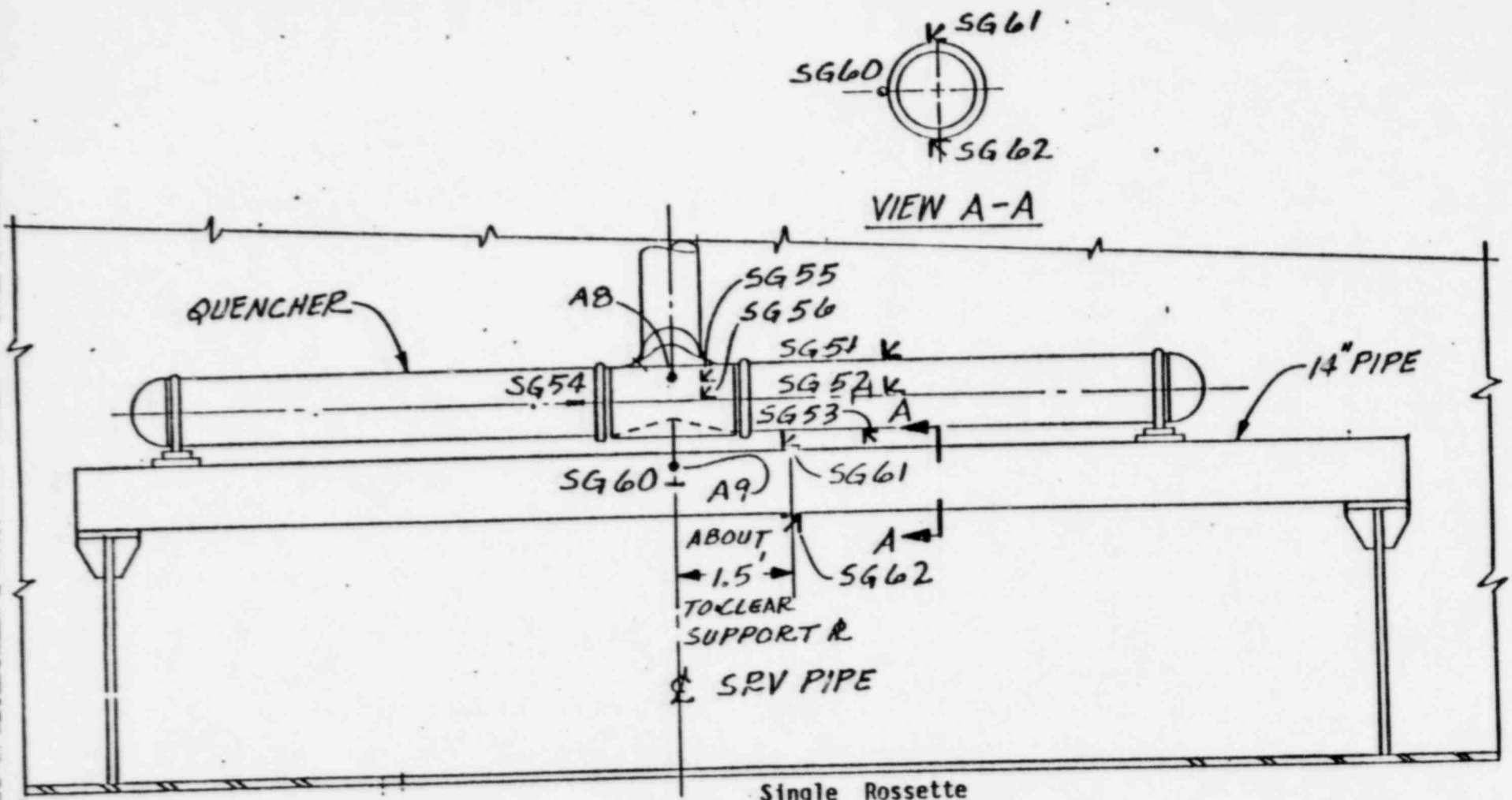


FIGURE 8: STRAIN GAUGE LOCATION - SRV PIPE & SUPPORT



Orientation of Accelerometers A8,A9 Naturally Vertical and Horizontal (Perpendicular to Quencher).

(See Figure 10 also for SG51 through SG56).

	Single	Rossette
SG51,52 53,55,56	-	5
SG54	1	-
SG60	1	-
SG61,62	-	2
Total	2	7
A8,A9	2	BI-AXIAL

K ROSSETTE
— SINGLE STRAIN GAUGE
A ACCELEROMETER
SG STRAIN GAUGE

FIGURE 9: STRAIN GAUGE AND ACCELEROMETER LOCATION - QUENCHER & SUPPORT

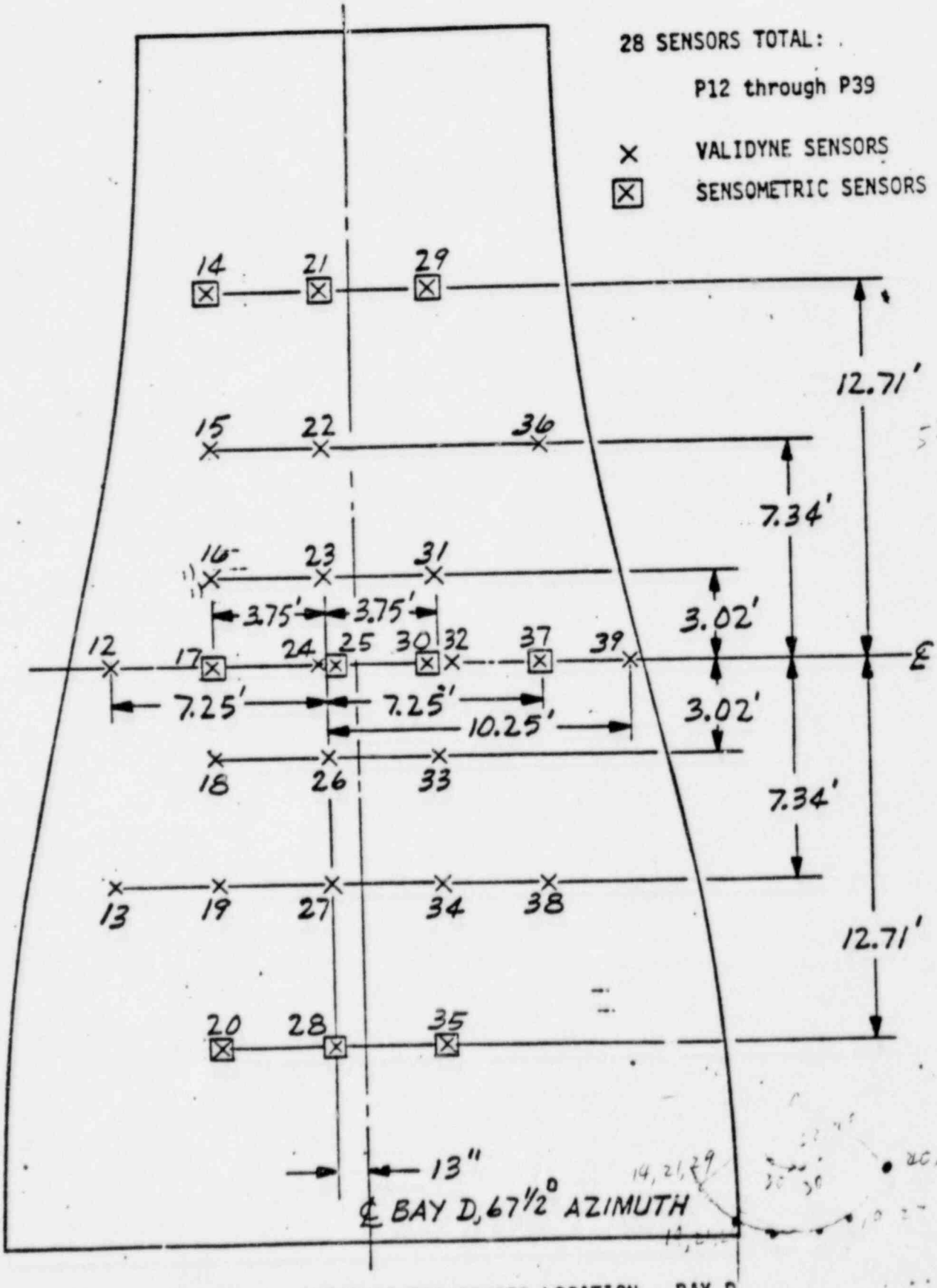


FIGURE 10: PRESSURE TRANSDUCER LOCATION - BAY D

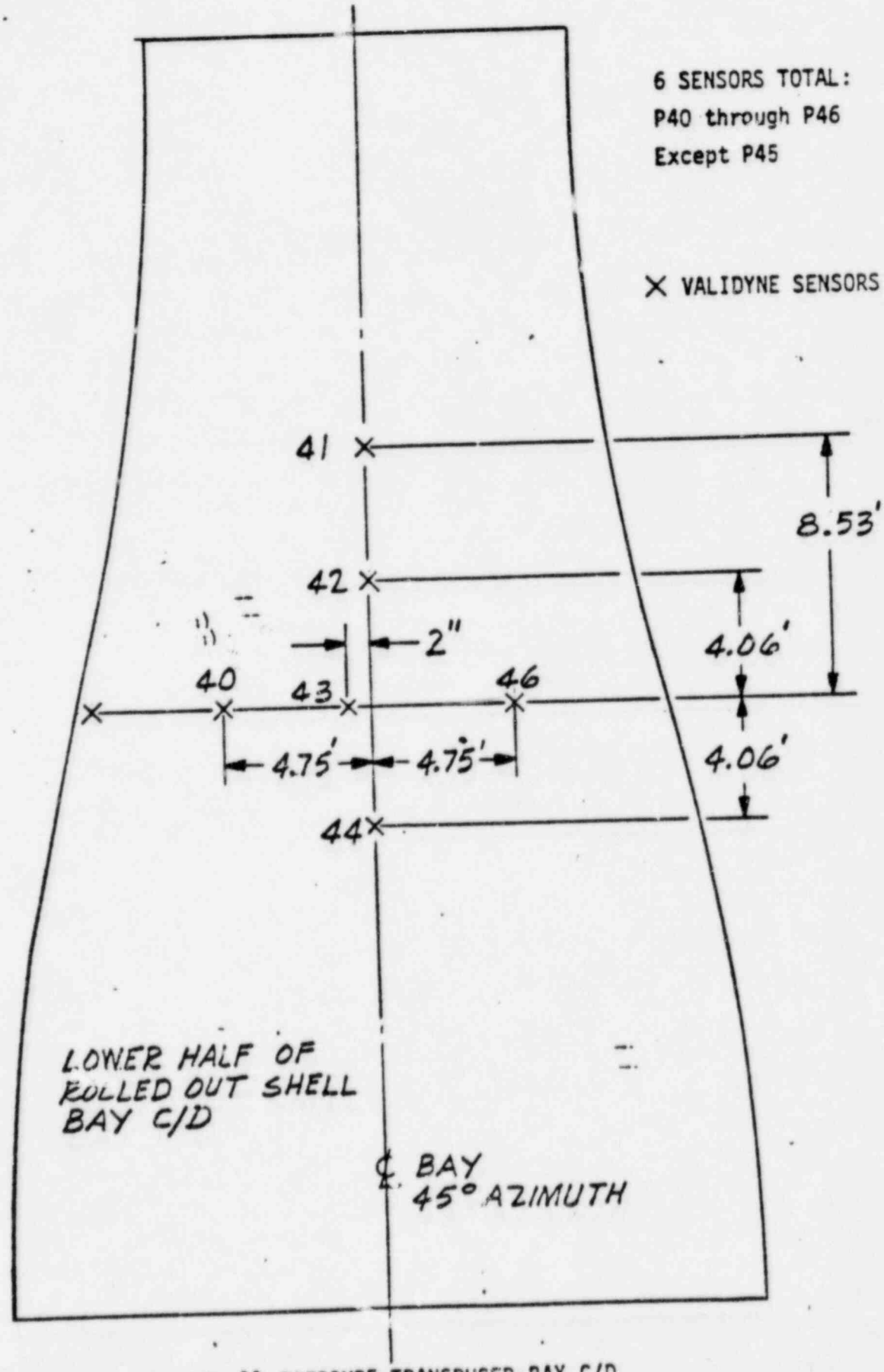
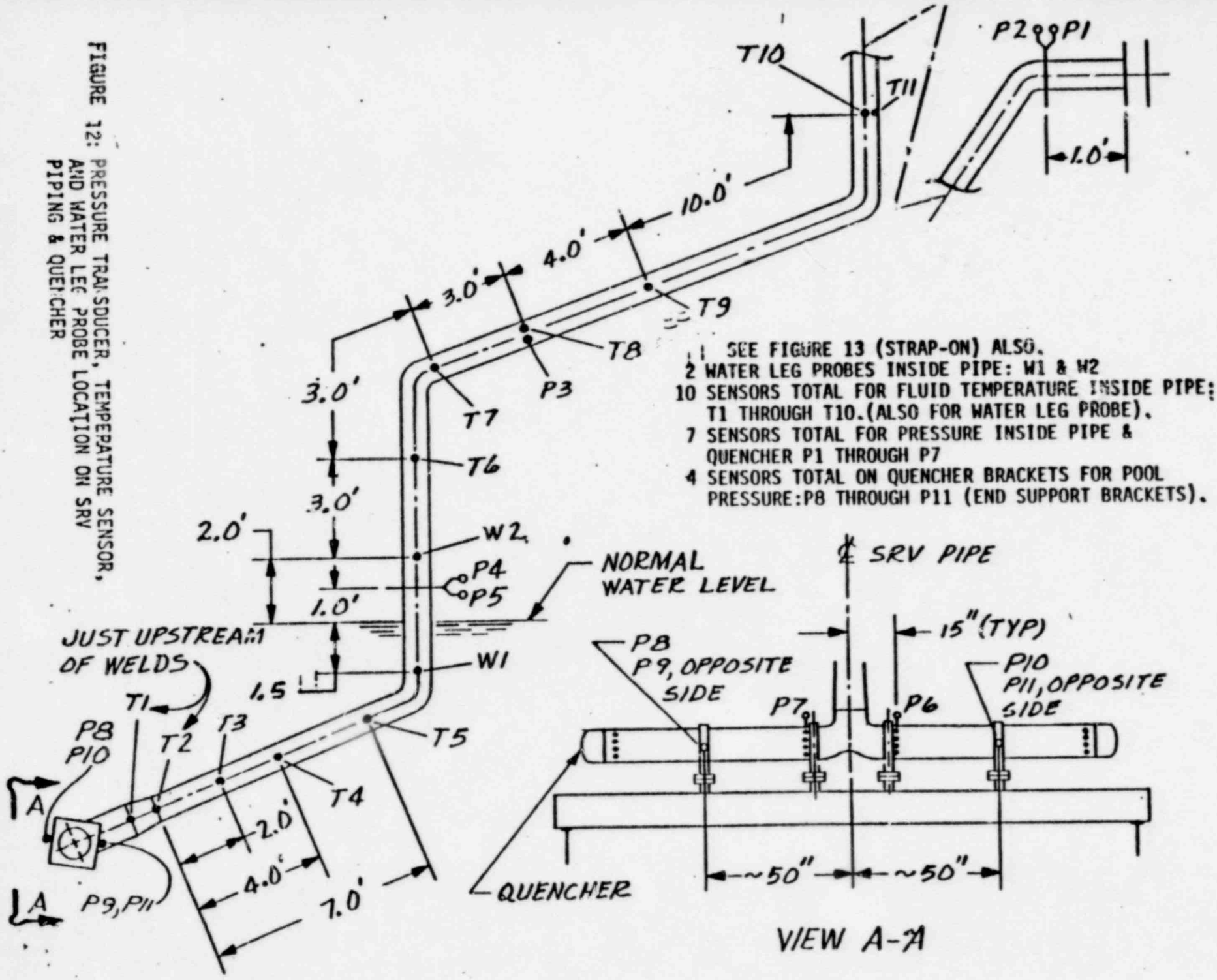
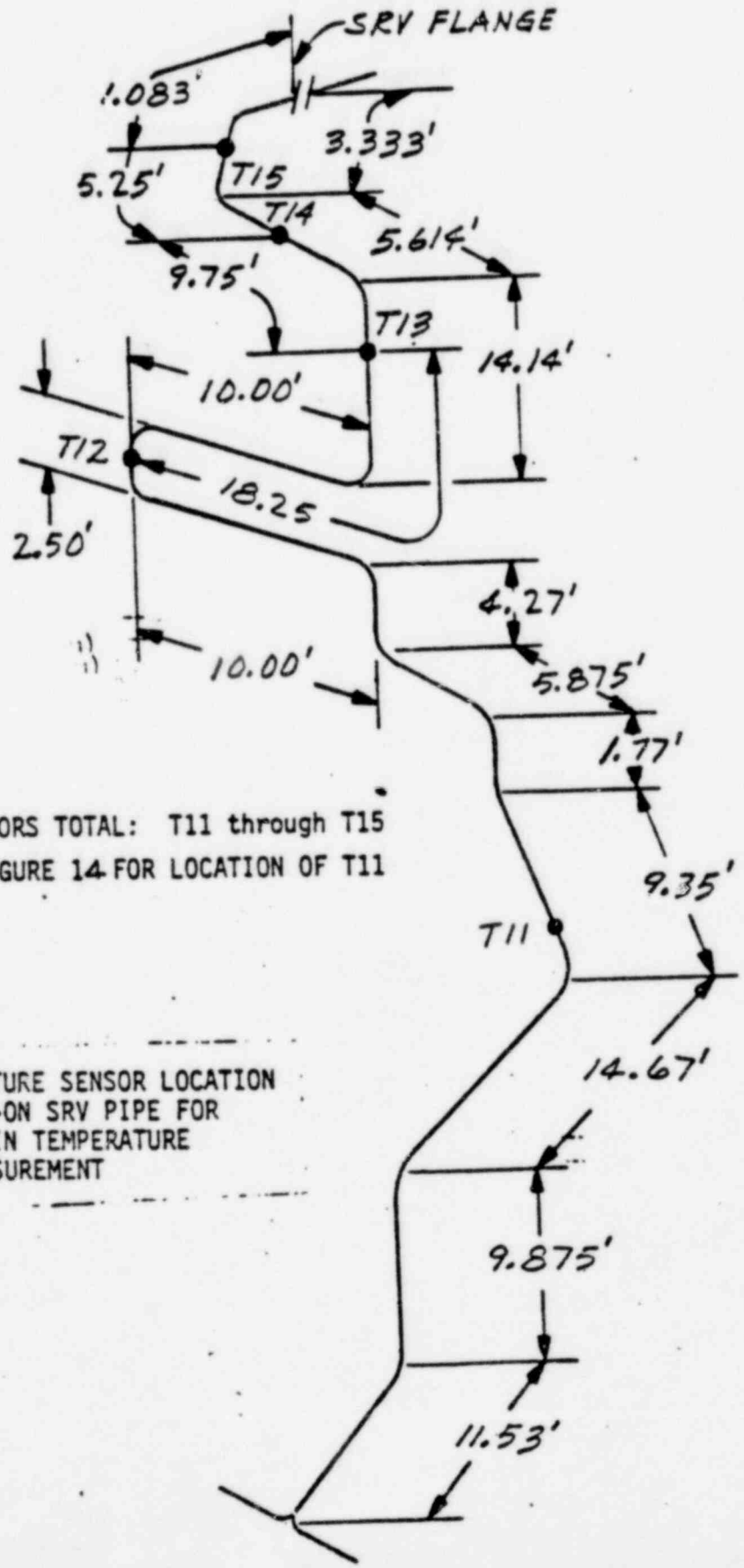


FIGURE 11: PRESSURE TRANSDUCER-BAY C/D



SEE FIGURE 13 (STRAP-ON) ALSO.
2 WATER LEG PROBES INSIDE PIPE: W1 & W2
10 SENSORS TOTAL FOR FLUID TEMPERATURE INSIDE PIPE: T1 THROUGH T10.(ALSO FOR WATER LEG PROBE).
7 SENSORS TOTAL FOR PRESSURE INSIDE PIPE & QUENCHER P1 THROUGH P7
4 SENSORS TOTAL ON QUENCHER BRACKETS FOR POOL PRESSURE:P8 THROUGH P11 (END SUPPORT BRACKETS).

FIGURE 12: PRESSURE TRANSDUCER, TEMPERATURE SENSOR, AND WATER LEG PROBE LOCATION ON SRV PIPING & QUENCHER



5 SENSORS TOTAL: T11 through T15

SEE FIGURE 14 FOR LOCATION OF T11

FIGURE 13: TEMPERATURE SENSOR LOCATION - STRAP-ON SRV PIPE FOR PIPE SKIN TEMPERATURE MEASUREMENT