CALIFORNIA PUBLIC UTILITIES COMMISSION
Utilities Division

SAFETY REPORT
ON
LIQUEFIED PROPANE STORAGE
WITH LOW TEMPERATURE PIPELINE
OF
PETROLANE INCORPORATED
SAN PEDRO, CALIFORNIA

San Francisco, California
September, 1977

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CHAPTER 1

INTRODUCTION, SUMMARY OF VARIOUS AGENCY STAFF CONCLUSIONS AND RECOMMENDATIONS

A - INTRODUCTION

1. This report is submitted in response to the request from the office of the Honorable Governor Edmund G. Brown, Jr. to the Public Utilities Commission to inspect the marine terminal of Petrolane, Inc., in San Pedro to determine its potential hazard to the surrounding area. The Commission is appreciative of the excellent cooperation and information contributed by other governmental agencies to this joint report.

2. The City of Los Angeles Department of Building and Safety issues permits for new construction. Contributions to this report include information on the pressure vessels, control building and dock wiring.

3. The City of Los Angeles Fire Department consults with owners of new construction as part of the building permit process to see that adequate fire fighting equipment is provided. The department also makes periodic inspections to ensure that proper fire prevention practices are followed. This department contributed material on the fire protection system, low temperature pipeline and dock facilities.

4. The City of Los Angeles Harbor Department has jurisdiction over all activities within the port limits. Contributions of the Harbor Department include information on loading procedures, dock facilities, fire fighting systems, future development plans, and earthquake operational plan.

5. The U.S. Coast Guard has jurisdiction over all shipping including the loading and unloading of hazardous materials. The Coast Guard Captain of the Port has the day-to-day responsibility for the safe operation of facilities when ships are involved. Contributions to this report include information on the dock facilities, ship movement and low temperature pipeline.

6. The California Division of Industrial Safety issues permits for the construction of pressure vessels and piping. Inspections are made annually to ensure that the vessels are being operated safely. In this case, inspections were made by personnel of the Los Angeles Department of Building and Safety and reported to the Division of Industrial Safety. The division contributed records of the low temperature storage tanks and pressure vessels to this report.

7. The Coastal Commission was formed to, among other things, monitor the construction of refineries and coastal dependent developments including ports and to see that adverse effects on coastal resources or coastal access 1,000 yards inland is minimized. The California Coastal Commission's staff provided comments on the risk analysis and a risk management plan.

8. Petrolane representatives arranged an inspection of the terminal and rendered technical information on request.

9. The Public Utilities Commission prepared the remaining chapters of this report. Senior Utilities Engineer Han L. Ong, who supervised report preparation, was assisted by John M. Peeples, Associate Utilities Engineer, for Chapters 15 and 16; Louis E. Krug, Associate Utilities Engineer, for Chapter 12; and Maurice D. Monson, Associate Utilities Engineer, for the remaining chapters.

B - SUMMARY OF VARIOUS AGENCY STAFF CONCLUSIONS

By the Department of Building and Safety, City of Los Angeles

10. The pressure vessels, loading docks and electrical wiring at the berth, were inspected by the Los Angeles Department of Building and Safety. The pressure vessels are inspected annually by a staff engineer from the Boiler and Pressure Vessel Division of the Department.

11. The City of Los Angeles Department of Building and Safety has determined that Petrolane's low temperature liquefied petroleum gas (LPG) tanks are not exempt from Section 91.0102 (b-16) of the Los Angeles Municipal Code as originally indicated. Accordingly, on April 20, 1977, the department issued an order to comply to Petrolane, Inc., which directs the company to file plans and obtain building permits for the two low temperature LPG storage tanks. The review will include a check to ensure their ability to resist seismic loading.

By the Department of Fire, City of Los Angeles

12. The capacity of the impoundment basin meets all Los Angeles Municipal Code requirements.

By the Harbor Department, City of Los Angeles

13. Personnel involved with the unloading of propane are specially trained for the purpose.

14. The Fire Department and Coast Guard ensure that safety requirements are met.

15. Propane will be unloaded in the Los Angeles Harbor according to safety procedures.

16. New dolphin and mooring bits are being installed and pilings are being replaced at Berth 120.

17. The master plan for Los Angeles Harbor includes a longer, larger, and realigned energy wharf and relocation of Sun Lumber Company.

18. The Harbor Department has an earthquake operational plan in effect.

By California Coastal Commission Staff

19. A risk analysis and risk management plan should be prepared before another propane laden ship is permitted to berth at the terminal.

20. One agency should be responsible for conducting a risk analysis. Presently, no one agency is responsible for ensuring that a risk management plan exists.

21. The City should develop as part of this risk management plan a set of contingency plans to deal with possible LPG disasters.

22. The existing facility appears to be poorly sited.

23. Surrounding land use should be considered in risk analysis and port planning.

24. Advanced ship traffic control systems and sabotage precautions would enhance the safety of propane ship transport.

25. The legal framework for public liability insurance is unspecified.

By the California Coastal Commission

26. The California Coastal Commission issued a permit on October 16, 1973, for the installation of the Marine Arm and connecting pipeline at Berth 120, Port of Los Angeles.

By the U.S. Coast Guard

27. A vessel laden with propane entering U.S. navigable waters becomes subject to Coast Guard jurisdiction. Chapter 15 discusses the many restrictions on ships entering the harbor.

28. A major fire at the dock or in the vicinity of the onshore valves could prevent access to the existing valves. The LPG in the pipe could cause additional hazards. (See Chapter 15)

By the Energy Resources Conservation and Development Commission Staff

29. The Energy Resources Conservation and Development Commission (ERCDC) staff reviewed the Draft of this report and submitted their comments. Responses to their comments have been incorporated within the text and their recommendations are presented in Section C of this chapter.

By the California Public Utilities Commission's Staff

30. Design work on the $9 million petrolane facility started in April, 1972, construction commenced in the Fall of 1972 and the terminal went on stream in May, 1974.

31. Safety guidelines for the facility were developed by the staff of Petrolane and by the underwriters utilizing the experience gained from the operation of the marine terminal in Providence, Rhode Island.

32. The plant designer, the underwriter, and the City of Los Angeles Fire Prevention Bureau participated in the conceptual design of the fire protection system including the code-requirements, product leakage and detection, fire detection and fighting, potential earthquake damage and automatic shutdown systems.

33. Operational features of the dock facility and operating features for ship unloading were determined by the same group augmented by the City of Los Angeles Harbor Department and the U.S. Coast Guard. Appendix 1 lists construction permits, approvals, and applicable codes for reference.

34. All welding on the two 300 Mbbl tanks was inspected and controlled by a qualified welding supervisor. The California Division of Industrial Safety and the Los Angeles Fire Department inspected tank construction and issued permits.

35. The low temperature storage tanks are equipped with a boiloff compression system to liquefy vapors from the tank. Therefore, venting of propane is rarely necessary.

36. The two 300,000 Bbl low temperature storage tanks are planned and equipped to store propane at -45°F. with design pressure of 1.5 psig and design temperature of -55°F.

37. It appears unlikely that the low temperature storage tanks would rupture unless due to an act of war, sabotage, aircraft collision, or other extreme conditions. Due to the proximity, the greatest potential for earthquake damage appears to be from the Palos Verdes fault. The tanks are designed for an acceleration of 0.4g. Chapter 12 discusses the potential earthquake hazards. A related recommendation is made under Section C.

38. Strategically placed switches and sensors shutdown the plant and isolate vessels containing propane if a fire occurs nearby.

39. A regular inspection and maintenance schedule is maintained for all plant equipment by Petrolane personnel.

40. An annual pressure test of the low temperature pipeline is required by the Coast Guard. The annual pressure test obviates the need for leakage surveys. The pipelines will soon be cathodically protected. Harco Corporation has recently determined that the pipelines can be included in the tank bottom protection systems.

41. The impoundment basin is capable of containing the liquid contents of only one 300,000 Bbl tank. Should both tanks rupture, the impoundment basin is obviously unable to contain the total possible spillage. A modification is proposed under Section C.

42. The use of tank trucks for loading and unloading at this terminal pose no new hazard to the immediate or greater Los Angeles area. This kind of traffic would be experienced whether originating at this terminal or not.

43. The use of tank cars for loading and unloading at this terminal do not appear to increase the hazard to the immediate or to the greater Los Angeles area.

44. A proposed 8-inch pipeline will deliver propane to Southern California Gas Company. This pipeline will be constructed and tested in accordance with

CPUC's General Orders Nos. 112-C, 94-B and U.S. Department of Transportation's 49 CFR, Part 195, and other staff's recommendations.

45. A security system is warranted at the Petrolane facility. The system should be similar to those being developed for proposed liquefied natural gas (LNG) facilities.

C - RECOMMENDATIONS

46. The capacity of the impoundment basin should be enlarged to contain a minimum volume of 100% of the combined volume of the two 300,000 Bbl. tanks. If this is accomplished by lowering the bottom elevation of the impounding basin spillage of liquid onto Gaffey Street would be minimized in the event the dike cracked. (By CPUC and ERCDC)

47. The seismic safety design of the low temperature 300,000 Bbl. LPG tanks should be reviewed in light of the recent studies indicating the potential activity of the Palos Verdes Fault. (By L.A. Dept. of Building and Safety, CPUC and ERCDC)

48. A security system adequate to protect the facility should be implemented by Petrolane. The system should be similar to those being developed for proposed liquefied natural gas (LNG) facilities. (By CPUC)

49. The upgrading of Berth 120 should be continued and completed within a reasonable time. (By L.A. Harbor Department)

50. Removal of the lumber stacked in the dock area should be completed as soon as possible. (By L.A. Harbor Department)

51. Additional intermediate shutoff valves in both the transfer and cooldown lines should be installed in an accessible location preferably in the midlength half toward the dock facility. (By U.S. Coast Guard and ERCDC)

52. One agency should be required to develop a comprehensive system of review and permit approvals that would apply to all facilities in the Port of Los Angeles which handle hazardous materials. (By Coastal Commission)

CHAPTER 2

LOCATION AND SITE DESCRIPTION - CPUC

A - INTRODUCTION

1. The projected shortfall of liquefied petroleum (LP)-gas supply in the United States has spurred the development of terminals designed to receive propane and butane from foreign sources.

2. Large ships transport LP-gases in a refrigerated condition at pressures ranging from 1 psig to 3 psig. A compression-refrigeration system on board ship accumulates, compresses and condenses the vapor to a liquid and returns it to the primary storage vessel. This storage vessel is externally insulated to minimize heat leakage and to maintain refrigeration.

3. The refrigerated terminal is designed to receive and store the LP-gas cargo at low pressure. A refrigeration system similar to that on the gas carrier is provided to handle vapor displacement during high volume liquid unloading as well as normal boil-off.

4. Due to transportation cost benefits, propane companies prefer marine terminal sites located in the midst of an industrial market area. Marine receipt and storage of large quantities of flammable liquids concerns some citizens, public safety authorities and neighboring businesses. Therefore, safety is a primary consideration for designers and operators of marine terminals and storage facilities.

5. The San Pedro facilities are intended primarily to receive propane imported from Venezuela, Algeria and possibly the Middle East, but will also accommodate butane shipments. Propane can also be shipped out or received by tank cars.

B - LOCATION

6. The terminal is located at 2110 North Gaffey Street, San Pedro, California (see maps). The site is surrounded by land which is devoted to petroleum storage facilities, and lies about a mile northwest of the west basin of the Los Angeles channel. A pipeline extending from Berth 120 on this channel conveys liquid propane from ship to terminal storage.

C - SITE DESCRIPTION

7. The nearly level portion of this site was used in the past as a dump and fill area. The subsurface conditions for this portion of the site were known to be relatively uniform for at least a depth of 35 feet. Site fill materials varied between 5 and 10 feet in thickness and had consistencies of loose and medium soft. The underlying natural materials to a depth of 60 feet probably consist of medium firm clays and medium firm to firm silts. Below this depth, the materials become dense deposits of sand and silts (San Pedro sand).

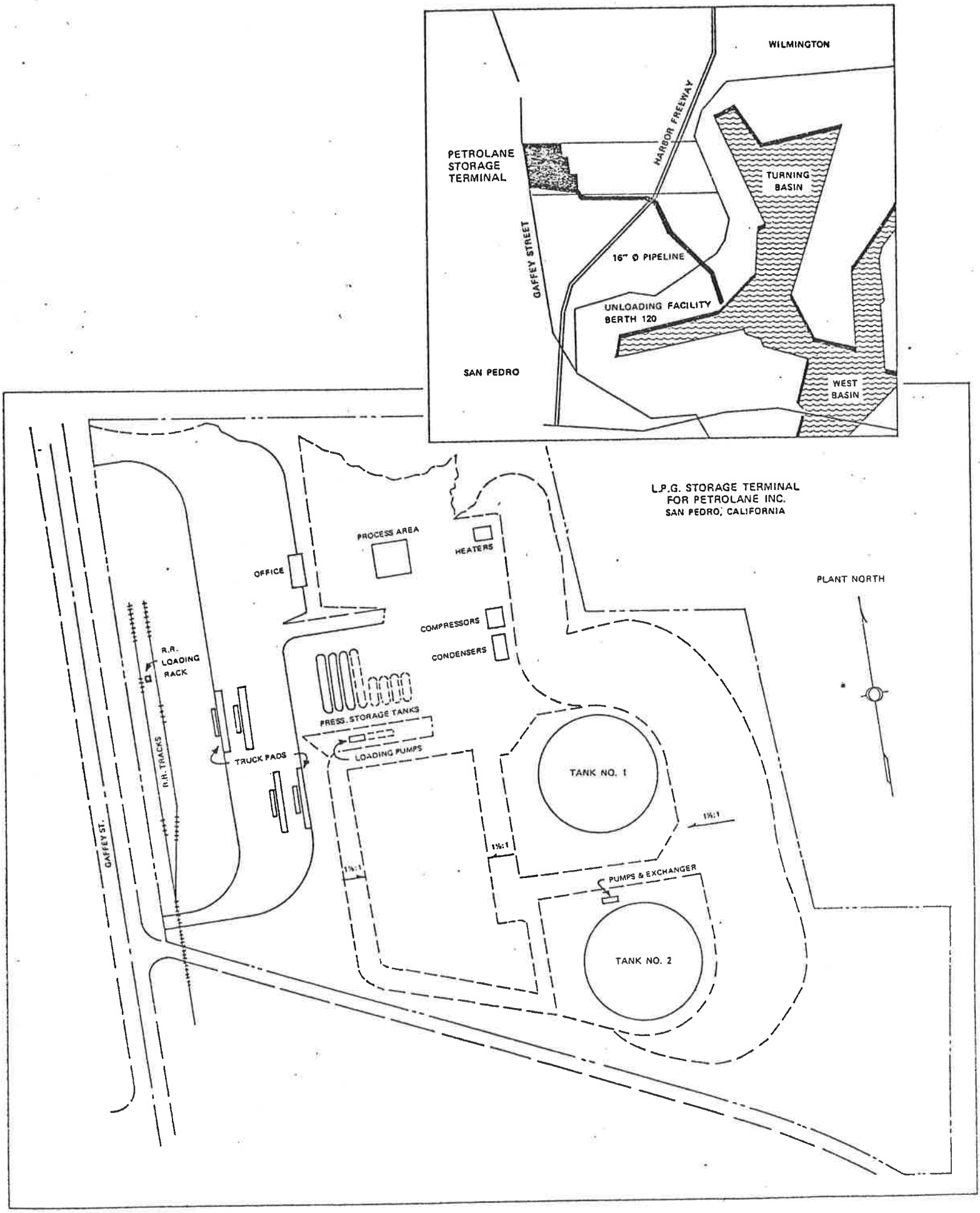
8. The easterly sloped portion of the subject site contains marine and non-marine terrace deposits, overlying the Quaternary San Pedro Sand. These materials were well-exposed in the near-vertical cuts at the toe of the slope gullies. These materials consist of sand and silts containing abundant shell fragments, and are generally firm to dense but extremely friable and erodable.

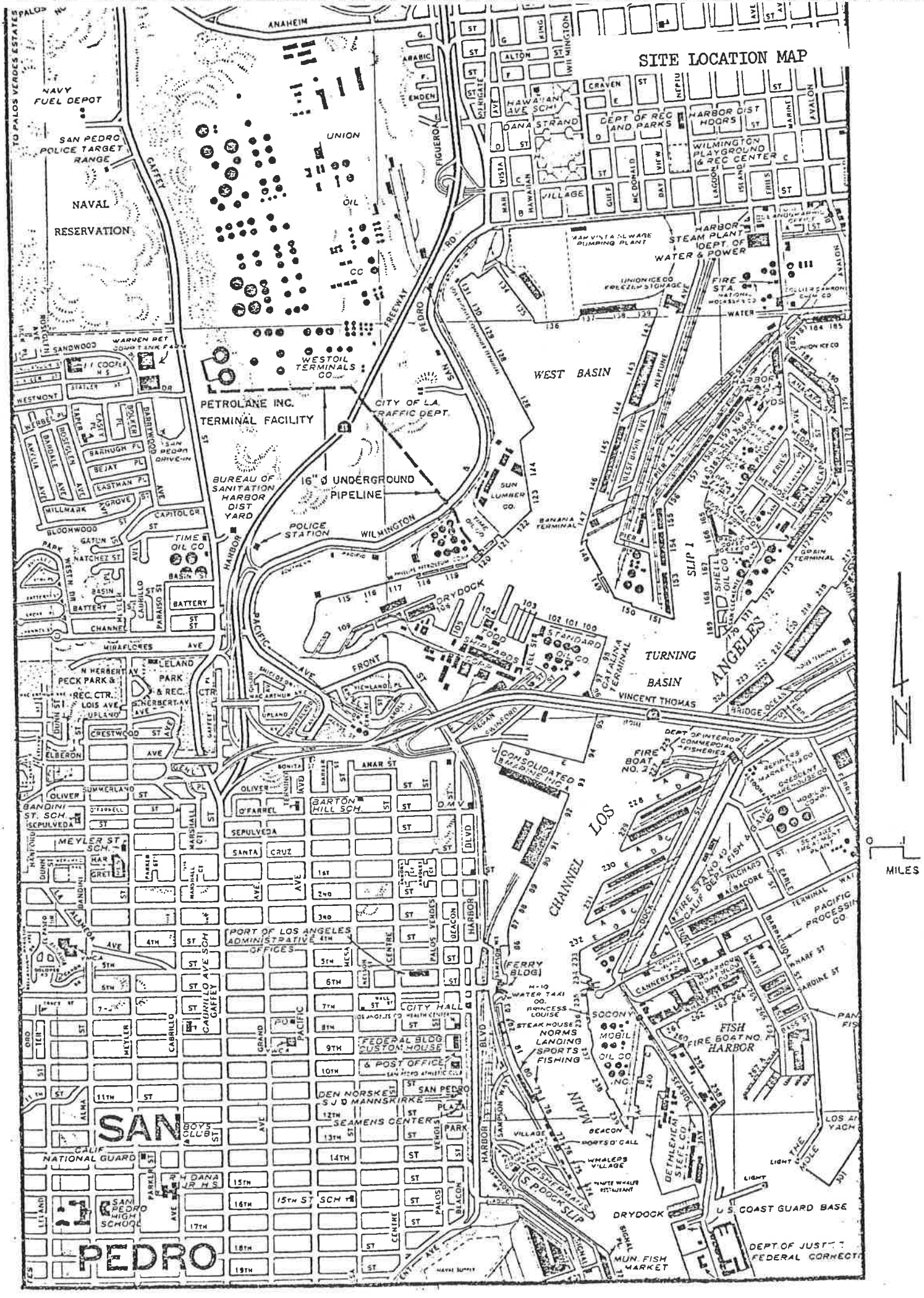
9. The Gaffey Street site was selected over two others because a conventional ring-type footing for the large refrigerated tanks could be developed on the San Pedro sand deposits by cutting back into the existing slope to allow the tanks to be founded entirely on natural material.

10. The grading or site development plan for this site was prepared by H. M. Scott and Associates of Rosemead, California. The dump area was excavated from the bluff at the back of the site. A multi-terraced plan was developed which allowed for disposal of soil on-site and operational functionality.

11. The site was developed to minimize the spacing between equipment groupings and maintain reasonable distances to adjacent property lines and facilities. (Photo) The fire department and insurers were involved with layout and spacing matters. Equipment separations were based on "Minimum Spacing Standards" of the Oil Insurance Association. The truck loading and unloading racks are about 140 feet distant from the curb line of Gaffey Street.

Equipment Location




SITE LOCATION MAP
TO PALOS VERDES ESTATES
ANAHEIM
NAVY FUEL DEPOT
SAN PEDRO POLICE TARGET RANGE
NAVAL RESERVATION
GAFFEY
UNION OIL CO
FIGUEROA
PEDRO
FREEWAY
SAN
WESTOIL TERMINALS CO.
PETROLANE INC. TERMINAL FACILITY
CITY OF L.A. TRAFFIC DEPT.
BUREAU OF SANITATION HARBOR DIST YARD
16" Ø UNDERGROUND PIPELINE
POLICE STATION
WILMINGTON
HARBOR
PACIFIC
FRONT
WEST BASIN
SUN LUMBER CO.
BANANA TERMINAL
SLIP 1
DRYDOCK
TODD SHIPYARDS
STANDARD OIL CO
CATALINA TERMINAL
TURNING BASIN
ANGELES
VINCENT THOMAS BRIDGE
HARBOR STEAM PLANT DEPT. OF WATER & POWER
UNION ICE CO
FIRE STA.
WATER
AVALON
NEPTUNE
WEST BASIN AVE
HARBOR BLVD
DEPT OF REC AND PARKS
HARBOR DIST HDQRS
WILMINGTON PLAYGROUND & REC CENTER
HAWAIIAN AVE SCHL
STRAND
VILLAGE
CRAVEN
ALTON
WILMINGTON
SANDWOOD
WESTMONT
STATLER
BARHUGH PL
BEJAY PL
EASTMAN PL
MILLMARK
GROVE
CAPITOL DR
BLOOMWOOD
GATUN
NATCHEZ ST
TIME OIL CO
BASIN
BATTERY
CHANNEL
CABRILLO
PARAISO ST
MIRAFLORES AVE
LELAND PARK & REC CTR
N HERBERT AV PECK PARK & REC. CTR.
LOIS AVE
UPLAND
CRESTWOOD ST
ELBERON AVE
OLIVER
SUMMERLAND
BANDINI ST. SCH.
SCPULVEDA
MEYLER ST SCH.
O'FARRELL
BARTON HILL SCH.
SEPULVEDA
SANTA CRUZ
ANAR ST
BONITA
PORT OF LOS ANGELES ADMINISTRATIVE OFFICES
CITY HALL
FEDERAL BLDG CUSTOM HOUSE & POST OFFICE
DEN NORSKE SJØ MANNSKIRKE SEAMENS CENTER
SAN PEDRO
CALIF NATIONAL GUARD
SAN PEDRO HIGH SCHOOL
DANA JR HS
15TH ST SCH
PEDRO
CONSOLIDATED MARINE INC.
FIRE BOAT NO. 2
DEPT OF INTERIOR COMMERCIAL FISHERIES
LOS ANGELES CHANNEL
FIRE STA NO 49
CALIF DEPT FISH & GAME
TERMINAL WAY
PACIFIC PROCESSING CO
BARRACUDA
WHARF ST
SARDINE ST
CANNERY
(FERRY BLDG)
M-10 WATER TAXI CO. PRINCESS LOUISE
STEAK HOUSE NORMS LANDING SPORTS FISHING
SOCONY MOBIL OIL CO INC.
FISH HARBOR
FIRE BOAT NO 2
MAIN
BETHLEHEM STEEL CO
BEACON
PORTS O' CALL
WHALER'S VILLAGE
WHITE WHALE RESTAURANT
S. POCK SLIP
DRYDOCK
THE MOLE
LIGHT
U.S. COAST GUARD BASE
DEPT OF JUSTICE FEDERAL CORRECTI
MUN. FISH MARKET
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MILES

CHAPTER 3

COMMENTS BY LOS ANGELES DEPARTMENT OF BUILDING AND SAFETY

Pressure Vessels

1. Permits were obtained from this Department for all pressure vessels installed at this location. These vessels and their interconnecting piping were inspected at the time of installation and were found to comply with the California Division of Industrial Safety Order for LPG systems and the Los Angeles Municipal Code. The three 60,000-gallon vessels are inspected annually by a safety engineer from the Boiler and Pressure Vessel Division and operating permits have been issued.

Low Temperature LPG Tanks

2. Petrolane applied for a construction permit in 1972, but was exempted under Section 91.0102 (b-16) of the Los Angeles Municipal Code that exempts tanks for the storage of flammable liquids from building permit requirements if they are surrounded by an impounding basin. However, since LPG is a gas in its natural state, rather than a liquid, it is not exempt under this code section so on April 20, 1977, the Department issued an order to comply to Petrolane, Inc., directing Petrolane, Inc. to file plans and obtain building permits for the two low temperature LPG storage tanks.

LPG Loading Station

3. The loading stations were checked at the time of installation for compliance with applicable codes and safety orders.

Inspection and Maintenance

4. The three 60,000-gallon vessels are inspected annually and found to have been maintained in excellent condition.

Earthquakes, Effect on LPG Tanks

5. When the requested plans for the LPG refrigerated storage tanks are received by the Department, they will be checked to insure their ability to resist seismic loadings.

Ship Unloading Facilities

6. The electrical wiring at the ship unloading dock was installed to comply with the requirements for Class I Hazardous Locations. A recent inspection by this Department verified that this electrical wiring has been properly maintained.

CHAPTER 4

LOW TEMPERATURE STORAGE TANKS - CPUC

A - TANK DESIGN

1. Propane is stored at -45° in two flat bottom, domed roof, insulated tanks having nominal capacity of 300,000 barrels each. The tanks are designed for an internal pressure of 1.5 psig and design temperature of -55°F, and protected from overpressure by pressure and vacuum relief valves. The double wall design is used. The "inner tank" contains the propane and the "outer shell" contains and protects the insulation. The tank heat leak is based on the maximum ambient temperature of 90°F. Tank design is in accordance with American Petroleum Institute Standard 620, Appendix R, "Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks".

2. An overfill indicator pipe is provided as a warning in the event electronic alarm and tank fill shutdowns fail to operate. The top of the indicator is set at a maximum design liquid level in the tank. The total height to the deck includes an additional 4'3" above the indicator to avoid the possibility of product contacting the suspended insulation deck in the event of an earthquake causing waves in a full tank.

3. The shell plates have been designed for the internal pressure plus the static head due to the weight of the product. The product head has been computed using the height of the overflow. The stress has been computed at the bottom of each ring.

4. The roofs are self-supporting and designed under the rules of Paragraph 3.01.1 of API 620. The inner tank shells are stiffened to resist the external pressure exerted by the flexible blanket and perlite insulation.

5. One-quarter-inch ($\frac{1}{4}$") thick bottom segmental plates, butt welded from both sides, are used immediately beneath the shell. The remainder of the bottom is 3/16" thick, single-lap welded, with two passes.

6. Anchor bars (embedded in a concrete foundation) designed for a 100 mph wind are provided to transmit the tank up-lift loads to the foundation. The bars are welded to the outer bottom, but attached to the inner shell by means of a bracket which allows for take-up of any slack or settlement which might occur during the water test. Anchor bar materials are the same as the shell materials or better.

7. All steel plate used in the primary components, as described in API Standard 620, Appendix R is in accordance with Table R2.2 or Table R2.3 of that standard. Base steel is firebox quality, quenched steel.

8. All materials used in the secondary components, as described in API Standard 620, Appendix R, are in accordance with Table R2.4 of that standard.

B - WELDING AND INSPECTION

9. All welders assigned to manual welding or welding operators assigned to automatic welding successfully passed the tests conducted by the contractor, Chicago Bridge and Iron Co., as prescribed for Welder Qualifications in Section IX of the ASME Boiler and Pressure Vessel Code. This is as specified in API 620. All welding was done with special CB&I-formulated procedures designed to insure durable welds for low temperature applications. The restrictions on welding procedures applied to all attachments of stiffeners, lugs and reinforcements, as well as to the main joints in the shell and bottom of the tank. Each temporary attachment (fit-up device) removed after construction was welded using a qualified procedure.

10. Welding test specimen were sent immediately to a metallurgical laboratory for inspection and testing. One set of test plates was welded in the laboratory for qualification of the automatic girth weld procedure. Charpy V-notch impacts were taken on the weld metal and the heat-affected zone at a temperature of -60°F.

11. A qualified welding supervisor was furnished full-time. This person supervised the welding to ensure that the tanks were constructed in accordance with the approved procedures, Codes and CB&I standards. In addition, he was responsible for quality control including vacuum box testing, magnetic particle testing and X-rays. He inspected the completed tank to ensure that all welds were sound and satisfactory.

12. On all tank shell rings designed for 100% joint efficiency, the vertical joint, including 3" on each side of the intersection with the longitudinal seams, was completely X-rayed as prescribed in API Standard 620, Paragraph 3.26.

13. Butt welds in the bottom sketch plates extending under the shell were inspected their full length by the magnetic particle method, and at least two spot X-rays were taken from the butt weld joints of the compression bar.

14. All bottom fillet welds were checked by applying soap film to the joint and pulling a partial vacuum by means of a special vacuum box. The welds of the fittings to the shell were inspected both inside and outside by the magnetic particle method. The shell to bottom weld was checked with liquid penetrant.

C - TESTING

15. The completed tanks were filled with water to the proper level to stress the bottom shell ring to a minimum of 1.25 times its maximum liquid stress during service. Hydrostatic overload testing offered the added advantage of relieving some of the residual welding stresses in the bottom shell rings and fittings.

16. A pneumatic pressure of 1.875 psi was imposed on the vessels. The pressure was then lowered to the design pressure at which time the roof and all shell seams above the water level, not previously checked with liquid penetrant, were soap film tested. The water was then withdrawn from the vessel and the design gas pressure was applied to check the anchorage and the relief valve pressure setting.

D - FOUNDATION

17. The tank foundations were designed on the basis of soils investigations and recommendations provided by Petrolane as prepared by Converse, Davis and Associates of Pasadena, California.

18. An electric foundation heating system is automatically controlled to maintain an average temperature of approximately +35°F. under the tank to prevent Frost heave.

E - INSULATION

19. The double wall tanks have an outer steel shell or vapor barrier. This includes a double bottom arrangment wherein the load bearing insulation is installed between the two bottoms. The bottom insulation is 5" of Foamglas. The area around the periphery of the inner tank which supports the shell and roof of the tank is designed such that the insulation will not be crushed. A thermal barrier is provided to limit heat flow through this special load bearing detail.

20. The shell of the tanks is insulated with 20" of loose fill perlite insulation and 4" of fiberglass. The fiberglass blanket is attached to the outside of the inner tank shell and controls perlite compaction. Without this fiberglass (resilient) blanket, tank shell movement due to the thermal or pressure cycling over the years would tend to compact the perlite thus increasing the external pressure on the shell. This build-up in external pressure could cause buckling in the shell.

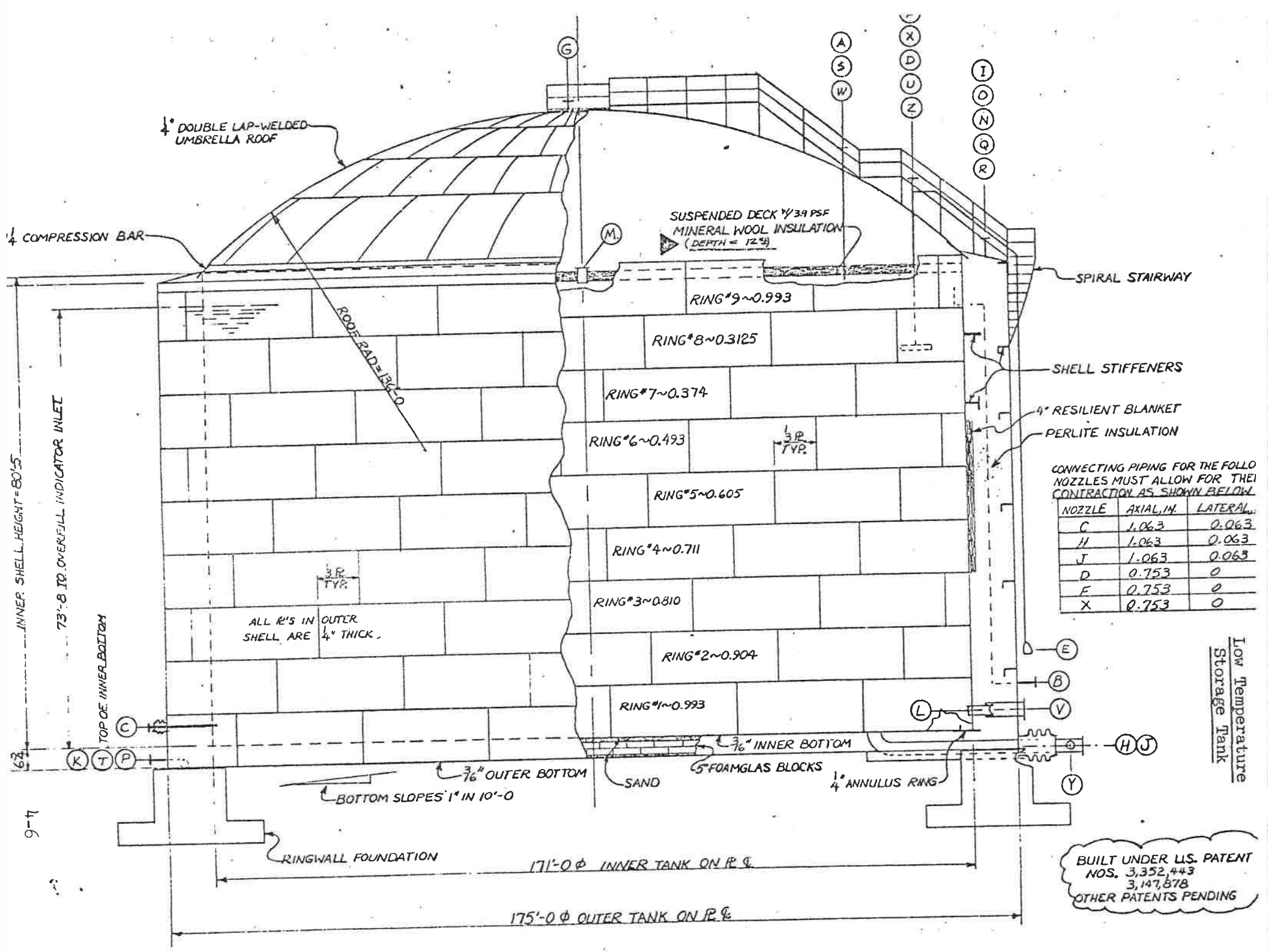
21. Loose fill perlite is an inorganic material which is expanded from perlite ore and placed in the tank hot and dry. This type insulation can be installed any time of the year. Because of the outer vapor barrier, it is not affected by adverse weather conditions such as rain or high winds.

22. The shell and bottom insulation space is kept under a very slight positive pressure by admitting a small quantity of dry natural gas to the annular space. This slight positive pressure ensures that the tank does not draw in moist air from the surrounding atmosphere, which would damage the insulation by freezing and lessen its efficiency.

23. The roof of the tanks is internally insulated with blown mineral wool or perlite. A false deck is suspended from the tank to support this insulating material. Nozzles through the deck provide free passage of gas so pressure across the insulation is equalized.

F - CATHODIC PROTECTION

24. A cathodic protection system protecting the tank bottoms from corrosion was completed shortly before the inspection and is now in operation.



CONNECTING PIPING FOR THE FOLLO
NOZZLES MUST ALLOW FOR THEI
CONTRACTION AS SHOWN BELOW

NOZZLE	AXIAL, IN.	LATERAL,
C	1.063	0.063
H	1.063	0.063
J	1.063	0.063
D	0.753	0
E	0.753	0
X	0.753	0

Low Temperature Storage Tank

BUILT UNDER U.S. PATENT NOS. 3,352,443 3,147,878 OTHER PATENTS PENDING

9-4

CHAPTER 5

PROCESS PIPING AND LIQUEFACTION - CPUC

1. This terminal receives propane from a ship, conveys it through a buried pipeline to two 300,000-barrel storage tanks where it is kept refrigerated. The propane is heated and transferred to three 60,000-gallon pressure vessels for shipments by trucks or tank cars. Propane can also be received by trucks and rail.

2. Although the large, refrigerated storage tanks are heavily insulated, heat of approximately 400,000 Btu/hour/tank is gained from the atmosphere. This "heat gain" tends to warm the large mass of liquid propane and gradually increase the vapor pressure. If this pressure was allowed to build, the tanks would reach their design pressure in a day or so.

3. As pressure builds in the tanks, vapor is allowed to flow from 14" lines at the top of each tank to the suction or inlet of three (3) gas engine driven compressors. The flow removes vapor and relieves pressure in the tanks.

4. The three gas compressors total 1,800 horsepower and are designed to handle all vapor which evolves during operations. The ship unloading operation places the maximum demand on the compressors because, in addition to normal heat leak, large amounts of vapor are displaced as the liquid level rises in the tanks. The normal "holding" operation when no ships are unloading requires only one 600 HP compressor to control pressure rise in the tanks.

5. The engine compressors are identical machines manufactured by the White Superior Division of White Motor Corporation. The six-cylinder, 4,948 cubic inch displacement engines are designed to operate on natural gas. The power rating is 580 brake horsepower at 900 RPM. The compressors are 6-inch stroke, four cylinder, double acting, horizontal, balance-opposed.

6. Each compressor receives propane vapor from the tanks at near atmospheric pressure and in three stages of compression, increases the gas pressure to 350 psig at 200°F. The capacity of each compressor is 2.5 million cubic feet at standard conditions (14.7 psia and 60°F.).

7. The high pressure, high temperature propane gas from the compressor discharge is cooled - condensed in an air-cooled heat exchanger. At 350 psig, propane is liquefied by cooling to 150°F. or below by using ambient air at 90 to 100°F. A cross exchanger cools the liquid to 40°F. and an expansion valve to minus 40°F.

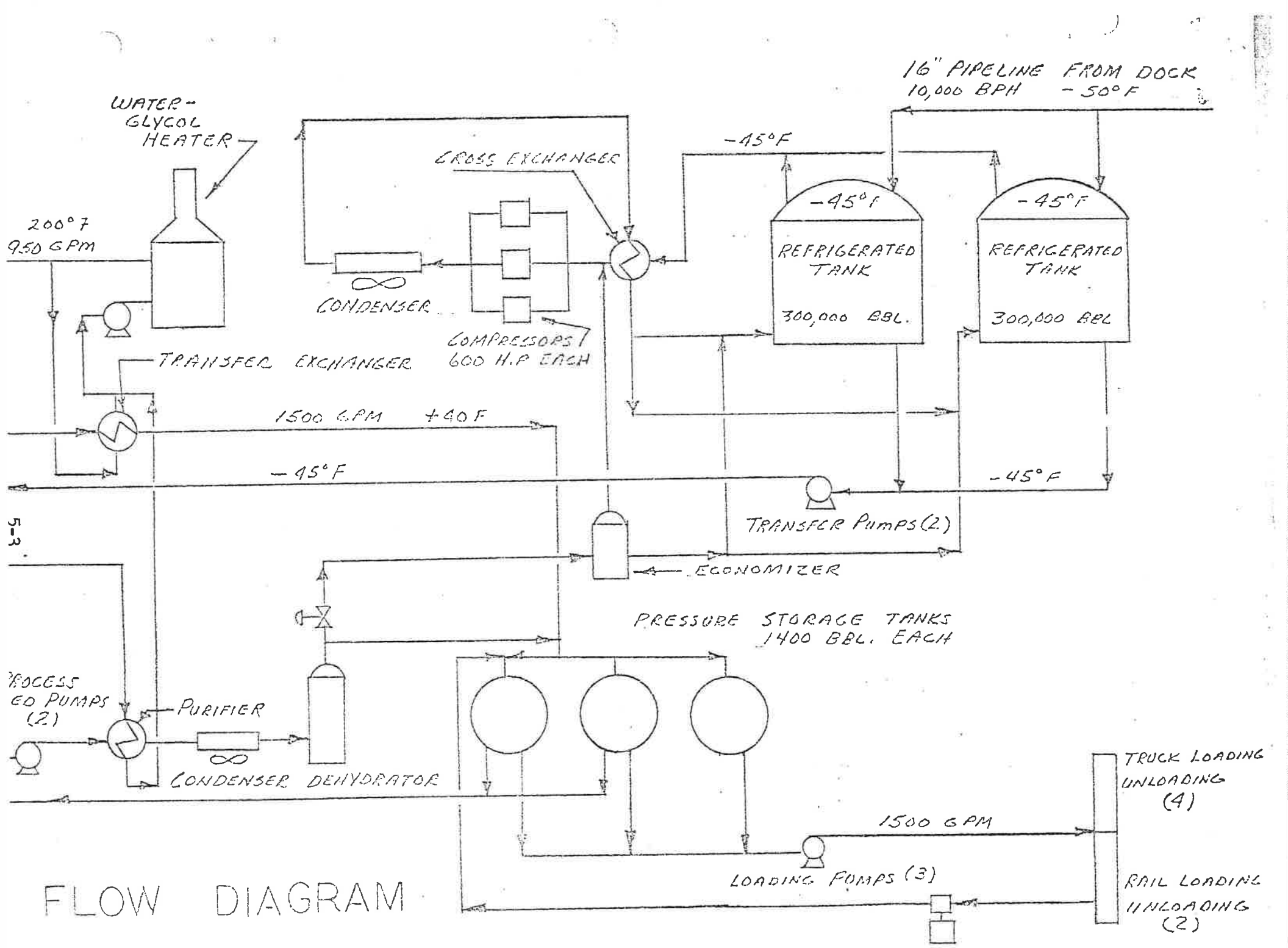
8. Propane will leave the air-cooled condenser as a liquid and will collect in a receiver vessel. The propane liquid is then returned automatically to the refrigerated storage tanks. A liquid level controller is provided for this operation.

9. While the terminal is designed for manned operation, the refrigeration system described above can run unattended for long periods of time. It is only necessary to select a desired refrigerated tank pressure on a pressure controller and place the compressors on automatic operation.

10. Vented gases from the refrigerated propane system are conveyed to the flare stack where a constant burning pilot insures safe ignition. Gases could be vented as a result of routine maintenance or relief opening. The flare stack is located atop the bluff in the southeast corner of the property.

11. A cathodic protection system protecting all yard piping was completed shortly before this inspection.

12. Piping was designed with provision for expansion and contraction including expansion loops and metallic bellows on the low temperature tank discharge lines. Angle iron stops at the ends of pipe supports will prevent piping from falling off if an earthquake occurs.



FLOW DIAGRAM

CHAPTER 6

OTHER FACILITIES - CPUC

Pressure Vessels

1. Three 60,000-gallon pressure vessels store warm propane to be pumped out to truck transports or rail cars. They will also be used to receive propane at ambient temperature from trucks or rail cars during the warm summer months. The vessels are rated at 250 psig and designed in accordance with American Society of Mechanical Engineers, "Boiler and Pressure Vessel Code, Section VIII". Propane from the 300,000 Bbl tanks is warmed before transfer to these vessels to prevent contact of the vessel shells with low temperatures.

2. These vessels and the interconnecting piping were inspected at the time of installation to ensure compliance with the California Division of Industrial Safety and the Los Angeles Municipal Code requirements for liquid petroleum gas systems. Permits were issued by the City of Los Angeles Department of Building and Safety. The vessels are inspected annually by a safety engineer from the Boiler and Pressure Vessel Division of this Department which reports to California State Division of Industrial Safety every three years.

3. The pressure vessels would be isolated automatically in the event of a nearby fire by emergency shutdown valves actuated electrically from ultra-violet detectors or by a fusible link. A check valve in each fill line prevents liquid outflow in the event of a line rupture.

4. Pressure vessels are equipped with safety relief valves. These valves would open only in the extreme situation where an uncontrolled fire under the vessel would threaten the shell through the vapor pressure of the propane. Since in all probability these valves would not open, these are vented to atmosphere.

5. Cold transfer pump operation is automatic and controlled by liquid level in the vessels. A liquid level float actuates an electrical circuit to turn the pump or pumps on and off. When the vessels are filling, the furnace for warming the propane shuts down at a level of 6'4". The pumps shut off when the level reaches 8'0". A separate high level shut down switch will stop the pumps and prevent overfilling in case of a malfunction of the primary level control device.

LPG Loading Station

6. Three 500 gpm centrifugal pumps are installed to load propane into truck transports or rail cars at four truck loading stations and two rail spots, respectively. Butane could be pumped directly from refrigerated storage at approximately 600 gpm.

7. The loading stations were inspected at the time of installation to ensure compliance with the requirements of the California Division of Industrial Safety and the Los Angeles Municipal Code.

Earthquake Design

8. The Los Angeles Department of Building and Safety approved the design including the seismic loading and issued permits for the control building and for the foundations of the 60,000 gals. pressure vessels.

Refrigeration Compressors

9. The first of three silencers was installed on a compressor engine exhaust on June 20, 1977. The remaining two are expected to be installed in September of 1977.

CHAPTER 7

INSPECTION AND MAINTENANCE PROGRAM - CPUC

1. Preventive maintenance is performed through inspection, lubrication, cleaning, adjusting, servicing, testing, replacing and reporting. This program was established in four steps: a) an inventory of all plant equipment was recorded on machine data cards, b) the type and frequency of maintenance was recorded on preventive maintenance work order cards, c) machine repair record and preventive maintenance summary cards to record cost, preventive maintenance and repairs performed were prepared, and d) a Modulex Preventive Maintenance Planning Board was prepared listing each piece of equipment with its required frequency of preventive maintenance indicated for a year in advance.

2. The Modulex Board consists of an equipment list followed by 52 columns representing weeks of the year. Pegs of various colors placed in the latter columns indicate the weekly, monthly, quarterly, semiannual or annual maintenance required. A string is moved across the board each week.

3. When the string crosses a peg, the preventive maintenance work order card is pulled, a copy made, the maintenance functions to be performed are marked and the card is issued to maintenance personnel. When the functions are completed the card is signed, dated and the copy is returned and the information thereon is posted to the file card.

4. The maintenance superintendent follows up with maintenance personnel to confirm that work orders are completed in detail and to determine if modification in the maintenance procedure or scheduling is necessary. The superintendent also spot checks the equipment.

CHAPTER 8

COMMENTS BY LOS ANGELES FIRE DEPARTMENT

A - PROJECT DESCRIPTION

LPG Loading Stations

1. There are four truck loading stations and two rail stations for delivering or receiving of propane. Sprinklers are provided at each loading rack. These sprinklers are sized and located to direct 0.3 gal./sq. ft./minute, primarily to the vapor space of the tank. The sprinklers, when activated, are directed at the loading side of each tank and are concentrated on about two-thirds of the length of the tank. In the event of fire in the loading area, these sprinklers would be automatically turned on by an ultraviolet sensor. In addition to backing up the sprinklers, water monitors located in the area are capable of covering the ends and outside of the tanks. Hydrants in the area provide additional backup.

Safety Alarms and Firefighting Systems

2. The basic intent of the firefighting system is to keep equipment cool to prevent failure while the source of the fire is eliminated and brought under control. In addition to the fire protection systems discussed under Loading Stations, the most severe demand on the water system would be for a fire near the two 300,000 barrel tanks. Initially, 5,000 GPM will be provided to the top of either tank. This water would be evenly dispersed around the perimeter of the tank through a circular weir at the top of the tank. After five minutes, the entire surface of the tank should be wet and the flow rate will be reduced to 1,200 GPM to keep the surface wet.

3. In addition, sprinkler systems and water monitors are provided over transfer pumps and pressure vessels within the facility. The process, heater, and compression areas each have one 95 GPM standpipe which is backed up by strategically located 20 lb. dry chemical hand portable extinguishers.

4. Nineteen hydrocarbon vapor detectors are placed at 12 critical points in the plant where leakage is most probable. In general, experience has shown that pump areas are more likely to have hydrocarbon leaks. The

vapor d. ctors are electrically operated and extremely sensitive. If a detector should sense escaping propane, it would send an alarm signal to the main control panel in the Control Building. The alarm will allow the operator to pinpoint the leak and take corrective action. If the propane concentration should reach 65% of the lower explosive limit, the vapor detection system will trigger the plant Emergency Shutdown (ESD). Basic to any ESD system is cessation of product flow and pumping by closing of automatic control valves to isolate the various plant areas.

B - LOW TEMPERATURE PIPELINE

Pipeline Specifications and Construction

5. A fully insulated 16-inch seamless steel pipeline connects the wharf unloading area to the terminal storage facility (approximately 6,000 feet). Running parallel to the 16-inch pipeline is a four-inch line which is used to circulate cold propane to cool the larger line in preparation for transfer from ship. Both of these lines are buried at a depth of approximately four feet below the existing ground elevation. The pipelines carry a design pressure of 275 psig and were tested to not less than 1.5 times the design pressure. Design temperature is -50°F., and all materials are impact tested to ensure ductility and safe operation at the low temperature. The piping system was built in conformance with the American National Standard Code for Pressure Piping Petroleum Refinery Piping, ANSI B 31.3, Division 39 L.A.F.D. Municipal Code.

Fail Safe Control and Firefighting Systems

6. The safety control valves for the pipeline are a system of automatically actuated flow control, check, and manual block valves. The flow control valve will automatically close if the cargo transfer operator pushes the shutdown switch or if predetermined temperature and refrigerated storage tank level conditions are exceeded.

7. All of these devices are easily controlled by qualified operators who are continuously in attendance on shore during transfer operations. Firefighting systems for the pipeline are centered around the marine arm and will be covered in the following chapter.

8 - COMMENTS BY LOS ANGELES FIRE DEPARTMENT

C - DOCK FACILITY

Ship Unloading Facility

8. A rigid pipe, swivel joint type unloading arm is mounted on top of a 600-foot long wooden wharf at Berth 120 to transfer refrigerated propane from the ship into a buried pipeline. The unloading arm, which stands 56 feet above dock elevation in its stored position, is manufactured of 12-inch diameter low-temperature seamless steel pipe. Many similar arms are installed throughout the Los Angeles Harbor area and the world.

Unloading Procedures

9. Several hours before the scheduled arrival of a ship at Berth 120, refrigerated propane from the storage tanks is slowly pumped down the four-inch line to a tee in the 16-inch line at Berth 120. The liquid flows back up the 16-inch line, and this circulation process will gradually reduce the main pipeline temperature from existing ground temperature to $-40^{\circ}F$. This is necessary to minimize thermal shock to the line material and prevent a huge uncontrolled heat release to the storage tanks from a warm line. An uncontrolled heat release would overtax the plant refrigeration system.

10. The ship will start pumping slowly until Petrolane dock and terminal operators check out all operations. Most critical is operation of the refrigeration system to control the rate of pressure rise in the refrigerated tanks.

11. The flow rate will be slowly increased to the maximum possible by adding pumps to the system. Most ships have 6 to 8 pumps, each capable of 75,000 gallons per hour discharge. A large ship will carry 300,000 barrels of propane, so the normal time for cargo discharge can run 36 hours or more.

12. Once the ship is empty and pumping has ceased, nitrogen from a permanently mounted storage tank is used to purge the line of propane from ship to the block valve on shore. The nitrogen equipment is also available during the entire discharge operation in case of an emergency where a line purge is necessary.

8 - COMMENTS BY LOS ANGELES FIRE DEPARTMENT

13. The only release of material to atmosphere occurs during depressuring of the unloading arm following the nitrogen purge. While there will be slight traces of propane released, over 95 percent will be nonpolluting nitrogen. Once the arm is depressured and disconnected, it is moved back to its upright storage position on Berth 120 and the ship is free to depart.

14. During transfer of cargo, portable radios or telephones in the control rooms of the terminal, dock, and ship are open to allow constant communication between the three key cargo transfer personnel. All three men have the means to stop line flow instantaneously. The dock and ship operators also have visual contact with each other and the transfer area at all times.

Firefighting Equipment During Transfer Operations

15. Two $2\frac{1}{2}$-inch hose lines 100 feet long are connected to two domestic water outlets on the wharf. In addition, two heavy stream portable water monitors are positioned approximately 150 feet apart on each side of the marine arm and approximately 80 feet from the vessel.

Fire Department Comments on Draft Review of July 7, 1977

16. With reference to Recommendation No. 1, it is not clear whether the purpose of enlarging the capacity of the impoundment basin is to:

A. Allow the basin to hold 100% of the total contents of both tanks in the event both tanks fail simultaneously; or

B. To minimize spillage onto Gaffey Street if the dike is cracked.

The diked area meets all Los Angeles Municipal Code requirements.

17. The following is the section of the Los Angeles Fire Code that addresses the issue:

"Sec. 57.31.36. Diked Areas:

"Where control of accidental discharge is by means of a diked area, such diked area shall comply with the provisions of this Section.

8 - COMMENTS BY LOS ANGELES FIRE DEPARTMENT

"A. The net impounding capacity available to a tank or group of tanks within a common diked area shall be not less than the capacity of the largest tank enclosed by the dike.

"(1) The volume of the largest tank up to the required height of the dike wall may be considered as part of the available capacity of the diked area.

"(2) No part of the volume of tanks other than the largest tank shall be considered as part of the available capacity of the diked area.

"(3) Where a separate catchment basin is used to reduce the required capacity of a diked area, drainage sufficient to prevent overflow of the dike and effective control of flow shall be provided.

"(4) The impounding capacity of a single catchment basin may be applied to reduce the required capacity of each of the diked areas draining to it.

"B. Walls of the diked area shall be of earth, steel, concrete or solid masonry designed to be liquid tight and to withstand a full hydrostatic head. Earthen walls 3 feet or more in height shall have a flat section at the top not less than 2 feet wide. An earth dike wall shall have a minimum slope of $1\frac{1}{2}$ feet horizontal to 1 foot vertical and shall be well compacted and coated with concrete, plaster (gunite), asphalt or other water impervious material to prevent erosion.

"C. The walls of the diked area shall be restricted to an average height of 6 feet above interior grade. The distance between the inside toe of any dike wall and the shell of any tank shall be not less than 5 feet. Concrete footing for steel, concrete, or slid masonry wall may project into this area, provided the top of the footing does not project above grade. (Amended by Ord. No. 148,916, Eff. 11/23/76.)

"D. For vertical cone roof tanks constructed with a weak roof-to-shell seam, approved floating roof tanks, tanks equipped with approved extinguishing systems, or tanks equipped with approved inerting systems; each diked area containing two or more tanks shall be subdivided by intermediate curbs or drainage channels as follows: One subdivision for each tank in excess of 10,000 barrels; and one subdivision for each group of tanks (no tank exceeding 10,000 barrels capacity) having an aggregate capacity not exceeding 15,000 barrels.

"E. For tanks not covered in Subsection D of this Section, each diked area containing two or more tanks shall be subdivided by intermediate curbs or drainage channels as follows: One subdivision for each tank in excess of 100,000 gallons; and one subdivision for each group of tanks (no tanks exceeding 100,000 gallons capacity) having an aggregate capacity not exceeding 150,000 gallons.

"F. The intermediate curbs or drainage channels required by Subsections D and E of this Section shall comply with the provisions of this Subsection.

"(1) Where intermediate curbs are used, they shall be not less than 18 inches in height and construction requirements shall be the same as for dike walls.

"(2) Where drainage channels are used, they shall comply with the provisions of Section 57.31.35.

"(3) The intermediate curbs or drainage channels shall be located between tanks so as to take full advantage of the available space with due regard for the individual tank capacities.

"G. Within each diked area drainage shall be provided at a consistent slope of not less than 1 percent away from tanks toward a sump, drainbox or other safe means of disposal located at the greatest practical distance from the tank. Such drains shall normally be controlled in a manner so as to prevent flammable liquids from entering natural water courses, public sewers, or public drains, if their presence would constitute a hazard. Control of drainage shall be accessible under fire conditions.

"H. No dry vegetation or combustible material not a part of the permanent installation nor any empty or full drum or barrel shall be permitted within a diked area."

CHAPTER 9

FIRE FIGHTING EQUIPMENT - CPUC

A - GENERAL DESCRIPTION

1. Four manually operated fire monitors, a hose station and two hydrants ring the truck and rail car loading and unloading racks. Another fire monitor protects three LP-gas pressure storage tanks. Two $1\frac{1}{2}$" hose stations provide coverage in the refrigeration and process areas of the terminal.

2. Overhead water spray systems automatically actuated by the ultra violet sensors or remotely controlled from push button stations will cool and protect equipment in the four truck racks, two rail car racks and the cold transfer pump area between the refrigerated tanks.

3. A 16" water service is located at a point 800 ft. north of Westmont Drive on Gaffey Street where 13,000 gpm at 100 psig are available. The main system in the plant consists of a 20" feeder line and two loops. One loop, a 14" line, circumvents the retention basin. A 4" line loops north of the office building and connects to the 14" line at the northeast corner of the retention basin. The following laterals are fed by this system for fire control.

   A. Three laterals off the 4" loop connect hose reels in the process, heater and compressor areas, and one lateral off the 20" feeder connects to a hose reel in the truck loading area.

   B. Five laterals off the 20" feeder line connect sprinklers over the truck and railcar loading racks. One lateral off the 14" loop connects sprinklers over the transfer pump location.

   C. One lateral off the 20" feeder line connects a hydrant near the office building. Two laterals off the 14" loop connect one hydrant on the west side of the basin and one south of the basin.

   D. Three laterals off the 20" feeder line connect monitors in the truck loading area, and four off the 14" loop connect one northeast of the pressure storage, one west of the impoundment basin and two remote control units located between the two low temperature tanks.

   E. Two laterals off the 14" loop run to circular weirs at the top of each refrigerated storage tank.

F. Two Ansul [illegible] wheeled dry chemical extinguish[illegible], each containing 125 lbs of Purple-K are located near the process skid. Twenty-six Ansul Model K-20-E dispensers, containing 20 lbs. of Purple-K dry chemical are located throughout the plant.

4. Primary control for water system is three 10" gate valves located where the 20" line connects to the 16" water service at Gaffey Street. These valves are part of the three 10" Clayton R.P. back flow preventers, and all three must be open when the water system is in normal operation, four 14" gate valves can isolate the 14" loop into two sections and two 4" valves isolate the 4" loop.

B - OPERATION

Hose Reels

5. A two and one-half inch manually operated Globe valve at the axis of the hose reel controls the flow of water to two hundred feet of hose. The hose stream of 95 gpm can be adjusted to various fog patterns, straight stream and shut off as required.

Sprinklers

6. The six sprinkler systems all operate in the same manner. A manually operated valve will permit turning the sprinklers off in the event that the fire sensor is triggered by a fire in another location or an electric arc at the power wires. When this valve is closed, a status panel light goes on in the control room and stays on until the valve is open. This valve must be open to permit automatic operation of the system. The panel is checked regularly to make sure no valve is inadvertently left closed. A three-way solenoid valve controls air to the operator of the fire water control valve for each sprinkler system. This operator is spring loaded open and held closed by air pressure. Air is directed to the operator when the solenoid is energized. Air or electric failure would open the valve. Should power fail the controls are automatically switched to a battery bank which can supply power for 7 hours. Therefore, the solenoid in the emergency electric circuit would only fail after prolonged loss of power. In the event of a fire the ultraviolet sensors will deenergize the solenoid and turn on the sprinkler.

7. The truck and tank car loading area sprinklers can be turned on and off from four push button stations. One is located on the panel in the control room, one at the loading rack and one each at the north and south side of the loading areas. The sprinklers over the transfer pumps can be turned on and off from three push button stations. One is located on the panel in the control room, one at the transfer pumps and one is located beside the road at the northeast corner of the catch basin.

Hydrants

8. The three hydrants are wet barrel type with individual valve control for the 2½" and the 4" outlets each with a National standard hose thread.

9. The five monitors located in the truck and tank car loading area and pressure storage area are manually operated. A four-inch valve at the base of the assembly turns the water on. The flow from the 500 gpm fog nozzle can be adjusted to various fog patterns, straight stream and shut off as required. The azimuth and elevation of the flow can be directed as required and locked in position to leave the monitor unattended if the safety of the location becomes questionable.

Monitors

10. The two monitors located between the two refrigerated tanks are remote controlled units using plant water pressure for hydraulic power. The valves controlling flow to these monitors are located at the top of the hill in back of the tanks along with the hydraulic controls. Water flow to these monitors is manually controlled by the same 14" valves that isolate the sections of loop feeding water to the top of the tanks. The north section of the loop controls the flow to the monitor on the west side of the tank area and the south section of the loop controls the flow to the monitor on the east side of the tank area. A three-way solenoid valve controls air to the operator of each valve that is spring loaded open. Air is directed to the operator when the solenoid is energized, holding the valve closed. Air or electric failure could open the valve. The solenoid in the emergency circuit can only fail when the battery bank expires. Push buttons located at the valves on the panel in the control room and at a station next to the road at the northeast corner of the catch basin will open or close these valves to the

monitors. Each monitor has a hydraulic dr . that can adjust the 750 gpm nozzle from shut off through various fog patterns to a straight stream. Separate hydraulic drive will provide seventy-five degrees of vertical control and one hundred eighty degrees of azimuth control. The hydraulic control valves are located at the top of the hill and can aim, alter or adjust the flow remotely. These monitors are stowed facing each other with the nozzles adjusted to form a curtain of water between the tanks. This position would be of value to protect a tank if the control area is inaccessible.

Tank Cooling

11. The flow to the top of the tank can be started and stopped by push buttons located on the panel in the control room, at a station near the northeast corner of the impoundment and at a station near the valves at the top of the hill. Flow of water to either tank can be manually controlled by two of the 14-inch gate valves in the 14" loop.

12. The valves controlling the flow of water to the tanks are located at the top of the hill. They are spring loaded closed and open when air pressure is directed to the operator through an energized solenoid valve. Air or electric failure will close the valve, but a hand jack located on top of the operator will permit opening these valves by hand. When the push button actuates the solenoid, it applies air pressure to the operator that overpowers the spring and opens the valve, permitting 6,200 gpm to flow to the top of the tank. At the same time a time delay relay is energized and after 5 minutes a reduced air pressure is directed to the operator that will partially close the valve permitting only 1,250 gpm to flow to the top of the tank. The water will be evenly disbursed around the perimeter of the tank through a circular weir at the top of the tank, and at 6,200 gpm it will wet the perimeter of the tank at approximately 0.14 gal./sq/ ft./min. After 5 minutes the entire surface of the tank would be wet, and the reduced flow rate of 1,250 gpm would keep the surface wet. In addition to the wetting of the tank shell, a curtain of falling water extending about 3 feet from the shell is formed and offers further insulation from an exterior source of heat. Because of the size of the area and the quantity of water involved, it is not practical to operate these valves automatically. A fire sensor could not determine which tank required the water.

9 - FIRE FIGHTING EQUIPMENT - CPUC

C - WATER SUPPLY

13. The 16" water service has dual supply from either a 20" cast iron or a 36" steel line in Gaffey Street. The 36" line is the main supply to San Pedro. In the event of fault displacement across Gaffey Street, the cast iron line would be more susceptible to rupture. The steel line would be likely to maintain continuity with displacement up to 2 feet (Chapter 12).

CHAPTER 10

ALARMS AND SHUTDOWN PROVISIONS - CPUC

1. There are four total plant shutdown switch locations, one in the control room on the main panel, one in the loaders building on the south wall, and one switch about one hundred yards from each of the two main gates at the west side of the road.

2. In the event the fire would be located in the loading area, a total plant shutdown may be necessary. There are six loading arm shutdown locations that will shut down all motors involved in loading operations and close all valves handling product to and from the area. One is located in the control room on the main panel, one in the loaders building on the south wall, one on the north side and one on the south side of the tank truck loading racks, one at the base of the stairway on the south side of the tank car loading platform and one near the base of the ladder on the north side of the tank car loading platform.

3. Ultra-violet (UV) detectors were installed to detect a flash, actuate alarms, shut down the plant and automatically trigger the plant fire water system. UV monitors are mounted in every equipment grouping of the terminal, but are particularly numerous in the truck and railroad car loading and unloading areas.

4. All fire sensors can be manually activated from the main control panel.

   A. Two sensors are located on the process skid, one at the north end and one at the south end. In the event of a fire they will sound an alarm and shut down the condenser fans F1A & F1B, the propane loading pumps P2A, P2B, and P2C, the process feed pumps P3A and P3B and the regeneration pumps P4A and P4B.

   B. Four sensors are located in the compressor building, one at the north end, one in the center and one at the south end. They sound an alarm and shut down the compressors.

   C. One sensor is located at the transfer pump pad. It will sound an alarm, turn on the sprinkler system over the pumps and shut down the cool down pumps P6A and P6B, and the propane transfer pumps P1A and P1B. The sprinklers can also be manually initiated by pushing buttons on the main control panel, at the transfer pump or near the compressor building.

D. Two sensors are located at the loading pump area. They will sound an alarm and shut down the propane unloading compressors K1A and K1B, the propane transfer pumps P1A and P1B, the loading pumps P2A, P2B and P2C, the process feed pumps P3A and P3B, and the regeneration pumps P4A and P4B. Also, the emergency valves on the pressure vessels and in the incoming pipeline will close.

E. One sensor is located at each of the four truck loading racks. They will sound an alarm and turn on the sprinklers over the tank truck they are monitoring. They will also shut down the propane unloading compressors K1A and K1B and the loading pumps P2A, P2B and P2C. The sprinklers can also be manually initiated at the loading rack, the main control panel, the emergency control station north of the loading racks or the emergency control station south of the loading office.

F. Two sensors are located at the tank car loading rack. They will sound an alarm and turn on the sprinklers over the tank cars. They will also shut down the propane unloading compressors K1A and K1B, and the loading pumps P2A, P2B and P2C. The sprinklers can also be manually initiated at the main control panel, the emergency control station north of the loading racks or the emergency control station south of the loader's office and at the tank car loading rack.

5. Since the LP-gas is stored unodorized, continuous combustible gas monitoring instruments in areas of most probable leakage, such as near pumps and compressors, were installed. Although no leakage from the large refrigerated tanks was anticipated, four gas detectors were installed between the tanks and the containment sump. The fired heater area is protected by a sensor which would shut off fuel gas if gas leakage was detected. These combustible gas monitors are set to alarm at 35% of lower explosive limit (LEL) and shut down the plant at 65% of LEL. The function is to warn the operators, stop operations and isolate various sections of the facility in case of a gas leak.

6. An earthquake switch is located in the control room. A steel ball resting on a pedestal maintains continuity in an electrical circuit. If a tremor rocks the ball off of the pedestal, an electric circuit is opened and the plant is shut down.

CHAPTER 11

LOW TEMPERATURE PIPELINE - CPUC

1. The 16" pipeline extends in a northwest direction from Berth 120. Just before crossing the abandoned Wilmington San Pedro Road it turns westward and continues to the Petrolane terminal.

2. The lines are fully insulated with 2 inches of polyurethane next to the pipe shell, a 1/8-inch layer of woven fiberglass, then PVC 40 mils thick over the exterior to keep out ground water. The PVC was pressure tested with air. Design temperature is -50°F. and all materials are impact tested to insure ductility and safe low temperature operation. This piping system was built in conformance with the American National Standard Code for Pressure Piping, ANSI B 31.3 and Division 39 L.A.F.D. Municipal Code. Material specifications are: for the pipe: ASTM A333 Gr.1; welding fittings: ASTM A420 WPL1; forgings: ASTM A350 Gr. LF1; bolts: ASTM A 320 L7 and A194 2H; and for the gaskets: Flexitallic Style CG. Operating pressure is 90 psig. Nine expansion loops are provided for the temperature variation from -50°F. to ambient.

3. The pipeline will be placed under cathodic protection soon.

4. An annual pressure test to 275 psig is required by the U.S. Coast Guard.

5. A temperature sensor at the midpoint of the 16" line operates to keep pneumatic valves closed until pipeline temperature is sufficiently low. Ships cannot be unloaded if line temperature at the midpoint is too high. A relief installed at the valve pit near the dock is set at 250 psig.

6. Minimum cover on the pipeline is 36". Depths are as follows at the various crossings:

Westoils Road	6'
Wilmington San Pedro Road	8'
Railroad Siding	5.5'

At the Wilmington San Pedro Road the pipeline crosses 10 other buried lines owned by Southern California Gas, Los Angeles Department of Water and Power, Arco, Time Oil, Mobil, Union and unknown parties. Road and rail crossings are encased.

7. A check valve near the dock would allow isolation of the pipeline in the event of heavy damage at the dock. However, if this check valve were damaged, the contents of the pipeline could spill onto the dock area and fuel a conflagration.

CHAPTER 12

EARTHQUAKES - CPUC

A - INTRODUCTION

1. The Petrolane LPG facility is in one of the many seismically active areas in the state. Some of the faults have been active within historic times (approximately 150 years). Others have not been active within historic times, but earlier activity of faults can be inferred from other geologic data.

2. The state of the art for predicting earthquakes has not developed to the point where anything can be predicted with certainty. Generally, estimates are made as to maximum credible earthquake, defined as the maximum earthquake (on the Richter scale) that appears to be reasonably capable of occurring under conditions of the presently known "geologic framework" and bedrock acceleration, measured as a fraction of the acceleration of gravity (g). It is these values together with their probabilities and costs (both replacement cost of facilities and potential impacts on the environment, especially when dealing with hazardous substances) that determine the design parameters for facilities.

3. This report is not intended to be an independent or original study of the potential seismicity at the Petrolane facility. It is rather an attempt to collect information from previously published material in an effort to determine if there is a consensus as to what the seismic hazards of the LPG facility actually are, based on the most up-to-date information available. In areas where there is no consensus, the differing views are presented.

4. Undoubtedly, a more extensive review of published material, or even an entirely new study, would yield additional differing views on some issues, especially probabilities and recurrence intervals; however, this would only serve to show that there is indeed controversy on some points rather than provide enough information to draw any definite conclusions.

B - LOCATION OF FAULTS

5. The Petrolane LPG facility lies in an area of recurring seismic activity. (See Exhibit 12-1.) The faults which pose the most serious hazard are the Newport-Inglewood Fault and the Palos Verdes Fault. The Newport-Inglewood Fault has shown significant activity within historic times and lies approximately seven miles from the facility.

6. Until the last couple of years, the Palos Verdes Fault was considered to be inactive but recent studies, most notably by the United States Geological Survey Open File Report 75-596[1/], November 1975, have indicated that this fault should be considered active. Roger W. Greensfelder of the California Division of Mines and Geology also shows the fault as being "potentially active" in the publication "Maximum Credible Rock Acceleration From Earthquakes in California", revised August, 1974[2/]. The exact location of this fault is not known since it does not exhibit obvious surface displacement. Most estimates, however, place it about one mile from the LPG site. (See Exhibit 12-2.)

C - DESIGN PARAMETERS FOR EXISTING FACILITY

7. The existing LPG facility was designed to withstand an acceleration of 0.4 g. The paper "Safety Considerations in the Design and Operation of a Refrigerated LP-Gas Marine Terminal"[3/], states the design criteria was "a zero period acceleration value of 0.31 g based on a 'design earthquake' along the Newport-Inglewood Fault". The Earthquake Analysis[4/] prepared by Chicago Bridge & Iron Company (CB&I) shows the facility was designed for a "maximum ground acceleration" of 0.4 g based upon a 5.5 to 6.0 magnitude earthquake on the Palos Verdes Fault. (See Exhibit 12-3.) Even though the Palos Verdes Fault was considered to be inactive at the time of design in August, 1972 (see Exhibit 12-4), the designers (Chicago Bridge & Iron Company) evidently decided that in the interest of safety, they would design the facility for such a seismic event.

1/ United States Department of the Interior Geological Survey, "Preliminary Report on the Environmental Geology of Selected Areas of the Southern California Continental Borderland", Open-File Report 75-596, Menlo Park, California, November, 1975.

2/ Roger W. Greensfelder, "Maximum Credible Rock Acceleration From Earthquakes in California", California Division of Mines and Geology, Map Sheet 23, August, 1974.

3/ R. A. Reed, "Safety Considerations in the Design and Operation of a Refrigerated LP-Gas Marine Terminal", Petrolane, Inc., Long, Beach, California, May 14, 1975, P.5.

4/ "Earthquake Analysis" for Petrolane, San Pedro, California, Chicago Bridge & Iron Company, August 2, 1972.

8. In a letter from CB&I to Petrolane, dated August 15, 1977 (see Exhibit 12-7, supplemental information after July 7, 1977), these design parameters were explained.

> "The term $\ddot{\delta}$ is defined as 'maximum ground acceleration', and we interpreted this to be the acceleration associated with the impulsive liquid mass acting at the 'tank' period. Technically speaking, the acceleration at 0 period (or ground acceleration) could have been used for this term. However, CBI policy has been to use the amplified acceleration (at the period of 0.132 seconds in our calculations on sheet 4 of 20). Recent findings (see reference 1) have confirmed that the amplified acceleration, rather than the ground acceleration, should be used in the analysis. This is where the slight discrepancy in the definition of terms arises.
>
> "The term S_a is defined as 'absolute spectral acceleration', and we interpret this as the acceleration associated with the sloshing liquid.
>
> "Using the original response spectrum curve for the Petrolane tanks, the horizontal accelerations can be determined."

9. The response spectrum curve was developed by Converse Davis Dixon Associates.5/ The zero period (or ground) acceleration for this curve is 0.29 g, and the acceleration at the period of the tanks (0.132 seconds) is 0.4 g.

5/ "Soil and Earthquake Engineering Investigations, Proposed Propane Distribution Facility, Gaffey Street Site, Los Angeles, California", Converse Davis Dixon Associates, May 30, 1972.

10. In May, 1977, CB&I analyzed the existing 300,000 bbl. tanks to determine the maximum horizontal acceleration which the tanks could withstand under different conditions. The vertical acceleration was assumed as one-half of the corresponding horizontal acceleration value, but not acting concurrently. The results are as follows:

ITEM	Maximum Horizontal Seismic Acceleration, 1.0 PSIG Operating Pressure	
	Tank Anchorage or Shell at Original Stress Allowables	Tank Anchorage or Shell Stresses Allowed to Increase to Yield
Full Liquid Level h= 73.67 ft.	0.43g (Shell Thickness Governs)	0.80g (Anchorage Governs)
90% Full h = 66.3 ft.	0.60g (Shell Thickness Governs)	1.05g (Anchorage Governs)
80% Full h = 58.94 ft.	0.81g (Shell Thickness Governs)	1.5g (Anchorage Governs)

11. As can be seen, the greatest risk to the tanks occur when they are full. When they are less than completely full they are able to withstand substantially greater seismic forces.

D - EVALUATION

12. In light of today's knowledge, the estimate of a "design earthquake" of magnitude 6.5 at the Newport-Inglewood Fault was too low. Recent information indicates that the maximum credible earthquake for this fault is 7. This is the magnitude postulated by Greensfelder, California Division of Mines and Geology, 1974, who is also used as a reference in the Environmental Impact Report for the Sohio Project[6] prepared jointly by the CPUC and the Port of Long Beach, and is very similar to the 7.1 postulated by the Long Beach Harbor Consultants* in their report, "Environmental and Geotechnical Sampling Program"[7], February, 1976, prepared for the Port of Long Beach.

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* Converse Davis Dixon Associates was a member of the Long Beach Harbor Consultants. (See footnote 5)

6/ "Sohio West Coast to Mid-Continent Pipeline Project", Environmental Impact Report by California Public Utilities Commission and the Port of Long Beach, June, 1977, Vol. 1, Part 1, p. III-2.

7/ "Environmental and Geotechnical Sampling Program", by Long Beach Harbor Consultants for the Port of Long Beach, February, 1976, p. III-185.

13. Assuming a magnitude of 7 and a distance of seven miles from the LPG facility, the maximum bedrock acceleration that could be expected at the site is estimated to be 0.45 g based upon the attenuation curves prepared by Schnabel and Seed, 1973.[8] (See Exhibit 12-5.)

14. Similarly, the Palos Verdes Fault has more recently been estimated to be capable of generating an earthquake magnitude of 7.0 to 7.2 on the Richter scale.[6,7] Converse Davis Dixon Associates says a magnitude of 7.2 earthquake is possible but improbable. (See table following paragraph 25.) In a separate study recently performed, Lindvall, Richter Associates states the maximum credible earthquake is 6.5.[9] The attenuation curves of Schnabel and Seed do not include values where the distance between the fault and the site in question is less than two miles. If taken literally, they indicate that the maximum bedrock acceleration to be anticipated from an earthquake of magnitude 7 would be in excess of 0.7 g. This is consistent with Roger Greensfelder whose map of "Maximum Credible Rock Acceleration" indicates a potential bedrock acceleration in excess of 0.5 g (see Exhibit 12-6) at the LPG site. Unfortunately, the U.S.G.S. Open-File Report 75-596 did not draw any conclusions as to maximum credible earthquake, maximum bedrock acceleration, or recurrence interval.

6/ "Sohio West Coast to Mid-Continent Pipeline Project", Environmental Impact Report by California Public Utilities Commission and the Port of Long Beach, June, 1977, Vol. 1, Part 1, p. 111-2.

7/ "Environmental and Geotechnical Sampling Program", by Long Beach Harbor Consultants for the Port of Long Beach, February, 1976, p. III-185.

8/ Per B. Schnabel and H. Boldton Seed, "Accelerations in Rock for Earthquakes in the Western United States", Bulletin of the Seismological Society of America, Vol. 63, No. 2, p. 501-516.

9/ Lindvall, Richter & Associates; Letter to Petrolane, Inc., August 18, 1977.

15. The accelerations discussed in this section are for bedrock acceleration as opposed to site or surface acceleration which is the actual motion that would affect the LPG storage tanks. While it can usually be expected that the surface acceleration would be somewhat less than the bedrock acceleration, this is not always the case. Under certain conditions, it can be amplified to exceed the bedrock acceleration. The amount of attenuation or amplification depends on subsurface conditions as well as the depth to epicenters, distance to the fault and size of the earthquake, but as pointed out by Greensfelder, "the seismic response of unconsolidated overburden materials is so highly variable and difficult to predict, even with good subsurface data, that it would be very impractical or misleading to attempt a generalized map of ground surface acceleration." Detailed site specific data is required in order to determine the actual motion any particular site might experience.

16. For the site in question, Converse Davis Dixon Associates developed the "Absolute Acceleration Response Spectra" in order to determine the spectral acceleration which the facility would experience based on a magnitude of 5.5 to 6.0 earthquake on the Palos Verdes Fault. This Response Spectra was used by CB&I in the design of the LPG tanks. (See Exhibit 12-3.)

17. Subsequent to the draft review of July 7, 1977, Converse Davis Dixon Associates reanalyzed the petroleum site and submitted a report dated August 9, 1977. The report stated the maximum ground acceleration (zero period acceleration) would not exceed 0.38 g in the event of a magnitude 7.2 earthquake on the Palos Verdes Fault at the closest approach to the site. (See Exhibit 12-8, supplemental information after July 7, 1977.)

E - RECURRENCE INTERVALS

18. While the fact that the Palos Verdes Fault should be considered active or potentially active is fairly well agreed upon, the estimates of recurrence interval for the maximum credible earthquake vary considerably. The Long Beach Harbor Consultants estimated it at 2,500 years. This estimate is concurred with by Soils Internationals, consultant to the CPUC and the Port of Long Beach in preparation of the EIR for the Sohio Project. On the other hand, Greensfelder states, "Faults which have been historically quiescent, but which are clearly active based on geologic data, such as offset of Holocene materials, pose a significant seismic hazard over the next 100 years." Whether the Palos Verdes

Fault offsets Holocene materials is questionable. Published material from various studies is contradictory but, if it is assumed that Holocene materials are offset, then the Palos Verdes Fault could fall in this category. Greensfelder also states, "as it cannot be stated which faults will produce major earthquakes during the next 50 years, it must be assumed that any known active fault or tectonic province is a potential source of a damaging earthquake." The location of numerous faults in southern California is shown in the same map.

19. Dr. Paul J. Fritts, Chairman of the Department of Geological Sciences at California State University at Long Beach, has calculated the recurrence interval at 489 years for a magnitude 7 earthquake and 91 years for a magnitude 6 earthquake on the Palos Verdes Fault.10/

20. Obviously, the calculation of recurrence intervals is far from an exact science. There are a number of methods of calculating recurrence intervals, each requires certain assumptions to be made, and no one stands out as being considered the best method. Even if it was generally agreed that the recurrence interval was 2,500 years, it is possible that a magnitude 7 earthquake might happen in the next few years. It is also possible that such an earthquake might never occur.

21. In assessing the seismic risks from this fault, the Federal Power Commission staff, while studying alternative sites to the Oxnard LNG terminal, declined to make probability or recurrence interval estimates. Instead it chose to paraphrase Lamar, et al., 1973 Earthquake Recurrence Intervals on Major Faults in Southern California, pages 265-276 in Geology Seismicity, and Environmental Impact, D-E. Moran ed. University Publisher, Los Angeles, and state:

> "Due to a lack of historical data and the absence of work to delineate slip rates on the Palos Verdes Hills Fault, it is not meaningful to attempt a determination of the probability of any events associated with that fault. It cannot be said that due to its lack of historical activity there is little probability for events in the near future since, with minor exceptions, it appears that every event since 1912 greater than magnitude 6 in southern California occurred on a fault without known prior historic activity.11/"

10/ Paul J. Fritts, Ph.D., Chairman of the Department of Geological Science at California State University at Long Beach, letter to Dr. Donald B. Bright, Port of Long Beach, concerning the EIR for the Sohio West Coast to Mid-Continent Pipeline Project, April 4, 1977.

11/ "Final Environmental Impact Statement for the Construction and Operation of an LNG Terminal at Oxnard, California", Federal Power Commission staff, December, 1976.

22. The Palos Verdes Fault is also referred to as the Palos Verdes Hills Fault. Due to the fact that it was located in the Palos Verdes Fault zone, the Los Angeles Harbor LNG alternative site was rejected from further study by the FPC staff.

23. Whether a facility should be designed for the maximum credible earthquake, regardless of its probability, or some lesser magnitude which has a greater probability often becomes the key question in the design of a facility. When hazardous substances are involved and potentially severe consequences to the public could result from damage to the structure, the problem becomes more acute. It is no longer a simple economic question of balancing the probability of damage and the replacement or repair costs versus the added cost of designing the structure to withstand greater seismic events.

24. A review of the original design method provides a good example. In "Soil and Earthquake Engineering Investigation", Converse Davis Dixon Associates made the statement: "the activity of the Palos Verdes Fault, although highly improbable, may generate a magnitude 5.5 earthquake at approximately one mile to the site". In the Appendix to the same report the statement was made: "Neither of these faults [referring to the Palos Verdes and Cabrillo Faults] have seismic events (greater than Richter magnitude 4.0) definitely associated with them and neither exhibits any evidence of surface rupture."[12/] Nevertheless, CB&I chose to design the tanks based on the event despite its extremely low probability. Petrolane obviously agreed, since it was their project and they had the final approval. CB&I also chose to design for the tank period rather than the zero period (or ground) acceleration and has stated that this value should be used in design analysis. (See Exhibit 12-7.) A similar approach appears to be appropriate in the analysis of the tanks' ability to withstand greater seismic events than thought possible at the time of the original design.

12/ "Earthquake Analysis" for Petrolane, San Pedro, California, Chicago Bridge & Iron Company, August 2, 1972.

25. In their reanalysis, Converse Davis Dixon Associates estimated a probability of 64% that a magnitude 6.0 earthquake would be exceeded in 100 years. They also estimated a 45% probability of exceeding a magnitude 6.5 and a less than 4% probability of exceeding a magnitude 7.2 in 100 years. (See following table.)

DESIGN EARTHQUAKES AND
HORIZONTAL GROUND MOTION PARAMETERS

Earthquake Parameter	Level I	Level II	Level III
Fault Name	Palos Verdes	Palos Verdes	Palos Verdes
Richter Magnitude	7.2	6.5	6.0
Site Distance to Fault (miles)	1	1	1
Maximum Peak Ground Acceleration(g)	0.38	0.31	0.27
Probability of Exceedance in 100 years (%)	≤ 4	45	64
Duration of Strong Ground Shaking (sec.)	15-25	10-20	5-15

CONVERSE DAVIS DIXON ASSOCIATES

F - EFFECTS ON THE LPG TANKS AND PIPELINE

26. The LPG storage tanks were designed to withstand a maximum acceleration of 0.4 g. (See CB&I explanation in paragraph 8.) Recent studies have indicated that the site might experience a bedrock acceleration in excess of 0.7 g within its lifetime. In their reanalysis, Converse Davis Dixon Associates developed Response Spectra Curves for earthquakes on the Palos Verdes Fault of magnitude 6.0, 6.5 and 7.2. From these curves, values for the peak ground acceleration (zero period) and the acceleration at the period of the tanks (0.132 seconds)can be determined. As can be seen for earthquake magnitudes of 6.5 and 7.2, the

acceleration at the period of the tanks is greater than the design acceleration of 0.4 g. (See Exhibit 12-9)

27. Based on information available to date, it is not possible to get a precise estimate of the probability of such an occurrence. However, simply because the tanks were designed for a 0.4 g acceleration does not mean that anything in excess of that will damage them, but it is possible. The conclusion that could be drawn is: Within their lifetime, the LPG tanks may experience an earthquake of such magnitude which could damage both tanks, spilling their contents. Even relatively small leaks that could not be stopped could allow a significant amount of LPG to escape over a period of time.

28. The actual effects of an occurrence where serious damage results depends on a number of factors, but mostly upon the amount of LPG actually in the tanks at the time of rupture and whether the escaping liquid is ignited. If the tanks should be damaged when empty, there would be little impact, but if both were full or nearly full and both ruptured, the impact could be disastrous especially since the impoundment basin can only hold the contents of one tank.

29. The pipeline itself roughly parallels the Palos Verdes Fault for its entire length of about 6,000 ft. Historically, pipelines have been able to withstand earthquake forces without damage except in those cases where a surface rupture (differential displacement) across the pipeline itself will cause a break. Buried steel pipelines are able to deform to some degree without damage so unless an earthquake caused more than a minimal displacement directly across the pipeline, no leakage would be expected. Holmes & Narver, Inc., have estimated that "When laid in a narrow steep-sided trench, in very stiff soil or rock, fault movement on the order of two feet or less are the most that can probably be accommodated without rupture by a ductile pipe having a diameter in the range of interest (30 in.)."[13/] The Petrolane pipeline has a diameter of 16 inches. In the event of significant surface differential displacement, little could be done to prevent a rupture. The Palos Verdes Fault, however, has shown no evidence of surface rupture (differential displacement) but such a break could theoretically occur at any point along the pipeline route. The amount of spill would depend on the flow rate in the pipe at the time of rupture and the length of time before flow was shut off.

13/ Holmes & Narver, Inc., "Geologic-Seismic Consideration and Earthquake Design Basis for the West Coast Mid-Continent Pipeline California Segment," June, 1976, pp. 7-1 and 8-3.

G - NATURAL DRAINAGE

30. In the event of an LPG spill as a result of rupture of both tanks, the liquid would flow directly into the impoundment basin below the tanks. Should the volume of the spill exceed the capacity of the basin, the liquid will follow natural drainage contours until it reaches a state of equilibrium. As the escaping liquid warms, it will vaporize. The resultant gas cloud will also roughly follow the same route as the liquid but it is much more susceptible to being influenced by wind. Since propane is heavier than air, in the absence of wind, propane will flow downhill and collect in low points. Wind would be capable of blowing the gas in virtually any direction, however, this same wind would cause the cloud to disperse. The rate at which the liquid would vaporize, the direction which the gas would travel, and the time it would take to disperse all depend on the specific conditions at the time of a spill. The factors involved are so variable that it would be virtually impossible to make predictions as to the migration and dispersion of the gas.

31. Before vaporization, the liquid will follow established drainage patterns similar to any other liquid. Should the liquid exceed the capacity of the impoundment basin, the excess would flow across the site itself toward Gaffey Street and enter a rectangular concrete drainage channel, 25 feet wide by 12 feet deep. This channel flows southward toward the harbor, paralleling Gaffey Street on the east, to a point near the Basin Street intersection, approximately 3,000 feet from the LPG facility. At that point, the channel enters a double concrete box, each 13 feet wide by 11 feet high, which outlets into the harbor, approximately 700 feet from the entrance. The channel has a maximum capacity of 5,000 cubic feet per second.

32. Should both tanks rupture while full or nearly full or if the impoundment basin cracks open, the volume of LPG could easily exceed the capacity of the drainage channel. In that case, the liquid would cross the channel and flow down Gaffey Street. This street is the low point of the surrounding area. The liquid would flow southward along Gaffey Street and would accumulate in a large pool around the intersection of Gaffey and Battery Streets. From there it would enter the storm sewers which flow into the harbor about 800 feet away.

33. The impoundment basin at Petrolane was designed to conform to the Los Angeles Municipal Code, Chapter 5, Article 7, which requires that the minimum capacity of an impounding area equals the volume of the largest container for inflammable atmosphere storage tanks. In the absence of a specific code section dealing with substances stored under pressure, such as propane, the requirements specified in that section were used for design purposes. Other agencies require greater impounding capacity.

34. The building code for the City of Long Beach requires a 110% capacity dike surrounding all inflammable atmospheric storage tanks. The Port of Long Beach code requires a 125% capacity dike. The Office of Pipeline Safety Operations (OPSO) of the U.S. Department of Transportation (DOT), in its Notice No. 77-4, Docket No. OPSO-46, proposed rule making for 49 CFR Part 193, Liquefied Natural Gas Facilities - Federal Safety Standards, Section 193.439, requires that the impoundment basin for more than one storage tank must have a minimum volumetric capacity of 100% of all tanks or 150% of the largest tank, whichever is greater.

H - REVIEW OF DESIGN

35. The Los Angeles Department of Building and Safety has reviewed the design of the tanks and determined that they were adequately designed based upon a magnitude 5.5 to 6.0 earthquake on the Palos Verdes Fault.

36. Since new information on this fault has become available, they have indicated that they will review the design again to determine the ability of the tanks to withstand the greater accelerations associated with the higher magnitude earthquakes now considered credible.

37. Converse Davis Dixon Associates has prepared absolute acceleration response spectra for magnitude 6.0, 6.5 and 7.2 earthquakes on the Palos Verdes Fault. Included are spectra for critical damping of 2% which is generally used for the design of steel tanks (see Exhibit 12-9). In addition, they have provided their estimates of the probabilities of these earthquake magnitudes.

38. Chicago Bridge & Iron Company will provide additional data on the tank design and calculations of the period and stresses of the tanks.

39. As indicated in Chapter 6, the Los Angeles Department of Building and Safety approved the design including seismic loading and issued permits for the control building and foundations of the 60,000-gallon pressure vessels. Also, the Los Angeles Department of Building and Safety has stated that they will thoroughly review the update materials when available before issuing a permit for the low temperature 300,000 bbl. tanks.

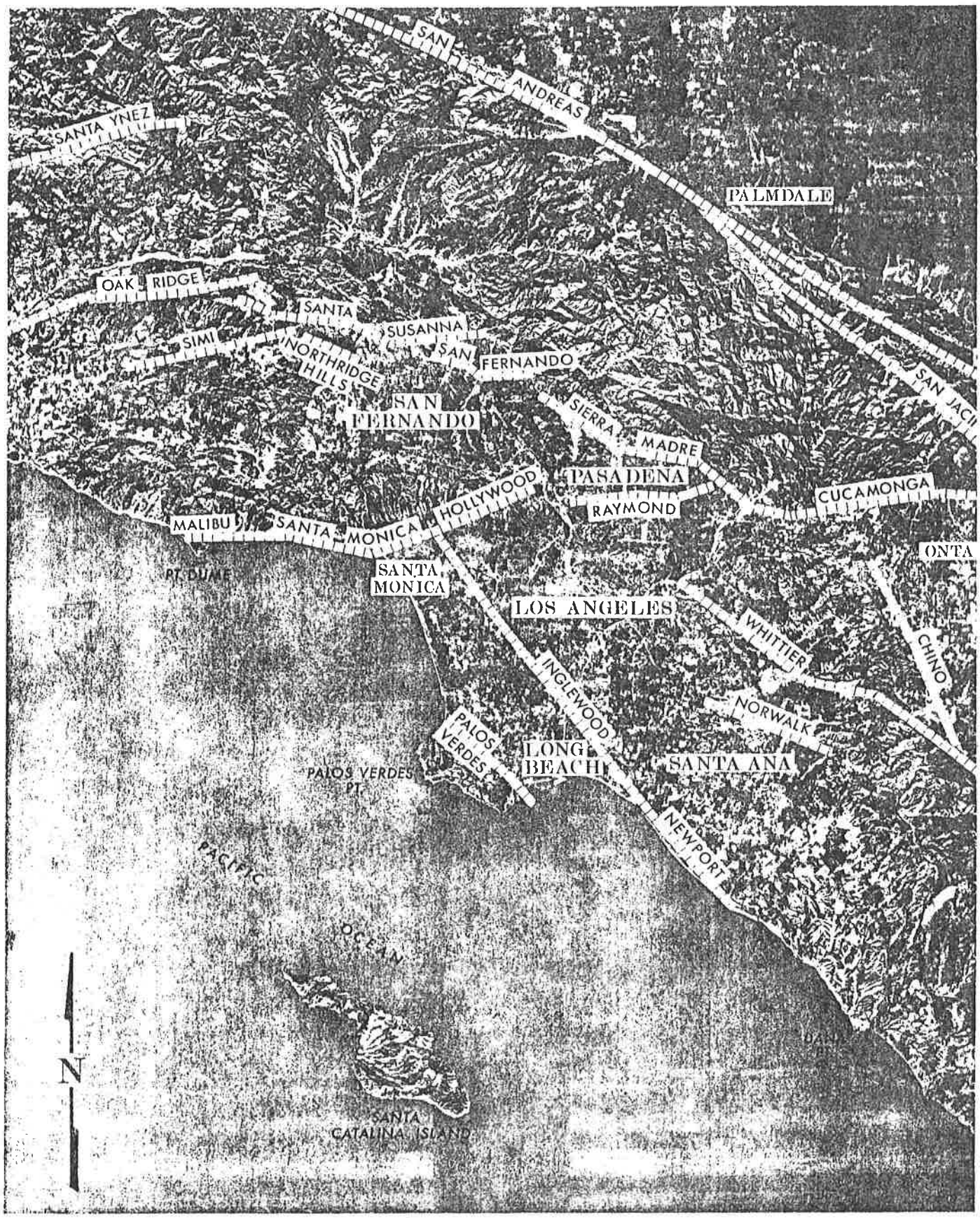


Figure 4.4-3 Principal faults of the Southern California area

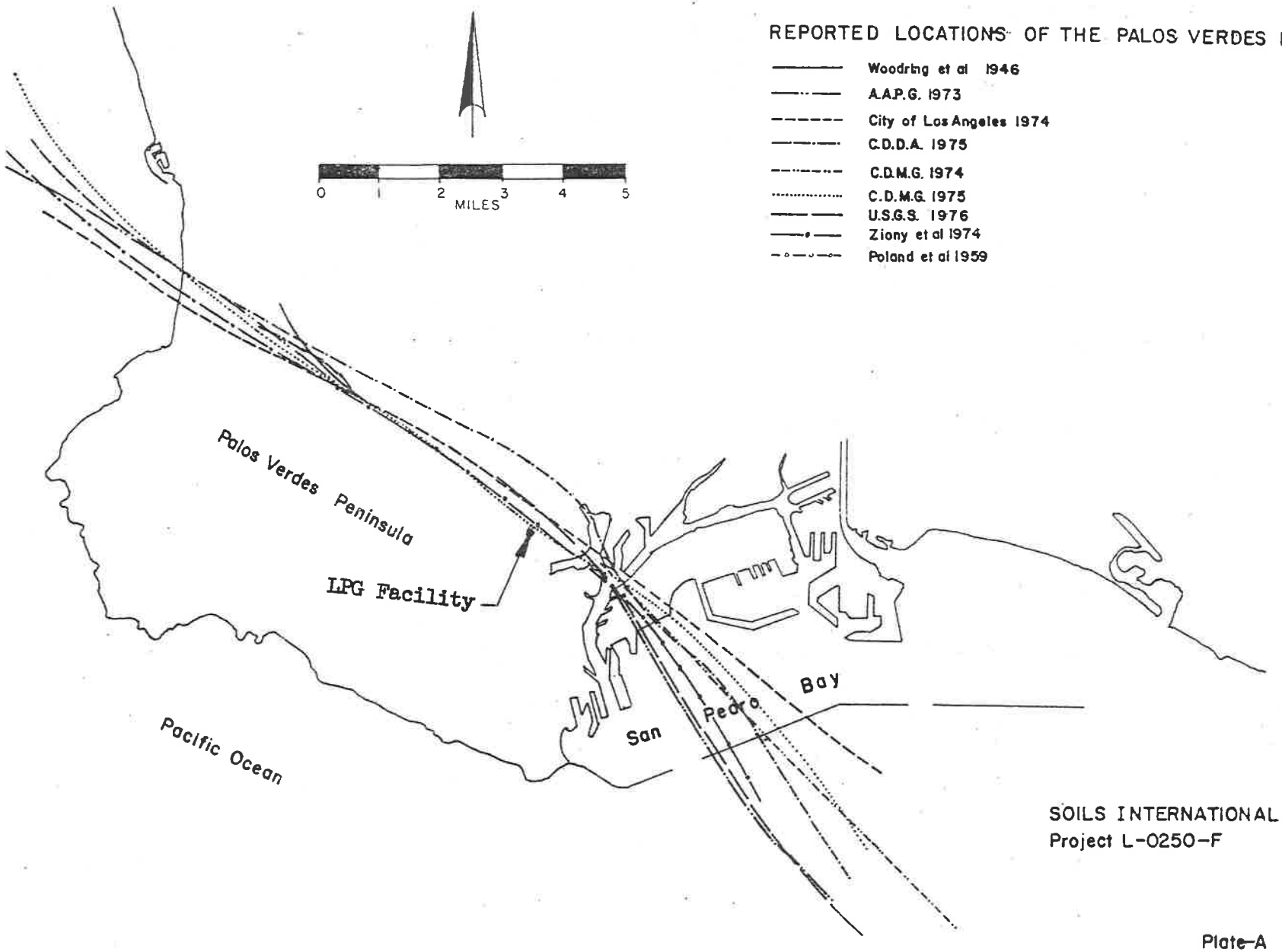

REPORTED LOCATIONS OF THE PALOS VERDES FAULT
Woodring et al 1946
A.A.P.G. 1973
City of Los Angeles 1974
C.D.D.A. 1975
C.D.M.G. 1974
C.D.M.G. 1975
U.S.G.S. 1976
Ziony et al 1974
Poland et al 1959
0 1 2 3 4 5
MILES
Palos Verdes Peninsula
LPG Facility
Pacific Ocean
San Pedro Bay
SOILS INTERNATIONAL
Project L-0250-F
Plate-A

EXHIBIT 12-2

CHICAGO BRIDGE & IRON COMPANY

EARTHQUAKE ANALYSIS

Location_____

(2)-300MBBL Propane Tanks
Ameron Incorporated
For Petrolane
San Pedro, California

CBI Contract 72-4145

A. CRITERIA

1. Design to be per Ameron inquiry No. 1006-1, Rev. 2 of 6/7/72, containing response spectra for three separate earthquakes.

   The spectra with 5% of critical damping, which produces the largest lateral load, is to be used. Resistance to lateral loads is provided by friction between soil and tank bottom and base of ringwall.

   Allow. coeff. of friction = 0.40.

   The components of force which determine lateral seismic loads to be combined as follows:

$$F = M_o \ddot{g}_{max} + \sqrt{2}\, M_1 S_a$$

   Where: F = Lateral seismic load
   M_o = Equivalent mass moving w/tank
   M_1 = Equivalent mass moving w/fluid
   $\ddot{g}$ = Maximum ground acceleration
   S_a = Absolute spectral acceleration

   Vertical accelerations to be assumed as one-half of horizontal accelerations, but not acting concurrently.

   All allowable stresses may be increased by one-third when seismic loads included in load combinations.

   Tank and fluid to be modeled as an equivalent dynamic system per "Dynamic Pressures on Accelerated Fluid Containers", by G. W. Housner, using fundamental mode only.

2. CBI Computer Program (717) calculates seismic forces and resulting stresses in flat bottom storage tanks. The program is based on the effective mass method as presented in TID 7024 "Nuclear Reactors and Earthquakes", Chap. 6, and "Earthquake Pressures on Fluid Containers", by G. W. Housner.

   TID 7024 document is in part, based on Housner's "Dynamic Pressures on Accelerated Fluid Containers".

CHICAGO BRIDGE & IRON COMPANY

Location _____

B. DESIGN

1. Find Max. Lateral Seismic Load (F)

Product Load (W) $= \frac{(\pi)(171)^2}{4} (73.67)(36.8) =$ 62,300. kips

From TID 7024,

$$M_o = \frac{(W)\tanh(\sqrt{3}\,\frac{R}{h})}{\sqrt{3}\,\frac{R}{h}}$$

$R = 85.5'$
$h = 73.67'$
$\sqrt{3}\,\frac{R}{h} = 2.01$

$$M_o = (62,300)\frac{(.9647)}{(2.01)} = 29,900. \text{ kips}$$

AND

$$M_L = (W)(0.318)\frac{R}{h}\tanh(1.84\frac{h}{R}) \qquad \frac{h}{R} = \frac{73.67}{85.5} = .862$$

$$= (62,300)(0.318)(1.159)(.9195) \qquad \frac{R}{h} = 1.159$$

$$= 21,100 \text{ kips}$$

In order to find $\ddot{g}_{max}$, it is necessary to determine the natural period of vibration for the tank and confined liquid.

Assume the tank shell is anchored to an adequate foundation and acts as a vertical cantilever fixed at the base. The period of the rigid tank and the confined liquid is determined by the "Lumped Mass" Raleigh-Ritz procedure assuming the total mass divided into equal parts and spaced to correspond to the number of shell rings in the tank.

Natural period = .132 seconds (mathematics performed by comp. prog.)

Figure 1 (see Page 3) -Response spectra for 5.5 to 6.0 magnitude earthquake on Palos Verdes Fault, using 5% of critical damping, controls for maximum acceleration

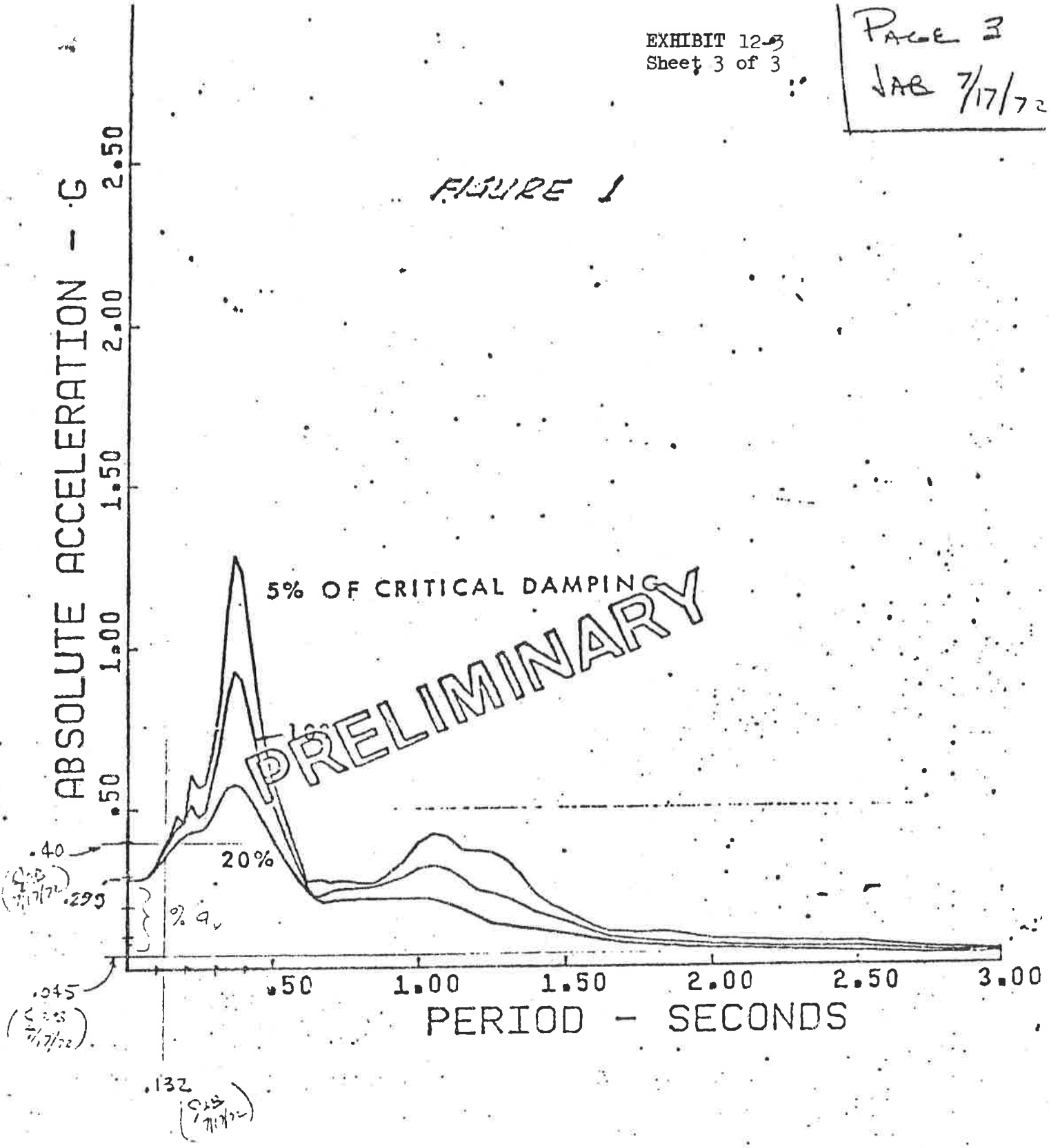
Max. Acceleration = $\ddot{g}_{max}$ = .40

MADE BY	CHKD BY	BY	CHKD	CHANGE NO.
JAB	DRL	JAL		72-4145
DATE 7-17-72	DATE 8-2-72			SHT 2 OF 20

EXHIBIT 12-3
Sheet 3 of 3

PAGE 3
JAB 7/17/72

FIGURE 1



ABSOLUTE ACCELERATION RESPONSE SPECTRA FOR A MAGNITUDE 5.5 TO 6.0 EARTHQUAKE ON THE PALOS VERDES FAULT

PROPOSED PROPANE DISTRIBUTION FACILITY
Gaffey Street Site, Los Angeles, California
for Petrolane, Inc.

CONVERSE, DAVIS AND ASSOCIATES — PASADENA • ANAHEIM, CALIF.

SEISMICITY AT THE SITE OF THE PROPOSED DEVELOPMENT

Proposed Propane Distribution Facility
Gaffey Street Site
Los Angeles, California

celeration Level (g)	Return Period (Years) *	Approximate Probability of Occurrence (%) 25 Years **	100 Years	Probable Magnitude to Cause	Duration of Strong Shaking (Seconds)	Probable Faults and Their Distances to the Site to Cause the Event
0.4	20,000	1	2	5.0 - 6.0	4 to 8	Palos Verdes Fault* (1.0 Mile)
0.3	3,000	3	10	5.0 - 6.5	4 to 12	Small Local Fault (1.0 to 3.0 Miles) Newport-Inglewood Fault (7.0 Miles)
0.2	400	12	40	5.0 - 8.0	4 to 40	San Andreas Fault (54.0 Miles) San Jacinto Fault (51.0 Miles) Newport-Inglewood, Norwalk, Whittier-Elsinore, and Raymond Faults (7.0 to 25.0 Miles)
0.1	60	45	90	5.0 - 8.0	4 to 40	Small local shock to large distant shock (1.0 to 70.0 Miles)

*No evidence of quaternary movement or seismic activity.

PETROLANE, INCORPORATED
(Project No. 72-025-A)

EXHIBIT 12-4

* On the average, one event of this magnitude or greater

** 1 chance out of 100 that we will have this size of quake in 25 years.

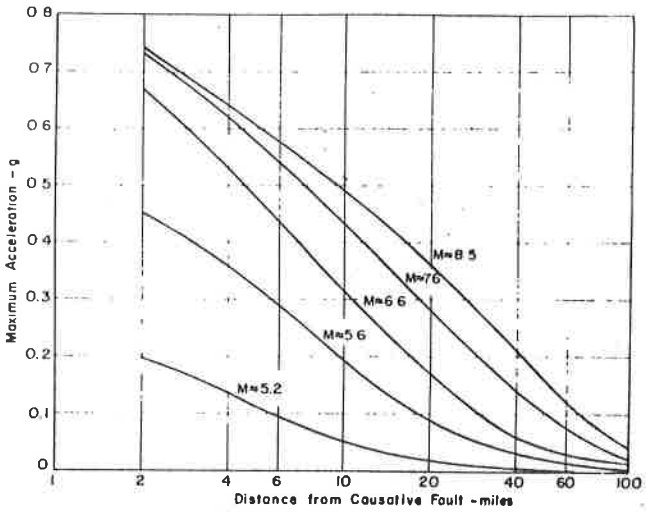


FIG. 5. Average values of maximum accelerations in rock.

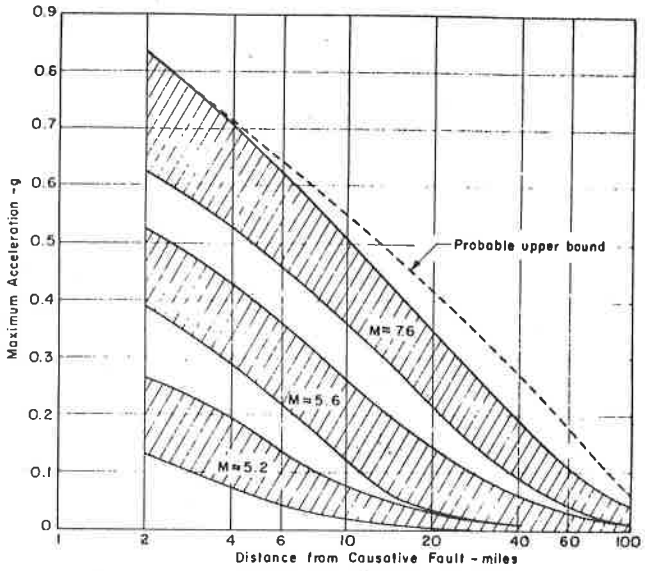


FIG. 6. Ranges of maximum accelerations in rock.

EXHIBIT 12-6

MAXIMUM CREDIBLE ROCK ACCELERATION FROM EARTHQUAKES IN CALIFORNIA

ROGER GREENSFELDER - CALIFORNIA DIVISION OF MINES AND GEOLOGY

1972

REVISED AUGUST, 1974

LEGEND

POTENTIALLY ACTIVE FAULTS

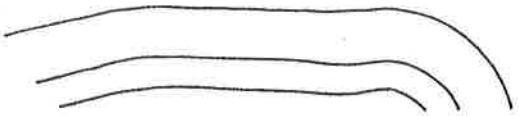
Approximately located

Number in parentheses is the maximum expected earthquake magnitude for the fault.

Lines and arrows divide the San Andreas fault into four tectonic sections.

Queries at the ends of a fault indicate lack of strong evidence for its activity.

BEDROCK ACCELERATION CONTOURS

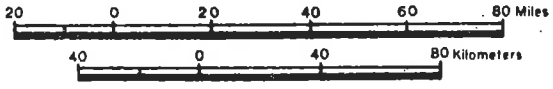


Units are decimal fractions of the acceleration of gravity, from .2g to .5g

PREDOMINANT PERIOD OF BEDROCK ACCELERATIONS

Acceleration range	Predominant period
≥0.2g	0.35 seconds
0.1 - 0.2g	0.40 "
0.05 - 0.1g	0.50 "

Mean duration of motion ≈ 20 - 30 seconds



SCALE = 1:2,500,000

THIS MAP IS TENTATIVE AND RELIES HEAVILY ON THE AUTHOR'S SUBJECTIVE EVALUATION OF FAULT ACTIVITY. IT IS INTENDED AS A TOOL FOR OFFICIAL USE ONLY. IT IS NOT INTENDED FOR DIRECT ENGINEERING USE WITHOUT CONSIDERATION OF FOUNDATION CONDITIONS AND TYPE OF STRUCTURE.

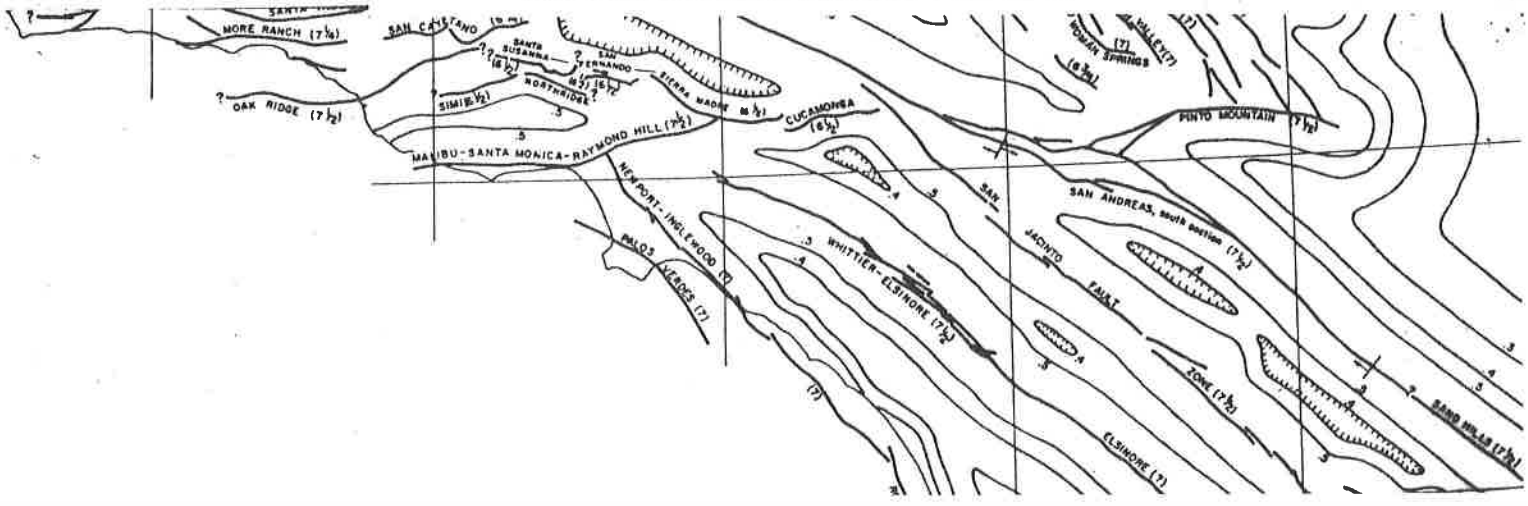


Exhibit L-7
Sheet 1 of 3
Supplemental Information
after July 7, 1977
Draft Review

Chicago Bridge & Iron Company

301 East Colorado boulevard
Pasadena California 91101

telephone (213) 684-0860

August 15, 1977

Petrolane, Inc.
P.O. Drawer 1410
1610 E. Hill Street
Long Beach, California 90801

Attention: Mr. Robert A. Reid
Manager of Engineering Services

Reference: Engineering Study
Petrolane LPG Tanks
San Pedro, California
CBI Contract 71711

Gentlemen:

The following definitions and technical comments are made in response to your letter of August 2, 1977 regarding CBI's "Design Calculations", dated July, 1972:

1. Definition of Terms

The wording used to define the terms given on sheet 1 of 20 in CBI's design calculations agrees exactly with the wording given in the original job specifications submitted to CBI by Ameron Process Systems, Inc.

It should be recognized that the formula for "Lateral Seismic Load", (F), incorporates terms which consider the acceleration effects of the impulsive liquid mass and the convective (sloshing) liquid mass. In order to determine the correct accelerations, which should be used to design a liquid storage tank, two periods are required. The "tank" period, associated with the impulsive mass, is normally be-between 0.07 and 0.20 seconds (.132 seconds for the Petrolane tanks). The "sloshing" period, associated with the mass of sloshing liquid normally exceeds 6 seconds (7.87 seconds for the Petrolane tanks). Very often, sloshing periods are greater than the limits of the spectral curve provided to the

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designer, as was the case for the Petrolane design. In this case, it is conservative to use the values at the curve limits to determine the acceleration on the sloshing liquid.

The term $\ddot{g}$ is defined as "maximum ground acceleration", and we interpreted this to be the acceleration associated with the impulsive liquid mass acting at the "tank" period. Technically speaking, the acceleration at 0 period (or ground acceleration) could have been used for this term. However, CBI policy has been to use the amplified acceleration (at the period of 0.132 seconds in our calculations on sheet 4 of 20). Recent findings (see reference 1) have confirmed that the amplified acceleration, rather than the ground acceleration, should be used in the analysis. This is where the slight discrepancy in the definition of terms arises.

The term S_a is defined as "absolute spectral acceleration", and we interpret this as the acceleration associated with the sloshing liquid.

Using the original response spectrum curve for the Petrolane tanks, the horizontal accelerations can be determined.

In discussing this with Jim Bell of Converse Davis Dixon, we tentatively agreed that the calculations could be revised to define $\ddot{g}$ as "maximum spectral acceleration", rather than "maximum ground acceleration". However, after further consideration, we believe the calculations should not be changed and that the explanation given in this letter should be attached to the calculations for permanent record to identify the assumptions made.

2. Natural Period of the Tank

The natural period of the storage tank will vary with changes in liquid level. Again, two periods should be considered.

The "tank" period will decrease as liquid level decreases. Therefore, accelerations associated with the impulsive liquid mass will be greatest when the tank is full, since the "tank" period is at its greatest value and is located on the rising slope of the spectrum curve.

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The "sloshing" period also decreases with decreasing liquid level. Since the sloshing period occurs on the downward slope of a response spectrum curve, it is possible that the lateral loads associated with the sloshing liquid could increase with decreasing liquid levels and decreasing periods. However, as acceleration increases slightly with reduced "sloshing" period, the acceleration acts on a much reduced mass, so that the lateral loads at reduced liquid levels are less than those that occur with a full tank. This is true for the Petrolane tanks.

(1) DYNAMICS OF FIXED-BASE LIQUID-STORAGE TANKS, by A.S. Veletos and J. Y. Young, presented at U.S. - Japan Seminar for Earthquake Engineering Research with Emphasis on Lifeline Systems, Tokyo, Japan, November 8-12, 1976.

We trust this provides you with the information needed. Should there be additional questions, let us know.

Very truly yours,

Harlan L. Bankester

Harlan L. Bankester
Contracting Engineer

jv

SUMMARY AND CONCLUSION

Table No. 1 summarizes maximum ground acceleration results obtained using five different engineering estimation procedures assuming the of a maximum credible magnitude 7.2 earthquake on the Palos Verdes fault at the closest approach to the site. (1/2 - 1-1/2 miles).

TABLE I

MAXIMUM HORIZONTAL GROUND ACCELERATIONS AND CORRESPONDING SOIL ATTENUATIONS AT THE PETROLANE LPG SITE DUE TO A MAXIMUM CREDIBLE MAGNITUDE 7.2 EARTHQUAKE ON THE PALOS VERDES FAULT

Method Of Estimation	Maximum Horizontal Ground Surface Acceleration (g)	Soil Attenuation Factor* (%)
Site-Specific Wave Propogation (SHAKE).	0.33 - 0.39	46 - 54
Caltrans Seismic Design Criteria (SHAKE on average dense granular soils)	0.43	60
Housner's Firm Ground Attenuation Curves	0.38	53
Analysis of PUB Ground Motion Record-1933 Long Beach Earthquake	0.21 - 0.26	29 - 36
Structural Damage Implications-1933 Long Beach Earthquake	0.26 - 0.33	36 - 45

*Soil attenuation factor defined as the ratio of the maximum peak ground and bedrock accelerations. Maximum bedrock acceleration taken as 0.72g based on Schnabel and Seed (1).

Based on the above summary of results, it is our opinion that the Petrolane storage tanks may be re-analyzed using maximum peak horizontal ground acceleration not exceeding 0.38g in the event that a magnitude 7.2 earthquake should occur on the Palso Verdes fault at the closest approach to the site during the operational life of the subject facility.

Smaller ground motions are currently being developed for re-analysis of the subject tanks given the occurrence of more probable design earthquakes.

8. DESIGN EARTHQUAKES

8.1 General

Three earthquakes were selected to represent a reasonable range of earthquake levels for re-analyses of the LPG storage facility. The three design earthquake were designated as Design Level I, II, and III earthquakes respectively. Definition of these different design levels and the final selected principal faults and specific earthquake magnitudes are discussed in the following sections.

8.2 Design Level I Earthquake

The Design Level I earthquake is intended to represent the governing maximum credible event. The selection of the Design Level I earthquake was based on experience, judgment and consideration of important ground motion characteristics presented in Table 6-1 including maximum peak acceleration, predominate frequencies and duration of shaking. The Palos Verdes Magnitude 7.2 earthquake was finally selected as the Design Level I earthquake.

The important characteristics of the Level I earthquake are summarized in Section 8.4.

8.3 Design Level II and III Earthquakes

Design Level II and III earthquakes are intended to represent two different levels of probable earthquakes which could significantly affect the site in terms of ground shaking. The Level II and III earthquake events should be considered to represent earthquake events which can reasonably be expected to occur during a 100-year design life. They are presented to provide a reasonable range of earthquake characteristics for re-analysis of the LPG storage facility.

Magnitude 6.5 and 6.0 earthquakes occuring on either the Newport-Inglewood or Palos Verdes faults were selected as the Level II and Level III earthquakes respectively. The selections of the Level II and III earthquakes were based primarily on our intent to provide a reasonable range of probable design earthquake characteristics for re-analysis combined with consideration of current geologic/seismic data, the results of seismic risk and probability analyses and our own experience and judgment.

The important characteristics of Level II and Level III earthquakes are summarized in Section 8.4

8.4 Summary of Design Level Earthquakes

The choice of specific design level earthquakes was made to reflect a reasonable range of the significant characteristics of possible site ground motions. The following Table 8-1 briefly summarizes the three design level earthquakes and important characteristics of the horizontal site ground motions.

TABLE 8-1

DESIGN EARTHQUAKES AND
HORIZONTAL GROUND MOTION PARAMETERS

Earthquake Parameter	Level I	Level II	Level III
Fault Name	Palos Verdes	Palos Verdes	Palos Verdes
Richter Magnitude	7.2	6.5	6.0
Site Distance to Fault (miles)	1	1	1
Maximum Peak Ground Acceleration(g)	0.38	0.31	0.27
Probability of Exceedance in 100 years (%)	≤ 4	45	64
Duration of Strong Ground Shaking (sec.)	15-25	10-20	5-15

9.GROUND MOTION RESPONSE SPECTRA

9.1 General

The nature and severity of the dynamic lateral motions which can take place at the base or foundation of a structure as result of an earthquake are very important in structural design. The response spectra is a useful indicator of the characteristics of the ground motion and its effect upon structures, fluid containers, and attached equipment. This section presents horizontal ground motion response spectra for each of the design level earthquakes discussed in Section 8. In addition, vertical ground motion is discussed and procedures are outlined for determining vertical response spectra.

9.2 Horizontal Ground Motion Response Spectra

Horizontal ground motion response spectra intended for re-analysis of the LPG Storage facility are presented in smoothed tripartite form in Figures 9, 10 and 11. Figures 12, 13 and 14 present corresponding unsmoothed elastic acceleration response spectra plotted arithmetically. These horizontal ground motion spectra represent the maximum response amplitude of a linear elastic single-degree-of-freedom system with equivalent viscous damping of 2, 5 and 10 percent of critical damping. Such spectra account for the amplitude, frequency and duration of the design earthquake ground motions.

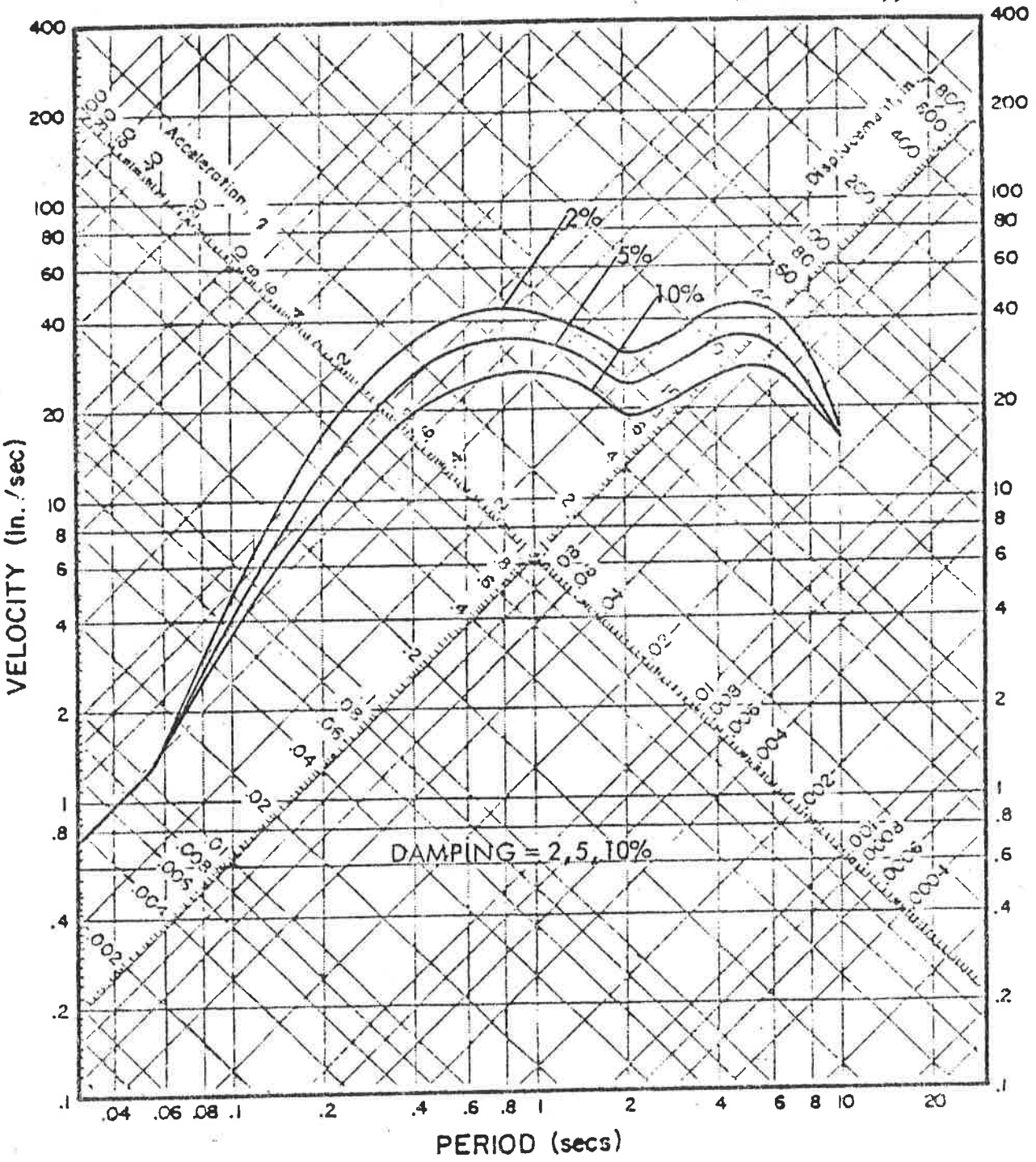
It is our opinion that proper application of these elastic ground motion spectra will provide a realistic assessment of the effects of the selected range of design level earthquakes on the LPG Storage facility. It is recommended that the structural engineer apply a currently appropriate reduction factor in determining lateral forces for design. Such a structural response modification factor varies widely with the type of structure and the specific design procedures used but generally includes the effects of ductility, reserve energy, energy absorption, multi-mode effects, system redundancy and experience and judgment. Little or no reduction in lateral force is made with elastic design which anticipates very little or no structural damage. A considerable reduction in lateral force may be appropriate with ultimate design which anticipates relatively large deflections and some structural damage. An ultimate design response modification factor varies considerably with the structural system and materials of construction.

9.3 Vertical Ground Motion Response Spectra

The preceding sections have only considered the characteristics and effects of the horizontal ground motions. Strong motion records to date indicate that on the average:

1. Maximum vertical accelerations are generally on the order of one-half to three-forths of the maximum horizontal accelerations.
2. Vertical ground motions have about 40 to 60 percent higher frequencies (shorter periods) than horizontal motions.
3. Maximum vertical and horizontal accelerations seldom occur simultaneously.

The elastic response to vertical ground motion, if required by the structural engineer in re-analysis, may be calculated by decreasing both the plotted acceleration (or velocity) and period by 33 percent (response spectra values presented in Figures 9 through 14). If required at a later date, we can supply time histories of acceleration (accelerograms) on computer cards to facilitate a more detailed dynamic analysis.



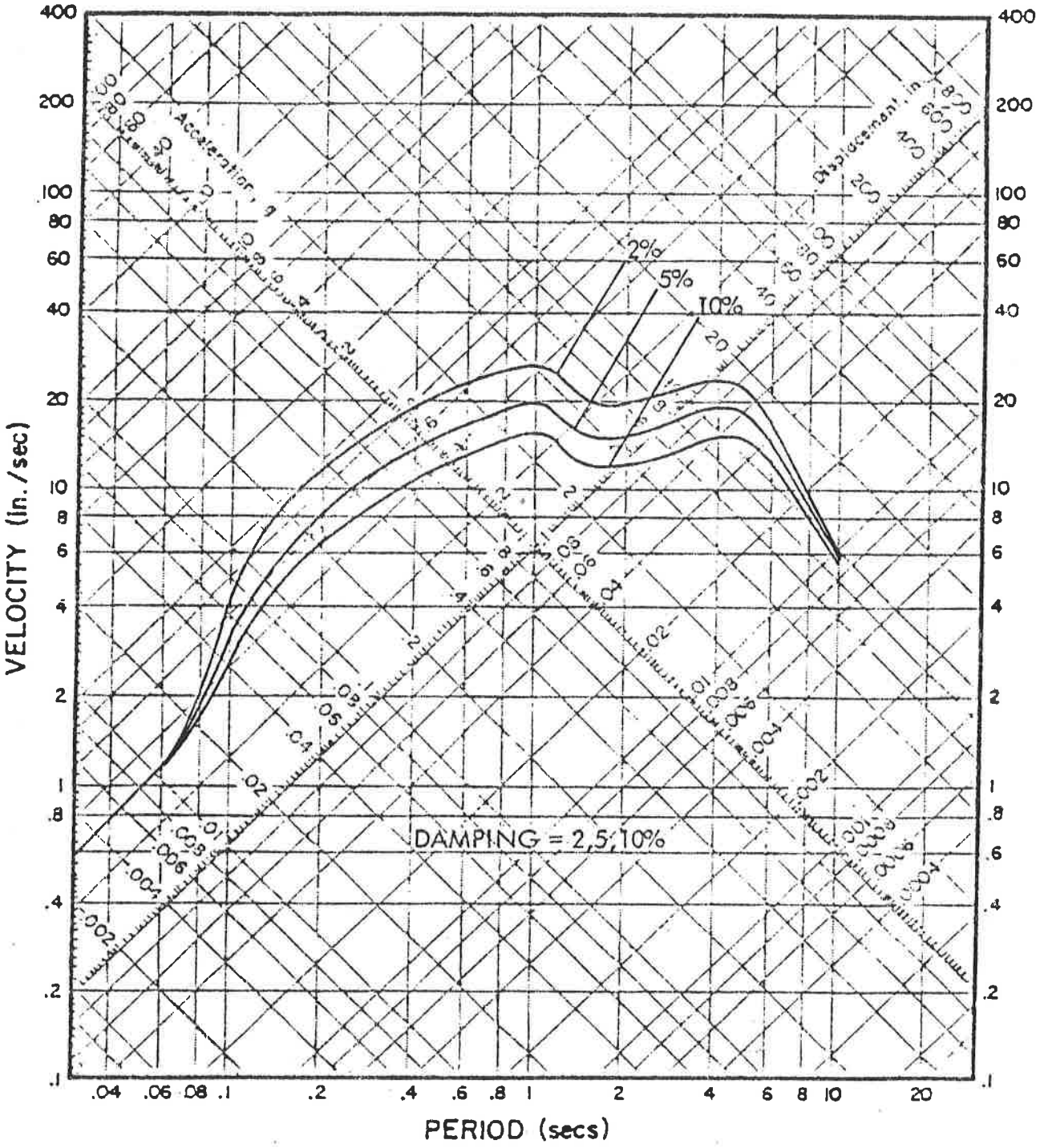
LEVEL I GROUND RESPONSE SPECTRA
MAGNITUDE 7.2 EARTHQUAKE ON
THE PALOS VERDES FAULT

PETROLANE LPG STORAGE FACILITY RE-ANALYSIS
Gaffey Street, Los Angles, Califomia
for Petrolane, Inc.

FIGURE 9

CONVERSE DAVIS DIXON ASSOCIATES *Geotechnical Consultants*

PROJ. NO. 72-025-21

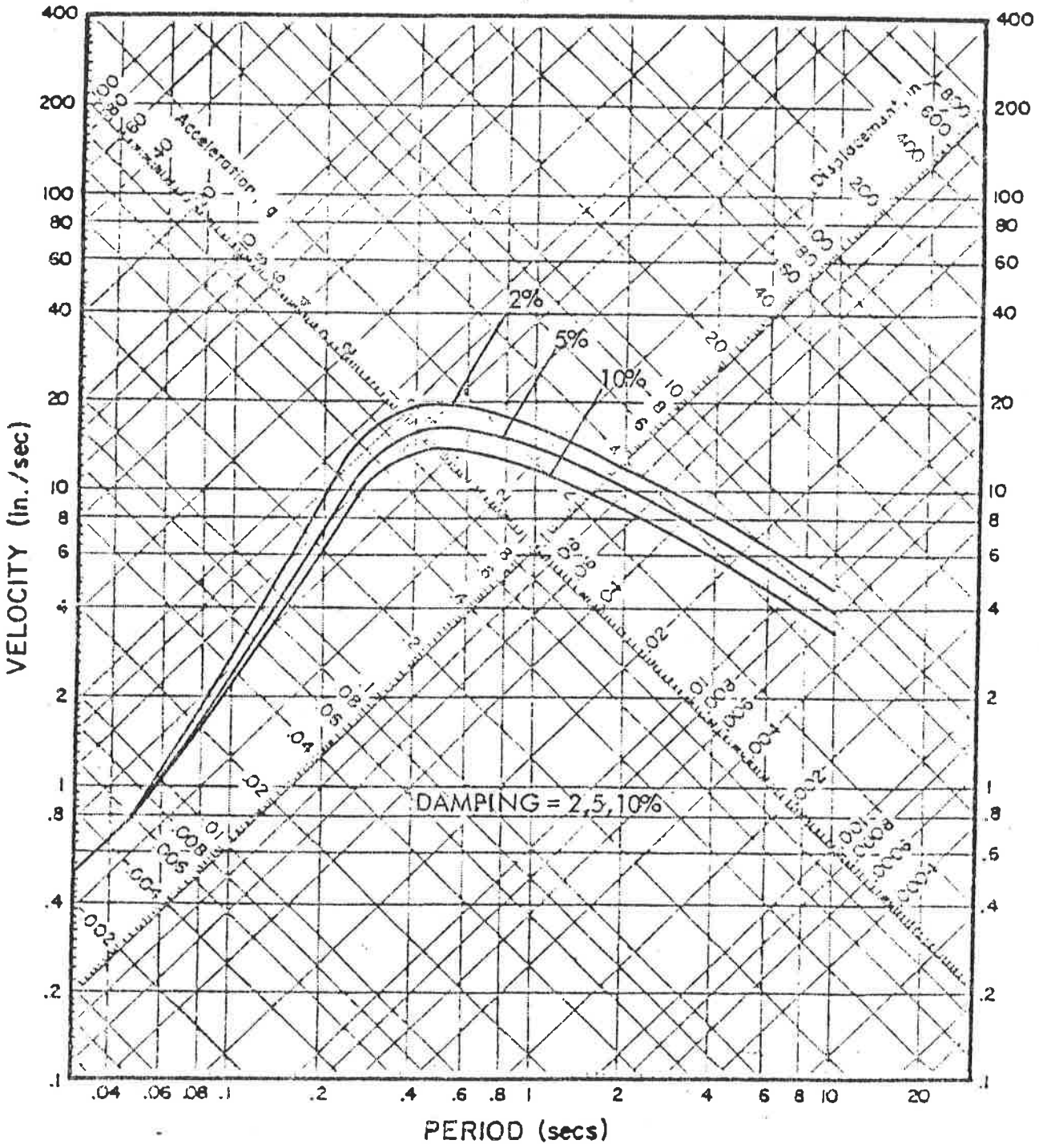


LEVEL II GROUND RESPONSE SPECTRA

MAGNITUDE 6.5 EARTHQUAKE ON

THE PALOS VERDES FAULT

PETROLANE LPG STORAGE FACILITY RE-ANALYSIS Gaffey Street, Los Angeles, California for Petrolane, Inc.	FIGURE 10



LEVEL III GROUND RESPONSE SPECTRA

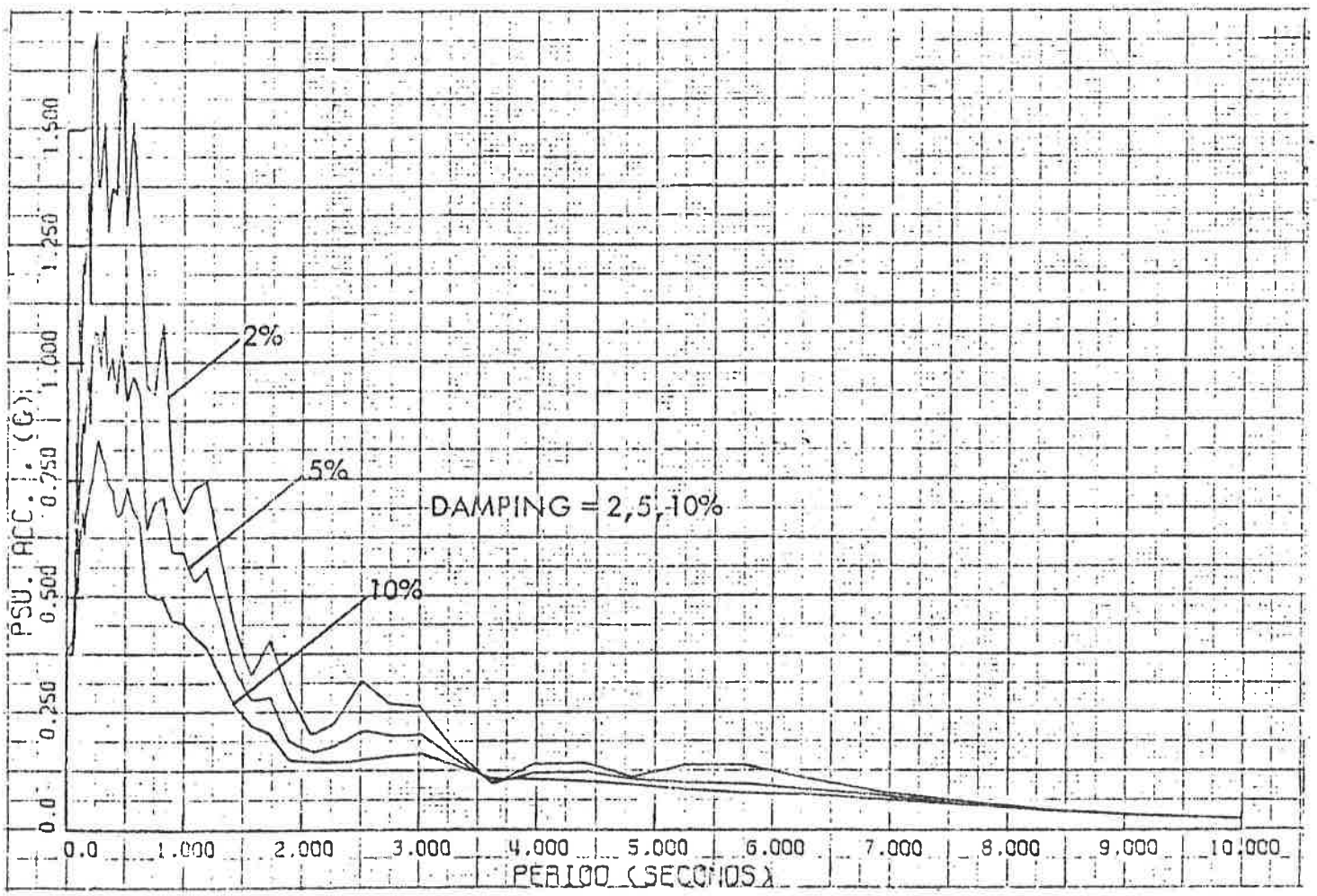
MAGNITUDE 6.0 EARTHQUAKE ON

THE PALOS VERDES FAULT

PETROLANE LPG STORAGE FACILITY RE-ANALYSIS
Gaffey Street, Los Angeles, California
for Petrolane, Inc.

FIGURE 11

CONVERSE DAVIS DIXON ASSOCIATES *Geotechnical Consultants* PROJ. NO. 72-025-21



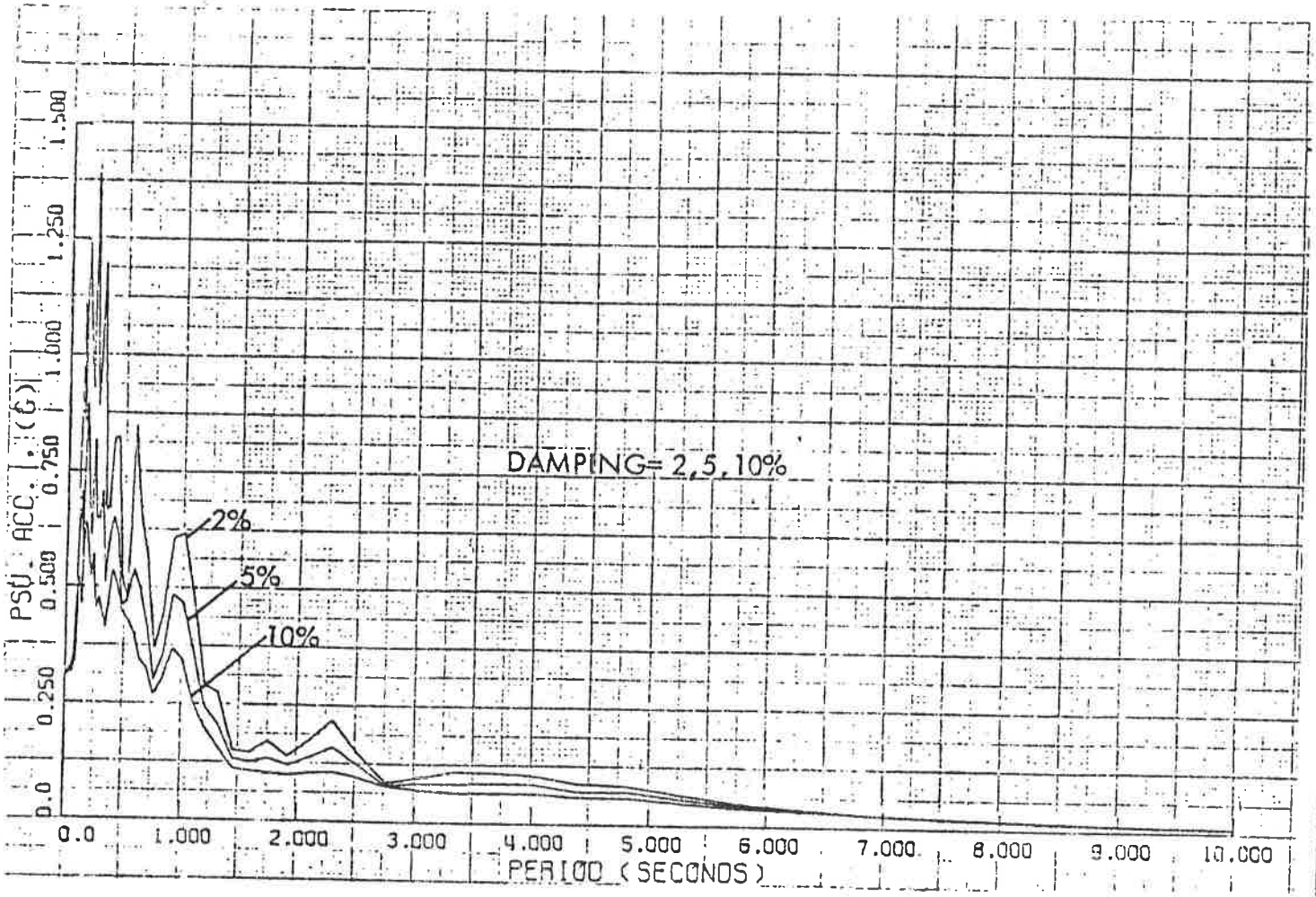
LEVEL I GROUND RESPONSE SPECTRA
MAGNITUDE 7.2 EARTHQUAKE ON
THE PALOS VERDES FAULT

PETROLANE LPG STORAGE FACILITY RE-ANALYSIS
Gaffey Street, Los Angeles, California
for Petrolane, Inc.

FIGURE 12

CONVERSE DAVIS DIXON ASSOCIATES *Geotechnical Consultants*

PROJ. NO. 72-025-21



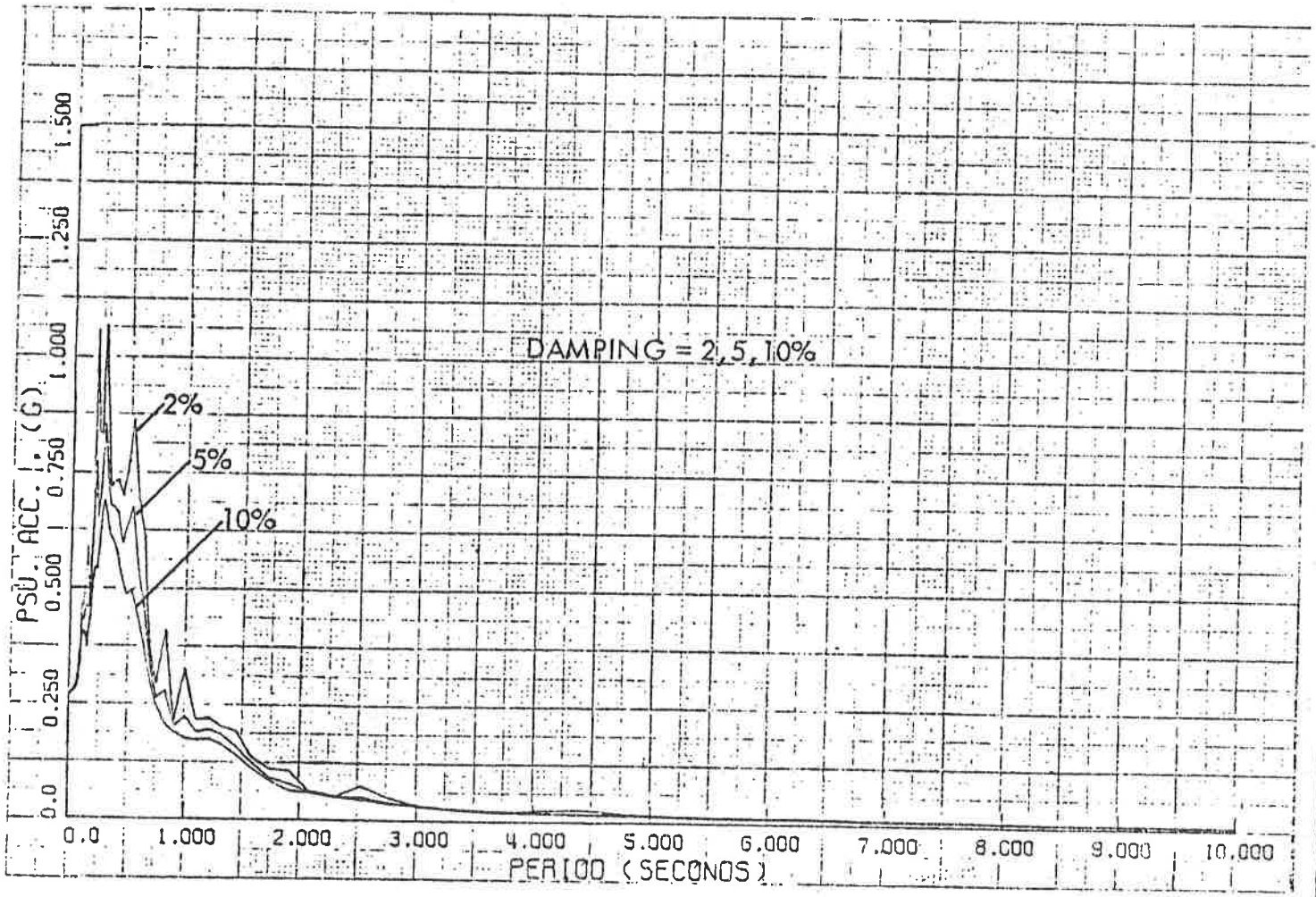
LEVEL II GROUND RESPONSE SPECTRA
MAGNITUDE 6.5 EARTHQUAKE ON
THE PALOS VERDES FAULT

PETROLANE LPG STORAGE FACILITY RE-ANALYSIS
Gaffey Street, Los Angles, California
for Petrolane, Inc.

FIGURE 13

CONVERSE DAVIS DIXON ASSOCIATES *Geotechnical Consultants*

PROJ. NO. 72-025-21



LEVEL III GROUND RESPONSE SPECTRA
MAGNITUDE 6.0 EARTHQUAKE ON
THE PALOS VERDES FAULT

PETROLANE LPG STORAGE FACILITY RE-ANALYSIS
Gaffey Street, Los Angles, California
for Petrolane Inc.

FIGURE 14

CONVERSE DAVIS DIXON ASSOCIATES *Geotechnical Consultants*

PROJ. NO. 72-025-21

CHAPTER 13

CITY OF LOS ANGELES HARBOR DEPARTMENT EARTHQUAKE OPERATIONAL PLAN

A - INTRODUCTION

1. This operational plan has a threefold purpose:

   A. To apprise the other departments involved in the total Los Angeles City Earthquake Operational Plan, of the Harbor Department's purposed plans, duties and responses in the event of a major earthquake affecting the Harbor area.

   B. To list the available emergency phone numbers and radio frequencies to utilize in order to obtain personnel, equipment, information or aid from the Harbor Department.

   C. A brief summary of the structural organization of the operational plan, the personnel and equipment that is available within the Los Angeles Harbor Department for emergency use.

2. It is visualized that the major operations will center around the Security Patrol Headquarters at Berth 84 located at the east end of Sixth Street, just east of Harbor Boulevard, San Pedro (Telephone 832-7241, Ext. 292) and at the Construction and Maintenance Yard, Berth 161, on Pier A Street just west of Fries Avenue, Wilmington (Telephone 832-7241, Ext. 231).

3. Both sites are geographically located in the Harbor Division of the Los Angeles Police Department.

4. Berth 84 is geographically located within Division II, Battalion 6, and Berth 161 is located in Division II, Battalion 16, of the Los Angeles Fire Department Operational Chart.

B - AUTHORITY AND RESPONSIBILITIES

5. City Ordinance 97,600, Section 9, Subsection J, empowers the Harbor Department and the Port Warden to move or evacuate from Harbor Department property or waterfront any vessel or mobile equipment that is in jeopardy from surrounding conditions or that may accelerate the disaster or impede salvage operations.

6. The responsibilities of the Port Warden are to:

A. Be active in port security.

B. Prepare an operational plan for ship anchorage and ship movement to avert collision and disaster.

C. Coordinate operations with jurisdictional Federal agencies, police, fire and public works departments.

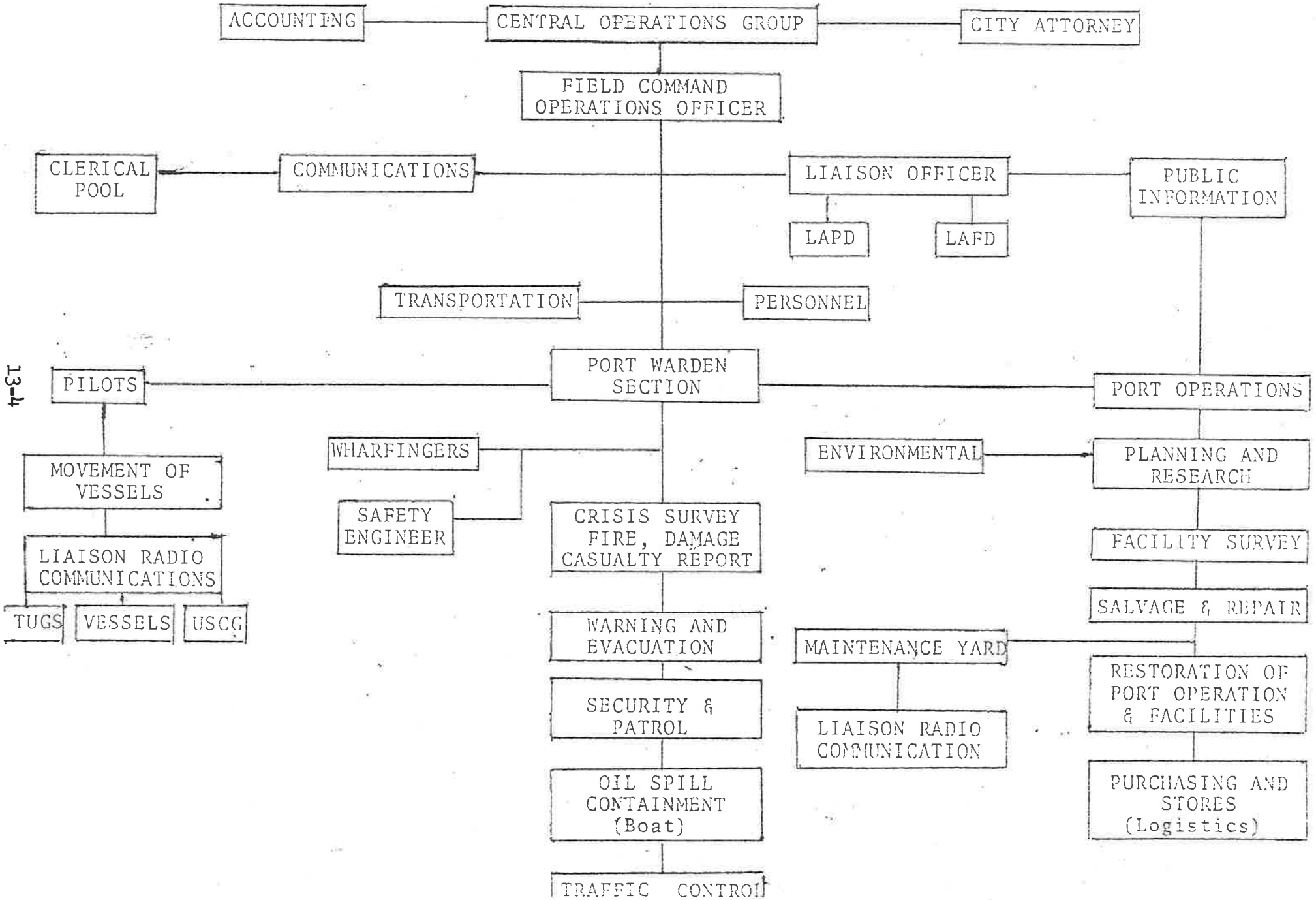
D. Direct Harbor Department personnel as listed below and volunteers from private industry.

DEPARTMENT ADMINISTRATIVE STAFF

General Manager Fred B. Crawford	255 W. 5th St. - Rm. 707 San Pedro	832-7241 Ext. 201
Asst. General Manager E. W. Clocksin	"	Ext. 407
Director, Port Administration John Grazer	"	Ext. 404
City Attorney J. Wells	Rm. 702	Ext. 213
Director, Port Operations R. W. Kennedy	Rm. 707	Ext. 482
Port Warden Edward C. Henry	Berth 84, San Pedro	Ext. 292
Chief Dep. Fred Warner	"	Ext. 291
Patrol Section	"	Ext. 288, 291, 419
Communications	"	Ext. 292
Personnel Bill Stein	Room 701	Ext. 282
Public Relations (Pub. Info.) Lee Zitko	Room 708	Ext. 285
Port Engineer L. L. Whiteneck	Room 814	Ext. 241
Construction & Maintenance Roy Cootes (Supt.)	Berth 161, Wilm.	Ext. 254, 231

RADIO CALL NUMBER — SUPERVISORS ON 24-HOUR CALL WITH VEHICLE

Echo 5-C	Electrician	Norton	Ext. 231, 292
Echo 6-A	Merchanical Repair	Pietrzak	Ext. 231, 292
Echo 7-A	Plumbing	Robertson	Ext. 231, 292
Echo 8-A	Const. & Maint.	DuVall	Ext. 231, 292


ACCOUNTING
CENTRAL OPERATIONS GROUP
CITY ATTORNEY
FIELD COMMAND OPERATIONS OFFICER
CLERICAL POOL
COMMUNICATIONS
LIAISON OFFICER
PUBLIC INFORMATION
LAPD
LAFD
TRANSPORTATION
PERSONNEL
PORT WARDEN SECTION
PILOTS
PORT OPERATIONS
WHARFINGERS
ENVIRONMENTAL
PLANNING AND RESEARCH
MOVEMENT OF VESSELS
SAFETY ENGINEER
CRISIS SURVEY FIRE, DAMAGE CASUALTY REPORT
FACILITY SURVEY
LIAISON RADIO COMMUNICATIONS
SALVAGE & REPAIR
TUGS
VESSELS
USCG
WARNING AND EVACUATION
MAINTENANCE YARD
RESTORATION OF PORT OPERATION & FACILITIES
SECURITY & PATROL
LIAISON RADIO COMMUNICATION
OIL SPILL CONTAINMENT (Boat)
PURCHASING AND STORES (Logistics)
TRAFFIC CONTROL

C - FIELD RESPONSIBILITIES

7. The Central Operations Group includes an administrative staff with overall command and administrative responsibility.

8. The Accounting Department provides personnel to set up and maintain an ongoing record of time and cost for the overall operation of an incident or disaster.

9. The City Attorney provides legal advice and assistance to the involved response and recovery operations.

10. Under the Field Command Operations Officer, the Port Warden Field Sergeant performs the following:

A. Establishes field command post.

B. Appoints personnel staff.

C. Staffs and activates the necessary units.

D. Correlates operations with associated agencies.

E. Establishes communications and dispatches units.

F. Establishes perimeters and remains cognizant of activities within those perimeters.

G. Makes situation reports to Department Commander.

11. Under the Liaison Officer, the Port Warden Deputy:

A. Maintains contact with associated agencies at Command Post.

B. Maintains contact with the Pilot Station and Maintenance Yard.

C. Records communications between the Command Post and associated agencies and departments.

12. The Public Relations Division:

A. Issues public notices and bulletins.

B. Maintains liaison with press.

C. Documents and photographs as required.

13. The Port Warden Deputy and Radio Telephone Operator receives, transmits and records all radio messages emanating from or directed to the Command Post and provides the necessary telephone service.

14. Under the Personnel Division, the clerical pool as provided by Director of Administration assists Communications Operator in recording and preparing reports, and assists at the Command Post, recording and preparing reports.

15. To provide transportation the Port Warden Deputy maintains the vehicle pool.

16. The Personnel Department maintains a roster and provides a pool of personnel who can supplement the work force of the response and recovery operation.

17. Under the Port Warden Section, the Port Warden Sergeant (Watch Commander):

A. Patrols the assigned area and reports to the Command Post any immediate crisis and need for emergency equipment. He also maintains liaison with the Police and Fire Departments, ambulance, rescue and coroner.

B. Assesses damage and need for emergency repair of oil terminals, buildings, roadways and bridges, plumbing and electrical equipment, wharves, fences and gates and evaluates the safety of the above.

C. Evaluates and reports to the Command Post the need for evacuation of unsafe areas. On Command Post order he transmits warnings and effects evacuations.

D. The Security Patrol of Harbor Department property excludes unauthorized persons, apprehends looters, assists and advises private security patrols and requests additional police, fire or emergency equipment if necessary.

E. The patrol boat assists with over water transportation, controls traffic on the water, inspects wharves and marinas for damage and assists in placing oil spill booms.

F. Traffic control is facilitated where necessary pending the arrival of LAPD.

18. The Wharfinger Division provides information regarding location and types of vessels that are in the port, pertinent information about each cargo terminal and a general description of the current cargo on the terminal.

19. The Safety Engineer assembles and directs Los Angeles Harbor Department personnel evacuated from Pacific Trade Center to a safe location away from the building.

20. Pilots move merchant vessels from hazardous locations to positions of safety and relay radio communications between Command Post and tugs, merchant vessels, USCG and certain LAHD vessels on special radio frequencies.

21. The Harbor Department Engineer coordinates restoration and maintenance of port operations, including the appointment of survey teams, the facilities survey and the direction of repairs. The Chief Maintenance and Construction Engineer directs salvage and construction of facilities as requested by facility survey teams. The work force, equipment and radio communications are furnished by the maintenance yard.

22. The L. A. Harbor Department Environmentalist surveys and advises of the environmental impact of an incident or disaster in the harbor, suggests possible means of lessening damage and assists in preparing plans for recovery and restoration of the harbor and its environment to a normal condition.

23. Planning and Research personnel provide statistics, and record vital information to the Engineering Department to facilitate recovery and restoration of the port to normal operation.

24. Purchasing and Stores provide logistical support to supply needs of field units.

D - INITIAL RESPONSE

25. A control base is established to facilitate communication from the field units to the Maintenance Yard Base, to the control base and between field units. Such communications are tested to ensure operability.

26. A command post is established in a safe and accessible location.

27. Units are assigned to keep each area under surveillance. Agencies and departments involved are notified of the command post location. Immediate emergency needs which can be met by the police or fire department, rescue security, traffic control (etc.) are reported.

28. Liaison with the pilot station, maintenance yard and Pacific Trade Center is maintained as personnel, equipment and vessels are moved to safe locations.

E - EMERGENCY CALL DIRECTORY

29. <u>If telephones are operative</u>, the following Command Posts can be contacted:

A. Command Post #1
Port Warden Headquarters, 6th St. & Harbor Blvd., San Pedro
Communications 832-7241 Ext. 292, 293, 294
From Central LA 775-3231 or Tie Line 7183 Ext. 292-3-4
Chief Deputy of Security
& Watch Commander 832-7241 Ext. 291, 288, 419
From Cent. LA 775-3231 or Tie Line 7183
Ext. 291, 288, 419

B. Command Post #2
Const. & mtce. Yard, Pier "A" St. & Fries Ave., Wilm.
Secondary Communications & Heavy Construction Equipment
Pool 832-7241 Ext. 231, 245
From Central LA 775-3231 or Tie Line 7183 Ext. 231, 245

C. Command Post #3 - Tuna and Albacore Street, Terminal Island
Dockmaster, Terminal Isl. Liaison Officer
832-7241 Ext. 236, 237
From Central LA 775-3231 or Tie Line 7183 Ext. 236, 237

D. Waterside Command Post - Berthed at 6th & Harbor, San Pedro
"ANGELENA" Harbor Dept. Public Relations Boat
Marine Operator WX 6427 ANGELENA

30. If telephones are inoperative, the following locations can be contacted by radio:

A. Communication & Patrol Frequency 45.74 MHz KTL 633

B. Construction & Maint. & Secondary Communications
Frequency 45.62 MHz KMG 511

C. Communications, Yard boats, tugs (in future Patrol Boats)
VHF Channel 14 156.7 MHz KNB 466
VHF Channel 16 156.8 MHz KMZ 506

D. Communications & Port Warden Vehicle
Civil Defense Frequency 39.90 MHz KJP 429

E. For Pre-Earthquake Planning & Information contact:

Chief Ed Henry, Berth 84, San Pedro 832-7241 Ext. 292
Chief Dep. Fred Warner " " " " 291
Deputy Ray Rush " " " " 291

F - LOS ANGELES HARBOR DEPARTMENT COMMUNICATIONS

31. The available frequencies are listed below by location:

I. Security Control Center

A. Normal Communications

1. Frequency #1 KMG 511 45.62 MHz

2. Frequency #2 KTL 633 45.74 MHz

a. Patrol Base Unit at Watch Commander Desk
b. Two (2) hand sets.
c. Security Patrol Units and boats.
d. Staff & Commission vehicles.
e. Limited number of pool vehicles.
f. Limited number of construction and maintenance vehicles, boats and equipment (except tugs).
g. Pilot and Wharfinger vehicles.

B. VHF

1. Channel 14 KNB 466 Frequency 156.7 MHz

a. Communications Channel

(1) LAHD Pilot Station
(2) Angels Pilot, Amos Fries, Angeles Gate Angelena, Tug #8, Arapahoe, Derrick Barge Pile Driver, and Badger Avenue Bridge
(3) U.S. Coast Guard
(4) All Commercial Vessels
(5) Certain Private Vessels

2. Channel 16 KNZ 506 Frequency 156.8 MHz is an emergency call channel at the same locations as listed above.

C. Civil Defense KJP 429 Frequency 39.90 MHz is in the Port Warden's Mobile Vehicle. Call No. 1082.

D. Monitors only are on the Los Angeles Fire Department and the Los Angeles Police Department Call Frequencies, Tac. Frequencies 1 & 2.

II. Pilot Station (24 Hours)

A. Security Frequency #1 in vehicle.

B. VHF

1. Channels 14 and 16 described above.

2. Channel 65A Restricted Frequency 156.275 MHz provides communications between pilot and tugs and emergency communication pilot to station not normally monitored.

C. 16 Hand Sets

1. 10 Sets, Channels 14, 16, 65A

2. 6 Sets, Channels 14, 16, 65A + 6. Channel 6 is an auxiliary tug frequency and emergency ship to ship communication channel.

D. Pilot Boats

1. Angels Pilot has VHF Channels 14, 16, 65A which include Channel 10, a Tug Frequency, and Channel 13, a Vessel Bridge to Bridge Communication Frequency.

2. Amos Fries has the same frequencies as the Angeles Pilot.

III. Angelena LAHD Public Relations Boat

A. Security Patrol Frequencies

B. VHF

1. Channels 6, 12, 14, 16, 26, 65A, 68

a. Channel 12. Ship to Shore, U.S. Coast Guard and Liaison with Recreational Boats.
b. Channel 68. Ship to Shore Telephone. Out of Ship to Ship Range.
c. Channel 26. K.O.U. Radio Telephone Marine Operator, San Pedro.

IV. Construction and Maintenance Yard (5 Days Per Week)

A. Frequency #1 KMG 511 Frequency 45.62 MHz provides communications with radio equipped construction and maintenance vehicles, boats and equipment.

B. VHF Equipped Maintenance Equipment includes:

1. Derrick Barge #39

2. Pile Driver

3. Badger Avenue Bridge

4. Tug #8 (Light Tug)

5. Arapahoe (Light Tug)

6. Angeles Gate (Large Tug)

G - HARBOR DEPARTMENT VEHICLES AND CONSTRUCTION EQUIPMENT

32. **These are listed below:**

Radio equipped vehicles & boats

21 light trucks - 1/2 to 3/4 T pickup
1 van
1 station wagon
14 passenger vehicles
7 private vehicles (supervisors)
3 patrol boats
1 service boat
2 light duty tugboats
1 heavy duty tugboat
1 derrick barge
1 pile driver
3 refuse collection boats

13 passenger vehicles (no radio)

Construction equipment

2 45 cu.yd. semi dump trucks
2 12-ton semi dump trucks
4 dump trucks 10, 8 ¢ 6 cu.yd.
1 56-ft. boom truck
2 30-ton truck cranes & boom dollies
1 600-lb. telescoping boom truck
1 1-ton ladder truck
1 2-ton high ranger
1 6-ton flatbed truck w/dump body
1 1 1/2 ton flatbed truck w/boom
1 1500-gal. water truck w/pump & 800-gal water t/r
1 track crawler skiploader/bulldozer w/trailer
2 skip loader/back hoes
1 sml skip loader
3 welding trucks
1 400-gal. gasoline & diesel fuel truck
1 1-ton wrecker truck
5 air compressor trailers 315 psi to 125 psi
8 portable electric generators

H - SPILL BOOM

33. **The spill boom available is listed below:**

LOCATION		PHONE	TOTAL AMOUNT	BOAT
B-37-40	Navy Fuel	832-4570/832-3545	1600 Ft.	15' 50HP O/B
B-70	GATX	547-0881	1000 Ft.	Rowboat
B-97-101	Standard Oil	832-6474	4200 Ft. 2-12'	15 PH O/B
B-118-9	GATX	831-6566	1600 Ft.	None
B-149-50	Union Oil	834-4691	2000 Ft.	None
B-163	Golden Eagle	834-4495	1000 Ft.	None
B-168-9	Shell Oil	834-2638	1000 Ft.	None
B-170	Clean Coastal Water	433-8346	1000 Ft.	None
B-172	Continental Oil	834-2004	500 Ft.	14' 20HP O/B
B-181	Dept. W. & P.	834-7608	1500 Ft.	16' 25HP O/B
B-215	Gulf Oil	832-7248	1000 Ft.	16' 40HP O/B
B-216	Refiners Mrktg.	832-8353	1000 Ft.	None
B-238-40	Mobil Oil	832-8311/775-6613 (1000 ft. on trailer)	2600 Ft.	2-17' Rowboa 117 HP O/B
	Hutchison & Sons	830-1720	8000 Ft.) 5000 Ft.)	On Trailers
	(4) Work Boats (10) Punts (4) Skimmers (1) Flat Barge			
	Crosby & Overton (9) Work Boats (1) Skimmer	432-5447	8000 Ft. 6" (8) Portable Skimmers)	
B-188	Crowley Environmental Service or	549-9222/23	50' boom laying boat + 2000 ft. 8" boom	16' 70HP O/
	United Towing 140 GPM Fire Pump with 200 Ft. of 2" hose -	547-4441		2-50 ft. fire ho 1500 ft. 8" boom 25' Boat and 25' Boom Ba
	500 ft. 8" boom Small Trl 1500 ft. 8" boom Large Trl 500 ft. 8" lengths of boom at B-188 backup. Several small 12 & 16 ft. workboats with O/B			

I - CIVILIAN RESOURCES

34. In addition to the Harbor Department heavy duty and construction equipment, the stevedoring, warehousing, and oil clean-up companies maintain fleets of related equipment that could be utilized to move equipment, cargo and assist in search and rescue operations. A brief summary of the major companies and associated equipment is as follows:

A. Metropolitan Stevedoring Co. 830-6220
Jack Clark, General Manager Res. 547-2657

This company has cargo handling equipment at various locations within Los Angeles and Long Beach Harbors. The equipment could be useful in rescue and restoration operations. The general inventory is as follows:

3 115-ton mobile cranes	200 2½ to 5-ton forklifts
3 30-ton mobile cranes	3 truck tractors and flat bed trailers
3 20-ton forklifts	15 bobtail flat bed trucks
10 12½-ton forklifts	2 portable 440 V. elec. generators

B. Hutchison & Sons 830-1720

In addition to waterborne spillboom equipment, there are numerous pieces of heavy duty support equipment (i.e., vacuum trucks, tank trucks, pumps, steam cleaning and tank cleaning equipment, breathing apparatus and chemical suits, and a fleet of radio equipped vehicles and trucks.

C. Crosby & Overton 432-5447

Has equipment similar to that described for Hutchison & Sons.

D. Crescent Wharf & Warehouse Co. 835-7111
Manager of all Terminals:
Bob Christofferson Res. 530-7693

This company has cargo handling equipment at various locations in the Los Angeles and Long Beach Harbor areas.

9 Mobile Cranes	Standard Forklifts 2-3 Tons	Heavy Duty Forklifts
1 150-Ton	365	51 11 to 20 Tons
1 140-Ton		25 7½ to 10 Tons
1 130-Ton	Jitneys	
3 115-Ton		Cletracs
1 8-Ton	114	3
2 5-Ton		

Standard Tractors	Dual Wheel Tractors	Car Loaders
33	20	3

Car Pullers	Personnel Carriers	Container Handling Equipment
5	4	25

Truck Tractors	Blowers	Container Strad. Carriers
10	13	12

Trailers	Air Compressors
10	3

Fuel Trucks

6 150 to 1,000 Gals.

J - AVAILABLE TUGS

35. These are listed below:

Wilmington Transportation Co. San Pedro		24 Hours	832-4293
9 Tugs - varying from 750 to 3,500 HP			
United Towing Company Wilmington		24 Hours	547-4441
6 Small Tugs	350 to 450 HP		
San Pedro Tug Company Terminal Island		24 Hours	832-1158 832-1159 832-1150
9 Tugs - varying from 1,500 to 3,000 HP			

Wilmington Transportation Co. tugs and San Pedro Tug Co. tugs are equipped with two $1\frac{1}{2}$" fire hose stations and sea water pumps to load the hoses.

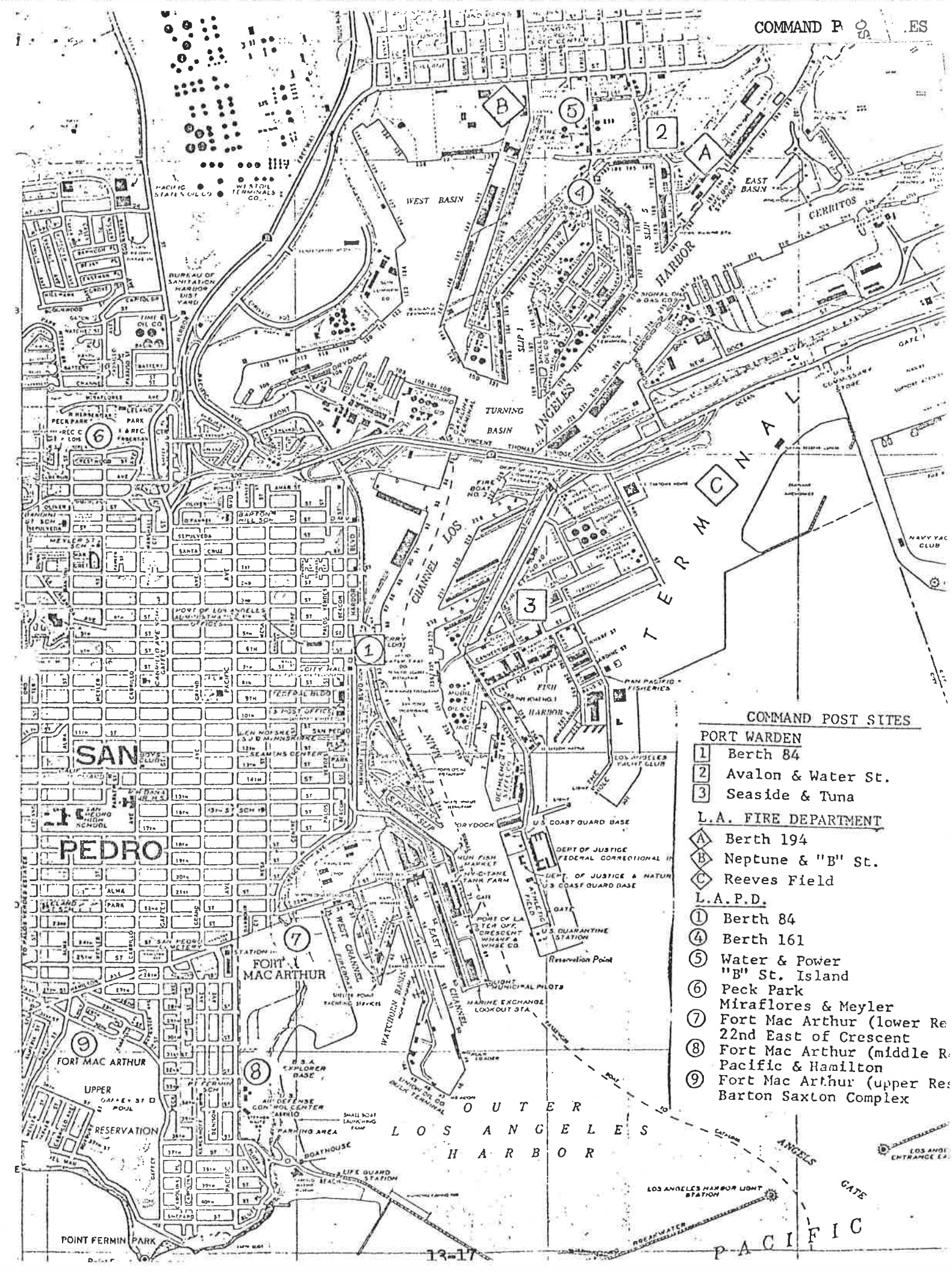
K - WATER TAXIS

36. This company is available:

H-10 Water Taxi Company Berth 84, San Pedro		832-7575
Frank Seehorn, Jr.	Res.	547-4928
Jeanne Seehorn	Res.	831-5026

9 Full-time employees
Normal operating hours - 18 Hours, 7 Days per Week

6 Water Taxis - Capacity 49 persons each


COMMAND P ES
WEST BASIN
EAST BASIN
HARBOR
SLIP 5
SLIP 1
TURNING BASIN
CERRITOS
ANGELES
TERMINAL
CHANNEL
LOS
FISH HARBOR
SAN PEDRO
PEDRO
FORT MAC ARTHUR
UPPER RESERVATION
POINT FERMIN PARK
WATCHORN BASIN
OUTER LOS ANGELES HARBOR
PACIFIC
ANGELES GATE
Reservation Point
LOS ANGELES HARBOR LIGHT STATION
BREAKWATER
COMMAND POST SITES
PORT WARDEN
1 Berth 84
2 Avalon & Water St.
3 Seaside & Tuna
L.A. FIRE DEPARTMENT
A Berth 194
B Neptune & "B" St.
C Reeves Field
L.A.P.D.
① Berth 84
④ Berth 161
⑤ Water & Power "B" St. Island
⑥ Peck Park Miraflores & Meyler
⑦ Fort Mac Arthur (lower Re 22nd East of Crescent
⑧ Fort Mac Arthur (middle R Pacific & Hamilton
⑨ Fort Mac Arthur (upper Res Barton Saxton Complex

CHAPTER 14

COMMENTS BY CITY OF LOS ANGELES HARBOR DEPARTMENT

A - DOCK FACILITY

1. The Los Angeles Harbor Department has granted Petrolane, Inc., a non-exclusive secondary berth assignment in conjunction with Western Fuel Oil Company at Berth 120 in the West Basin of the Los Angeles Harbor. The assigned boundaries include a land parcel (illustrated on attached map) and 494 feet of water frontage, with a 401-foot wooden wharf (illustrated by the area map).

Ship Unloading Facility

2. Petrolane, Inc. has erected a 12" diameter rigid pipe, swivel joint type unloading arm, approved for propane transfer, on the wooden wharf at this location. A 16" diameter seamless, insulated steel pipeline connects the marine arm to the tank storage area at 2110 North Gaffey Street, San Pedro. The 16" pipeline is used to transport liquid petroleum gas 6,000 feet from the wharf to the tank storage area. A 4" diameter cooldown pipeline parallels the large transfer line between the wharf and tank storage area. The 16" line is capable of delivering 10,000 barrels of refrigerated liquid petroleum gas per hour at 90 psig at an optimum temperature of $-40^{\circ}F$. The line is designed to carry a pressure of 275 psig and pressure tested to 425 psig at $-50^{\circ}F$. The marine arm is designed to withstand wind velocities of 100 mph.

3. The entire system is nitrogen pressure tested annually at 285 psig for one-half hour. Then the pressure is reduced and held at 275 psig for four hours.

4. Vessels are berthed at the facility with towing wires rigged and bow to seaward.

B - UNLOADING PROCEDURES

Pre-Shipment

5. Notifications are made at the earliest possible time after the necessary approval and confirmation regarding a shipment are completed.

6. The following agencies are notified; the necessary conferences are conducted, and permits are obtained from:

U. S. Coast Guard	Captain of the Port
Los Angeles Fire Department	Fire Prevention Bureau
Los Angeles Harbor Department	Port Warden
Western Fuel Oil Company	General Manager

7. The agencies are informed of the:

a. Ship involved;

b. Cargo quantity;

c. Port of export;

d. Estimated time of arrival.

8. Preparations:

a. An independent petroleum inspector is employed.

b. A ship's agent is engaged.

c. A. U. S. Customs broker is engaged.

d. A security guard service is engaged during vessel unloading.

e. Tug boats and standby tugs are engaged as needed.

f. Arrangements are made to have adequate nitrogen available at Berth 120.

g. An inspection of the facility is made and adequate warning signs are placed at the berth per regulations.

h. One 150 lb. dry chemical fire extinguisher is placed at the berth.

i. First aid equipment is supplied at the berth.

j. Breathing apparatus and heat resistant protective clothing is supplied.

k. An inspection for adequacy of bonding system is made.

l. A notification to the pilot of the mooring requirements at berth is made.

Cargo Transfer (Preliminary)

9. Approximately 24 hours prior to the arrival of a refrigerated LPG carrying tank vessel, a pipeline cooldown procedure is initiated. The

cooldown is accomplished by pumping and circulating refrigerated LPG through the 4" diameter cooldown pipeline into the 16" diameter product transfer pipeline. The filling and circulating of the LPG in the pipelines is at a slow rate of flow at the outset to prevent thermal shock to the product transfer systems and over-burdening of the plant refrigerating system. When an optimum temperature of -40°F. and a line pressure of approximately 80 psig is reached, the system is held in readiness, pending the arrival of the tank vessel and the beginning of the product transfer.

10. Upon the arrival of a tank vessel at the facility at Berth 120, the person in charge of the transfer operation performs the following tasks:

a. Directs the positioning of the vessel at the marine loading arm.

b. Boards the vessel after it has been cleared by the U. S. Coast Guard, Customs, Agriculture, Public Health inspectors and the ship's agent, examines and signs a notice of readiness that has been prepared by the ship's master.

c. Accompanies an independent petroleum inspector and ship's First Mate to verify the following items:

   1) Ship trim;
   2) Cargo temperatures at all points in each tank;
   3) Cargo vapor pressure for each tank;
   4) Cargo liquid level as read by tape gauges;
   5) Calculation of cargo quantity.

d. Participates in the pre-cargo transfer conference, required by the U. S. Coast Guard regulations, with the ship's First Mate, Cargo Officer and Gas Engineer.

Cargo Transfer

11. These operations are completed before off-loading commences:

a. An electrical bonding cable is securely fastened on board the vessel.

b. The marine unloading arm is connected to the vessel's cargo manifold.

c. The communication system is connected to the marine arm.

d. The off-loading transfer is started.

1) Initially at a slow rate of flow

2) An inspection for leakage is made

3) The transfer pressure is gradually increased to 90 psig, the normal operating pressure

4) A detailed log is maintained on each phase of the operation and continuous periodic inspections are made during the transfer and recorded.

Conclusion of Cargo Transfer

12. The ship's agent is notified approximately three hours in advance of the completion of the cargo transfer. He in turn notifies the U. S. Coast Guard and Federal inspection agencies and schedules tugs and pilot for the vessel's departure.

13. The marine arm is drained and purged, disconnected, blank flanged and lowered into the storage position.

C - EMERGENCY EQUIPMENT

Fire Fighting Equipment

Water System.

14. Berth 120 is equipped with an electric motor-driven fire pump which by suction takes sea water from the harbor and distributes it under high pressure to hose stations located along the back of the dock. The 1½-inch hoses near the Petrolane marine arm will be connected and deployed during the ship unloading operation. Additionally, an engine-driven pump with fire monitors may be leased for standby during operations. The pump will flow approximately 900 gpm at 150 psig and would mount on shore near the valve pit.

Fire Extinguishers.

15. One large 150 lb. wheeled fire extinguisher will be located outside the control building on Berth 120. The unit has 50 feet of 3/4-inch hose and the nozzle has a range of 25 feet. The unit can easily be moved by one man.

16. The facility fire extinguishers contain "Purple K" dry chemical which provides effective protection against flammable liquid and gas fires. Reflashes are less of a problem due to holding power of "Purple K" agent on liquid and gas fires.

Facility Alarms and Shutdowns

Fire Alarm

17. Activated by the emergency flow shutdown, flammable gas detectors, or a 140 degree temperature sensitive probe located at the base of the marine arm. The alarm and shutdown system may also be activated by any one of four push buttons at strategic locations on the wharf.

Marine Arm Travel Limit Alarm

18. The maximum travel of the arm right or left is 45 degrees. An air horn mounted on the riser will alarm when this travel exceeds 30 degrees. Normal travel within design limits is 25 degrees. The maximum included angle between inboard and outboard arm when extended is 150 degrees. The air horn will alarm when this angle reaches 135 degrees. Normal extended angle when operating design limits is 100 degrees. The alarm will sound when the angle above horizontal reaches 5 degrees or when the arm is retracted 10 degrees back of vertical.

Emergency Pipeline Flow Shutdown

19. Pipeline shutdown is accomplished by closing a vee ball valve at the base of the marine arm. There is a check valve on shore designed to prevent a backflow in the event of a leakage or a cessation of pumping.

20. The vee ball flow valve may be closed by any of the emergency shutdown buttons on the wharf or will automatically close when activated by the flammable gas detectors sensor, or the fire alarm sensor system.

D - EMERGENCY PROCEDURES

21. Procedure in Event of Facility Fire:

a. Shutdown LPG flow from ship.

b. Notify storage terminal to call emergency numbers.

c. Pre-instruct gate guard to evacuate all visitors from the area and clear fire lanes.

d. Begin nitrogen purge of outboard section of marine arm from control location on shore (see purge procedure) with the help of ship personnel.

e. Activate fire water system and get steady stream of water on fire.

f. Extinguish an LP-gas fire only after shutting off the source of LP-gas.

g. After initial purge of outboard section of marine arm, order ship personnel to close valve TV-1 on ship and of marine arm and remove mating flange bolts and studs so vessel can get underway.

h. If control valve is accessible, continue nitrogen purge of inboard section of marine arm and pipeline section up to valve pit on shore.

22. Procedure in Event of Ship Fire:

a. Shutdown LPG flow from ship by closing flow control valve, PCF-150.

b. Notify storage terminal operator to call emergency numbers.

c. Pre-instruct gate guards to evacuate all visitors from the area and clear fire lanes.

d. Stand by to activate fire water system on shore.

e. Begin nitrogen purge of outboard section of marine arm (see purge procedure) if ship manifold valves are still open.

f. After outboard arm purge, close valve TV-1 on ship end of marine arm and remove mating flange bolts and studs.

g. Move marine arm away from ship manifold into storage position on shore so vessel can get underway.

23. Procedure in Event of Leak:

a. Shutdown flow from ship.

b. Notify storage terminal operator to stand by.

c. Evacuate the area of visitors.

d. Actuate fire pump.

e. Immediately apply water spray to leaking component to diffuse LP-gas vapors.

f. Approach the leak from upwind, if possible.

g. Repair leak if possible and if cause can be immediately determined.

h. Start nitrogen purge of marine arm to clear LP-gas liquid from the piping around the leaking component if unable to make immediate repair.

24. Procedure in Event of Spill:

a. Shutdown flow from ship.

b. Notify storage terminal operator to call emergency numbers.

c. Evacuate area of visitors.

d. Actuate fire pump.

e. Apply water spray to spill area to diffuse vapors which will evolve.

f. Close block valves on either side of component releasing the spill, or use nitrogen purge to remove LP-gas from piping if possible.

E - SHIP MOVEMENT

25. Prior to the time a vessel containing hazardous cargo enters the Inner Harbor, a conference is held between the ship's master, the Coast Guard, the Los Angeles Harbor Department pilots and the Port Warden to establish procedures insuring that the movement of the vessel will be done in the safest manner. Primary consideration is given to the protection and safety of the Los Angeles Harbor and its surrounding area. The Coast Guard, the Harbor Department pilots and the Port Warden have the authority to prevent a vessel from entering the Inner Harbor if the conditions established are not complied with.

26. On November 4, 1976, at 2205 hours the "FERNWOOD", a liquid petroleum gas carrier tank vessel of Norwegian registry arrived at the entrance to the Los Angeles Harbor with a cargo of 130,000 barrels of LPG to be offloaded at the Petrolane facility at Berth 120. The tank vessel "FERNWOOD" was built in 1969. The vessel is 561 feet long and 80 feet wide. At 100 percent capacity 157,000 barrels of LPG, it draws 27 feet of water. By today's standards the "FERNWOOD" is considered a <u>small</u> size LPG carrying tank vessel by the industry. The vessel was escorted by a Los Angeles Port Warden patrol boat to an anchorage in the Outer Harber where it was anchored, boarded and inspected by representatives from the U. S. Coast Guard, the Los Angeles Fire Department, U. S. Customs and the Los Angeles Harbor Port Warden. The vessel was held at anchorage until the tank vessel "COASTAL CALIFORNIA" left Berth 120 and had cleared the Main Channel.

<u>Ship Traffic</u>

27. All boat and ship traffic in the Main Channel and in the West Basin was stopped by U. S. Coast Guard and Los Angeles Port Warden patrol boats. The "FERNWOOD" was escorted from anchorage to Berth 120 and was secured to the wharf at 2320 hours without incident.

28. A perimeter was established on land and maintained by guards posted by Petrolane. The Los Angeles Fire Department stationed fire fighting equipment on land and the U. S. Coast Guard stationed a boat

in the water near Berth 120 to prevent unauthorized boats from entering the restricted area. The Los Angeles Port Warden's patrol boats made frequent inspections of the area.

29. The "FERNWOOD" offloaded 127,221 barrels of LPG without incident and departed from Berth 120 at 1455 hours on November 6, 1976, escorted by the U. S. Coast Guard and L. A. Port Warden patrol boats. All boat traffic in the Main Channel was stopped as the vessel left the berth and along the entire route to Los Angeles Harbor Entrance at the Angels Gate. At 1535 hours, the "FERNWOOD" passed through Angels Gate and left Los Angeles Harbor.

30. To this date the "FERNWOOD" is the only LPG tank vessel that has offloaded a cargo of LPG at the Petrolane facility at Berth 120.

Harbor

31. The route from the entrance to the Main Channel of the Los Angeles Harbor to Berth 120 has a mean depth of 35 feet.

32. The Main Channel to the Turning Basin has an average width of 1,000 feet. The entrance to the West Basin, the approach route to Berth 120, has an average width of 500 feet.

33. Presently the facility will accommodate a 710-foot tank vessel. The Petrolane Company has requested that the facility be modified to accommodate a 720-foot tank vessel, the longest vessel that will be calling at Berth 120 in the foreseeable future.

34. Aside from the control and regulations described in the previous paragraphs placed on LPG carrying tank vessels, two large cargo carrying vessels have free passage at any point in the Main Channel and the entrance to the West Basin.

F - CONCLUSIONS AND RECOMMENDATIONS

35. Based on the incidents of the "FERNWOOD" call at Berth 120 in November, 1976, the following conclusions were drawn.

36. The total operation proved to be an extremely efficient and safe procedure. This efficiency and safety were contributed to by the fact

that all the persons involved with the handling of the cargo were especially trained in handling this type of cargo. The Fire Department and the Coast Guard insured that all safety precautions were taken and that all parties involved cooperated in the requirements that had been set forth.

37. It is the observation of the Port Warden that the handling of LPG in Los Angeles Harbor is a safe procedure and that the precautions taken lessened the possibilities of anything untoward happening.

38. It is recommended that the present regulations, policies and safety procedures be continued during arrival, cargo transfer operations and departure of LPG tank vessels calling at the Petrolane facility at Berth 120 in the Los Angeles Harbor.

Comments

39. The facilities at Berth 120 are currently being upgraded. New dolphins and mooring bits are being installed to insure more stability for the vessels' mooring at the wharf. The pilings beneath the wharf are being replaced.

40. The master plan for the Los Angeles Harbor's future development includes a longer and larger energy wharf, relocation of Sun Lumber Company and realignment of the wharves for easier access. (See attached Future Development Map.)

G - TEXT OF LETTER TO TANKSHIP FERNWOOD

41. Pursuant to the request of Petrolane, agents for the Norwegian LPGC Tankship "FERNWOOD", the vessel will be permitted to enter the Port of Los Angeles on or about November 4, 1976 at 0300 hours for the purpose of discharging approximately 130,000 barrels of refrigerated liquefied petroleum gas (propane) at Berth 120, providing the following terms and conditions are met and accepted:

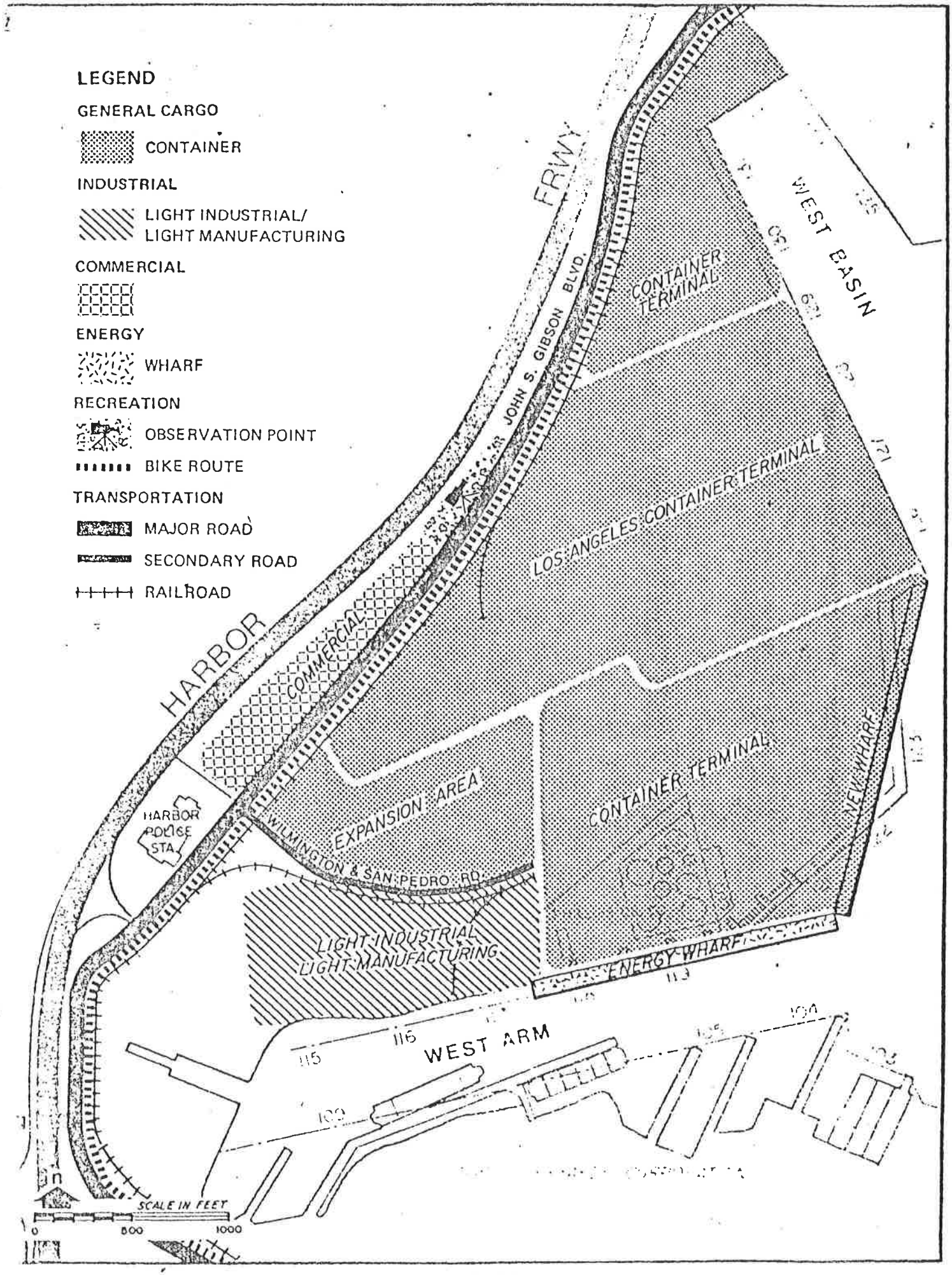
1. All fire fighting equipment, navigational equipment, including steering gear engine controls, communications and detecting systems shall be tested prior to vessel's entry into Los Angeles Harbor.

2. While the vessel is underway on approach to or within the harbor limits the Master shall be present on the bridge.
3. The vessel shall be fully manned for maneuvering on bridge and in engine room.
4. When underway while maneuvering within the harbor or its approaches, vessel's anchors shall be kept ready for instant use, clear of the hawse pipe, and an officer shall be forward with competent assistance.
5. The vessel shall at all times during daylight hours exhibit the International Code Flag "BRAVO", and at night a red light where it can best be seen.
6. The vessel shall moor bow to seaward at the discretion of the Port Pilot and be prepared to get underway on short notice.
7. The vessel shall have towing wires rigged fore and aft.
8. The vessel shall display on the outboard sides fore and aft signs which read: "DANGER - KEEP CLEAR."
9. When alongside the wharf a watch shall be maintained on the weather deck and in the engine room at all times.
10. There shall be a deck officer, an engineering officer and sufficient personnel on board the vessel at all times to maneuver the vessel in case of emergency.
11. One man shall be stationed at the gangway at all times.
12. No unauthorized persons shall be permitted on board.
13. The decks shall be illuminated from sunset to sunrise.
14. No hot work shall be permitted on the vessel.
15. A warning sign shall be displayed at the accommodation ladder (gangway) with the following notice: WARNING - No Open Lights - No Smoking - No Visitors.
16. Arrangements shall be made for tugs to respond immediately should any emergency arise while the vessel is docked at Berth 120. One tug shall be committed to the vessel and

fully manned during off loading and shall monitor Channel 16. The name of the tug company shall be recorded with the Los Angeles Pilots and Port Warden.

17. Any additional requirements which might be imposed or required by the Coast Guard Captain of the Port or the Los Angeles Fire Department.
18. Failure to comply with any of the aforesaid provisions shall revoke this permit.

FUTURE DEVELOPMENT WEST BASIN



CHAPTER 15

COMMENTS BY U.S. COAST GUARD

A - SHIP TRAFFIC

1. The primary focus of attention for carrying and handling propane and other hazardous cargoes in the Port of Los Angeles is the safe transit of the vessel to and from the berth and the safe handling of the cargo at the dock.

2. Prior to a vessel arriving at Petrolane's terminal at Berth 120 Los Angeles Harbor, the vessel is checked out by this office. Presently, the only known LPG ships in operation are of foreign nationality and are subject to the Coast Guard's Letter of Compliance inspection procedures if the vessel intends to carry propane into U.S. ports. Propane is one of a number of cargoes which are subject to the Letter of Compliance program. The Letter of Compliance program has been in effect since about 1963. Its current form in federal regulations is Part 154 of 46 CFR under the title of Special Interim Regulations for Issuance of Letters of Compliance. This adds special requirements upon the design and equipment based upon the cargo that a ship may carry, in addition to all of the other rules that apply to a ship, and also reflects the more recent IMCO Codes for chemical and liquefied gas carriers. This program begins with plan review done at Coast Guard Headquarters of the several aspects related to the ship's carriage of the cargo, inspection during construction by recognized agencies and the initial and biennial examinations by marine inspectors of the Coast Guard. A vessel not having a current Letter of Compliance is not permitted into a U.S. port.

3. Vessels laden with propane arriving in the near future would be restricted similarly to the FERNWOOD which delivered propane at Berth 120 in November of 1976. Special restrictions are placed upon the vessel to ensure a safe transit in the port. Most of these restrictions are listed in Part II of the Captain of the Port Los Angeles/Long Beach Public Notice No. 21-76 which is a draft of proposed requirements for the carriage of cargoes of particular hazard (which includes propane) in the harbors of Los Angeles and Long Beach.

4. Although these are only proposed requirements, they were applied to the FERNWOOD in November 1976, except for some few details that will be modified in a future draft.

B - HARBOR PROCEDURES

5. A vessel laden with propane would be required to give an 72-hour advance notice of arrival and further state in a message the vessels seaworthiness and the condition of its cargo handling and detection equipment. The vessel shall also give 24-hour and a one (01) hour advance notice of arrival.

6. When the vessel enters U.S. navigable waters (approximately 3 miles from the coastline) it becomes subject to the Navigation Safety and Vessel Inspection Regulations (33 CFR 164) which became effective on June 1, 1977. These regulations require the ship to have certain navigational equipment aboard which must be in good working order, competent persons to use the equipment and navigate the ship, have current charts and publications of the area they are transiting, have its propulsion machinery properly manned and working, test communications, emergency equipment, steering equipment, and main propulsion machinery just prior to entering U.S. waters, lists various navigation practices to be followed, and so forth.

7. As the vessel approaches the harbor entrance several other restrictions would apply. When it approaches the entrance and another vessel is in imminent transit of the harbor entrance, it must wait until that vessel has passed through before entering or leaving. The Los Angeles Pilots normally have excellent control on vessels arriving and leaving such that this passing situation would not likely occur. Also, the vessel must have sufficient personnel for emergency maneuvering, have its anchor clear of the hawse pipe and ready to drop in an emergency, must continuously guard Channel 13 (ship to ship communication), and have no less than two tugs in assistance. If the visibility is less than one mile, the approaching vessel would be denied entry into the port and would be instructed to proceed to the O-3 anchorage or another designated anchorage outside of the harbor. Also the vessel would not be permitted to get underway in the port if the visibility were less than one mile.

8. Once inside the harbor the vessel should have no interference with other vessels in proceeding to or from berth as the other vessel traffic would be restricted. The Los Angeles Pilot Station also assists in the coordination of ship movements. The station uses a radar system to assist the pilot aboard a vessel and he is in voice contact with the radar operator by portable radio. When the FERNWOOD came in, this office closed the Los Angeles Main Channel to other ships when it proceeded to and from berth. Further, the Los Angeles Harbor Department closed this channel to all vessels including small craft and prohibited the takeoff and landing of the Air Catalina Seaplanes and Ports-O-Call helicopters during the vessel's transit of this channel. The channel was secured by using harbor patrol boats. The vessel would be escorted by a Coast Guard boat with flashing light and probably by Los Angeles Harbor Department boats as when the FERNWOOD came in. The same procedures would apply for any movement the vessel makes in port and when heading back to sea even though the vessel had discharged its cargo.

9. Petrolane anticipates an LPG ship arrival approximately every 19 to 23 days. This would be a negligible increase in total ship traffic in the Port of Los Angeles. Although there would be an increase in the number of LPG ships transiting the Port of Los Angeles, the same procedures and restrictions listed above would be applied to each LPG vessel transiting the port.

10. When the vessel is at berth it will have a dedicated tugboat on standby call ready to reach the vessel within 30 minutes, in an emergency. If it is the vessel's first port arrival with LPG, a joint conference with representatives of the Coast Guard Captain of the Port, Coast Guard Marine Inspection Office, Los Angeles Fire Department, Los Angeles Harbor Department, the facility, and vessel personnel is held.

C - DOCK FACILITY

11. In regards to the facility, the entire facility (at the wharf and the storage area) was thoroughly inspected prior to the FERNWOOD arrival by representatives of the Los Angeles Fire Department, Los Angeles Harbor Department, Coast Guard Captain of the Port, and Coast Guard Marine Inspection

Office although the Coast Guard's primary concern was at the wharf where the cargo is transferred. The dock facility is regulated by 33 CFR 126 as a facility of particular hazard, as propane is listed under 33 CFR 124.14(b)(1) as a cargo of particular hazard. The facility complied with all of these requirements. In addition, it satisfied those proposed in the Captain of the Port Public Notice No. 21-76 Parts V through VIII applicable to facilities. Note that these proposed local regulations are to be revised.

12. The electrical installations in the gas hazardous area on the dock are satisfactory. All components are either explosion-proof or intrinsically safe. This topic comes under the cognizance of the Los Angeles Building and Safety Department. The fire fighting capabilities were reviewed by this office and the Los Angeles Fire Department and were deemed to be adequate. This office also required that the facility fire system be connected to the ship's firemain, and that emergency breathing apparatus and fire resistant clothing be readily available on the wharf.

13. The cargo transfer system is essentially new as it has been used only once. Most of its piping's length is underground inside of an insulated jacket. 33 CFR 126 (o)(7)(iv) requires that the cargo piping and transfer arm be hydrostatically tested annually to 1.5 times its maximum allowable working pressure, and similarly its relief valve is to be tested annually. The use of water in a large diameter low temperature piping system is neither practical nor good engineering practice as traces of water cannot be tolerated. Therefore this was pneumatically pressure tested using nitrogen in accordance with Coast Guard Regulations for pressure vessels (as in 46 CFR 54.10-15, and similar to ASME Code UG-100) at 275 psi. After equilibrium was reached, the pressure was locked-in (i.e. its source removed) and held for over four hours. No leaks or pressure loss were found. Note: The proposed rule VII-2 will be modified to allow annual pneumatic pressure tests using nitrogen.

14. The wharf is considered adequate for its primary purpose which is to moor ships. Modifications are considered necessary to accommodate the longer ships that are excepted in the future. The FERNWOOD was approximately 500', future ships may be over 700'. The Port of Los Angeles intends to install mooring points for this. Whether the dock should be of concrete or of wood is not addressed in the rules. Due to the relatively short length of Petrolane's Berth 120, other vessels will not be permitted at Berth 121 (both berths are on the same wharf) when an LPG ship is at this dock. A similar restriction is being considered for Berth 119 nearby. This restriction may be to limit the size of the vessel permitted at 119.

15. Coast Guard personnel will be at the berth the entire time that the vessel is transferring LPG cargo to monitor the operation. This office has stipulated that the transfer will be immediately shut down during emergency situations including fire, electrical storm, or if any cargo is released except for small leaks at fittings which can readily be secured through tightening. Venting of cargo in port is prohibited.

D - ADDITIONAL SHUT-OFF VALVES FOR THE PIPELINES

16. The pipelines between the dock and the storage tank area consists of a 6,000-foot long 16" diameter insulated liquid transfer pipe and a 4" cooldown line. All of it is underground except for its end sections with valves on Petrolane property. It may be accessible where it passes through a culvert under the highway. A vapor return line is not provided.

17. The cargo transfer line has the following valves at the dockend; a manual valve at the end of the Chicksan arm, a remotely controlled fail-safe valve at the base of the Chicksan arm on the dock and nearby on shore in a subsurface concrete pit, an automatic check valve next to another manual stop valve. The cooldown line from the tank farm area connects at this point in this pit with a manual stop valve. The next valving in these lines is at the tank farm area one mile away.

18. The concern is for the large quantity of liquid propane that is in this pipe during and following transfer operations. Should a break occur between valves, it would spill liquid by gravity as well as vapor due to boiloff.

A. It is difficult to envision how such a break might occur in this below ground length due to an external cause other than an earthquake.

B. A major fire at the dock or in the vicinity of the onshore valves could prevent access to the existing valves, though the check valve would automatically protect a break on the dock.

C. In the tankship SANSINENA explosion incident a similar subsurface cargo line was ruptured ashore upstream of its inshore stop valve and fed oil to the fire for several days until it was plugged.

19. The above is food for thought toward recommending or requiring additional intermediate shutoff valves in both the transfer and cooldown lines in an accessible location preferrably in the midlength half toward the dock facility.

20. Fire protection at the dock area might merit upgrading, though it meets present standards. It does have two installed water fire hydrant systems; one off of the city's firemain and a separate emergency system fed off of an electric motor driven pump that takes water suction from the harbor under the dock. Portable dry chemical fire extinguishers and two wheeled semiportable units are also provided when an LPG ship (only one to date) is at the dock. Two water spray monitors were set up on the dock temporarily for this one ship arrival, but this is not a firm requirement. In the event of a major LPG spill and fire this equipment would not be effective and a wider scope plan and capability would be needed.

21. Again, the overall operation by Petrolane can barely be considered as a port related operation. It is primarily served by railway tank cars and tank trucks. The storage tanks are located beyond a land ridge that separates them from the port area. The only connection to the port is the pipeline to the dock which permits occasional ship delivery. The dock is used primarily for the transfer of petroleum products and its construction is like that of many others in the port.

26. The details of this proposed permit procedure regarding the information and action the Coast Guard would require are presently being drawn up at Coast Guard Headquarters in the form of regulations under the authority of the Ports and Waterways Safety Act of 1972, to be issued soon as part of a waterfront facilities advance notice of proposed rule making. This will consist of a total rewrite of 33 CFR 126 and a combining of all safety and environmental facility regulatory requirements in one section of the code of Federal regulations. In addition to this, the Chief of Staff of the Coast Guard has recently established an interoffice Waterfront Facilities Task Force to review, revise and reissue all Coast Guard Waterfront Facility Regulations.

27. As announced in the Federal Register of July 7, 1977, a meeting of CTIAC's Subcommittee on Bulk Liquid Facilities will be held on August 10, 1977. They will discuss the drafting of proposed Waterfront Facility Regulations.

28. The office of Pipeline Safety Operations, Department of Transportation published their newly proposed standards for LNG facilities in the Federal Register of April 21, 1977.

29. Many restrictions placed upon a vessel to ensure a safe transit in the Port of Los Angeles are listed in Part II of the COTP LA/LB Public Notice No. 21-76, which is a draft of proposed requirements for the carriage of cargoes of particular hazard (which includes propane and butane) in the harbors of Los Angeles and Long Beach. Although these are only proposed requirements, many of them have been applied in the past. Note that these proposed local regulations are to be revised.

30. The Coast Guard is considering amending the Navigation Safety Regulations (33 CFR 164) by adding a requirement for vessels of 10,000 gross tons or more, both U.S. and foreign, that call at American ports, to have a second radar system and collision avoidance equipment. This proposal was published in the Federal Register of May 16, 1977.

31. As published in the Federal Register of March 17, 1977, the Coast Guard proposes to amend the Ports and Waterways Safety Regulations (33 CFR 160, 165) by adding a new part authorizing the establishment of Safety Zones. The Coast Guard would protect vessels, structures, waters and shore areas by establishing water or waterfront safety zones, by limiting access to the zones, and by controlling movements in the zones.

E - FUTURE REGULATIONS, STANDARDS AND GUIDELINES

22. LPG is a hazardous substance and its hazards have been recognized. The Coast Guard is still continuing research that may provide findings that prompt new safety measures.

23. The Coast Guard has a study contract under way to establish manning criteria, licensing criteria, and qualification procedures to assure that personnel manning LNG vessels under U.S. flag will possess the highest degree of competence. Many LNG regulations also apply to LPG vessels and facilities. Simultaneously, we have participated in the development of international standards for officers and crews on all seagoing ships.

24. In 1978, a major international conference is scheduled under the auspices of the Inter-governmental Maritime Consultative Organization (IMCO) to develop agreements on qualification of ship's crew. In my opinion, this activity will be a most significant event associated with ship safety, as it is quite well understood that most breaches of ship safety arise from human failure, not failure of equipment. The fruit achieved already in IMCO internationally now appear in the proposed U.S. rules published in the Federal Register of April 25, 1977.

25. Coast Guard permit procedures for marine terminals intending to handle hazardous material have been drafted by a task force of the Chemical Transportation Industry Advisory Committee (CTIAC) under the Coast Guard Marine Safety Council. According to the CTIAC document, a marine terminal proposal would be reviewed by the Coast Guard considering the following broad categories:

A. The waterway conditions between the terminal and the open sea.

B. The berthing area and nearby channels.

C. The land on which terminal equipment is to be located.

D. The specific design, construction and operation of all terminal storage tanks and all appurtenant equipment and all safety, fire protection and security facilities.

E. The procedures to be used in operation.

F. The competence of on-site management and crew assigned to the terminal.

15 - COMMENTS BY U.S. COAST GUARD

F - SUPPLEMENT

32. The comments on Chapter 15, included at the end of this supplement, were received from the United States Coast Guard too late to be incorporated in the text of Final Report. Their comments on Chapter 1 have been incorporated in the text, however.

33. In addition, Section E - FUTURE REGULATIONS, STANDARDS AND GUIDELINES was submitted subsequent to July 7, 1977 Draft Review but has been included at the end of Chapter 15.

34. The following conclusions were also submitted by the Coast Guard for inclusion in the report:

A. The arrival of an LPG ship approximately every 19 to 23 days to the marine terminal of Petrolane, Inc. does not present a problem in ship traffic (see Chapter 15).

B. The electrical installations in the gas hazardous area on the dock are satisfactory. All components are either explosion-proof or intrinsically safe (see Chapter 15).

C. The cargo transfer system was tested and no leaks or pressure loss were found (see Chapter 15).

D. The wharf is considered adequate for its primary purpose which is to moor ships (see Chapter 15).

E. As this facility will also accommodate butane shipments, it might be well to note that butane receives the same treatment in Federal Regulations as does propane.

35. Comments on Chapter 15.

It looks like most of this chapter is taken verbatum from the information previously supplied by us; therefore, many of the following comments are merely editorial recommendations. Because these comments are actually representing the Coast Guard as a whole rather than just this office, it is recommended that "COTP LA/LB be substituted for "this office" throughout this chapter. Also, Coast Guard Captain of the Port, Los Angeles/Long Beach is recommended to be written out on page 1-1, item A-5 and "(COTP LA/LB)" inserted immediately afterwards. If this recommendation is adopted and inserted into the final draft of this report it is recommended that the abbreviation "COTP LA/LB" be used for the remainder of the report. Comments are listed by page and item number.
15-1,A-2 (2nd line) Delete "... This office" and insert "... COTP LA/LB."
(8th line) Capitalize "F" in Federal.
15-1,A-3 (5th line) Delete "... Captain of the Port Los Angeles Long Beach..." and insert "...COTP LA/LB..." (6th line After "...No. 21-76...insert a period and delete the remainder of the item, (Included in item E-5).
15-2,A-4 Delete entire item. This was also considered better addressed in item E-5.

15-3,B-9 We would like to expand on our reasons for the conclusion that increased LPG ship traffic, as a result of this facility, is no problem. Therefore, the following is recommended to be inserted at the beginning of this item:

> "The total number of movements in and out of the Port of Los Angeles and Long Beach per day is on the order of 28. For comparison Rotterdam has nearly eight to ten times that number. Hamburg seven times that number, London and Antwerp four to five times that number. It is also a fact that the number of ports calls into Los Angeles and Long Beach in 1976 was less than in 1966."

15-3,B-10 (4th line) Delete "...Coast Guard captain of the Port... and insert "...COTP LA/LB..." (5th line) Insert "(MIO)" After "...Marine Inspection Office..."

15-3,C-11 (4th line) Delete "...Coast Guard Captain of the Port, and Coast Guard Marine Inspection..." and insert COTP LA/LB and MIO..."

15-4,C-11 (1st line) Delete "...office..." (5th & 6th lines) Delete "...Captain of the Port..." and insert ...COTP LA/LB..." Delete last sentence. It is felt that it appropriately belongs in item E-5.

15-4,C-12 (5th line) Delete "... This office..." and insert "...COTP LA/LB..." (6th line) Delete "...This office also..." and insert "...COTP LA/LB..."

15-5,C-15 (2nd line) Delete "... This office..." and insert "The COTP LA/LB..."

15-6,D-20 We suggest separating items 20 and 21 from section "D - ADDITIONAL SHUT-OFF VALVES FOR THE PIPELINES." Item 20 addresses fire protection and item 21 is merely a closing statement. However, as published they appear to be a part of section "D".

CHAPTER 16

COMMENTS BY COASTAL COMMISSION STAFF

Introduction

1. Questions about the Petrolane LPG facility in San Pedro, as reflected in the Los Angeles Times, April 4, 1977, together with the explosion of the oil tanker Sansinena last December in the Port of Los Angeles and the uncertainties surrounding the safety of proposed liquefied natural gas terminals in California have focused public attention on risk analysis and risk management in the Port of Los Angeles. The Coastal Commission is involved with transportation of hazardous materials in the Port in two ways. Pursuant to Section 30700 et. seq. of the California Public Resources Code, the Port (and the Ports of Long Beach, Port Hueneme, and San Diego) must prepare a master plan for submission to the Coastal Commission. Until the Commission certifies such a plan as being consistent under the Coastal Act of 1976, Coastal Commission permits must be obtained for new developments in each port. The Commission thus must deal with the issue of hazardous materials in both permit and planning work.

Risk Analysis and Risk Management

2. When planning the transportation and storage of LPG, LNG, explosives, and other hazardous commodities that have the possibility of resulting in widespread fatalities, injuries, and damage, we believe that public agencies should prepare a risk analysis and a risk management plan. The risk analysis should systematically identify how risks to the general public could occur. The risk management plan should identify and provide for methods to prevent such risks and to cope with accidents if they do occur. This latter part of the risk management plan is the disaster contingency plan, which outlines procedures for limiting the potential extent of damage.

3. The basic steps were not implemented when the Petrolane LPG facilities were being approved, partly because no public agency had overall responsibility for the project. The Petrolane facilities should not be singled out for criticism, however, because it appears that these steps were not taken for the approximately 40 materials classified as hazardous by the

U.S. Coast Guard and handled in West Coast ports. A number of studies underway address many of the critical safety questions related to handling hazardous materials in the harbor complex and we look to them for assistance in permit and planning work. These include the "General Regulations for the Transport and Discharge of LNG/LPG in Los Angeles Harbor" by the Navigational Safety Committee of the Los Angeles/Long Beach Safety Council, the "Contingency Plan for Hazardous Cargoes" by the United States Coast Guard, and the "Hazardous Materials Task Force Study" commissioned by the Los Angeles City Council.

The Petrolane LPG Facilities

4. Because the studies listed above are being conducted by different agencies, with limited resources, it seems unlikely they will provide a complete risk analysis and risk management plan for Petrolane LPG operations. But such an analysis and plan should be completed before another LPG tanker is permitted to berth at the LPG terminal. We understand no LPG tanker arrivals are expected until next year. The analysis and plans should deal with berthing facility design, LPG carrier safety, harbor traffic control, controls of surrounding land uses, sabotage precautions, and public liability insurance.

Risk Analysis

5. The report being prepared by the Public Utilities Commission staff, with the assistance of other state and local agencies, could be the basis for a complete risk analysis of the LPG operations. One agency should conduct such an analysis and insure that the risk management plan addresses all elements of the risk analysis. The City and Port of Los Angeles have major responsibilities to protect public safety in LPG operations and we anticipate the City's Hazardous Materials Task Force will present a start at a comprehensive risk analysis.

Risk Management Plan

6. No one agency appears to have authority to insure there is a complete risk management plan for the LPG operations. The Los Angeles Department of Buildings and Safety, Fire Department, and Port of Los Angeles, the

United States Coast Guard, and the California Division of Industrial Safety appear to have slices of responsibility and authority. One agency should be made responsible for pulling together all elements of a comprehensive risk management plan.

Contingency Plan

7. The City should develop as part of the Risk Management Plan a specific set of contingency plans to deal with possible LPG disasters anywhere along the LPG transportation system. The Coast Guard contingency plan should be integrated into this plan.

Berthing Facility Design

8. The existing unloading and transfer facility appears to be poorly sited and equipped for receiving LPG tankers. We would strongly support further studies into the possible relocation of the berthing facility and, pending results of such a study, would urge that maximum effort be directed to modifying the wooden berth to ensure that future unloading operations at this facility will pose the least possible hazard to the surrounding area.

Controls on Surrounding Land Uses

9. The LPG terminal is adjacent to petrochemical transport and storage facilities and to a large lumber yard. An LPG accident with major consequences could result not only from direct LPG operations, but also from accidents occurring at these nearby facilities. Thus, surrounding land use should be carefully considered in risk analysis and in port planning.

LPG Carrier Safety

10. Accidents involving LPG ships could be minimized by regulation of the characteristics of ships that will call on the facility. The Coast Guard can set and enforce advanced safety levels for these ships. The Coast Guard could ensure use of the best available navigation and collision avoidance systems, automated off-loading controls, and proper crew selection and training.

Harbor Traffic Control

11. Ship collisions near the LPG terminal or in the entrance channel of the harbor could cause high-consequence accidents, and advanced, computer-aided harbor ship traffic control systems can help minimize this potential safety hazard.

Sabotage Precautions

12. The existing facility has minimal protective devices. LPG vessels entering the harbor and proceeding down the main channel to the berthing facility must pass congested and readily accessible areas.

Public Liability Insurance

13. The City of Los Angeles and the facility operator must operate within the existing legal framework for public liability insurance. In the case of a high-consequence LPG accident, such a legal framework is unspecified.

CHAPTER 17

DELIVERY SYSTEMS - CPUC

1. Propane can be received at the terminal by tank car, truck or ship movements covered in Chapter 15. Locations of inland propane sources include the Bakersfield area of California, New Mexico, Wyoming, Washington and Oregon.

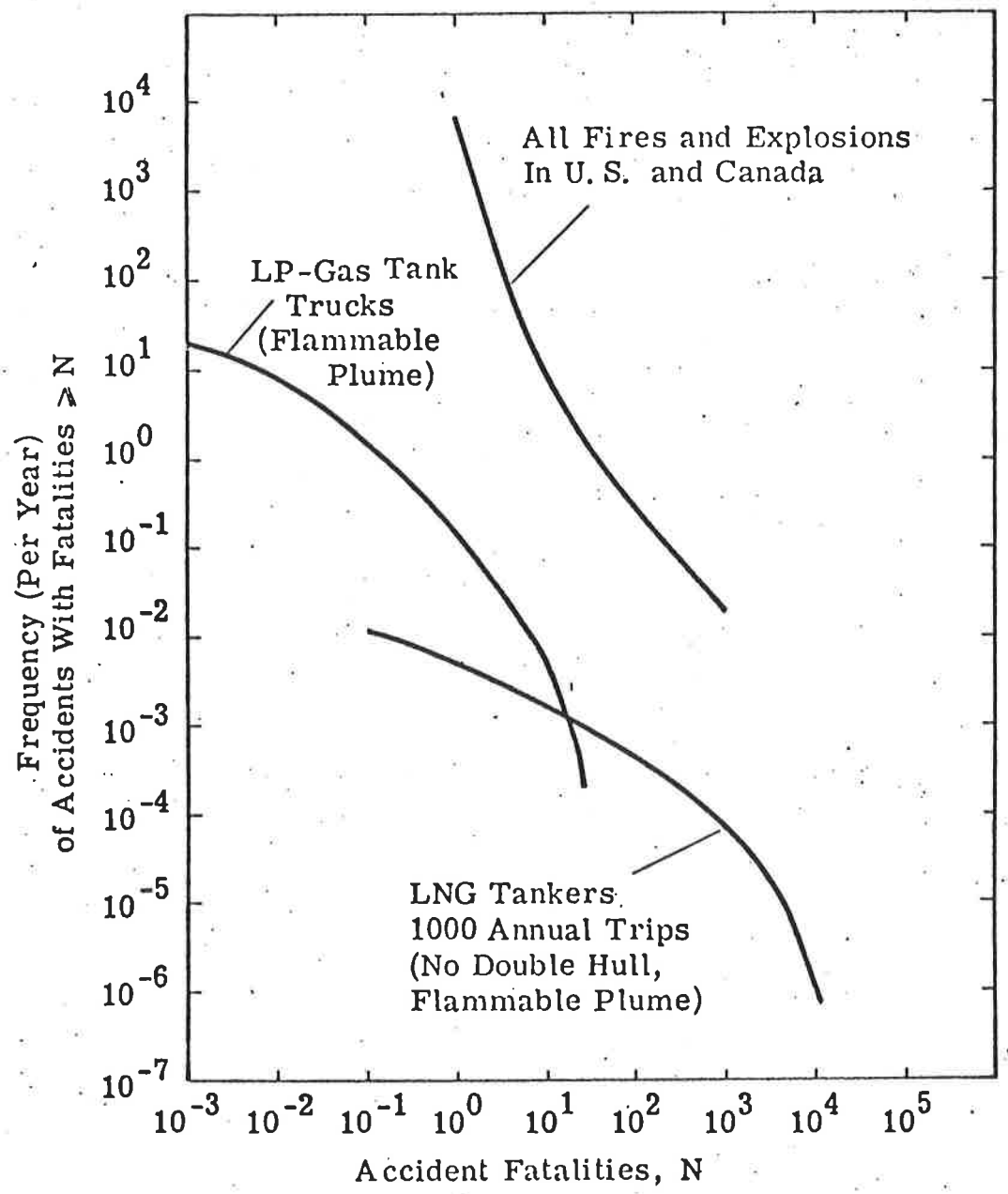
2. Tank trucks are vulnerable to puncture from the many forms of vehicular accidents on highways. Spills during transfer of propane to and from trucks can also occur. Access streets to and from the terminal site will bear more such truck traffic. Approximately 55 truck-trailer rigs per day could be loaded at peak operation. On a nationwide basis, an average of 1.23 fatalities per year were experienced from liquid petroleum gas tank truck accidents from 1931 to 1961.[1/] The estimated LP-gas and LNG risk spectrums are less than 1% of all fires and explosions. The relative risk with other similar hazards are shown in Exhibit 17-1.[1/]

3. Each freeway and some of the streets in the greater Los Angeles area are presently driven by large tank trucks and trailers delivering propane to large customers. Hazards to nearby structures or residents of the greater Los Angeles area are the same as has existed historically.

4. Tank cars loaded and unloaded at the loading docks travel the Southern Pacific and Santa Fe over tracks through the greater Los Angeles area. S.P.R.R. tracks extend northward from San Pedro. A.T. and S.F. tracks run approximately east-west through the city. The volume of propane shipped by Petrolane is very small compared to the volume shipped by others. Petrolane would ship 8 tank cars per day at most. Union and Texaco ship large volumes of butane by rail. Some chemical companies ship 50 cars of hazardous materials per day. GATX ships large volumes of exotic chemicals placarded hazardous. About two-thirds of Petrolane's volume shipped is by truck and one-third is by rail car. Summer volume shipped is approximately 50% rail and 50% truck. Each tank car carries about 30,000 gallons. Plant capacity is one million gpd.

1/ "Risk Assessment of Storage and Transport of Liquefied Natural Gas and LP-Gas", Science Applications Inc., November 25, 1974.

5. An 8-inch pipeline, 3.3 miles in length has been proposed to supply liquid propane to Southern California Gas Company. This line would extend from the terminal north on Gaffey to Anaheim, east on Anaheim generally through the city streets to a mixing plant located in the redevelopment area. The safety of this pipeline and facility has been discussed in Commission proceedings for a certificate of public convenience and necessity, Application No. 56206. Operation of this pipeline installed in residential neighborhoods would pose little additional risk as long as the necessary maintenance was regularly performed.



COMPARISON OF SOME FIRE RISKS

Source: "Risk Assessment of Storage and Transport of Liquefied Natural Gas and LP-Gas", Science Application, Inc., November 25, 1974

CHAPTER 18

ADJACENT LAND USE - CPUC

A - GENERAL DESCRIPTION

1. From Berth 120 the 16-inch line extends in a northwest direction between properties owned by Time Oil and Sun Lumber Companies and alongside petroleum storage facilities. After the line turns westward, it crosses property owned by Sun Lumber, the Los Angeles Container Storage Terminal, the J.S. Gibson Boulevard, the Harbor Department and West Oil Terminals Company property, then continues to the storage tanks.

2. Lumber presently stacked on the Sun property will be moved in the near future. A warehouse exists on the Los Angeles container property. Petroleum storage facilities are standing on the Time Oil and West Oil Terminals property.

3. The dock lies about a mile east and on the opposite side of a ridge which separates it topographically from the storage and transfer facilities.

4. The storage and transfer facilities front on Gaffey Street. Across Gaffey and at a distance of approximately 300 yards is a tank farm for jet fuel storage owned by Bray Oil Company, west of the tank farm is a housing tract. The nearest home is approximately 1,000 feet to the west of Petrolane site. An elementary and a junior high school are approximately 2,000 feet from the facility. South of the Bray Oil tanks are a drive-in theatre and a bakery. North of this tank farm is a naval reservation which is largely open space. East of the two 300,000 Bbl storage tanks, a ridge, as mentioned above, topographically separates the facilities from oil tank farms owned by West Oil Terminals Company. The Los Angeles Refinery of Union Oil Company is located adjacent to and north of the Petrolane facility.

5. The West Oil Terminals Company's facility is engaged in storing and transporting fuel oils. Their fire equipment consists of monitor nozzles and hose carts, located throughout the area. The water supply is from a 10-inch main that is separate from the one on which Petrolane depends. There are, on the average, eight people working on each shift at this facility. The facility has been located at this spot since 1925.

6. The large oil tank storage facility owned by Union Oil Company has an extensive fire fighting system not completely dependent on city water mains. It has a 2,500,000-gallon reservoir and its own water well. In addition, it has a salt water fire system, separate from the fresh water mains. The facility has a 1,000-gallon foam truck and a 900-gallon foam trailer available. There are two cryogenic tanks in Union's facility, similar in purpose to the ones at Petrolane. Union's fire fighting system was studied and used as a guide in establishing the systems for the Petrolane facility.

B - POTENTIAL EFFECT FOLLOWING A LEAK OR RUPTURE

7. The significance of adjacent land use is the consequence of escape of a hazardous amount of propane. In the case of the pipeline, the worst possible situation would be in line rupture. Precedents which could demonstrate the effect of such a rupture would be the pipeline rupture near Port Hudson, Missouri, which allowed the formation of a propane-air cloud covering several acres. Twenty-four minutes after the break, the cloud detonated damaging structures 1,000 feet away. A rupture of the 8-inch propane line owned by Sun Oil at Rumulus, Michigan was caused by a combination of construction defect and operational error. Propane escaped from the rupture, sprayed into the air, vaporized, then ignited. Flames 500 feet high engulfed a 600-foot diameter area. Similarly impacts could result from tank failure. The flames from the failure of two LNG tanks in Cleveland in 1944 radiated heat which ignited combustibles more than 1,000 feet distant. While an accident at Petrolane could theoretically have the same results, the actual effects would depend upon the specific situation at the time of the accident.

8. If a hazardous amount of propane were to escape, the scenarios which could take place are shown in Exhibit 18-1. The resulting propane air mixture could ignite relatively soon after release or ignition could be delayed while propane vapor accumulated in the atmosphere. Liquid propane will expand to about 270 times its volume in the gaseous state. Consequently, even relatively small volumes of liquid spill would result in propane gas overflowing the impoundment basin. Propane is heavier than air so it will tend to flow downhill and collect in low points until dispersed by the wind. Propane gas is considered to be

non-toxic, although the inhalation of high concentration may cause asphyxiation. The principle hazard is from a fire or explosion.

9. If there is an early ignition, damage may be limited to nearby structures. In the case of the pipeline, a rupture and subsequent ignition on the Time Oil property could involve the petroleum storage facilities, or the warehouse on the Los Angeles Container property. Propane burning in the impoundment basin could conceivably involve the Bray Oil tanks and the drive-in theatre across Gaffey Street. Such a conflagration may not affect the three 60,000-gallon pressure vessels or the tank cars at the rail siding since these are protected with sprinkler systems. However, if the wall of a tank is overheated, weakened and subsequently ruptured by an impinging flame, the high velocity of flashing vapors could propel the liquid fragments in all directions.

10. A large propane spill into the sump would result in an initial high boil-off. When the walls and floor of the sump cool to equilibrium with the liquid, its surface would probably calm and vaporization would continue at a lower rate. An attempt would be made to dissipate or to herd the vapors with fog. Winds to assist with dissipation cannot be relied upon, especially in the still of the evening. For about two-thirds of the year, San Pedro is subject to a slight breeze. Propane vapor or gas would probably be displaced from the impoundment as it filled with liquid. The gas would spill over the dike surrounding the sump and gravitate generally downhill to Gaffey Street as discussed in Chapter 12.

11. The scenario of combustible vapor where ignition is delayed for an appreciable interval is a controversial one. Considerable experimentation on the ignition possibilities of a large body of liquified natural gas has been performed by various federal agencies but to date results are not available as pertains to propane. In this scenario propane vapor could accumulate and linger over the site of the escape if there is no wind. If ignition later occurs, damage would be inflicted over a wider area than in the first scenario. A detonation of the cloud could occur. Under certain conditions, ignition at an early stage of the spill is preferable. However, fire fighters probably

would not deliberately ignite escaping propane vapors. It is doubtful that the escape of a hazardous amount of propane would go unnoticed for very long since the ultraviolet and gas detectors, alarms and the operating personnel on duty around the clock would allow early detection and quick reaction. In addition, the Los Angeles Fire Department could be on site in short duration to assist.

12. In order for ignition to occur, the fuel mixture must be greater than 2.4% but less than 9.6% propane in air. When propane gas vaporizes from a body of liquid, there is insufficient air to allow combustion. Sufficient diffusion must occur to bring the concentration of propane down to 9.6%. If diffusion brings the concentration below 2.4%, no ignition will occur. The distance which could be traversed while the gas-air mixture is passing through this range of concentration is unknown at the present time.

13. Most releases of combustible material due to failure of a metallic container are accompanied by ignition. If ignition does not occur at the time of hazardous release, an outside source might be found. Possibilities of ignition source are the pilot in the flare, a cigarette lighter or a vehicle passing through the area, etc. Escaping propane is generally easier to control when burning. If it is not burning, it must be dispersed. Damage from an early ignition would probably be concentrated in the immediate area of the site. The probability of ignition is shown in Exhibit 18-2.

C - OTHER HAZARDS

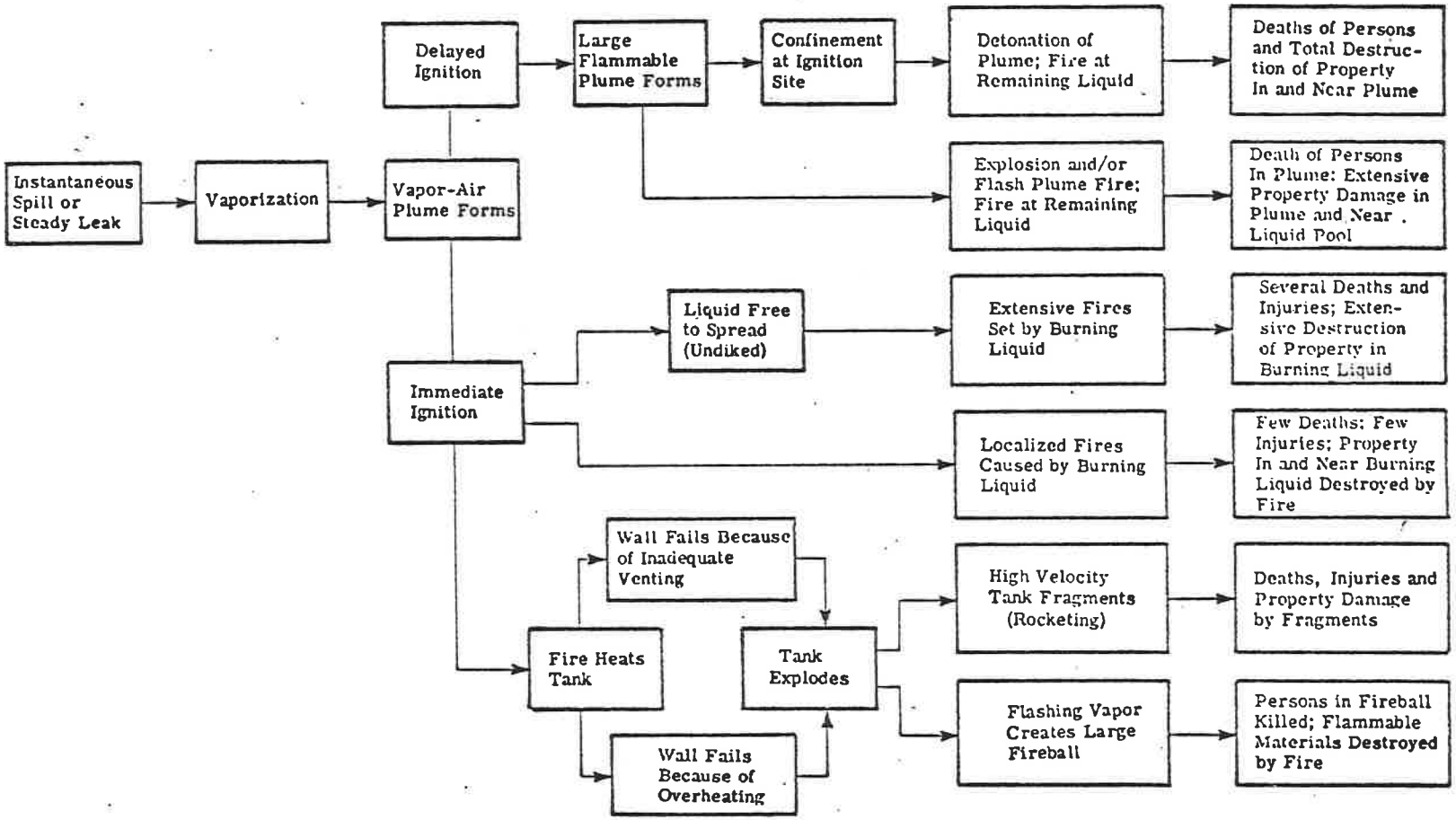
14. Other hazards to which the facility is exposed include an airplane crashing into the facility and sabotage. The Los Angeles metropolitan area has many airports; the closest being the Torrance Airport. It is possible that an out-of-control aircraft could hit the facility. The possibility of such an event is considered remote. Using the data contained in Science Application, Inc., LNG Risk Assessment Study for Los Angeles, California, the probability of an aircraft crashing into one of the LPG tanks is approximately 4 in 10,000 per year. Of all crashes, about 95% are aircraft of less than 12,500 lbs. The impact of relatively light planes would not necessarily pierce the tanks.

The consequences would be the same as for any of the other accidents except that if a rupture did occur, immediate ignition would be almost certain.

15. Sabotage is a potential hazard for virtually any facility. While it could be speculated that the LPG facility has a high possibility of being the target of sabotage, since severe public consequences could result, the probability of an attack cannot be calculated.

16. The consequences of an act of sabotage could not be any more severe than for other scenarios, namely, the spillage of the contents of the tanks.

17. A security system is warranted at Petrolane. A system similar to those being developed for proposed liquefied natural gas (LNG) facilities should be implemented. Due to the nature of a security system, it is not appropriate to discuss the specifics in a published document.



EVENT CHAINS FOR LNG AND LP-GAS LEAKS AND SPILLS

Exhibit 18-1

Plume Area Ignition Probability

Area Range (m^2)	Probability
<30	0.5223
30-100	0.1173
100-300	0.0969
300-1,000	0.0884
1,000-3,000	0.0615
3,000-10,000	0.0479
10,000-30,000	0.0287
30,000-$1x10^5$	0.0183
$1x10^5$-$3x10^5$	0.0094
$3x10^5$-$1x10^6$	0.0052
$1x10^6$-$3x10^6$	0.0022
$3x10^6$-$1x10^7$	0.0011

Source: "Risk Assessment of Storage and Transport of Liquefied Natural Gas and LP-Gas", Science Applications, Inc., November 25, 1974.

REFRIGERATED LPG MARINE IMPORT TERMINAL

Petrolane Incorporated
San Pedro, California

CONSTRUCTION PERMITS AND APPROVALS OBTAINED BY PETROLANE OR PRIME CONTRACTOR

Issue Date	Description	Issuing Department
July 21, 1972	Permit for private fire hydrant system (Permit No. 21630).	L.A. Fire Department
August 14, 1972	Approve slope stability analysis.	Grading Division, L.A. Dept. of Building and Safety
September 1, 1972	Grant request to oil spray cut slopes.	Grading Division L.A. Dept. of Building and Safety
September 7, 1972	Grant request to encroach on pipeline easement.	Department of the Navy
September 15, 1972	Permit for site grading. (Permit No. 57884)	Grading Division, L.A. Dept. of Building and Safety
September 15, 1972	Permit to construct retaining wall (Permit No. 57785)	L.A. Dept. of Building and Safety
September 20, 1972	Permit for two low pressure tanks (not required)	L.A. Dept. of Building and Safety
September 27, 1972	Permit for two low pressure tanks (Reg. No. 21927)	L.A. Fire Department
October 2, 1972	Request granted to place earth fill.	Grading Division, L.A. Dept. of Building and Safety
November 20, 1972	Permit for three pressure tanks (Permit No. 22145)	L.A. Fire Department
December 4, 1972	Permit for 30-year right-of-way at rear of Berth 120 (Permit No. 263)	L.A. Board of Harbor Commissions
December 11, 1972	Permit for compacted fill at 2100 North Gaffey (Permit No. 57884)	L.A. Dept. of Building and Safety
January 2, 1973	Permit for three pressure tank foundations.	L.A. Dept. of Building and Safety

Issue Date	Description	Issuing Department
January 15, 1973	Grant request to install and obtain inspection of conduit under refrigerated tanks.	Electrical Division, L.A. Dept. of Building and Safety
January 29, 1973	Permit for RR crossing over storm drain (Permit No. 73015-B)	L.A. County Flood Control District
February 6, 1973	Grant request for compacted fill.	Grading Division, L.A. Dept. of Building and Safety
February 9, 1973	Approve final geological and soil engineering reports.	Grading Division, L.A. Dept. of Building and Safety
April 16, 1973	Permit for one (1) industrial processing equipment N.O.S. (Reg. No. 22586)	L.A. Fire Department
April 23, 1973	Permit for seven special extinguishing systems and five (5) industrial processing equipment N.O.S. (Reg. No. 22788)	L.A. Fire Department
May 24, 1973	Permit to jack and bore steel casing under Harbor Freeway. (Permit No. 772-E-776485)	Division of Highways Dept. of Public Works State of California
June 1, 1973	Permit to install three (3) propane storage vessels (Permit Nos. A 42936-8)	Boiler and Pressure Vessels Division, L.A. Dept. of Building and Safety
June 21, 1973	Grant request to use special power heating cable.	Electrical Division, L.A. Dept. of Building and Safety
August 20, 1973	Grant request to install and obtain inspection of conduits.	Electrical Division, L.A. Dept. of Building and Safety
October 16, 1973	Permit to install permanently mounted marine arm and connecting buried steel pipelines, Berth 120, Port of Los Angeles (Permit No. P-2-12-73-253)	Coastal Zone Conservation Commission, State of California
November 15, 1973	Grant request to use an unlisted fire protection signaling system.	Electrical Division, L.A. Dept. of Building and Safety

Issue Date	Description	Issuing Department
November 5, 1973	Grant request to install two wire feeder system.	Electrical Division, L.A. Dept. of Building and Safety
December 26, 1973	Permit for installation of roof cover (Permit No. 50823/D)	L.A. Dept. of Building and Safety
January 14, 1974	Grant request to install high-pressure gas piping.	Plumbing Department L.A. Dept. of Building and Safety
January 18, 1974	Fire permit.	L.A. Fire Department
January 29, 1974	Grant request to install unlisted gas analyzer and sensing assemblies.	Engineering R & D Bureau, L.A. Dept. of Building and Safety
February 20, 1974	Grant request to establish electrical classification, Berth 120.	L.A. Fire Department
June 6, 1974	Grant request to use certain electrical heat conductors.	Electrical Division, L.A. Dept. of Building and Safety
June 20, 1974	NPDES permit deemed not necessary.	California Regional Water Quality Control Board
September 17, 1974	Grant request to install unlisted flow switch and level indicator.	Engineering R & D Bureau, L.A. Dept. of Building and Safety
October 2, 1974	Grant request to use unlisted alarm relay, meter and power supply at Berth 120.	Engineering R & D Bureau, L.A. Dept. of Building and Safety
December 26, 1974	Permit for LPG storage and handling system (Permit No. P-59295)	Air Pollution Control District, County of Los Angeles
"	Permit for LPG storage and handling system (Permit No. P-59296)	"
"	Permit for LPG odorizing system (Permit No. P-59298)	"
"	Permit for LPG tank truck loading and unloading facility (Permit No. P-59192)	"
"	Permit for LPG rail car loading and unloading facility (Permit No. P-59193)	"

Issue Date	Description	Issuing Department
December 26, 1974	Permit for LPG process and dehydration systems (Permit No. P-59213)	Air Pollution Control District, County of Los Angeles
December 10, 1975	Permit for plant emergency relief system (Permit No. P-65221)	Air Pollution Control District, County of Los Angeles

LOS ANGELES TERMINAL PROJECT

APPLICABLE CODES

1. Los Angeles City Fire Code
2. Los Angeles City Plumbing Code
3. Los Angeles City Heating, Ventilating and Air Conditioning Code
4. Los Angeles City Building Code
5. Los Angeles City Electrical Code
6. Occupational Safety and Health Standards (OSHA), Part 1910
7. LP-Gas Storage, NFPA No. 58
8. LP-Gases at Utility Plants, NFPA No. 59
9. LNG Storage, NFPA No. 59A (reference only)
10. National Electrical Code, NFPA No. 70
11. Design and Construction of LP-Gas Installations, API Standard 2510
12. Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks, API Standard 620
13. Recommended Practice for Liquid Petroleum Pipelines Crossing Railroads and Highways, API RP 1102
14. Venting Atmospheric and Low-Pressure Storage Tanks, API Standard 2000
15. ASME Boiler and Pressure Vessel Code, Section VIII: Unfired Pressure Vessels
16. California Division of Industrial Safety, Unfired Pressure Vessel Safety Orders
17. Uniform Building Code
18. Petroleum Refinery Piping, ANSI B 31.3
19. Minimum Spacing Standards, Oil Insurance Association (reference only)
20. Regulations Governing Clearances on Railroads, PUC State of California, General Order 26-D
21. Transportation of Natural and Other Gas by Pipeline, Department of Transportation Office of Pipeline Safety