Consumers Power Company

General Offices: 212 West Michigan Avenue, Jackson, Michigan 49201 • Area Code 517 788-0550

June 24, 1975

Mr. James G. Keppler
Region Director
Office of Inspection Enforcement
Region III
US Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Re: Docket 50-255
License DRP-20
Palisades Plant
AO-4-75
Pipe Restraints

Dear Mr. Keppler:

By letter dated April 25, 1975, your staff requested that we provide a description of the scope and extent of the engineering evaluation of pipe hangers and restraints that was performed by our Palisades Plant Architect Engineer (A-E). This report is enclosed.

A number of deficiencies have been observed and corrected which apparently occurred during initial construction and subsequent modification of the plant. These deficiencies may have involved non-uniform application of designated criteria, incomplete review of installed systems, and incomplete documentation and follow-up prior to and after turnover. Since this design and construction work was performed, significant changes in our Construction Quality Assurance Services program have been instituted. Our Quality Assurance Services group has reviewed the seismic restraint deficiencies and has concluded that the present QA programs and procedures are adequate to detect the types of deficiencies observed, should they recur.

Some of the deficiencies may have been related to the start-up and hot functional testing program; however, since this program was conducted at the Palisades Plant, significant changes have been made. Our General Office plant start-up organization has reviewed the seismic restraint deficiencies with respect to their preoperational test procedure development program and has concluded that our current procedures are such that similar deficiencies are not likely to occur in the future.

A number of deficiencies could have been detected and corrected through a preventive maintenance program for pipe hangers and restraints. We have begun the development of such a program, and plan to have it in effect by about August 1, 1975.

6880

It is possible that some of the deficiencies resulted from inadequate maintenance procedures. While we have not been able to find any documentary evidence of this and consider it unlikely, we are currently developing improvements to our present procedures and expect these improvements to be completed by about August 1, 1975.

Yours very truly,

D. A. Bixel for

Ralph B. Sewell
Nuclear Licensing Administrator

DAB/ds

CC: Division of Reactor
Licensing

PIPING SUPPORT SYSTEMS REVIEW

PALISADES PLANT
COVERT, MICHIGAN

CONSUMERS POWER COMPANY

Bechtel Job 10512-021

Bechtel Associates Professional Corporation
Ann Arbor
Michigan

20 June 1975

CONTENTS

PALISADES PLANT

PIPING SUPPORT SYSTEMS REVIEW

1. Summary

During May, 1974, a pipe restraint on the suction line of the low-pressure safety injection pump was pulled loose from its mounting. This event was reported by CPCo as abnormal occurrence (74-08). The cause was apparently water hammer. Although calculations proved the restraint to be adequate for the design basis earthquake ("DBE") load, CPCo requested a review of the as-installed piping support systems in certain seismic Class I systems. The review of the piping support systems in the Seismic Class I systems listed in Appendix A and Appendix B has been completed.

This review of the piping support systems included a physical survey of the as-installed support systems for compliance with the initial design and criteria in the Palisades FSAR.

During the review, it was determined that certain work was advisable to insure compliance with the support systems design and criteria, and because there was insufficient time to perform a further analysis in order to determine whether or not many of the work items were actually required. The work items were identified, appropriate material was procured and installation was completed prior to the end of March, 1975. Nevertheless, the engineering opinion was that there was no significant safety problem and that the functional integrity of the piping systems would have been preserved in the event of a DBE.

An identification and description of these work items is contained in Appendix C to this report and is summarized below.

	Base Plant Piping						Facility Change Piping			
	Added	Replaced	Modified	Removed	Relocated	Maint.	Added	Modified	Maint.	
6" & Larger	4	3	5	2	0	6	0	1	0	
4" & Smaller	81	10	43	4	5	3	19	0	2	
TOTAL	85	13	48	6	5	9	19	1	2	188

The restraints added were of the rigid type, anchored to either concrete or existing structural steel members, and having U-bolt clamps or steel framing around the piping. Some of the work items consisted of maintenance and upgrading type activities such as adjusting U-bolts, adding shims and other minor work.

Subsequent to the review and completion of the work items, further analyses have been performed and it has been determined that 74 of the 188 work items were not required to meet the Palisades FSAR criteria of not exceeding 110% of the piping material yield stress under DBE loads. It is believed that additional analyses would demonstrate that there were additional work items performed as part of the review which were not required.

2. Discussion

A. Basis for Systems to be Reviewed

The basis for the determination of the piping systems to be reviewed consisted of the identification of those systems required to ensure the functional integrity of the shutdown cooling piping system for normal shutdown and of the Engineered Safeguards Systems piping systems, in the event of a design basis earthquake.

The physical limits of each piping system included in the review included the system itself and each branch connection through the first restraint beyond a remote operable or accessible manual isolation valve. The basic piping systems or portions of systems included in the review are listed below and are delineated in Appendix A and Appendix B to this report:

a) High and Low Pressure Safety Injection Systems inside and outside containment (P&ID M-201, 202, 203, 204, 210, 221).

b) Critical Service Water System inside and outside containment through isolatable branch connections (P&ID M-208, 213).

c) Component Cooling Water System outside containment (P&ID M-209).

d) Charging System (P&ID M-201, 202).

e) Concentrated Boric Acid System (P&ID M-202).

f) Air Room Purge and Containment Air Purge outside containment (P&ID M-218).

g) Containment Spray (P&ID M-203, 204).

h) CVCS letdown system through flow control valves (P&ID M-201, 202).

i) Fuel oil to the emergency diesels (P&ID M-214, 655, 653).

j) Connections to the primary coolant loop through the isolation valves (P&ID M-201).

k) Auxiliary Feedwater System (P&ID M-207, 220).

l) Gas decay tank connections (P&ID M-211).

m) Diesel Generator Auxiliary Systems (P&ID M-214).

n) High pressure air to the safeguard valves (P&ID M-225).

Portions of the piping systems shown on the associated P&ID's, but not included in the review, were excluded because they are not necessary to the functioning of the shutdown cooling systems or the Engineered Safeguards Systems.

Each of the as-installed piping systems, or portions of systems, encircled on the attached P&ID's were physically observed to determine where support work was advisable. As part of this review, the acceptability of the location and type of all piping support components including spring supports, rigid supports, guides and hydraulic snubbers for thermal, dead weight and seismic loads was confirmed (Estimated total in excess of 2700).

Spring hanger settings were not reviewed, but the work described herein would not significantly change the settings on existing spring supports.

B. Basis for Piping Support Systems Evaluation

The basis for the evaluation of the as-installed support systems was as follows:

The base plant calculations, drawings or criteria were used in physically determining where the as-installed support systems differed from the initial criteria.

1) Piping 6" and larger: The base plant calculations and drawings provided the location of seismic restraints to ensure that the piping primary stress levels would not exceed 110% of the material minimum yield stress at temperatures under DBE load condition. The restraints were designed so that the structural member maximum stress levels would not exceed 60% of the material yield stress.

2) Piping 4" and smaller: The base plant design criteria provided for the physical location of supports at such intervals that, for a particular pipe size, the natural frequency would be approximately equal to, or greater than, 20 CPS for design in the rigid range. These criteria were followed in the small piping systems review and in the definition of the work items.

Where the as-installed support systems differed from the design criteria, engineering judgments were made during the review to determine whether the support could be accepted, as is, or whether a specific restraint should be added, deleted, replaced or modified to insure compliance with the 20 CPS criteria.

3. Conclusion

The piping systems review described in this report included all piping support components in the systems required for safe shutdown.

The Appendices to this report delineate the work items accomplished. The engineering opinion that adequate functional integrity of the piping systems would have been maintained during a design basis earthquake, even if the work items had not been performed, is based upon the following:

The majority of the work was on small piping, 4" and under. Modified dynamic analyses and other evaluations were completed and acceptable stress levels calculated subsequent to the accomplishment of the work items. (less than 110% of S_y assuming that the work items had not been done. These analyses have confirmed that a significant number of work items were not required to meet the Palisades maximum stress level criteria.

The modified dynamic analysis utilized has been submitted to NRC as part of Bechtel's Topical Report BP-TOP-1. The topical report is in the final stages of NRC acceptance review.

In addition to the modified dynamic analysis performed, a number of the work items accomplished are considered as upgrading to (1) improve the restraint/support condition; (2) minimize the potential for vibration; (3) add conservatism in modifying single directional restraints to multi-directional restraints. (Unistrut Corp. has recently confirmed that their product is suitable for carrying the imposed loads in all directions.)

Although the engineering opinion was that there was no significant safety problem and that the functional integrity of the piping systems would have been preserved in the event of a DBE, completion of the identified work items has provided further assurance that the shutdown cooling and ESS piping system restraints are in conformance with and in some cases exceed, the Palisades FSAR criteria.

The major portion of design and construction of the Palisades base plant took place in the late 1960's. Due to our limited knowledge of start-up and hot functional testing, certain changes in the plant and the operation of the plant, it is impossible for us to determine the cause for each specific work item. However, they generally appear to be due to the following:

1. During the recent piping support systems review, numerous relatively simple devices, such as U-bolts, were added on small pipe piping systems on the basis of the rigid design in areas where it could not readily be determined that they were necessary, inasmuch as the performance of a further analysis to confirm that they were not required would have unnecessarily delayed start-up of the plant. As indicated above, the subsequent analysis has confirmed that the majority of these work items were not required. (74 of 188)

2. Subsequent to completion of base plant design and construction, certain Seismic Class I piping systems were added, expanded or modified without uniform application of the designated criteria for restraints. (20 of 188)

3. Some devices which had been or appear to have been installed during base plant construction were subsequently removed and not replaced. (13 of 188)

4. Some of the adjustments and minor modifications, such as the adding or replacement of shims and replacement or adjustment of nuts and bolts, were ordinary maintenance type items which could have been routinely identified and corrected. (11 of 188)

5. Many of the work items consisted of corrections and adjustments to eliminate interferences that are typical of the type items normally checked and corrected during a start-up and hot functional testing program. (15 of 188)

6. Other work items may have been the result of differences in engineering judgment between the engineer originally performing the design and the engineers performing the review; incomplete documentation and follow-up prior to and after turnover; late piping changes and modifications; lack of documentation of engineering approval of field changes in location from the original drawings; and an incomplete check out of the installation of the restraints. (68 of 188)

The 74 work items determined as not required in Item 1 above include approximately 13 in Items 2, 3, 4, and 5.

The work items discussed in this report arose out of circumstances believed to be unique to Palisades. As indicated, a number of the work items were subsequently determined not to be required, and others relate to facility modifications subsequent to the completion of plant design and construction, maintenance type items and the replacement of restraints which had previously been installed and removed.

Start-up testing programs which are normally performed by Bechtel on other projects were performed at the Palisades Plant by Consumers Power Company. This procedure and the manner in which turnover was handled may have caused incomplete coordination of follow-up items.

Subsequent to the design and construction of the Palisades Plant, the application of seismic restraint criteria by engineering and construction has become more formal and disciplined and has been subjected to extensive procedural control. In addition to the development of the procedural approaches to restraint work, quality control and quality assurance programs governing such work have evolved substantially from the Consumers/Bechtel Quality Assurance program for Palisades, so that even if some of the underlying causes were to reoccur in spite of the programmatic and procedural developments, the Consumers/Bechtel QA program for Midland, or the Bechtel program in conjunction with the QA programs of other utilities have and will continue to provide for prompt identification and correction.

APPENDIX A

CRITERIA FOR PHYSICAL LIMITS OF PIPING SYSTEMS REVIEW

P&ID M-201: Piping connections to the primary coolant loops out through the normally closed double isolation valves and connections to the ESS and shutdown cooling.

The primary coolant loop piping was excluded because all seismic restraints are engineered and built into the equipment supports.

P&ID M-202: Piping systems for concentrated boric acid injection by the charging pumps and letdown through the remote operable flow control valves, pumps and interconnecting piping.

All other piping systems are excluded in that they are not necessary for operation of the ESS or shutdown cooling systems.

P&ID M-203: Piping systems for LP injection, HP injection, containment spray and connections on the safety injection tanks.

All other piping systems are excluded in that they are not necessary for operation of the ESS or shutdown cooling systems.

P&ID M-204: Piping systems for LP injection, HP injection and shutdown cooling. Also included are the connections on the SIRW tank out through the first isolation valve.

All other piping systems are excluded in that they are not necessary for operation of the ESS or shutdown cooling systems.

P&ID M-207: Piping systems for the auxiliary feedwater system including main feedwater and main steam out through the isolation valves.

All other piping systems are excluded in that they are not necessary for operation of the ESS or shutdown cooling systems.

P&ID M-208: Piping systems in the critical service water system supply to the ESS and shutdown cooling equipment, plus discharge water piping from air coolers through RCB wall to isolation valve. Also included are branch connections to other services out through an isolation valve.

All other piping systems are excluded in that they are not necessary for operation of the ESS or shutdown cooling systems.

P&ID M-209: Piping systems in the component cooling water system outside containment. Also included are branch connections to non-essential equipment out through the first isolation valve.

All other piping systems are excluded in that they are not necessary for operation of the ESS or shutdown cooling systems.

P&ID M-210: Piping systems to the SIRW tank from the tank to the isolation valve (continuation from P&ID M-204).

All other piping systems are excluded in that they are not necessary for operation of the ESS or shutdown cooling systems.

P&ID M-211: Piping systems from the gas decay tanks out to the first isolation valve.

All other piping systems are exluded in that they are not necessary for operation of the ESS or shutdown cooling systems.

P&ID M-213: Piping systems in the critical service water system (continuation from P&ID M-208).

All other piping systems are excluded in that they are not necessary for operation of the ESS or shutdown cooling systems.

P&ID M-214: Auxiliary piping systems for the emergency diesel generators and emergency fuel oil supply to the diesels.

All other piping systems are excluded in that they are not necessary for operation of the ESS or shutdown cooling systems or they are an integral part of the diesel generators and have been seismic qualified by the supplier.

P&ID M-218: Piping systems for the containment air purge from the containment penetration out through the containment isolation valves.

All other piping systems are excluded in that they are not necessary for the operation of the ESS or shutdown cooling systems.

P&ID M-220: Piping systems from the condensate storage tank to the auxiliary feedwater system (continuation from P&ID M-207).

All other piping systems are excluded in that they are not necessary for the operation of the ESS or shutdown cooling systems.

P&ID M-221: Piping systems to the SIRW tank from the isolation valves to the tank (continuation from P&ID M-204).

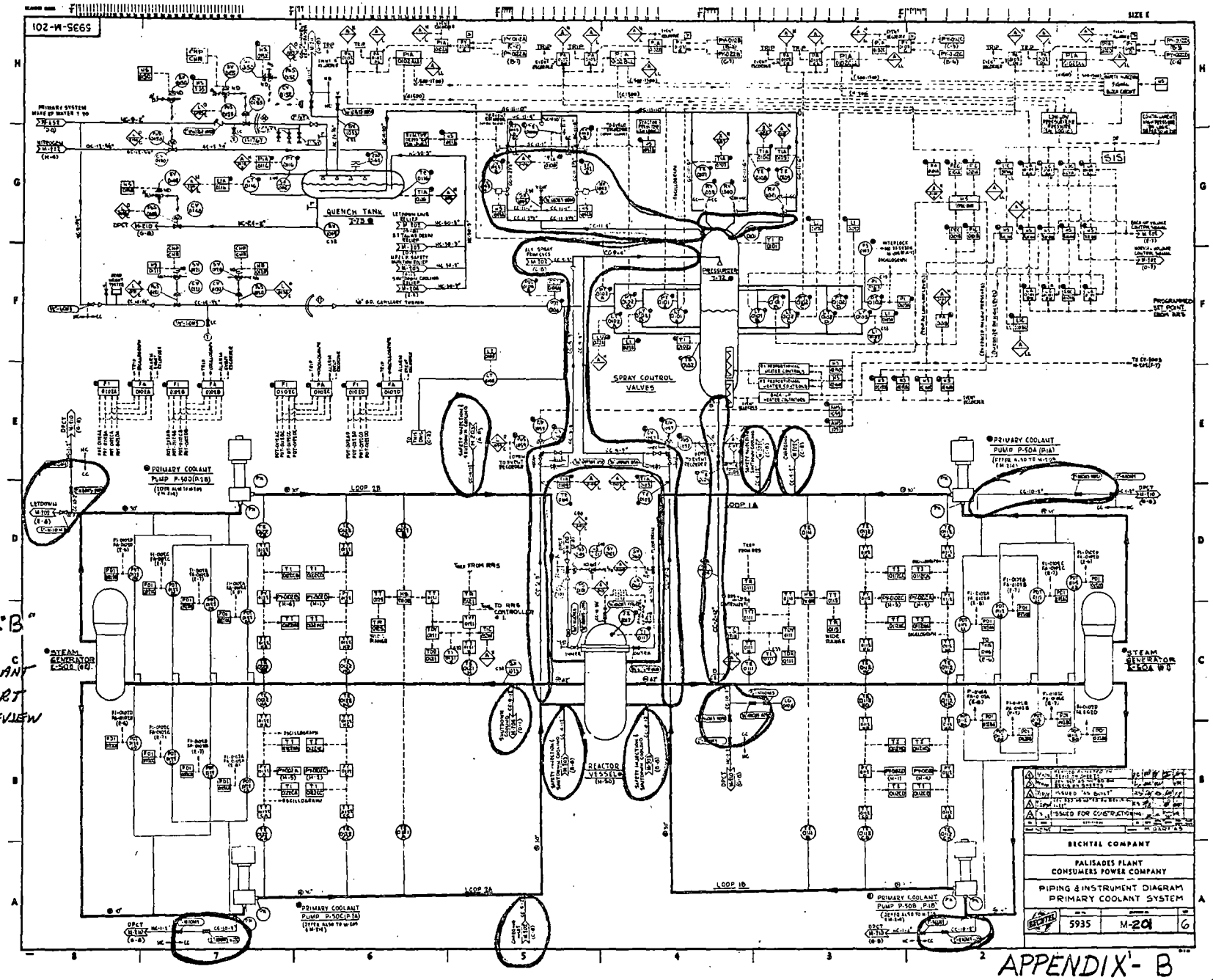
All other piping systems are excluded in that they are not necessary for the operation of the ESS or shutdown cooling systems.

P&ID M-225: Piping systems in the HP air supply to the ESS valve operators.

All other piping systems are excluded in that they are not necessary for the operation of the ESS or shutdown cooling systems.

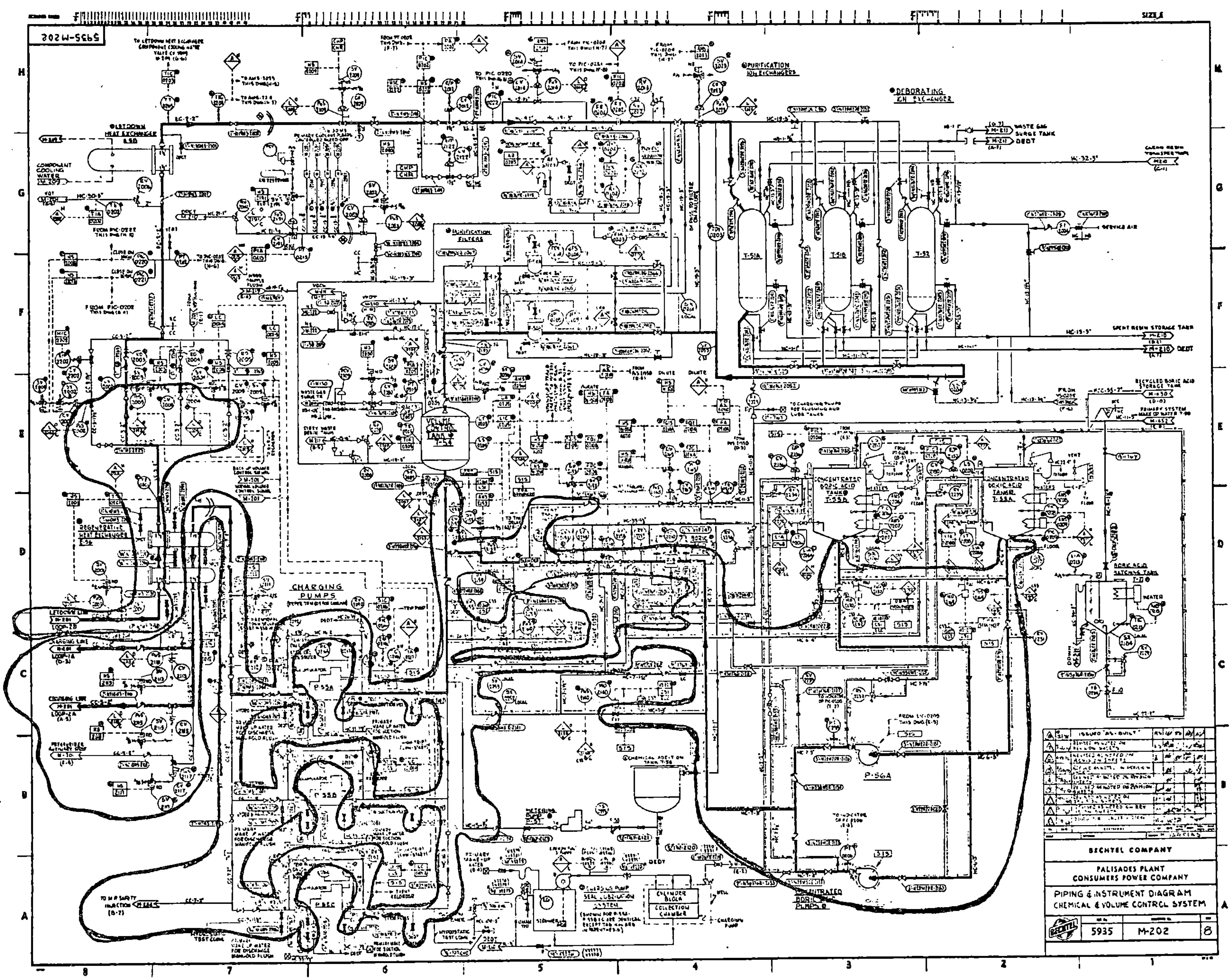
P&ID M-653 & M-655: Piping systems from the emergency fuel oil system out to the first isolation valve (continuation from P&ID M-214).

All other piping systems are excluded in that they are not necessary for the operation of the ESS or shutdown cooling systems.



APPENDIX "B"
TO
PALISADES PLANT
PIPING SUPPORT
SYSTEMS REVIEW

APPENDIX - B


5935-M202
LETDOWN HEAT EXCHANGER
COMPONENT COOLING WATER
PURIFICATION ION EXCHANGERS
DEBORATING ION EXCHANGER
PURIFICATION FILTERS
VOLUME CONTROL TANK T-54
REGENERATIVE HEAT EXCHANGER
CHARGING PUMPS
CONCENTRATED BORIC ACID TANK T-53B
CONCENTRATED BORIC ACID TANK T-53A
T-51A
T-51B
T-52
P-55A
P-55B
P-55C
P-56A
BORIC ACID BATCHING TANK
METERING PUMP
CHEMICAL ADD'N TANK T-56
SPENT RESIN STORAGE TANK
SERVICE AIR
ISSUED "AS-BUILT"
BECHTEL COMPANY
PALISADES PLANT
CONSUMERS POWER COMPANY
PIPING & INSTRUMENT DIAGRAM
CHEMICAL & VOLUME CONTROL SYSTEM
5935
M-202
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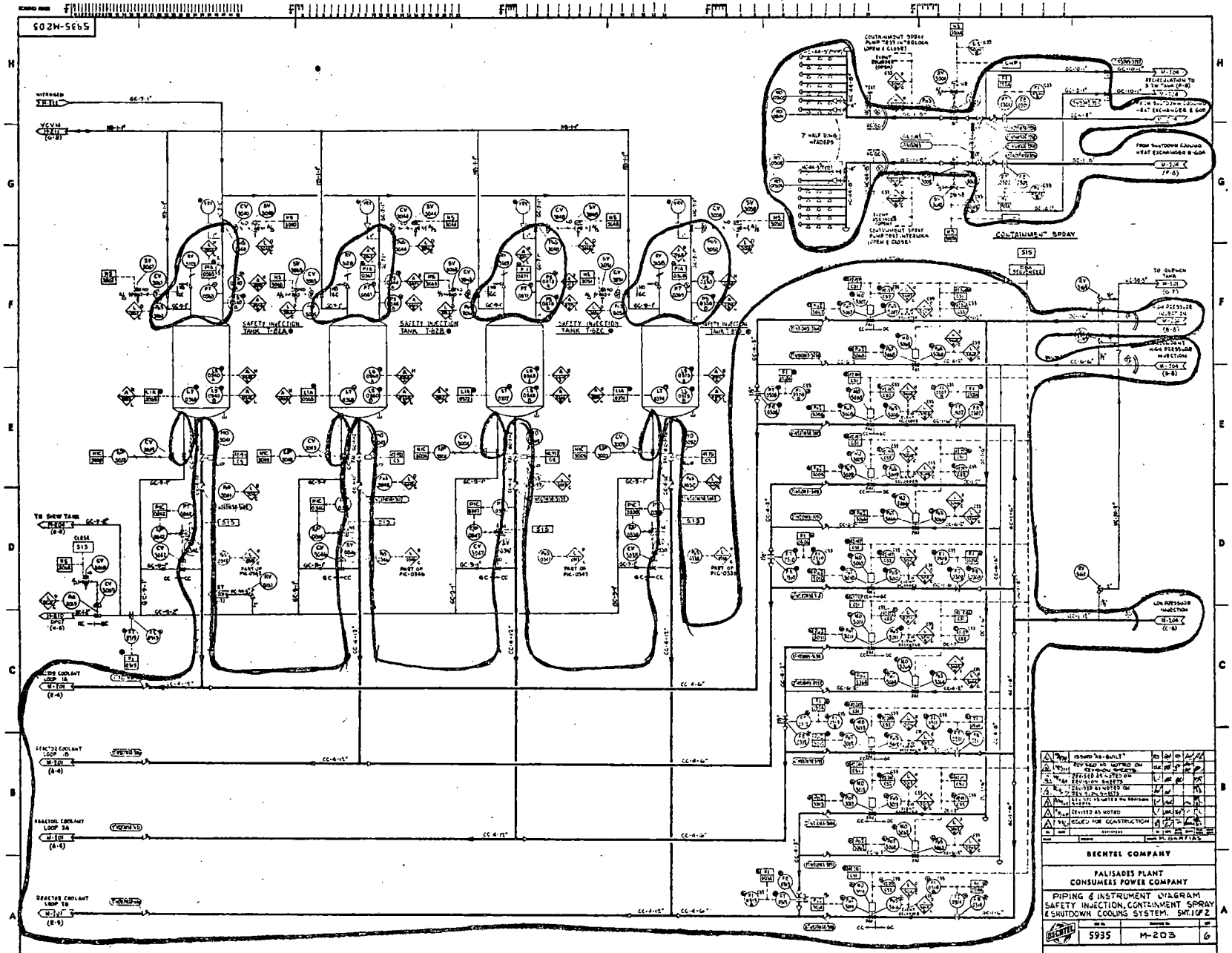
5935-M203
SAFETY INJECTION TANK T-82A
SAFETY INJECTION TANK T-82B
SAFETY INJECTION TANK T-82C
CONTAINMENT SPRAY
TO SHUTDOWN COOLING HEAT EXCHANGER B-60A
TO SHUTDOWN COOLING HEAT EXCHANGER B-60B
TO SWING TANK
TO REACTOR COOLANT LOOP 1A
TO REACTOR COOLANT LOOP 1B
TO REACTOR COOLANT LOOP 2A
TO REACTOR COOLANT LOOP 2B
BECHTEL COMPANY
PALISADES PLANT
CONSUMERS POWER COMPANY
PIPING & INSTRUMENT DIAGRAM
SAFETY INJECTION, CONTAINMENT SPRAY & SHUTDOWN COOLING SYSTEM. SHT. 1 OF 2
BECHTEL
5935
M-203
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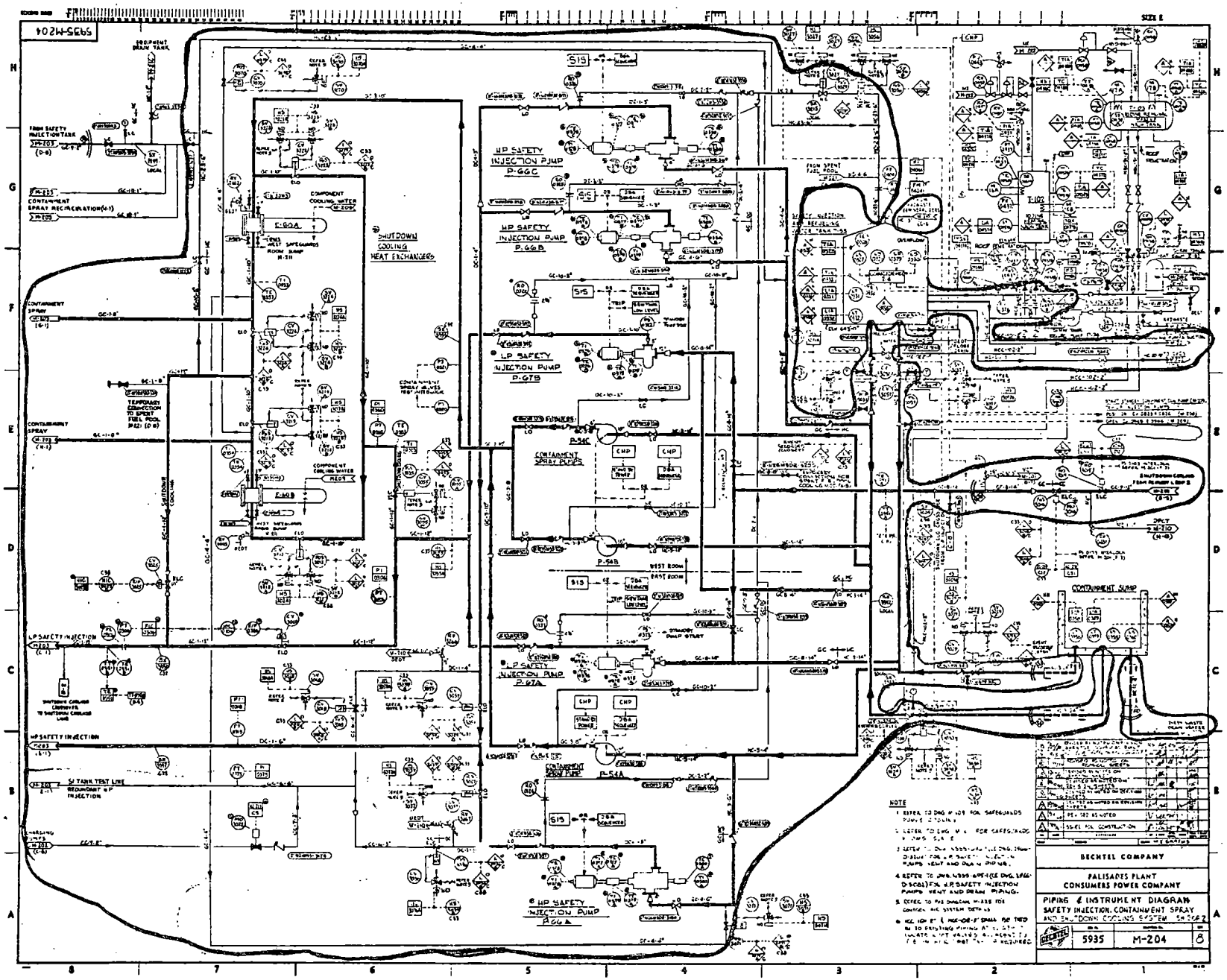
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HP SAFETY INJECTION PUMP P-66C
HP SAFETY INJECTION PUMP P-66B
LP SAFETY INJECTION PUMP P-67B
LP SAFETY INJECTION PUMP P-67A
HP SAFETY INJECTION PUMP P-66A
CONTAINMENT SPRAY PUMP P-54C
CONTAINMENT SPRAY PUMP P-54B
CONTAINMENT SPRAY PUMP P-54A
SHUTDOWN COOLING HEAT EXCHANGERS
E-66A
E-66B
CONTAINMENT SUMP
BECHTEL COMPANY
PALISADES PLANT
CONSUMERS POWER COMPANY
PIPING & INSTRUMENT DIAGRAM
SAFETY INJECTION, CONTAINMENT SPRAY
AND SHUTDOWN COOLING SYSTEM
5935
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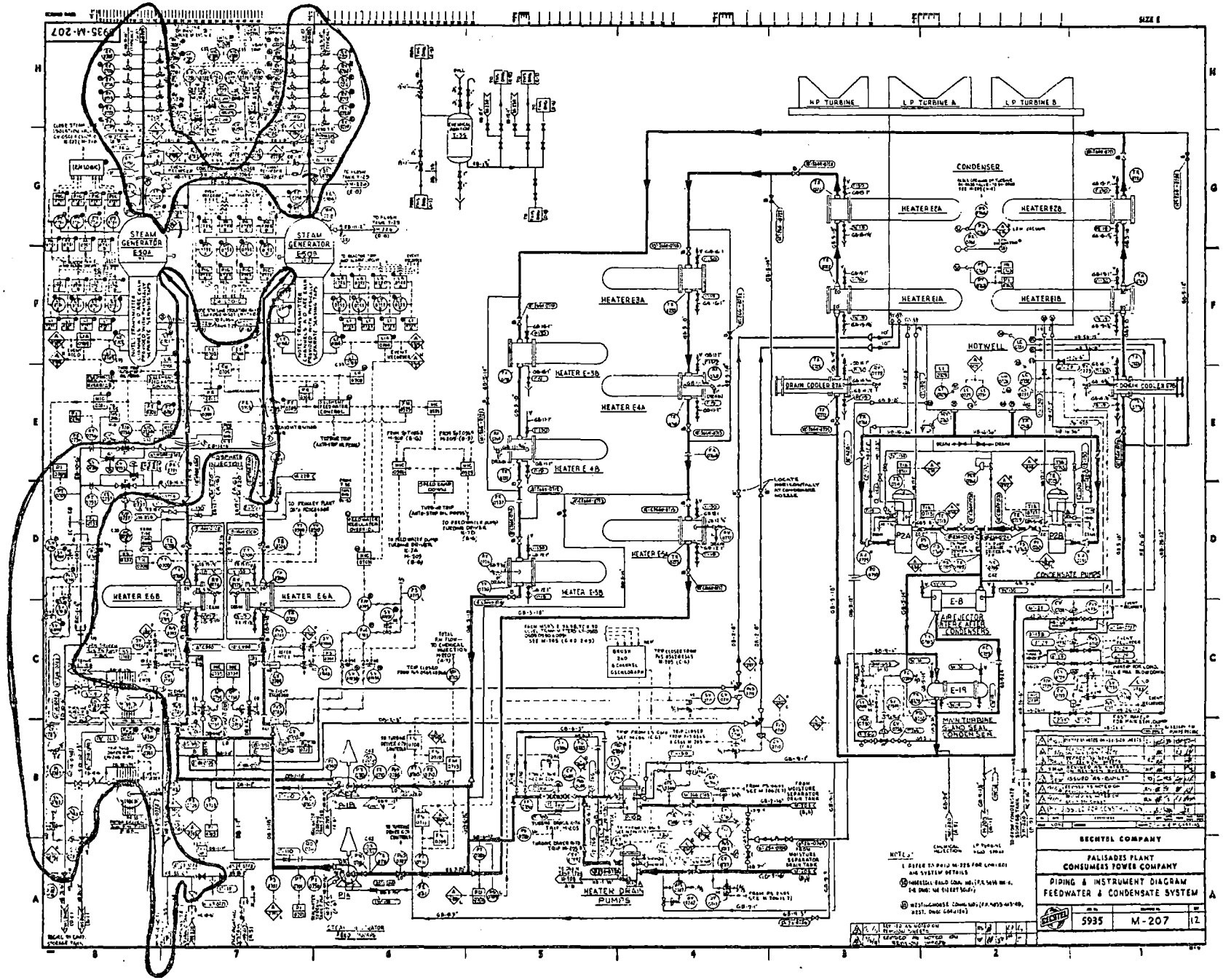
H.P. TURBINE
L.P. TURBINE A
L.P. TURBINE B
CONDENSER
HEATER E2A
HEATER E2B
HEATER E1A
HEATER E1B
HOTWELL
DRAIN COOLER E7A
DRAIN COOLER E7B
HEATER E3A
HEATER E-3B
HEATER E4A
HEATER E 4B
HEATER E5A
HEATER E-5B
HEATER E6B
HEATER E6A
STEAM GENERATOR E-50A
STEAM GENERATOR E-50B
CONDENSATE PUMPS
E-8
E-19
MAIN TURBINE GLAND SEAL CONDENSER
HEATER DRAIN PUMPS
BECHTEL COMPANY
PALISADES PLANT
CONSUMERS POWER COMPANY
PIPING & INSTRUMENT DIAGRAM
FEEDWATER & CONDENSATE SYSTEM
5935
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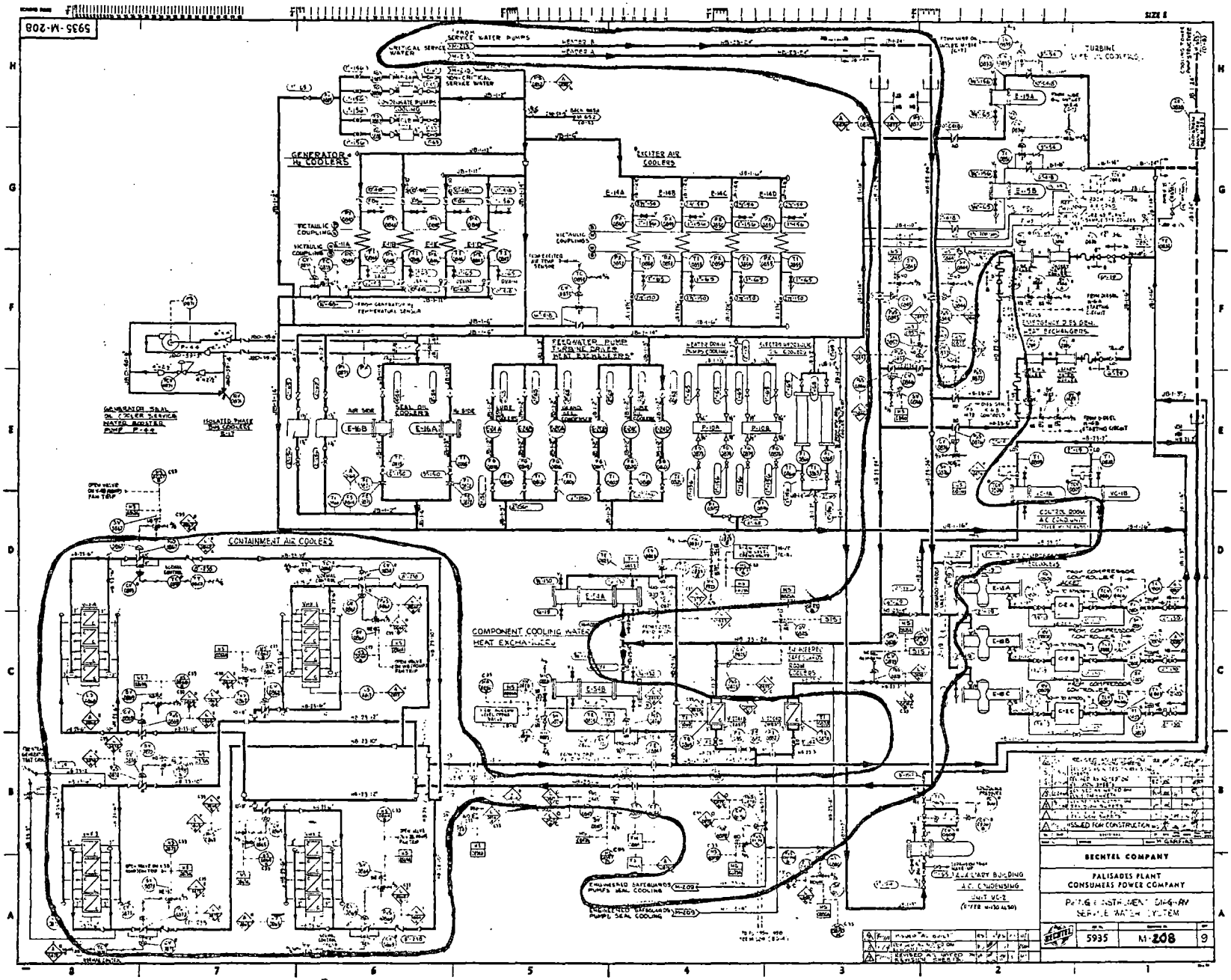
5935-M-208
SIZE E
SERVICE WATER PUMPS
CRITICAL SERVICE WATER
NON-CRITICAL SERVICE WATER
HEADER B
HEADER A
TURBINE
GENERATOR H2 COOLERS
EXCITER AIR COOLERS
METALLIC COUPLING
FEEDWATER PUMP TURBINE DRIVEN LUBE OIL HEAT EXCHANGERS
GENERATOR SEAL OIL COOLER SERVICE WATER BOOSTER PUMP P-44
ISOLATED PHASE BUS COOLER UNIT
CONTAINMENT AIR COOLERS
COMPONENT COOLING WATER HEAT EXCHANGERS
AUXILIARY BUILDING A.C. CONDENSING UNIT VC-2
ENGINEERED SAFEGUARDS PUMPS SEAL COOLING
CONTROL ROOM A.C. CONDENSING UNIT
ISSUED FOR CONSTRUCTION
BECHTEL COMPANY
PALISADES PLANT
CONSUMERS POWER COMPANY
PIPING INSTRUMENT DIAGRAM
SERVICE WATER SYSTEM
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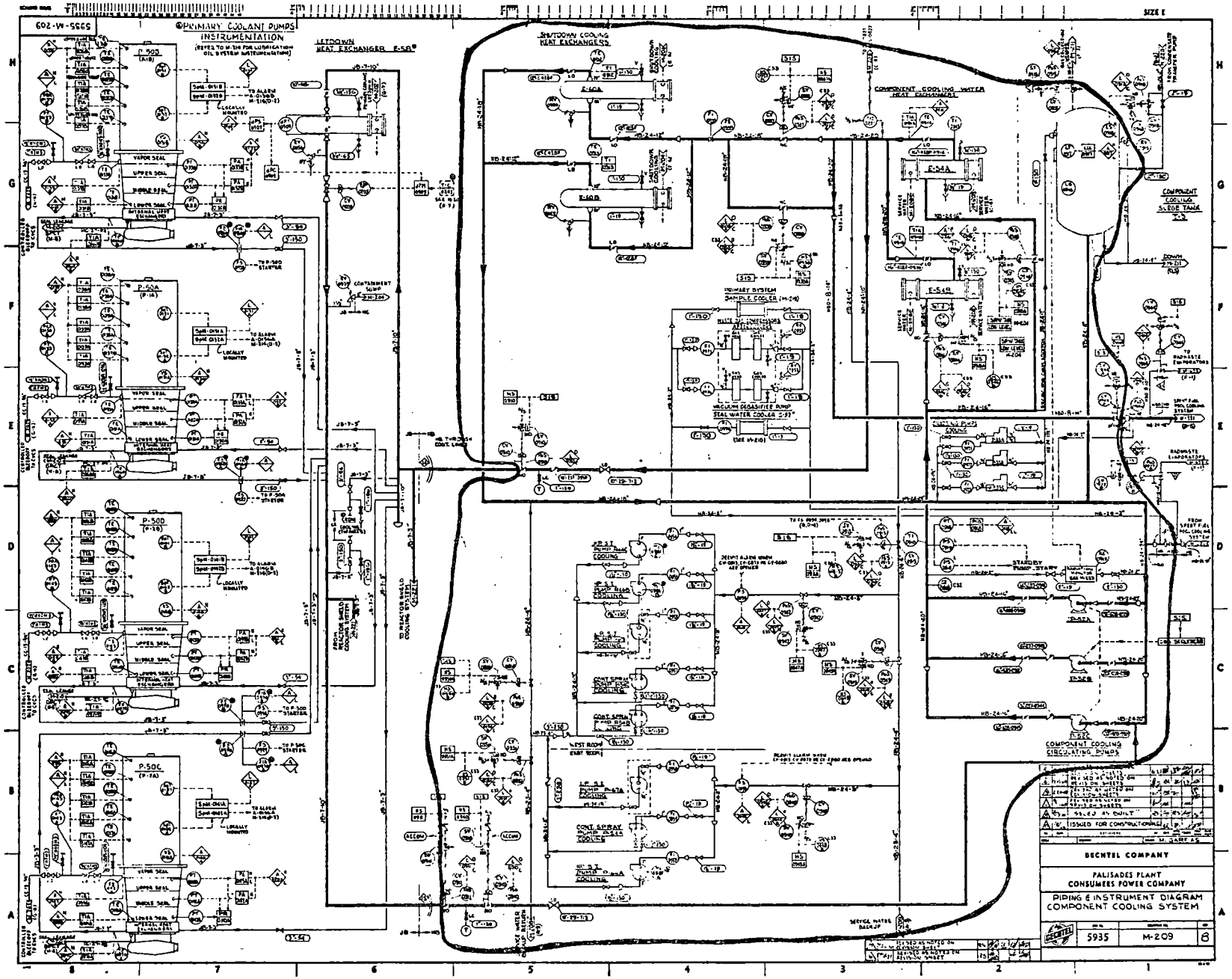
5935-M-209
PRIMARY COOLANT PUMPS INSTRUMENTATION
(REFER TO M-314 FOR LUBRICATION OIL SYSTEM INSTRUMENTATION)
LETDOWN HEAT EXCHANGER E-52
SHUTDOWN COOLING HEAT EXCHANGERS
COMPONENT COOLING WATER HEAT EXCHANGERS
COMPONENT COOLING SURGE TANK
P-50D
P-50A
P-50C
E-52A
E-52B
E-54A
E-54B
PRIMARY SYSTEM SAMPLE COOLER
VACUUM DEGASIFIER PUMP SEAL WATER COOLER
COMPONENT COOLING CIRCULATING PUMPS
CONT. SPRAY PUMP COOLERS
SERVICE WATER BACKUP
BECHTEL COMPANY
PALISADES PLANT
CONSUMERS POWER COMPANY
PIPING & INSTRUMENT DIAGRAM
COMPONENT COOLING SYSTEM
5935
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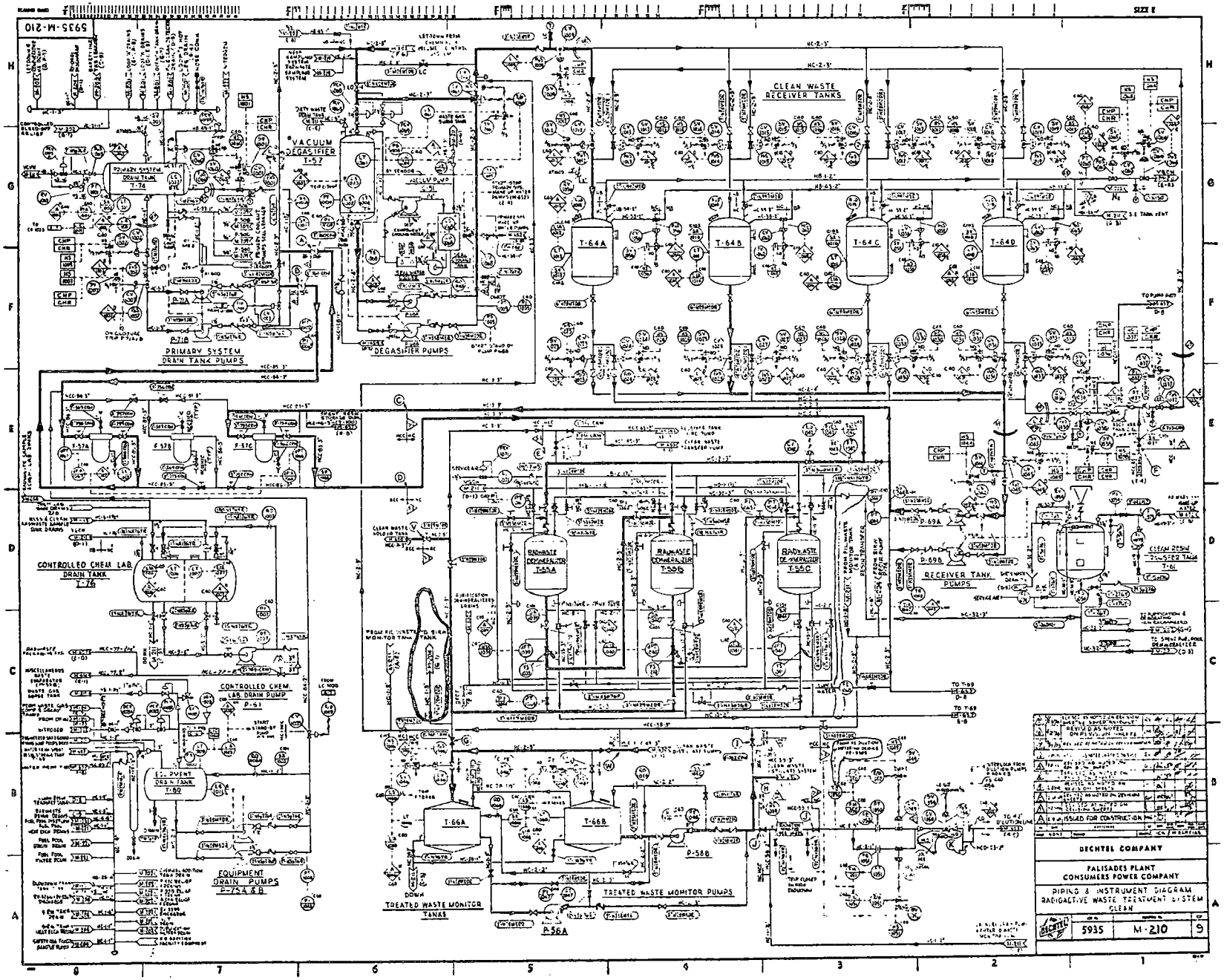
5935-M-210
CLEAN WASTE RECEIVER TANKS
T-64A
T-64B
T-64C
T-64D
VACUUM DEGASIFIER T-57
PRIMARY SYSTEM DRAIN TANK T-74
PRIMARY SYSTEM DRAIN TANK PUMPS P-71A
DEGASIFIER PUMPS
CONTROLLED CHEM. LAB DRAIN TANK T-76
CONTROLLED CHEM. LAB DRAIN PUMP P-61
EQUIPMENT DRAIN TANK T-80
EQUIPMENT DRAIN PUMPS P-75A&B
RADWASTE DEMINERALIZER T-65A
RADWASTE DEMINERALIZER T-65B
RADWASTE DEVAPORATOR T-65C
RECEIVER TANK PUMPS P-69A
P-69B
CLEAN DRAIN T-61
TREATED WASTE MONITOR TANKS T-66A
T-66B
P-56B
TREATED WASTE MONITOR PUMPS
P-56A
DECHTEL COMPANY
PALISADES PLANT
CONSUMERS POWER COMPANY
PIPING & INSTRUMENT DIAGRAM
RADIOACTIVE WASTE TREATMENT SYSTEM
CLEAN
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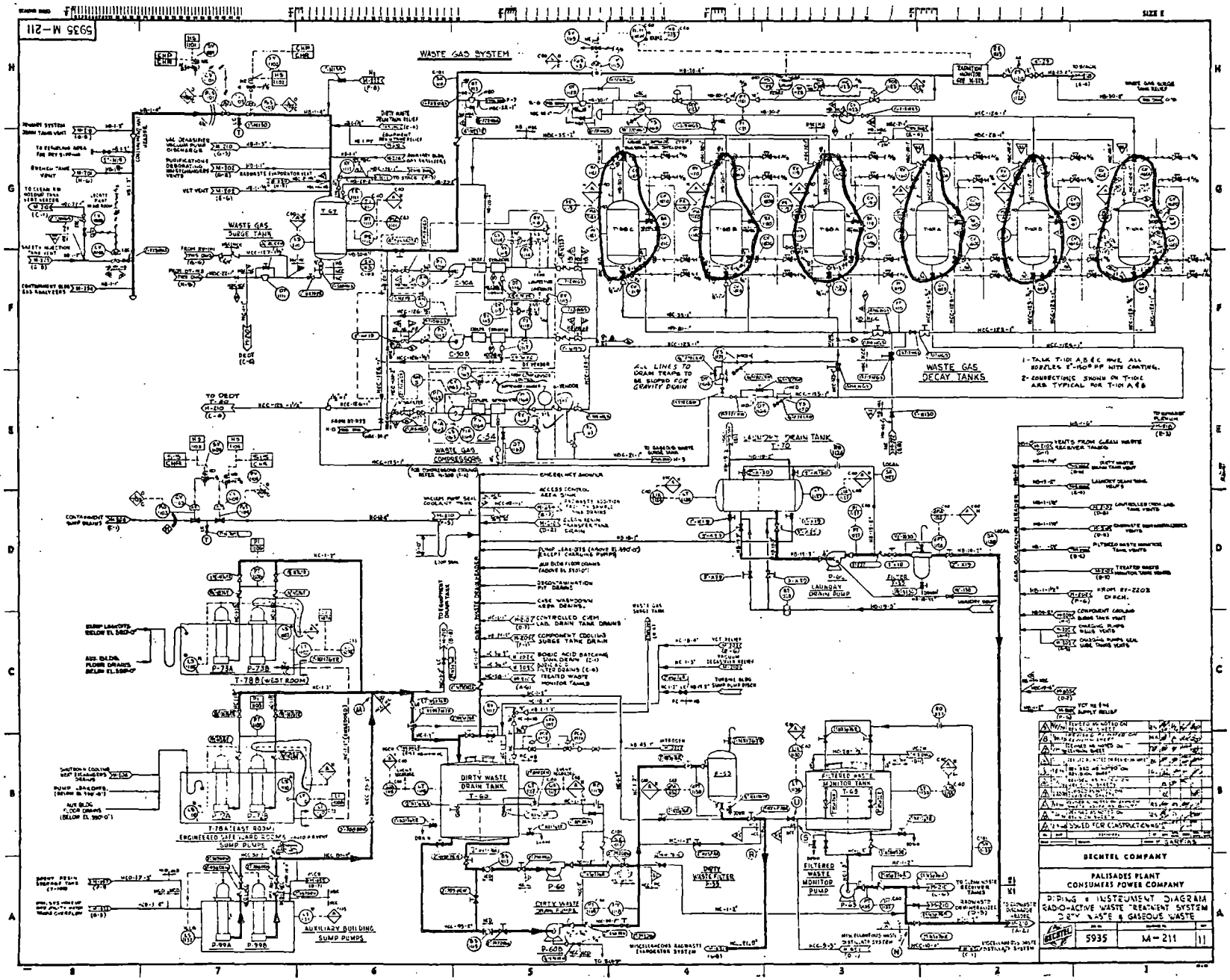
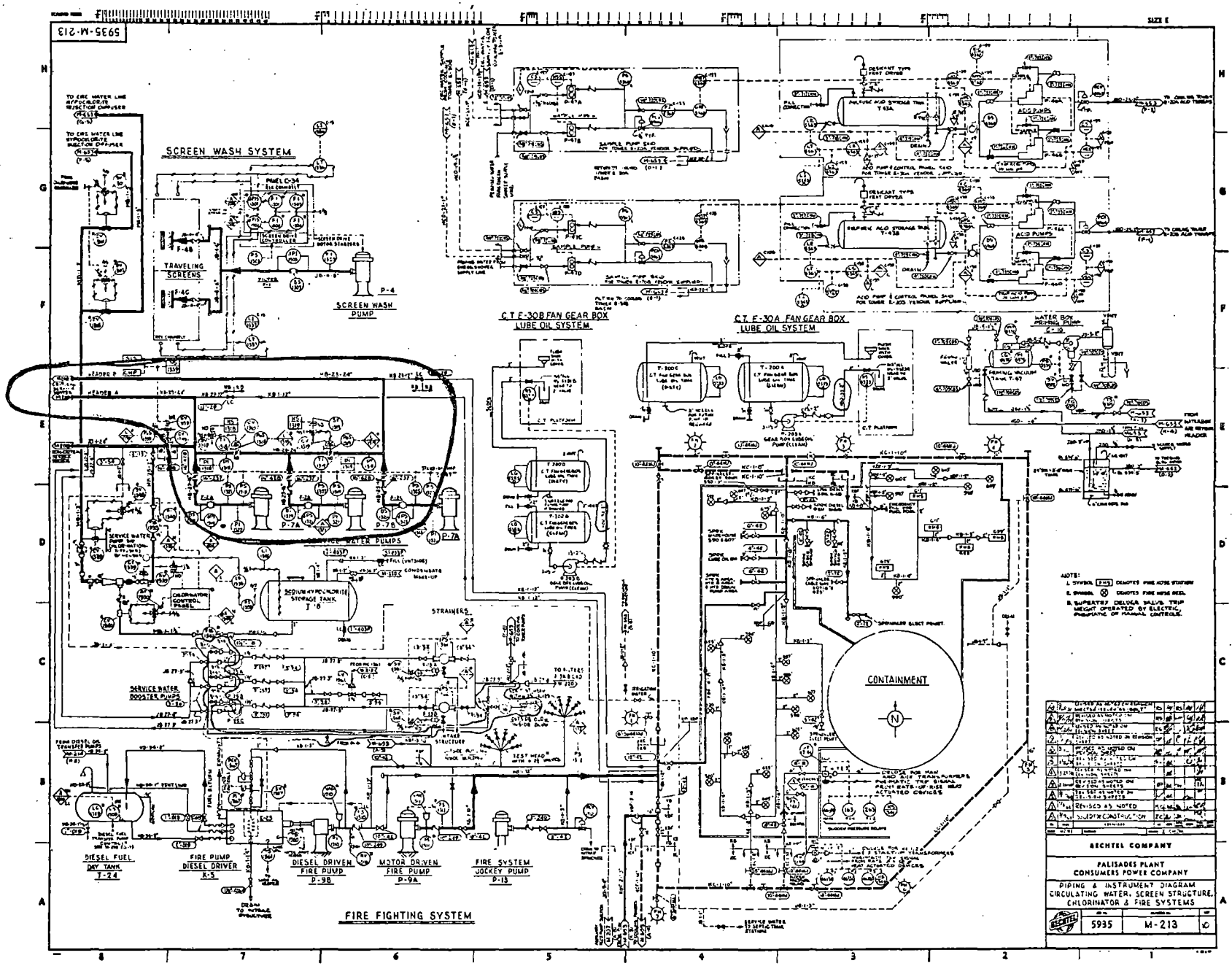
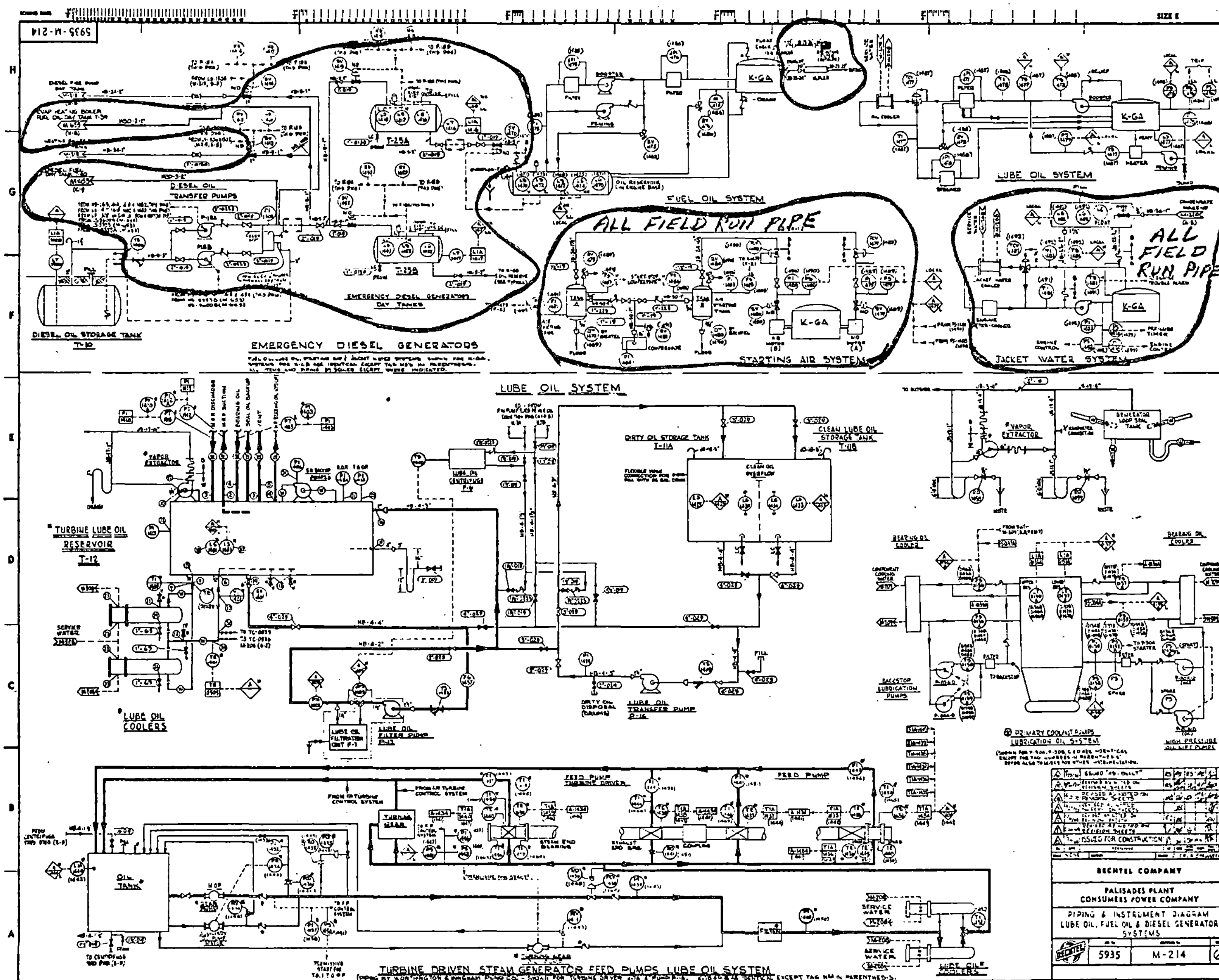

5935 M-211
WASTE GAS SYSTEM
WASTE GAS DECAY TANKS
WASTE GAS SURGE TANK
WASTE GAS COMPRESSORS
LAUNDRY DRAIN TANK T-70
LAUNDRY DRAIN PUMP
DIRTY WASTE DRAIN TANK T-69
DIRTY WASTE FILTER F-59
FILTERED WASTE MONITOR TANK T-65
FILTERED WASTE MONITOR PUMP
DIRTY WASTE DRAIN PUMPS
AUXILIARY BUILDING SUMP PUMPS
ENGINEERED SAFEGUARD ROOMS SUMP PUMPS
T-78B (WEST ROOM)
T-78A (EAST ROOM)
ALL LINES TO DRAIN TRAPS TO BE SLOPED FOR GRAVITY DRAIN
1 - TANK T-101 A,B & C HAVE ALL NOZZLES 8"-150# RF WITH COATING.
2 - CORRECTIONS SHOWN ON T-101C ARE TYPICAL FOR T-101 A & B
ISSUED FOR CONSTRUCTION
BECHTEL COMPANY
PALISADES PLANT
CONSUMERS POWER COMPANY
PIPING & INSTRUMENT DIAGRAM
RADIO-ACTIVE WASTE TREATMENT SYSTEM
DRY WASTE & GASEOUS WASTE
5935
M-211


5935-M-213
SCREEN WASH SYSTEM
TRAVELING SCREENS
SCREEN WASH PUMP
P-4
C.T. E-30B FAN GEAR BOX LUBE OIL SYSTEM
C.T. E-30A FAN GEAR BOX LUBE OIL SYSTEM
SERVICE WATER PUMPS
P-7A
P-7B
P-7C
SODIUM HYPOCHLORITE STORAGE TANK T-10
STRAINERS
SERVICE WATER BOOSTER PUMP
CONTAINMENT
DIESEL FUEL DAY TANK T-24
FIRE PUMP DIESEL DRIVER K-5
DIESEL DRIVEN FIRE PUMP P-9B
MOTOR DRIVEN FIRE PUMP P-9A
FIRE SYSTEM JOCKEY PUMP P-19
FIRE FIGHTING SYSTEM
NOTE:
1. SYMBOL FHS DENOTES FIRE HOSE STATION
2. SYMBOL ⊗ DENOTES FIRE HOSE REEL
3. SUPERVISORY DELUGE VALVE TRIP MEANS OPERATED BY ELECTRIC, PNEUMATIC OR MANUAL CONTROLS.
BECHTEL COMPANY
PALISADES PLANT
CONSUMERS POWER COMPANY
PIPING & INSTRUMENT DIAGRAM
CIRCULATING WATER, SCREEN STRUCTURE, CHLORINATOR & FIRE SYSTEMS
5935
M-213


5935-M-214
EMERGENCY DIESEL GENERATORS
DIESEL OIL STORAGE TANK T-10
DIESEL OIL TRANSFER PUMPS
EMERGENCY DIESEL GENERATOR DAY TANKS
T-25A
T-25B
FUEL OIL SYSTEM
LUBE OIL SYSTEM
K-6A
ALL FIELD RUN PIPE
STARTING AIR SYSTEM
JACKET WATER SYSTEM
ALL FIELD RUN PIPE
LUBE OIL SYSTEM
TURBINE LUBE OIL RESERVOIR T-12
VAPOR EXTRACTOR
LUBE OIL COOLERS
LUBE OIL FILTRATION UNIT F-1
LUBE OIL FILTER PUMP P-13
DIRTY OIL STORAGE TANK T-11A
CLEAN LUBE OIL STORAGE TANK T-11B
DIRTY OIL DISPOSAL (DRUMS)
LUBE OIL TRANSFER PUMP P-16
BEARING OIL COOLER
BACKSTOP LUBRICATION PUMPS
PRIMARY COOLANT PUMPS LUBRICATION OIL SYSTEM
HIGH PRESSURE OIL LIFT PUMPS
FEED PUMP TURBINE DRIVER
FEED PUMP
OIL TANK
FILTER
SERVICE WATER
LUBE OIL COOLERS
TURBINE DRIVEN STEAM GENERATOR FEED PUMPS LUBE OIL SYSTEM
ISSUED FOR CONSTRUCTION
BECHTEL COMPANY
PALISADES PLANT
CONSUMERS POWER COMPANY
PIPING & INSTRUMENT DIAGRAM
LUBE OIL, FUEL OIL & DIESEL GENERATOR SYSTEMS
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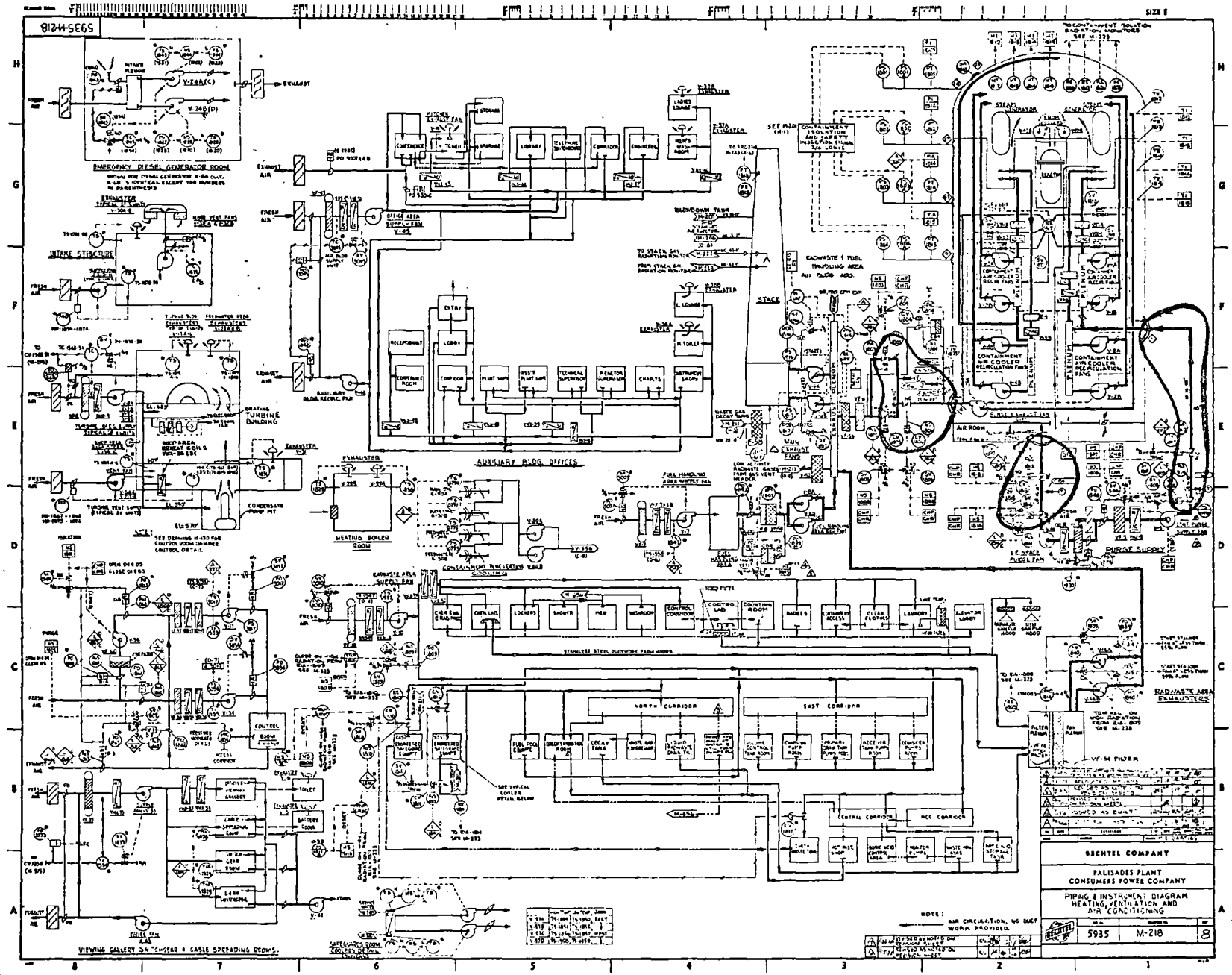
5935-M218
SIZE E
EMERGENCY DIESEL GENERATOR ROOM
INTAKE STRUCTURE
AUXILIARY BLDG. OFFICES
HEATING BOILER ROOM
STACK
AIR ROOM
PURGE SUPPLY
NORTH CORRIDOR
EAST CORRIDOR
CENTRAL CORRIDOR
VIEWING GALLERY, SWITCHGEAR & CABLE SPREADING ROOMS
NOTE: AIR CIRCULATION, NO DUCT WORK PROVIDED.
BECHTEL COMPANY
PALISADES PLANT
CONSUMERS POWER COMPANY
PIPING & INSTRUMENT DIAGRAM
HEATING, VENTILATION AND
AIR CONDITIONING
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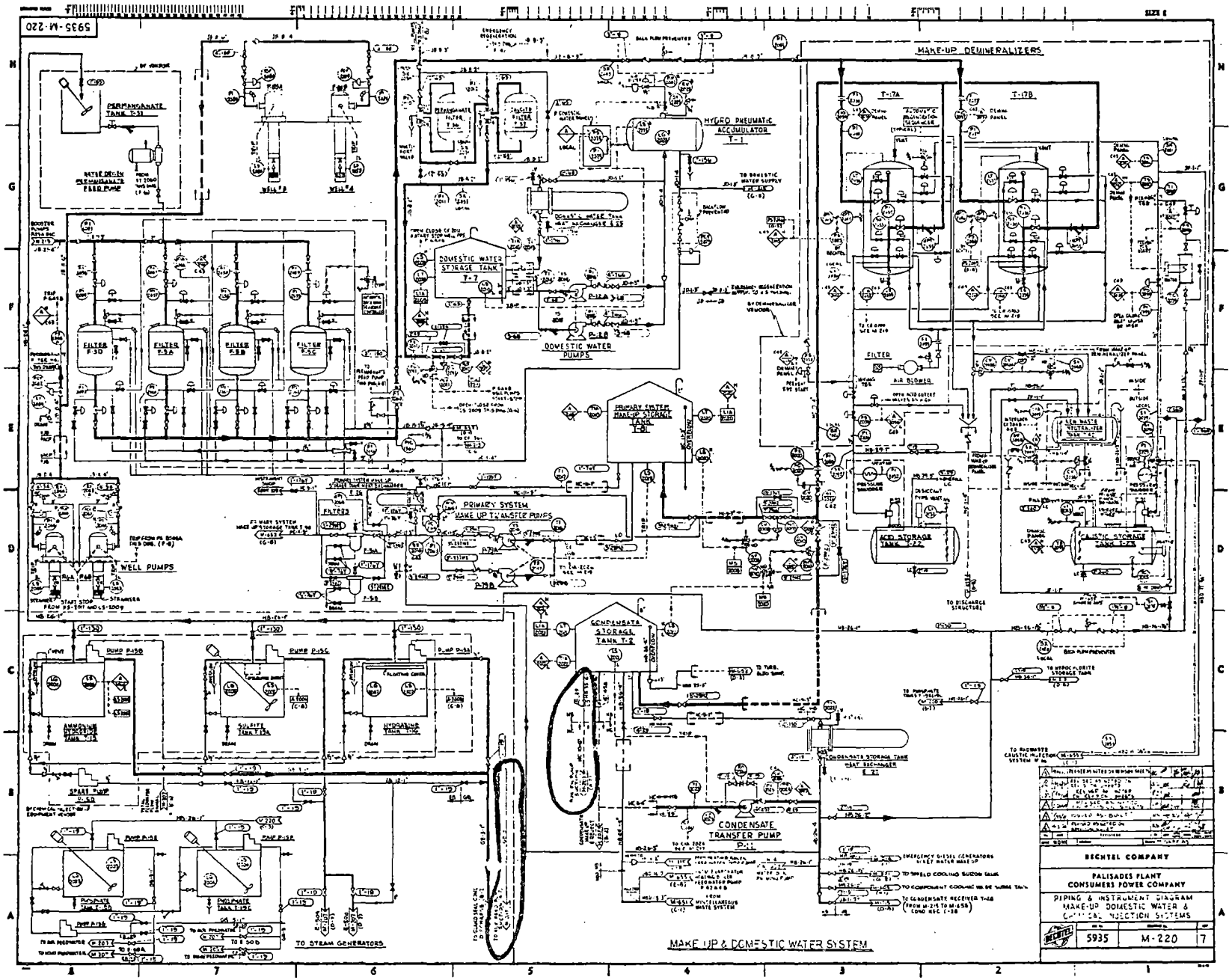
5935-M-220
MAKE-UP DEMINERALIZERS
T-17A
T-17B
PERMANGANATE TANK T-31
HYDRO PNEUMATIC ACCUMULATOR T-1
DOMESTIC WATER STORAGE TANK T-7
DOMESTIC WATER PUMPS
FILTER F-30
FILTER F-31A
FILTER F-31B
FILTER F-31C
PRIMARY SYSTEM MAKE UP TRANSFER PUMPS
WELL PUMPS
CONDENSATE STORAGE TANK T-2
CONDENSATE TRANSFER PUMP P-11
SPARE PUMP P-32
TO STEAM GENERATORS
MAKE UP & DOMESTIC WATER SYSTEM
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PIPING & INSTRUMENT DIAGRAM
MAKE-UP DOMESTIC WATER &
CHEMICAL INJECTION SYSTEMS
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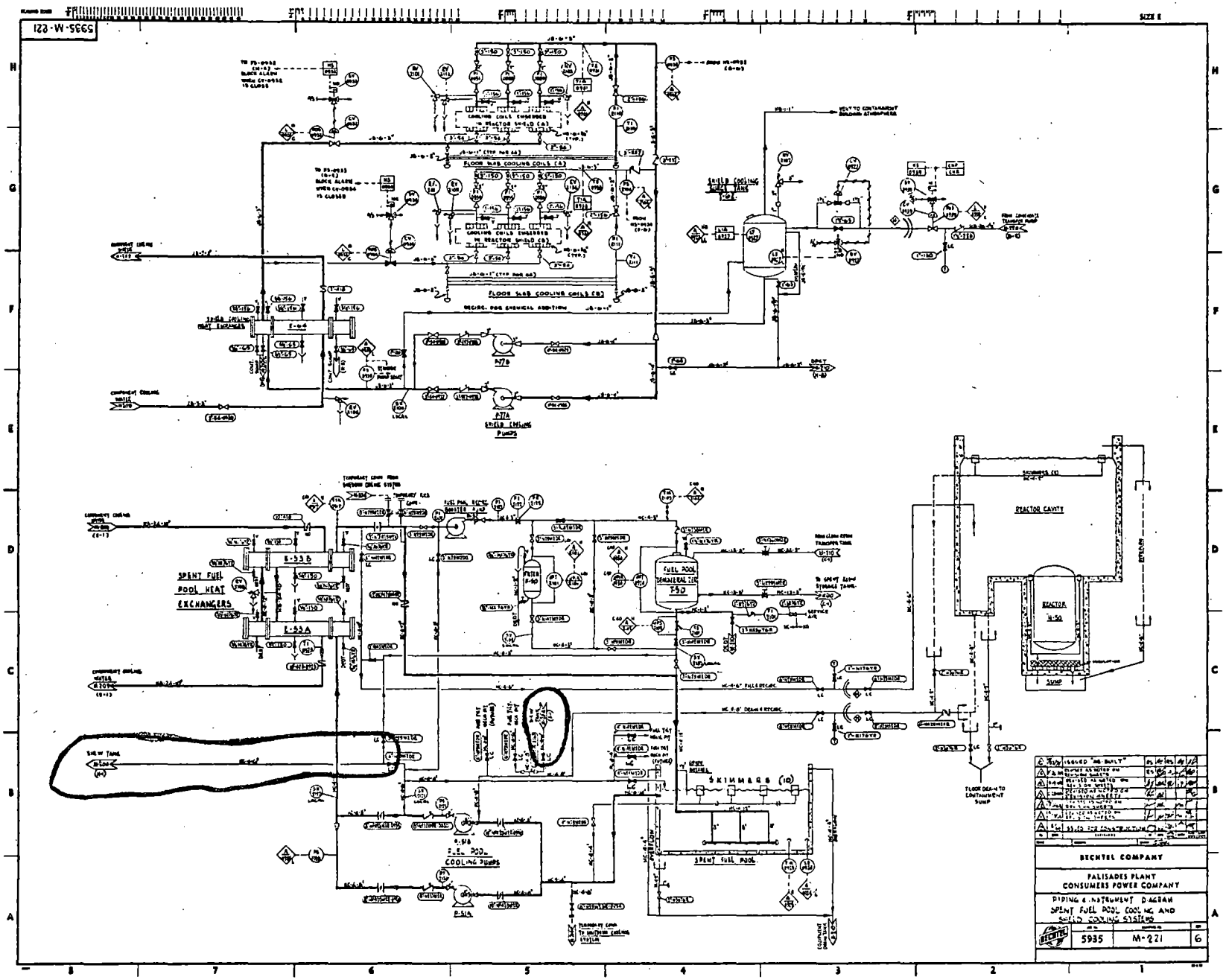
5935-M-221
SIZE E
FLOOR SLAB COOLING COILS (A)
FLOOR SLAB COOLING COILS (B)
P-77A
SHIELD COOLING PUMPS
SPENT FUEL POOL HEAT EXCHANGERS
E-53B
E-53A
FUEL POOL DEMINERALIZER
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REACTOR M-50
SUMP
SKIMMERS (10)
SPENT FUEL POOL
P-51A
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FLOOR DRAIN TO CONTAINMENT SUMP
BECHTEL COMPANY
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CONSUMERS POWER COMPANY
PIPING & INSTRUMENT DIAGRAM
SPENT FUEL POOL COOLING AND
SHIELD COOLING SYSTEMS
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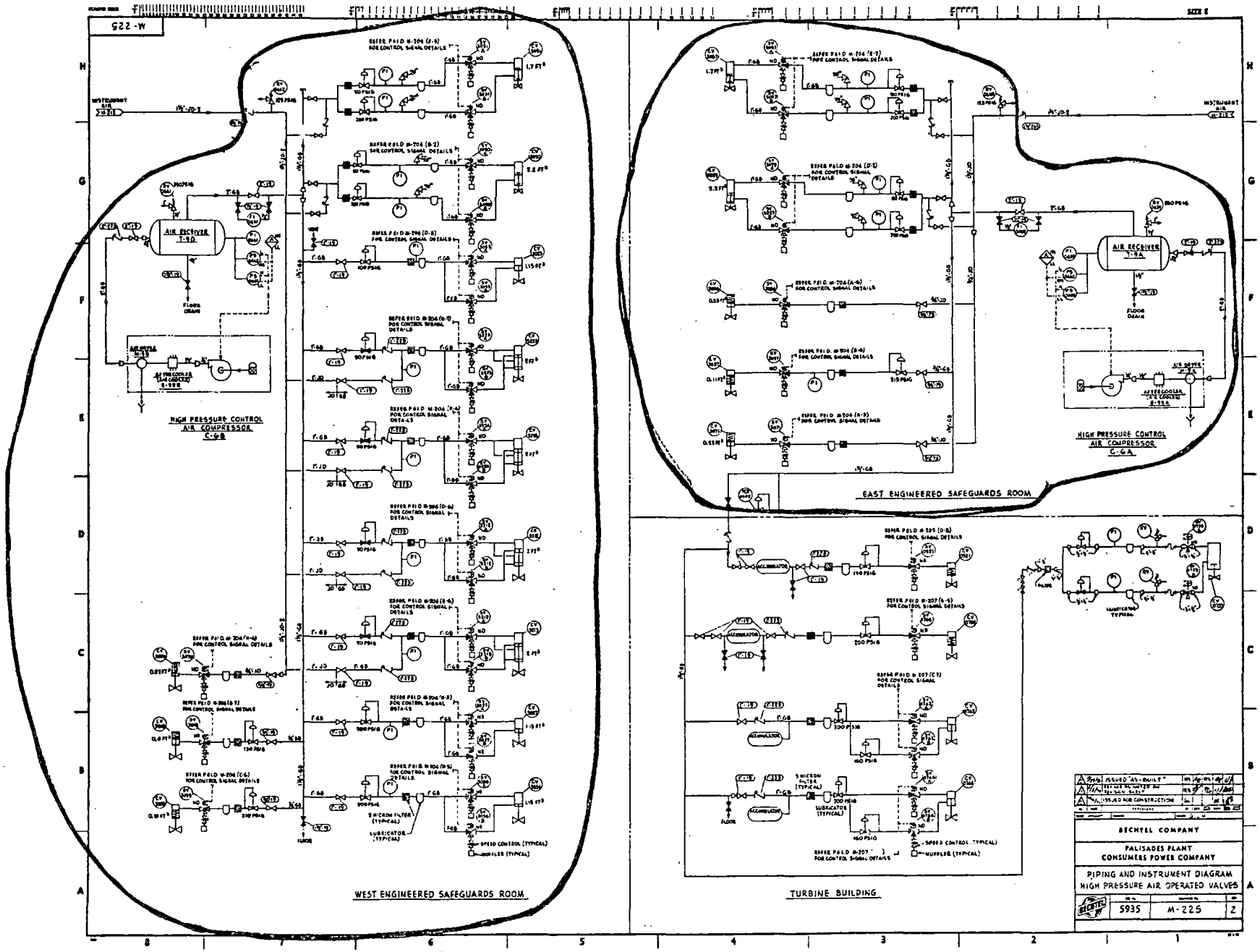
M-225
WEST ENGINEERED SAFEGUARDS ROOM
EAST ENGINEERED SAFEGUARDS ROOM
TURBINE BUILDING
HIGH PRESSURE CONTROL AIR COMPRESSOR C-6B
HIGH PRESSURE CONTROL AIR COMPRESSOR C-6A
AIR RECEIVER T-9D
AIR RECEIVER T-9A
INSTRUMENT AIR
FLOOR DRAIN
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MUFFLER (TYPICAL)
LUBRICATOR (TYPICAL)
5 MICRON FILTER (TYPICAL)
ACCUMULATOR
AFTERCOOLER
BECHTEL COMPANY
PALISADES PLANT
CONSUMERS POWER COMPANY
PIPING AND INSTRUMENT DIAGRAM
HIGH PRESSURE AIR OPERATED VALVES
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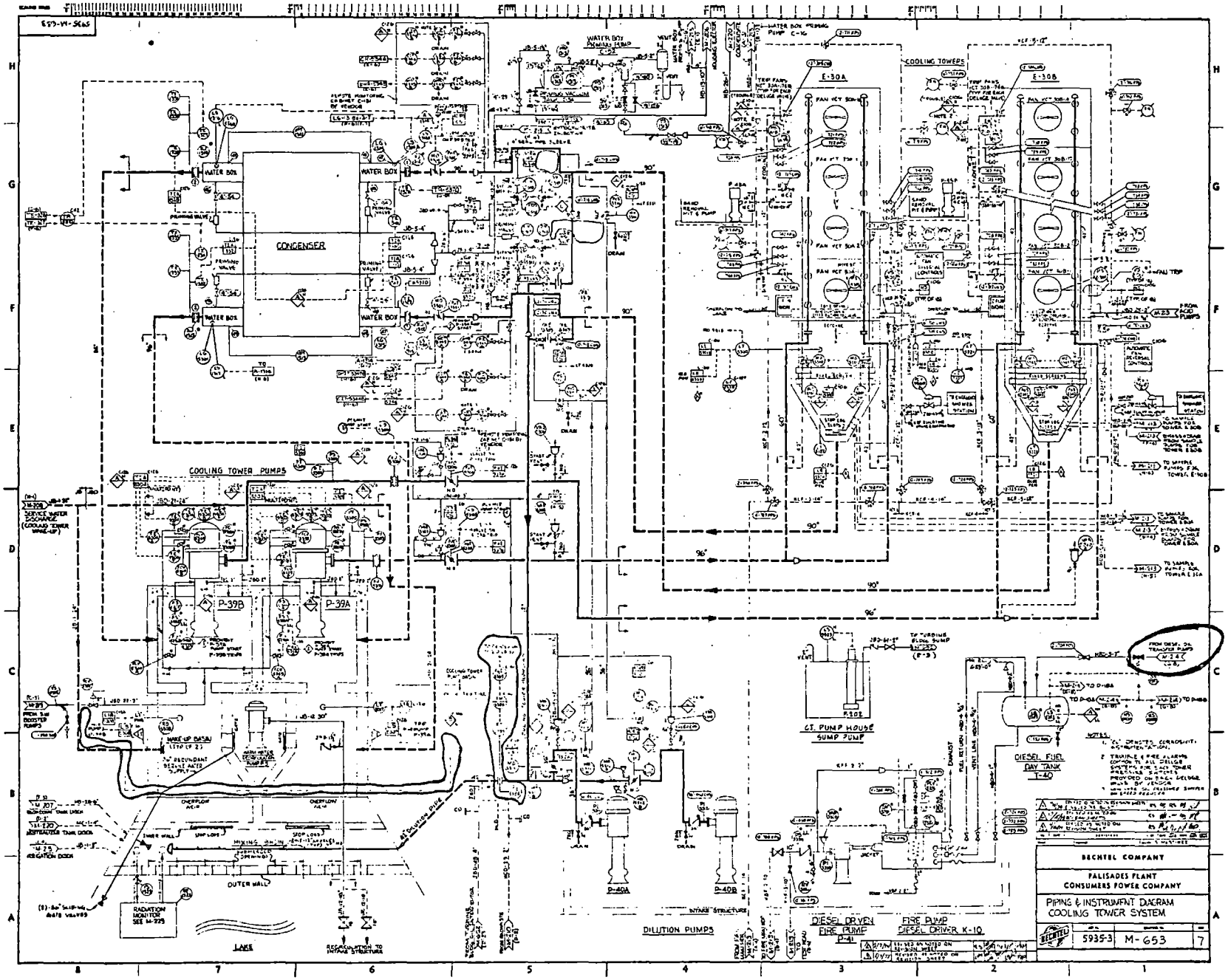
CONDENSER
WATER BOX
COOLING TOWERS
E-30A
E-30B
COOLING TOWER PUMPS
P-39B
P-39A
P-40A
P-40B
DILUTION PUMPS
GT. PUMP HOUSE SUMP PUMP
DIESEL FUEL DAY TANK T-40
DIESEL DRIVEN FIRE PUMP P-41
FIRE PUMP DIESEL DRIVER K-10
OUTER WALL
LAKE
RADIATION MONITOR SEE M-929
BECHTEL COMPANY
PALISADES PLANT
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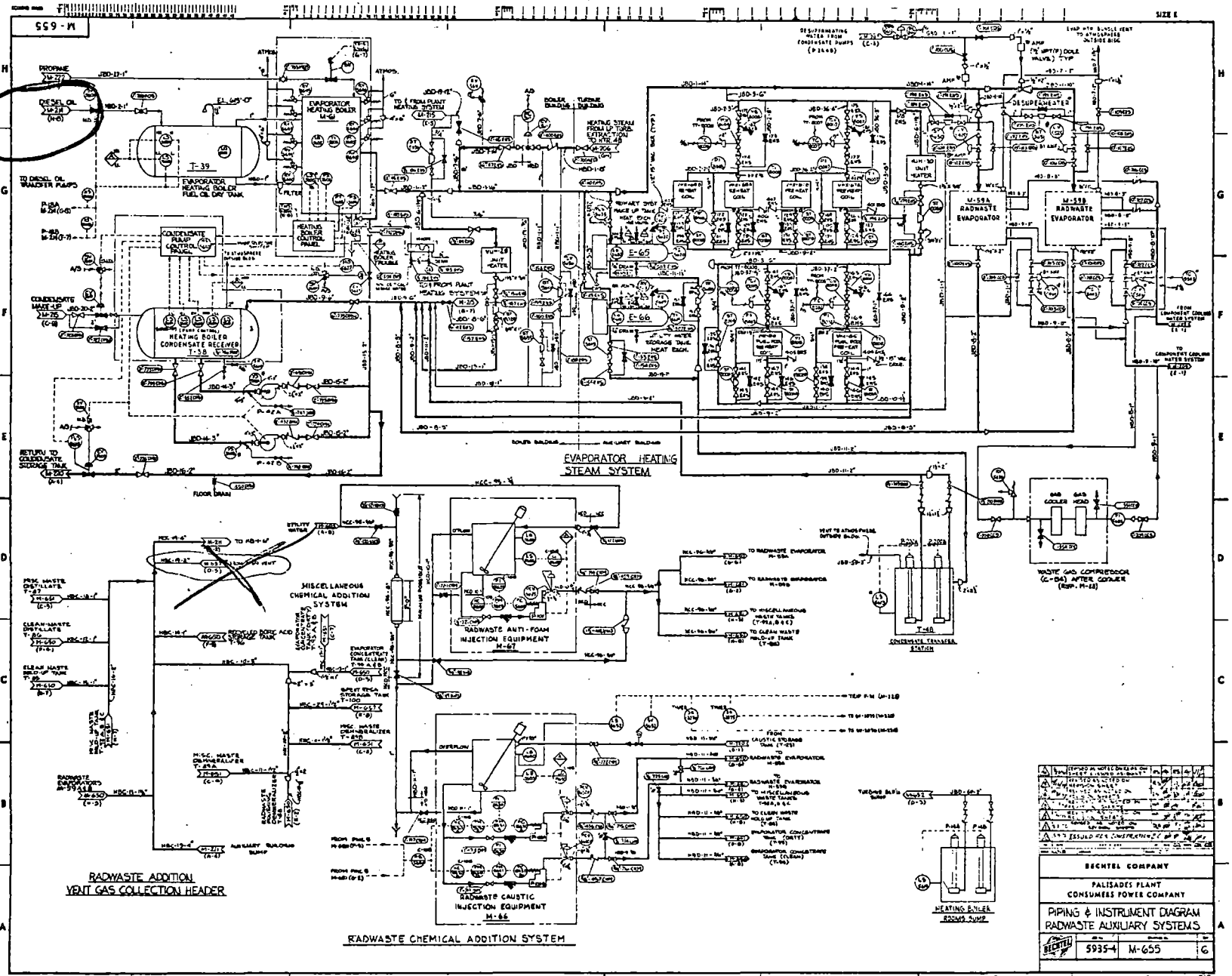
PIPING & INSTRUMENT DIAGRAM
COOLING TOWER SYSTEM
BECHTEL 5935-3 M-653 7


M-655
EVAPORATOR HEATING STEAM SYSTEM
RADWASTE ADDITION VENT GAS COLLECTION HEADER
RADWASTE CHEMICAL ADDITION SYSTEM
MISCELLANEOUS CHEMICAL ADDITION SYSTEM
RADWASTE ANTI-FOAM INJECTION EQUIPMENT M-67
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EVAPORATOR HEATING BOILER FUEL OIL DAY TANK T-39
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WASTE GAS COMPRESSOR (C-94) AFTER COOLER
M-58A RADWASTE EVAPORATOR
M-58 RADWASTE EVAPORATOR
BECHTEL COMPANY
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RADWASTE AUXILIARY SYSTEMS
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APPENDIX C
SUPPORT/RESTRAINT
WORK ITEMS DESCRIPTION

DETAIL M-598-	NO.	LINE CLASS & SIZE	SYSTEM	WORK ITEMS				③ ADDITIONAL ANALYSIS COMPLETED	
				NATURE	① TYPE SUPPORT	DESCRIPTION	②		
1	2	HB-24-4"	C.C.W. O/S CTMT to and From ESS Pumps	MOD.	S	Added 3X3X3/8 L, a U bolt & removed the rod hanger.	B2		
	3	3"		MOD.	S	Added 3" L, plate and a U bolt to existing steel and removed the rod hanger.	B2	X	
	4	3"		NEW	S	Added 3" L, U bolt and welded to existing steel.	B1	X	
	5	3"		MOD.	S	Added U bolt and L to existing restraint for axial loads.	B2		
2	2	HB-23-3"	S.W. to ESS Rooms Air CLRS	MOD.	S	Replaced clip with U bolt.	B3	X	
	3	3"		MOD.	S	Replaced clip with U bolt.	B3	X	
	4	3"		MOD.	S	Replaced clip with U bolt.	B3	X	
	5	3"		NEW	S	Added 4X4X1/2 L, 2 U bolts & cinch anchors. Cinch anchors and angle are common to other restraints. 598-3-3, 598-4-5, 598-6-3.	B1	X	
	6	3"		MOD.	S	Added shims to reduce gaps.	B1	X	
3	2	HB-23-3"	S.W. to ESS Rooms Air CLRS	MOD.	S	Replaced clip with U bolt.	B3	X	
	3	3"		NEW	S	Added U bolt to existing steel for 598-2-5.	B1	X	
	4	3"		MOD.	S	Added shims to reduce gaps.	B1	X	
4	2	HB-23-4"	S.W. to ESS Rooms Air CLRS	MOD.	S	Replaced clip with U bolt.	B3	X	
	3	4"		MOD.	S	Replaced clip with U bolt.	B3	X	
	4	4"		MOD.	S	Replaced clip with U bolt.	B3	X	
	5	4"		NEW	S	Added U bolt to existing steel for 598-2-5	B1	X	
5	2	HB-23-2"	S.W. to Air Compr. & Cont. Room A/C	NEW	S	Added 3X3X3/8 L, U bolt. Welded to existing steel.	B1		
	3	2"		NEW	S	Added 3X3X3/8 L, U bolt.	B1	X	
	7	2"		NEW	S	Added 4X4x1/2 L, 2 U bolts for 2 pipes. Welded to existing steel.	B1		
	11	2"		NEW	S	Added 3X3X3/8 L, 1 U bolt. Welded to existing steel.	B1		
	12	2"		NEW	S	Added 3X3X3/8 L, 1 U bolt. Welded to existing steel.	B1		
	13	2"		NEW	S	Added L, U-bolt.	B1	X	
	14	2"		NEW	S	Added 4X4X3/8 L, 2 U bolts for 2 pipes. Welded to existing steel.	B1	X	
	15	2"		NEW	S	Added 3X3X3/8 L, 3/8" plate, 2 U bolts for 2 pipes cinch anchors.	B1		

① S-Seismic
W-Weight
T-Thermal
V-Vibration
(F)-Resulting from Facility Change

② See Sheet 8 for Explanations

③ X-Analysis Completed Subsequent to Performing Work Items and Noted Work Items Were Not Required to Meet FSAR Criteria.

APPENDIX C
SUPPORT/RESTRAINT
WORK ITEMS DESCRIPTION

DETAIL M-598-	NO.	LINE CLASS & SIZE	SYSTEM	WORK ITEMS				③ ADDITIONAL ANALYSIS COMPLETED	
				NATURE	① TYPE SUPPORT	DESCRIPTION	②		
6	2	HB-24-4"	C.C.W. O/S CTMT to ESS Pumps.	NEW	S	3/8 PL, 3X3" L, 1 U bolt, cinch anchors.	B1		
	3	4"		NEW	S	U bolt to existing steel for M-598-2-5.	B1	X	
	4	4"		NEW	S	3X3 L, 1 U bolt, welded to existing steel.	B1	X	
7	2	HB-24-3"	C.C.W. O/S CTMT to ESS Pumps	NEW	S	Added 4X4X1/2 L, U bolt to existing steel.	B1	X	
	3	3"		MOD.	S	Added 3X3X3/8 L, U bolt and removed rod hanger.	B2	X	
8	2	HB-24-1 1/2"	C.C.W. O/S CTMT to ESS Equipment	REPLACE	S	Added 3X3 L, 3/8" PL, 4 U bolts for 2 pipes. Welded to existing steel.	B1		
	3	1 1/2"		NEW	S	Added 3X3" L, U bolt, welded to existing steel.	B1	X	
	4	1 1/2"		REPLACE	S	Added 3X3" L, U bolt, welded to existing steel.	B1		
	5	1 1/2"		REPLACE	S	Added 3X3" L, U bolt, welded to existing steel.	B1		
9	2	CB- -2"	H.P. Air - ESS Rooms	MAINT(F)	S	Added 2 bolts to existing bracket.	B1,C4		
	3	2"		NEW(F)	S	Added 3" angle, 1 U bolt welded to existing steel.	B1		
	4	2"		NEW(F)	S	3/8 PL, 3" angle, 2 U bolts.	B1		
	5	1 1/2"		NEW(F)	S	3" angle, 1 U bolt, cinch anchors 3/8" PL	B1		
	6	1 1/2"		NEW(F)	S	3" angle, 1 U bolt, welded to existing steel.	B1		
	7	1 1/2"		NEW(F)	S	3" angle, 1 U bolt, welded to existing stl.	B1		
10	2	CC-4-1"	Primary Loop Drains CVCS Letdown Line	RELOCATE	S	Added PL, 3" angle, 2 U bolts to 2 pipes, cinch anchors.	C1,5		
	3	3-2"		NEW	S	Added 4" channel, 3" angle, 1 U bolt welded to existing steel.	B1		
11	2	HB-23-2"	S.W. to Air Compressors	NEW	S	3" angle, 2 U bolts, plate and cinch anchors.	B1		
	3	2"		NEW	S	3" angle, 2 U bolts, plate and cinch anchors.	B1	X	
	4	2"		MOD	S	Added clevis and angle and replaced the bent rod and C-Clamp.	C4	X	
	5	2"		MOD	S	Added clevis and angle, removed C-Clamp.	C4	X	
12	2	HB-23-2"	S.W. to S.G. Test Coolers	MOD(2)	S	Added channel 6", 3" angle, 4 U bolts for 4 pipes, cinch anchors and plate. Remove rod hanger.	B2		
	3	2"		MOD	S	Added 2 U bolts to existing structure.	B2	X	
	4	2"		NEW	S	3" angle, plate, cinch anchors, 4 U bolts on 4 pipes.	B1		

APPENDIX C
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WORK ITEMS DESCRIPTION

DETAIL M-598-	NO.	LINE CLASS & SIZE	SYSTEM	WORK ITEMS				③ ADDITIONAL ANALYSIS COMPLETED	
				NATURE	① TYPE SUPPORT	DESCRIPTION	②		
13	2	CC-5-2"	Charging Inlet to Loop "2A"	MOD	S	Replaced existing strap with U bolt - 1/2" gap.	C1,5		
	3	2"		NEW	S	3" angle, U bolt, welded to existing steel.	B1		
	5	2"		MOD	T/W	Removed grating to relieve hanger rod interference.	C1,5	X	
14	2	HB-5-2"	Critical F.O.-Piping to D.G. Day Tanks	NEW	S	Added L, plate, U bolt, cinch anchors.	B1	X	
15	2	HC-15-1/2"	Metering Pump Discharge	NEW	S	Added L, U bolt, cinch anchors.	B1	X	
	3	1/2"		NEW	S	Added 3" L, plate, U bolt and cinch anchors.	B1		
	4	1/2"		NEW	S	Added 3" L, plate, U bolt and cinch anchors.	B1		
	5	1/2"		NEW	S	Added 3" L, plate, U bolt and cinch anchors.	B1	X	
	6	1/2"		NEW	S	Added L, plate, 2 U bolts, cinch anchors.	B1		
	7	1/2"		NEW	S	Added L, plate, U bolt, cinch anchors.	B1		
	8	1/2"		NEW	S	Added L, plate, U bolt, cinch anchors.	B1	X	
	9	1/2"		NEW	S	Added L, plate, U bolt, cinch anchors.	B1		
	10	1/2"		NEW (F)	S	Added L, U bolt, cinch anchors.	B1		
16	2	HB-24-2"	C.C.W. O/S CTMT-Surge TK Line	NEW(F)	S	Added L, plate, U bolt, cinch anchors.	B1,4		
	3	2"		NEW	S	Added L, cinch anchor, 4 U bolts - 4 pipes.	B1,4		
	4	2"		NEW	S	Added L, 4 U bolts on 4 pipes and supported from the larger pipe.	B1,4		
17	2	CC-7-2"	Charging Pumps to CVCS and HPSI	MOD	V	Added 3/8" plate.	C3		
	3	2"		REPLACE	V	Added 3" L, 5/8" plate, cinch anchors.	C3	X	
	4	2"		REPLACE	V	Added 3" L, 5/8" plate, cinch anchors.	C3	X	
	5	2"		NEW	V	Added 3" L, 5/8" plate, cinch anchors.	C3	X	
	6	2"		MAINT.	S	Added 3/8" plate.	C4		
	7	2"		NEW	S	Added 3" L, 5/8" plate, cinch anchors.	B1		
	8	2"		MAINT.	V	Tightened existing bolts and tack welded.	C4	X	
	9	2"		NEW	V	Added 3" L, 5/8" plate, cinch anchors.	C3	X	
18	2	HC-3-18"	SIRW Tank to ESS	MOD	S	Added Shim plate to reduce gaps.	A1		
19	2	HC-3-14"	CTMT Spray Pump "A" Suction	REPLACE	S	Added plate & clamp to existing anchor.	A1		
	3	14"		REPLACE	S	Added plate & clamp to existing anchor.	A1		
20	2	HC-15-1/2"	Metering Pump Discharge	REPLACE	S	Added L, U bolt to existing steel.	B1		

APPENDIX C
SUPPORT/RESTRAINT
WORK ITEMS DESCRIPTION

DETAIL M-598-	NO.	LINE CLASS & SIZE	SYSTEM	WORK ITEMS				③ ADDITIONAL ANALYSIS COMPLETED	
				NATURE	① TYPE SUPPORT	DESCRIPTION	②		
21	2	CC-4-6"	S.I. to Loop 1B	MOD	S	Removed spring to make it a rigid rod hanger.	A1		
22	2	HBD-8-10"	C.C.W. to Radw. Evaporators	MOD(F)	S	Added U bolt to existing assembly.	B1		
23	2	HC-20-3"	SIRW TK Piping to & from CVCS	MOD	S	Provided 1/16" clearance.	C1,5	X	
24	2	HB-24-1"	C.C.W. O/S CTMT to & from Misc. Equipment	NEW	S	Added L, plate, 2 U bolts for 2 pipes, cinch anchors.	B1		
	3	2"		RELOCATE	S	Added L and U bolt to existing steel. Interference existed previously.	C4	X	
	4	2";1 1/2"		MOD	S	Added L, plate, cinch anchors.	B2		
	5	2";1 1/2"		MOD	S	Added L, plate, cinch anchors.	B2		
	6	2";1 1/2"		MOD	S	Added L, plate, cinch anchors.	B2	X	
	7	2";1 1/2"		MOD	S	Added L, plate, cinch anchors.	B2		
25	2	DC-1-6"	HPSI Inside CTMT	MAINT.	T/W	Install bolt in 6" clamp.	C4,5	X	
26	2	HC-7-3"	CVCS-Boric Acid Supply	NEW	S	Added L, U bolt and cinch anchors.	B2	X	
27	2	GC-1-12"	S.I.T.-82C to Loop 2A	MAINT.	S	Tightened turnbuckle and jam nut.	C4	X	
28	2	HB-24-3/4"	C.C.W. O/S-Chemical Add Tank Piping CTMT Spray Pump Discharge	NEW(F)	S	Added clamp to 14" pipe to support 3/4" pipe and 2 U bolts.	B2		
29	2	GC-3-8"	CTMT Spray Pump Discharge	MOD	S	Added shims to reduce gaps.	A1		
	3	8"		REMOVE	T	Removed temp. horizontal guide.	C2		
	4	8"		REMOVE	T	Removed temp. horizontal guide.	C2		
30	2	HB-5-1"	Critical F.O.-D.G. "A"	NEW	S	Added L, plate, cinch anchors, 2 U bolts on 2 pipes.	B1	X	
31	2	HB-22-1"	D.G. "A"-Jacket Water	NEW	S	Added L,plate, U bolt, cinch anchors.	B1	X	
	3	1"		MOD	S	Added L, 2 U bolts on 2 pipes.	B2		
	4	1"		NEW	S	Added L and U bolt to existing restraint.	B1	X	
	5	1"		RELOCATE	S	Added L, plates, cinch anchors. Restraint was attached to equipment.	C3	X	
32	2	GC-1-3"	HPSI Discharge O/S CTMT	REPLACE	S	Added plates to existing pipe whip restraint.	A1		
	3	3"		REPLACE	S	Added plates to existing pipe whip restraint.	A1		
	4	6"		NEW	S	Added plates to existing pipe whip restraint.	A1		
33	2	GC-1-10"	L.P.S.I. Pump Discharge	MAINT.	S	Replaced bent channel.	C4		

APPENDIX C
SUPPORT/RESTRAINT
WORK ITEMS DESCRIPTION

DETAIL M-598-	NO.	LINE CLASS & SIZE	SYSTEM	WORK ITEMS				③ ADDITIONAL ANALYSIS COMPLETED	
				NATURE	① TYPE SUPPORT	DESCRIPTION	②		
34	2	GC-1-8"	Shutdown Cooling HX'S to CTMT Spray	NEW	S	Added Channel, plate, cinch anchors. Welded to existing clamp on pipe.	A1		
35	2	CC-9-3"	Pressurizer Spray Line (Loop 2A)	NEW	S	Added L and cinch anchors.	A2	X	
	3	3"		MOD	T	Provided 1" gap in the U bolt.	C1,5		
36	2	CC-6-6"	Redundant HPSI	NEW	S	Added plates to pipe whip restraint.	A1		
37	2	HB-24-16"	C.C.W. at HX	MAINT.	-	Removed existing temporary support.	C4	X	
38	2	HC-23-6"	SIRW Tank Recirc.	NEW	S	Added plate, L's, cinch anchors.	A1		
39	2	CC-9-3"	Pressurizer Spray Line (Loop 1B)	NEW	W	Added bracket.	C2,5	X	
	4	3"		NEW(F)	S/T	Added L, plate, U bolt.	C2		
	5	3"		NEW(F)	S/T	Added L, plate, U bolt.	C2		
40	2	DC-2-2"	S.I. Recirc. to S.I.R.W Tank	REPLACE	S	Added L, welded to existing steel, 2 U bolts on each of 2 pipes.	B1		
	3	2"		REPLACE	S	Added L and U bolt to existing steel.	B1		
41	2	GC-9-1"	S.I. Tanks Vents & Drains	NEW(4)	S	Added L, plate, U bolts.	B1		
	3	1"		NEW	S	Added L, U bolt, cinch anchors.	B1		
	4	1"		MOD	S	Added L and 1" U bolt to existing restraint for axial loads.	B2		
	5	1"		NEW	S	Added L, U bolt, welded to existing steel.	B1		
	6	1"		NEW	S	Added L and U bolt.	B1		
42	2	GC-9-3"	Pressurizer Spray Lines	NEW	S	Added L's, welded to existing steel.	C2		
	3	4"		NEW	S/T	Added L, U bolt, welded to steel.	C2	X	
	4	4"		NEW	S/T	Added plate, L's, cinch anchor, U bolt.	C2	X	
	5	4"		NEW	S/T	Added U bolt to existing frame for 2 pipes.	C2	X	
	6	3"		NEW	S/T	Added L, plates, cinch anchors, U bolt.	C2		
	7	3"		NEW	S/T	Added L and U bolt to existing steel.	C2		
	8	4"		MOD	S	Replaced U bolt and provided 1/16" gap.	C1,5		
43	2	HB-20-1"	Gaseous Radwaste	NEW	S	Added L, U bolt, cinch anchors.	B1		
	3	1"		NEW	S	Added L, plate, U bolt, cinch anchors.	B1		
	4	1"		NEW	S	Added L, U bolt, cinch anchors.	B1		
44	2	HB-5-1"	Critical F.O.-D.G. "B"	NEW	S	Added L, plate, cinch anchors, 2 U bolts to 2 pipes.	B1	X	
45	2	JB-22-1"	D.G. "B"-Jacket Water	RELOCATE	S	Added L, U bolt, plate, cinch anchors. Restraint was attached to equipment.	C3	X	

APPENDIX C
SUPPORT/RESTRAINT
WORK ITEMS DESCRIPTION

DETAIL M-598-	NO.	LINE CLASS & SIZE	SYSTEM	WORK ITEMS				③ ADDITIONAL ANALYSIS COMPLETED	
				NATURE	① TYPE SUPPORT	DESCRIPTION	②		
45	3	JB-22-1";3/4"	D.G. "B"-Jacket Water	RELOCATE	S	Added L, U bolt, plate, cinch anchors. Restraint was attached to equipment.	C3	X	
	4	3/4"		NEW	S	Added L, U bolt to existing steel.	B1	X	
	5	3/4"		NEW	S	Added L, plate, cinch anchors, U bolt.	B2	X	
46	2	HBC-35-1"	Gaseous Radwaste	NEW(F)	S	Added L, plate, cinch anchors, 2 U bolts.	B1		
	3	1"		NEW(F)	S	Added L, plate, cinch anchors, 1 U bolt.	B1	X	
	4	1"		NEW(F)	S	Added L, plate, cinch anchors, 2 U bolts on 2 pipes.	B1		
	5	1"		NEW(F)	S	Added L, cinch anchors, 3 U bolts for 3 pipes.	B1	X	
	6	1"		NEW(F)	S	Added L, plate, cinch anchors, 2 U bolts.	B1		
47	2	HC-20-3"	S.I.R.W. Tank to CVCS	NEW	S	Added L, plate, cinch anchors, 1 U bolt.	B1	X	
48	2	HB-24-1"	C.C.W. O/S CTMT to & from Gas Compr.	NEW	S	Added L, U bolt, welded to existing channel.	B1	X	
	3	1"		NEW	S	Added L, U bolt, welded to existing channel.	B1	X	
	4	1"		NEW	S	Added L, U bolt, welded to existing channel.	B1		
	5	1"		NEW	S	Added L, U bolt, cinch anchors.	B1		
	6	1/2"		MOD	S	Removed clip. Added U bolt.	B3	X	
	7	1"		MOD	S	Removed clip. Added U bolt.	B3	X	
	8	1/2"		MOD	S	Removed clip. Added U bolt.	B3	X	
	9	1"		MOD	S	Removed clip. Added U bolt.	B3	X	
49	2	HB-50-3/4"(1")	D.G. "A"-Starting Air	MOD	S	Removed clip. Added U bolt.	B3	X	
	3	3/4"(1")		NEW	S	Added L, 2 plates, cinch anchors, U bolt.	B1		
	4	JB-24-1 1/2"		NEW	S	Added 3X3X3/8 L.	B2		
50	2	HC-1-4"	SIRW Tank Piping	NEW	S	Added L, plate, cinch anchors and U bolt.	B1	X	
	3	4";2"		NEW	S	Added L, plate, cinch anchors, 2 U bolts for 2 pipes.	B1		
	4	HC-1-3" HC-23-3"		NEW	S	Added L, plate, cinch anchors, 2 U bolts for 2 pipes.	B1		
51	2	CC-3-2"	CVCS	NEW	S	Added L and U bolt.	B1	X	
52	2	HB-24-10"	C.C.W. Return from CTMT	MOD	S	Changed spring hanger to rod.	A1		
53	2	HB-24-10"	C.C.W. O/S CTMT to FPC HX & RW Evap.	MAINT.	S	Add 10" clamp. Removed 14" clamp.	C4,5		
	3	14"		MAINT.	S	Tightened bolts on the pipe clamp.	C4	X	
54	2	HB-23-6"	S.W. to D.G.	MOD	S	Added angle.	A1		

APPENDIX C
SUPPORT/RESTRAINT
WORK ITEMS DESCRIPTION

DETAIL M-598-	NO.	LINE CLASS & SIZE	SYSTEM	WORK ITEMS				③ ADDITIONAL ANALYSIS COMPLETED	
				NATURE	① TYPE SUPPORT	DESCRIPTION	②		
55	2	GC-1-12"	LPSI	REPLACE	S	Added angle, cinch anchors.	A1		
56	2	HCC-102-2"	Iodine Removal & NAOH Make-Up to HC-3-24"	NEW(F)	S	Added plates, cinch anchors & U bolt.	B1		
57	2	CC-4-1"	SI Tank Drain	REMOVE	T	Removed bracket.	C1,5		
	3	1"		REMOVE	T	Removed U bolt.	C1,5		
	4	1"		REMOVE	T	Removed U bolt.	C1,5		
	5	1"		NEW	S	Added L, plate, U bolt.	B1		
58	2	CC-4-1"	SI Tank Drain	REMOVE	T	Removed U bolt.	C1,5		
	3	1"		MOD	T	Provided gap in U bolt.	C1,5		
59	2	CC-4-1"	SI Tank Drain	MOD	T	Provided gap in U bolt.	C1,5		
	3	1"		MOD	T	Provided gap in U bolt.	C1,5		
60	2	CC-4-1"	SI Tank Drain	MOD	T	Added plate and removed clip.	C1,5		
61	2	HB-24-1 1/2"	C.C.W. to & from Charging Pumps	MOD	S	Added L, plates, 4 U bolts on 2 pipes.	B1		
	3	1"		MOD	S	Added L, cinch anchors, plate, 2 U bolts to 2 pipes.	B1	X	
	4	1"		NEW	S	Added plate and U bolt to existing restraint.	B1		
	5	1"		MOD	S	Added plate, cinch anchors, L & U bolt to existing restraint.	B1	X	
	6	1"		NEW	S	Added angle, plate, U bolts to 2 pipes.	B1		
62	2	HB-24-1"	C.C.W. Chem. & Recirc.	NEW	S	Added angle, U bolt welded to existing steel.	B1		
	3	1"		NEW	S	Added angle, U bolt, welded to existing steel.	B1		
63	2	HCC-123-1"	Gas Compressor Disch.	NEW(F)	S	Added angle, U bolt, cinch anchors.	B1		
	3	1"		NEW(F)	S	Added angle, U bolt, welded to existing steel.	B1		
	4	2"-1"		NEW(F)	S	Added angle, plate, cinch anchors, 2 U bolts for 2 pipes.	B1		
	5	1"		MAINT(F)	S	Welded existing plate to steel.	B1,C4		
64	2	HB-23-2"	S.W. to Contr. Rm. A/C	NEW	S	Added L, 3 U bolts to 3 pipes, welded to existing steel.	B1		
65	2	JB-24-1 1/2"	D.G. "B"-Starting Air	NEW	S	Added L, U bolt and welded to existing steel.	B1		
	3	HB-50-3/4"		NEW	S	Added L, U bolt, plate and cinch anchors.	B1		
	4	3/4"		MOD	S	Added U bolt, removed clip.	B3	X	
66	2	HB-5-3"	Critical F.O. Recirc. Line	MAINT.	S/W	Adjust nuts on hanger rod.	C4	X	

APPENDIX C

SUPPORT/RESTRAINT WORK ITEMS DESCRIPTION

A The initial design was based on a dynamic analysis with the piping system maximum primary stress levels not to exceed 1.1 S_y in the event of a DBE.

A1 The initial calculated pipe stress approached S_y, therefore the original restraint design was considered necessary to prevent the piping from exceeding 1.1 S_y. Without the original restraint, it did not appear that S_u would have been exceeded.

A2 With the original restraint design, the initial calculated pipe stress was below S_y and the original restraint design was installed. Because of the margin below S_y, a reanalysis of the system may show that the work item was not necessary to prevent the piping system from exceeding 1.1 S_y.

B The initial design was based on a calculated restraint spacing to maintain the pipe system in the rigid range with a natural frequency of equal to or greater than 20 cps.

B1 The calculated restraint span was adhered to.

B2 A single direction restraint was changed to a multi-direction restraint. The existing restraint may have been adequate.

B3 Uni-strut pipe clamp suitable for single direction and possibly multi-direction was changed to a U-bolt design for multi-direction restraint. (The existing uni-strut clamps have subsequently been confirmed by the manufacturer as suitable for multi-directional restraints).

B4 Alternate modified dynamic analysis or engineering judgement have indicated that the work item may not be necessary to maintain pipe stress below 1.1 S_y. It is believed that a detail stress analysis, rather than 20 cps criteria, would show that stress levels would be below 1.1 S_y even if the work item had not been done.

C Existing restraints or supports were modified, relocated, or removed based on conservative engineering judgement.

C1 To provide additional clearance for pipe thermal growth.

C2 To minimize the potential of local stress concentrations.

C3 To minimize the potential for vibration.

C4 Minor maintenance or upgrading type work was done to improve the restraint/support condition.

C5 This work item is typical of the type item normally checked and corrected during start-up and hot functional testing.

S_y - Minimum yield stress

S_u - Ultimate stress