May 3, 1983

Docket No. 50-206
LS05-83-05-006

Mr. R. Dietch, Vice President
Nuclear Engineering and Operations
Southern California Edison Company
2244 Walnut Grove Avenue
Post Office Box 800
Rosemead, California 91770

Dear Mr. Dietch:

SUBJECT: SEP TOPIC II-1.C, POTENTIAL HAZARDS DUE TO NEARBY TRANSPORTATION, INSTITUTIONAL, INDUSTRIAL AND MILITARY FACILITIES - FINAL SAFETY EVALUATION FOR THE SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1

By letter dated December 27, 1982, the staff issued a safety evaluation report on this topic. Your letter of April 21, 1983, provided corrections to this evaluation. Enclosed is our final evaluation of SEP Topic II-1.C for the San Onofre Nuclear Generating Station, Unit No. 1.

We conclude that the probability of explosions exceeding .5 psi over-pressure at the site, due to accidents involving materials on both Route I-5 and the Atchison Topeka and Sante Fe railroad, is about 4.5×10^{-6} per year. This exceeds current criteria, however, the analysis includes sufficient conservatisms such that the risk is judged to be substantially lower than the above value. With regard to these calculations it is requested that the shipment frequencies in the second paragraph of Section 5.2.2 be updated to assure that assumptions made in the evaluation are accurate.

SE04
DSU USE (08)
ADD:
G. Staley

This evaluation will be a basic input to the integrated safety assessment for your facility unless you identify changes needed to reflect the as-built conditions at your facility. This assessment may be revised in the future if your facility design is changed or if NRC criteria relating to this subject are modified before the integrated assessment is completed.

Sincerely,

Original signed by:

Walter A. Paulson, Project Manager
Operating Reactors Branch No. 5
Division of Licensing

Enclosure: As stated

ORB#5
DCrutchfield
5/3/83

OFFICE	cc w/enclosure: See next page			SEPB	SEPB	SEPB	ORB#5
SURNAME				EMcKenna:bl	CGrimes	WRussell for	WPaulson
DATE				5/02/83	5/2/83	5/2/83	5/3/83

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Docket No. 50-206
San Onofre 1

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San Onofre Nuclear Generating Station, Unit 1
SEP Safety Assessment Report
Revision 1

Topic II-1.C - Potential Hazards or Changes in Potential Hazards Due to Transportation, Institutional, Industrial, and Military Facilities

1.0 INTRODUCTION

The objective of this topic is to assure that San Onofre Unit 1 is adequately protected and can be operated with an acceptable degree of safety with regard to potential accidents which may occur as the result of activities at nearby industrial, transportation, and military facilities.

2.0 CRITERIA

Standard Review Plan Section 2.2.1-2.2.2 states that all identified facilities and activities within 5 miles of the plant should be reviewed. Facilities and activities at greater distances should be considered if they otherwise have the potential for affecting safety-related features.

Standard Review Plan 2.2.3 defines design basis events external to the station as those accidents for which a realistic estimate of the annual probability of exceeding 10CFR100 exposure guidelines is in excess of approximately 10^{-7} or for which a conservative estimate of this probability is in excess of approximately 10^{-6}.

3.0 RELATED SAFETY TOPICS AND INTERFACES

A. Topic III-4.D, Site Proximity Missiles (Including Aircraft), October 23, 1981.

B. SCE submittals on NUREG-0737 Item III.D.3.4 - Control Room Habitability, June 13, and June 20, 1981.

C. San Onofre Nuclear Generating Station, Units 2 and 3 FSAR.

D. Analysis of Hazards For Rail and Highway Transportation Routes Near San Onofre Nuclear Generating Station, Unit 1, NUS-4099.

4.0 REVIEW GUIDELINES

Standard Review Plans 2.2.1, 2.2.2 and 2.2.3 were used as review guidelines.

5.0 EVALUATION

Data for hazardous materials, frequency of shipments of hazardous materials and accident rates were extracted from the San Onofre Units 2 and 3 FSAR and are reproduced here for completeness. Additional data and analytic methods are contained in Reference D. These data were analyzed for their effect on Unit 1, taking into account differences in plant design criteria and location with respect to transportation routes.

Where firing or weapon impact is permitted, training is conducted under very close supervision since populated areas, the highway, railroad, and infantry maneuvering areas are located along the seacoast of the reservation to a distance of approximately 5 miles inland.

Firing ranges are shown on U.S. Geological Survey (1968), 7.5 minute quadrangle sheets: San Clemente, Margarita Peak, San Onofre Bluffs, and Las Pulgas Canyon.

The nearest firing range (approximately 3 miles away) is a known-distance range over which small arms are used to gain sighting data. The maximum range of firing is about 100 feet, with rounds impacting into a steep hillside. All other firing ranges are generally inland from Camp San Onofre and located such that the maximum range of the weapons would not permit an impact closer than approximately 2 miles from the plant, even assuming firing was directed toward the plant rather than into the designated sectors. Firing is also directed into hillsides or valleys to avoid any danger of projectile skipping.

Aircraft practice firing and artillery bombardment is controlled at all times and is directed into impact areas located further than 5 miles inland. Aircraft approaches and pullouts do not pass near the plant. There are two bombing and strafing ranges located approximately 6 miles from the plant. Various types of aircraft delivered ordnance of up to 500-pound bombs are employed on these ranges.

No bombardment from the sea is ever permitted, and the shore landing maneuvers do not involve the use of live ammunition. Thus, Marine Corps activities which could otherwise conceivably constitute a hazard to the plant are all conducted well away from the coastline and do not constitute a credible hazard to plant safety.

The Marine Corps indicated that there are no missile sites on Camp Pendleton and none within at least 10 miles of Unit 1.

5.1.3 Transportation Routes

The three transportation routes within 5 miles of the plant are described below:

(1) The old Highway 101, immediately east of the site, does not carry through traffic, but is the entrance road to the south end of San Onofre State Beach.

(2) Interstate 5 (I-5) is east of the site and is the only public coastal vehicular link between Orange County and San Diego County. The 1974-75 estimated average daily traffic was 63,570 vehicles, with an estimated passenger population of 130,240. The years 1970-1974 averaged 3,672 trucks per day adjacent to the plant. This figure includes vehicles over 6,000 pounds, with two or more axles, but does not include buses, vans, campers, and pickups.

A. Size: 12-inch diameter

B. Age: It was constructed in several phases. The section from 0.4 miles northwest to 1.6 miles northwest of the plant was built in 1932. The section from 1.6 to 1.9 miles northwest was constructed in 1960. The section from 1.9 to 2.8 miles northwest was built in 1966. The section from 2.8 to 5.0 miles northwest was built in 1929. And the section from 0.4 miles northwest to 5.0 miles southeast of the plant was built in 1966. About 0.1 miles of pipeline 3.3 miles north of the plant was replaced in 1963.

C. Operating pressure: 400 psig (maximum allowable)

D. Depth of burial: 30 inches average

E. Location: See Figure 1. The pipeline is located approximately 673 feet northeasterly from the centerline of Unit 1 containment. The pipeline is located within the right-of-way of U.S. Highway 101, approximately 5 feet southwesterly of the northeast edge of the right-of-way.

F. Valves: There are three plug valves located 1.3 and 2.8 miles northwest of the plant and 2.1 miles southeast (see Figure 1).

G. Material: Natural gas (91% methane, 5% ethane, 4% miscellaneous)

H. Storage: The pipeline is not used for gas storage

I. Future plans: There are no plans for expansion or to use the pipeline for a product other than natural gas.

J. Leaks: There have been two leaks within 5 miles of the plant. One, in 1967, was approximately 3.5 miles north of the plant, a small corrosion leak with no fire or explosion. The other, in 1963, was approximately 3.3 miles north of the plant, a break in the pipeline due to exterior stress, with no fire or explosion. Repair was made by replacing 449 feet of pipe.

(3) San Diego Pipeline Company - 10-inch refined petroleum products pipeline 2 to 5 miles northeast of the plant in Camp Pendleton. The characteristics of this pipeline are:

A. Size: 10-inch diameter

B. Age: Constructed in 1962

C. Operating pressure: 1,440 psi (maximum)

The number of shipments of hazardous cargo shipped on I-5 adjacent to the plant is given in the second column of Table 1. Several of the cargo categories used for presenting the survey results in Table 1 contain a number of different materials. Table 2 lists the various cargoes contained within these categories.

The expected number of military explosive shipments past the plant on I-5 was estimated to be 1,411 for the year June 1978 through May 1979. The Navy stated that changes in shipment routes and requirements for 911 of the shipments would occur after 1980 so that there will be less than 10% of the 911 shipments. Assuming that the remaining shipments are unaffected, the projected I-5 military explosive shipment frequency is 592. The maximum net explosive weight per I-5 shipment is 11,400 lbs.

5.2.3 Waterways

The principal uses of the coastal waters are pleasure boating, industrial cooling, military exercises, and sport and commercial fishing. Commercial vessel traffic lanes lie at distances greater than 5 miles from the plant. Military exercises are discussed elsewhere in this report.

5.2.4 Projections of Industrial Growth

There are no plans for expansion of existing facilities or new industrial development with 5 miles of the plant. Existing pipelines and waterways are also not scheduled for expansion.

San Diego County, in conjunction with the CALTRANS, has forecast an increase of 45% in truck traffic on I-5 in the vicinity of the plant. Hazardous cargo shipments are expected to decrease on I-5 as a percent of total shipments because increased industrialization in San Diego will provide these products locally. Fuel shipments (gasoline, LPG, LNG, etc.) may decrease in absolute number because of the development of these processing facilities in San Diego and the increasing cost to ship fuels by truck. Explosive shipments by the U.S. Navy will remain constant to the U.S. Marine Corp Camp Pendleton and will decrease for other shipments. Industrial gas and chemical shipments will vary as a function of future industrial process requirements, availability from local sources, products manufactured and shipment costs. The largest increase in truck activity can be expected in food and other consumer products.

5.3 EVALUATION OF POTENTIAL ACCIDENTS

The accidents considered in this section include:

1. explosions of hazardous materials,
2. delayed ignition of flammable vapor clouds,
3. liquid spills,
4. release of toxic vapors,
5. offsite brush fires, and
6. accidents at sea.

$$\text{Correction factor} = \frac{\text{1973 accident rate}}{\text{1971-72 accident rate}} \quad \frac{0.952 \times 10^{-6}}{(2.19 \times 10^{-6} + 2.31 \times 10^{-6})/2}$$

$$= 0.423$$

This factor is applied to the I-5 accident rates based on the assumption that California accident rates would be reduced by the same proportion as that observed on the national level. The fact that the California threshold is \$200.00 vs. \$250.00 for the U.S. DOT would make the correction factor a conservative assumption.

The I-5 accident rate for all trucks corrected to the \$2,000.00, death or injury reporting criteria:

$$0.423 \times 0.566 \times 10^{-6} = 0.239 \times 10^{-6} \text{ accidents/truck-mile}$$

The bulk of hazardous commodities carried on I-5 past the plant are in tank trucks. Nationwide truck accident statistics show that loaded tank trucks have a lower accident rate than all types of trucks combined (1.33×10^{-6} vs. 2.41×10^{-6} for years 1968 through 1972 with the same reporting criteria). Therefore, the I-5 accident rate for all types of trucks (0.239×10^{-6}) is corrected to loaded tank-truck accident rate by assuming the same relative improvement exists in California (I-5) as observed nationwide.

$$\text{Loaded tank truck accident rate on I-5} = 0.239 \times 10^{-6} \frac{1.33 \times 10^{-6}}{2.41 \times 10^{-6}} = 0.132 \times 10^{-6} \text{ accidents/mile}$$

The accident rate for trucks carrying explosives was determined in a similar manner. The nationwide accident rate for trucks carrying explosives is 0.96×10^{-6} accidents/mile. Therefore, the accident rate for trucks carrying explosives on I-5 is:

$$\text{Explosive Truck accident rate} = \frac{2.39 \times 10^{-7}}{2.41 \times 10^{-6}} \times 0.96 \times 10^{-6} = 0.95 \times 10^{-7} \text{ accidents/mile}$$

5.3.2.2 Explosions Due to Transportation Accidents on I-5

There are three categories of materials transported on I-5 which have a potential for creating a hazard for San Onofre Unit 1 in the event of an accident on the highway. These materials are military ordnance, flammable liquids and flammable gasses (shipped as either compressed liquid or compressed gas).

5.3.2.2.1 Military Ordnance

The expected number and size of explosive shipments past the San Onofre site are shown in Table 7. This table is based on information provided by the Departments of the Army and Navy. The explosives are Class 7 (1 pound of explosive is equal to 1 pound of TNT).

$$R = KW^{1/3}$$

where:

R = distance from explosion site to point of interest

K = constant related to overpressure

= 131 feet/lb$^{1/3}$ for 0.5 psi

W = weight of explosive (lb)

Thus:

$$L_i = 3.79 \times 10^{-4}[(131W^{1/3} + 240)^2 - 780^2]^{1/2} \text{ miles}$$

The probability of exceeding 0.5 psi overpressure at the site due to a munitions truck accident on I-5 is calculated to be 1.92×10^{-6} per year.

All other explosive shipments past the plant are Class B explosives which, in general, function by rapid combustion rather than detonation and therefore do not pose an explosion hazard to the plant.

5.3.2.2.2 Flammable Liquids

Flammable liquids are shipped at ambient temperature and pressure and would not pose an explosion hazard unless vaporized. The nature of the explosion or fire for the flammable liquids listed in Table 1 is dependent on the chemical and physical properties of the materials. These chemicals, in general, have low vapor pressures and high vapor densities. Thus, the vapor formed tends to hug the ground, and only a thin vapor interface exists between the air and the liquid. Therefore, spilled liquids are unlikely to produce an explosion with a strong blast wave but will produce a simple flash-over flame igniting the remainder of the fuel.

A review of the materials shipped indicates that gasoline has the highest vapor pressure and therefore the highest evaporation rate. The next most volatile liquid shipped is acetone. For gasoline, the estimate downwind distance to the lower flammable limits is estimated to be less than 460 feet compared to minimum distance to the plant from the highway of 635 feet. This calculation assumes Class G stability, 1.43 m/sec wind speed and 100°F temperature for evaporation. For acetone, the distance to the lower flammable limit is less than 120 feet.

From the above, it is concluded that because of their low vapor pressures, flammable liquids shipped past San Onofre do not contribute to the overpressure or flammable cloud hazards at the plant.

For vapor cloud explosions, it is common practice to utilize a TNT equivalent calculated as follows:

$$W_i = \left[F \frac{Si\ Q\rho}{A} \Delta H_c E \right] \Big/ 500 \text{ Kcal/lb - TNT} \qquad (3)$$

F = Fraction of spill quantity involved in vapor cloud

$\frac{Si\ Q\rho}{A}$ = gm-mole of combustible chemicals spilled

Si = spill fraction

Q = maximum quantity of shipment in volume

ρ = density of liquid

A = mulecular weight

ΔH_c = Heat of combustion $(\frac{Kcal}{gm\ mole})$,

E = Yield of explosion

For liquified gases shipped at atmospheric temperature under their own vapor pressure, the fraction of spill quantity in the vapor cloud is the isenthalpic flash fraction. For compressed gases it is 1.0. These values are consistent with the conservatively assumed instantaneous puff release model. For cryogenic liquids shipped at essentially atmospheric pressure, a 10% flash fraction was used to account for initial vaporization on mixing with warm air and boiling from the spilled liquid pool.

The entire quantity in the cloud was assumed to be involved in the fuel air reaction. The change in the quantity of vapor between upper and lower flammable limits as the cloud disperses was conservatively neglected. Analysis of a drifting puff release has shown that the maximum quantity between flammable limits is on the order of 60-70% for materials of interest here and that for much of the travel distance, it is less than this amount.

To obtain the equivalent TNT yield, the range of explosion yields reported in the literature were surveyed and Table 9 compiled. In Table 9, the yields are roughly combined so as to approximate a value for probability distribution. The given values of the yield are applied to the total quantity of material released from the tanker, rather than the flash fraction. This is consistent with the way that the yield has been defined in the literature.

Equations 2 and 3 give the maximum distance from any structure at which the explosion involving a particular commodity could yield the specified overpressure. The length of route within this distance of a plant safety-related structure can be obtained from the geometrical plant layout shown in Figure 4. This length (and the size of Region I) is spill size and commodity dependent.

considered. The crosswind distance is effectively added to the boundary of Region II to determine the probability of a flammable cloud being swept into a plant air intake.

Most spills of flammable vapor are ignited essentially at the accident site. For example, statistics from the Association of American Railroads indicated that for 81 vapor cloud ignitions, 58% occurred from a few feet up to 50 feet, 18% between 50 and 100 feet and 24% from 100 feet to 300 feet.

Integrated ignition probability as a function of distance from historical data for LPG spill accidents were published in "Risk Assessment of Storage and Transport of Liquified Natural Gas and LP-Gas" by J. A. Simmons. The data indicates that 10.5% of the drifting cloud ignitions resulted in an explosion while 89.5% resulted in a fire.

The magnitude of explosions is dependent on the chemical and physical properties of the material. For LPG, LNG, and liquified hydrogen, the amount of flashing of liquid to vapor was calculated from the enthalpy differences at the cryogenic shipping condition and at atmospheric pressure. The enthalpy of combustion of a stoichiometric fuel-air mixture for each of the flammable gases was equated to the enthalpy of detonation of TNT. For the unconfined vapor cloud explosions of LPG and LNG it was assumed that the maximum yield of the TNT equivalent weight was based upon the probability distribution discussed above. For hydrogen and acetylene, it was conservatively assumed that the maximum yield was 100% of the TNT equivalent weight. Analysis shows that the probability of exceeding 0.5 psi is 0 for LNG and 3.93×10^{-8} for liquified hydrogen.

The annual probability of an overpressurization from a release of LPG was realistically analyzed as an extension of the previous analysis using the following modified inputs:

(1) The single value of possible accident locations on I-5 has been replaced by a distribution across the southbound lanes and shoulder.

(2) Sixty percent of the LPG shipments on I-5 are in tandem trailers with a maximum of 5,000 gallons available for involvement in a vapor cloud detonation. Forty percent are in single tanks with a capacity of 10,000 gallons available for involvement in a vapor cloud detonation.

(3) The single yield of explosion has been replaced by a distribution of yields which is applied to the entire quantity of material released.

A review of LPG shipment data on I-5 shows that most shipments are southbound or on the side of the highway nearest the plant. The possible accident locations used in the realistic analysis were derived from actual truck accident locations along the ten-mile stretch of I-5 near the plant. The resulting locations and the assigned relative probabilities are:

Another possible cause of damage to the plant is a fireball generated by the explosion of tank trucks on I-5. Ignition of a 10,100 gallon LPG tank consuming the entire contents would result in a fireball with a radius of 156 feet with a duration of 7.4 seconds. Since the outer dimension of the fireball is a minimum of 479 feet away from the nearest safety-related building, a fireball caused by an LPG tank truck will not be a hazard to the plant.

5.3.2.2.3 Release of Toxic Gases Due to Transportation Accidents on I-5

Toxic chemicals are transported along I-5 on a regular basis. Tables 1 and 2 list the observed materials transported past the site and their estimated frequency of shipment.

The following five substances have been identified as a result of the probabilistic risk assessment as having probabilities near to or greater than 10^{-7}/years:

(1)	Chlorine	1×10^{-6}/year
(2)	Butane	1×10^{-6}/year
(3)	Gasoline	1×10^{-6}/year
(4)	Ammonia	9×10^{-7}/year
(5)	Propane	2×10^{-6}/year

As a result of the control room habitability review performed on Unit 1 as required by NUREG-0737 Item III.D.3.4-Control Room Habitability, the Unit 1 control room HVAC will be replaced. The new HVAC system will include an automatic isolation feature sensitive to the above chemicals.

5.3.3 Transportation Accidents on the Atchison, Topeka, and Santa Fe Railroad

Hazardous materials transported past San Onofre on the AT&SF railroad track are military ordnance and LPG. The AT&SF Railway Company does not anticipate any other hazardous materials being shipped through the San Onofre area.

5.3.3.1 Accident Rates for AT&SF

Railroad accident rates were determined from data supplied by the AT&SF Railroad for a section of track from Fullerton, California to San Diego (102.5 miles) and passing by San Onofre. Data is for 11 years between 1968 to 1978. During this period, there were 26,378 trains and 10 accidents. Therefore, the accident rate for trains passing San Onofre is:

$$\frac{10 \text{ accidents}}{(102.5 \text{ miles})(26,378 \text{ trains})} = 3.70 \times 10^{-6} \text{ accidents/train mile}$$

It has been estimated that there were 1.98×10^7 explosive train-miles per year based on statistics for a 57 year period from 1917 to 1973. The annual average train miles during this same period was 1.36×10^9. During this 57-year period there were 35 explosions involving in-transit shipments of explosives. The national annual probability of an explosion due to a train accident involving explosives is 3.1×10^{-8} explosions per explosive train mile. The accident rate for the AT&SF is significantly less than the national average. Therefore, using the ratio of AT&SF to the national rate, the probability of an explosion on the AT&SF is 1.05×10^{-8} explosions per explosive train mile. The IIT report also ~~determined~~ a significance factor to account for those accidents which did not yield a significant explosive overpressure. This significance factor is 0.154.

The probability that a munitions train explosion on the AT&SF will cause a peak positive normal reflected pressure at the station which exceeds 0.5 psi is estimated by the following equation:

$$P_{op} = P_{ex} \times SF \times \sum N_i L_i$$

where

P_{op} = The annual probability of an overpressure at the station exceeding the design basis overpressure of 0.5 psi

P_{ex} = probability of an explosion per AT&SF explosive train mile (1.05×10^{-8})

SF = significance factor (0.154)

N_i = the number of munitions train shipments/year which carry a total of W_i pounds net explosive weight past the San Onofre site

L_i = the critical length of track over which the detonation of W_i pounds of TNT would produce an overpressure at the station exceeding the design basis overpressure of 0.5 psi

Values for W_i and N_i assumed for the calculation are given in Table 6. The length of track, L_i, is calculated in a manner similar to that for explosions on I-5, discussed above.

Assuming the entire explosive cargo of a train detonates in-mass, the annual probability of peak positive normal reflected overpressure at the station exceeding 0.5 psi caused by ordnance detonations on the AT&SF track, is 2.0×10^{-8}. This number can be considered to be conservative, and the actual probability of occurrence is expected to be much lower since, if an explosion were to occur in a boxcar of ordnance of the type normally shipped past San Onofre (small arms ammunition) it is more likely to detonate in small individual bursts rather than as a single large blast. Overpressures experienced at the site would be correspondingly lower.

D. Type IV - This type of incident would be caused by a leak, a tank puncture, a released safety valve or a burst transfer line or valve resulting in a controllable fire. The fire may be of considerable time duration and does not result in tank rupture, either due to fire control measures or protective insulation. This type of incident is characterized by a controllable fire with no explosion.

E. Type V - This type of incident would involve a leak or a puncture, either small or large, which does not result in fire. If no source of ignition occurs, the liquid will be dispersed in the atmosphere in a relatively short time. This type of incident is characterized by loss of lading, but no fire.

Reviewing the information available about the incidents cited above, it is concluded that these 163 tank car accidents can be classified as follows:

Type	Number	Frequency of Occurrence
I	3	0.0184
II	19	0.1166
III	54	0.3313
IV	4	0.0245
V	83	0.5092

In addition to the mechanical damage, exposure of LPG cars to fire can lead to explosions. There were 17 incidents involving 49 LPG tank cars during the period of 1965-1970. These accidents can be classified as follows:

Type	Number	Frequency of Occurrence
I	0	0.0
II	39	0.796
III	2	0.041
IV	7	0.143
V	1	0.020

Although fuel-air detonations from fire-induced loss-of-lading accidents are conceivable, it is not credible that the escaping gas would fail to detonate very near the car (the heat from the fire which caused the tank car failure would also be available to initiate the detonation). The probability of a delayed detonation for these cases is accordingly assumed to be zero.

One hundred thirteen carloads of LPG were shipped past the San Onofre site during the first 11 months of 1975. The annual frequency of shipments is taken to be 124 LPG cars/year, based upon the opinion of the AT&SF that there will be minimal future growth in LPG haulage. The AT&SF has also stated that there are no more than two or three LPG tank cars in any one train.

Using an average train length of 70 cars and 10 cars involved in the accident, the annual probability of a Type II rupture due to non-LPG tank car induced fire is 6.5×10^{-8} per track mile.

The combined annual probability for Type II rupture from all causes is 4.28×10^{-6}. If it is conservatively assumed that all Type II events will produce one rocketing fragment, the total annual probability that an LPG tank generated fragment strikes a safety-related structure of the unit is 2.0×10^{-8}.

The effects of missile impacts on the plant are discussed in the assessment of Topic III-4.D, Site Proximity Missiles (Including Aircraft).

5.3.4 Accidents Involving Natural Gas Pipelines

A 12-inch nature gas pipeline is located approximately 510 feet from the nearest safety-related plant structure. An analysis has been performed to determine the likelihood of a pipeline accident that leads to an unacceptable concentration of 4.4% natural gas at the air intake and is documented in the San Onofre Units 2 and 3 FSAR. The analysis results in a negligibly small probability (6.75×10^{-9}/year) of intersection of the 4.4% concentration with the plant intake. The analysis is also applicable to and conservtive for San Onofre Unit 1 for the following reasons:

1. The terrain at Unit 1 is similar to that at Units 2 and 3. However, the bluff between the plant and the pipe line is both higher and steeper at Unit 1 than at Units 2 and 3. Therefore, flow separation from the ground is more likely for Unit 1.

2. The Unit 1 control room air intake is at a lower elevation than Units 2 and 3. Therefore, the gas concentration would be lower at the intake for Unit 1 than Units 2 and 3.

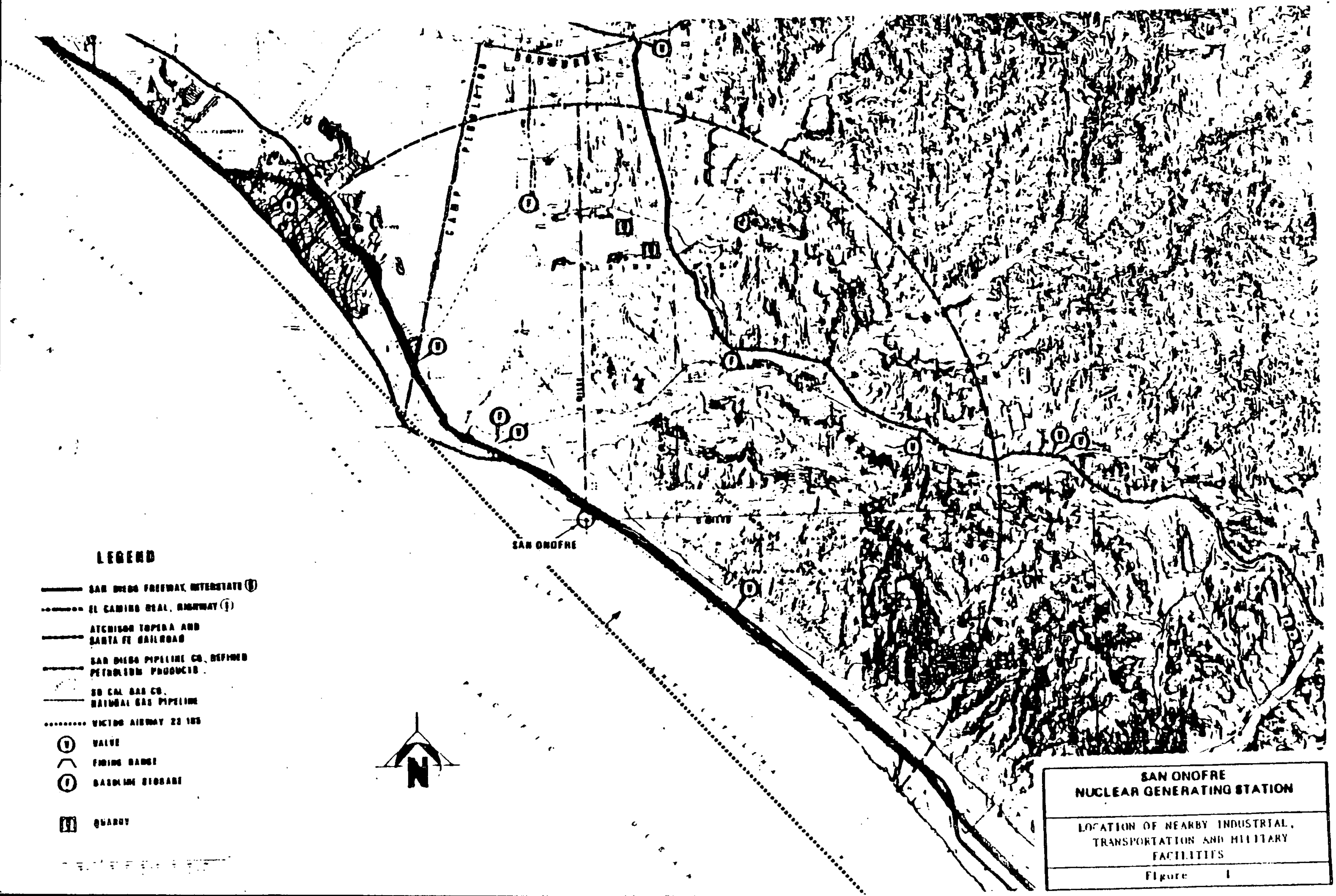
3. The Unit 1 air intake is farther from the pipe line than Units 2 and 3.

5.3.5 Offsite Fires

Offsite fires are not considered a credible hazard to the plant.

5.3.6 Accidents at Nearby Industrial and Military Facilities

There are no significant manufacturing plants, chemical plants, refineries, wells, oil or gas storage facilities, or mining operations within 5 miles of the site. Hazards associated with the Camp Pendleton Marine Corps base are discussed above.



SAN ONOFRE NUCLEAR GENERATING STATION

LOCATION OF NEARBY INDUSTRIAL, TRANSPORTATION AND MILITARY FACILITIES

Figure 1

REGION II DEFINED BY THE BUILDING LAYOUT

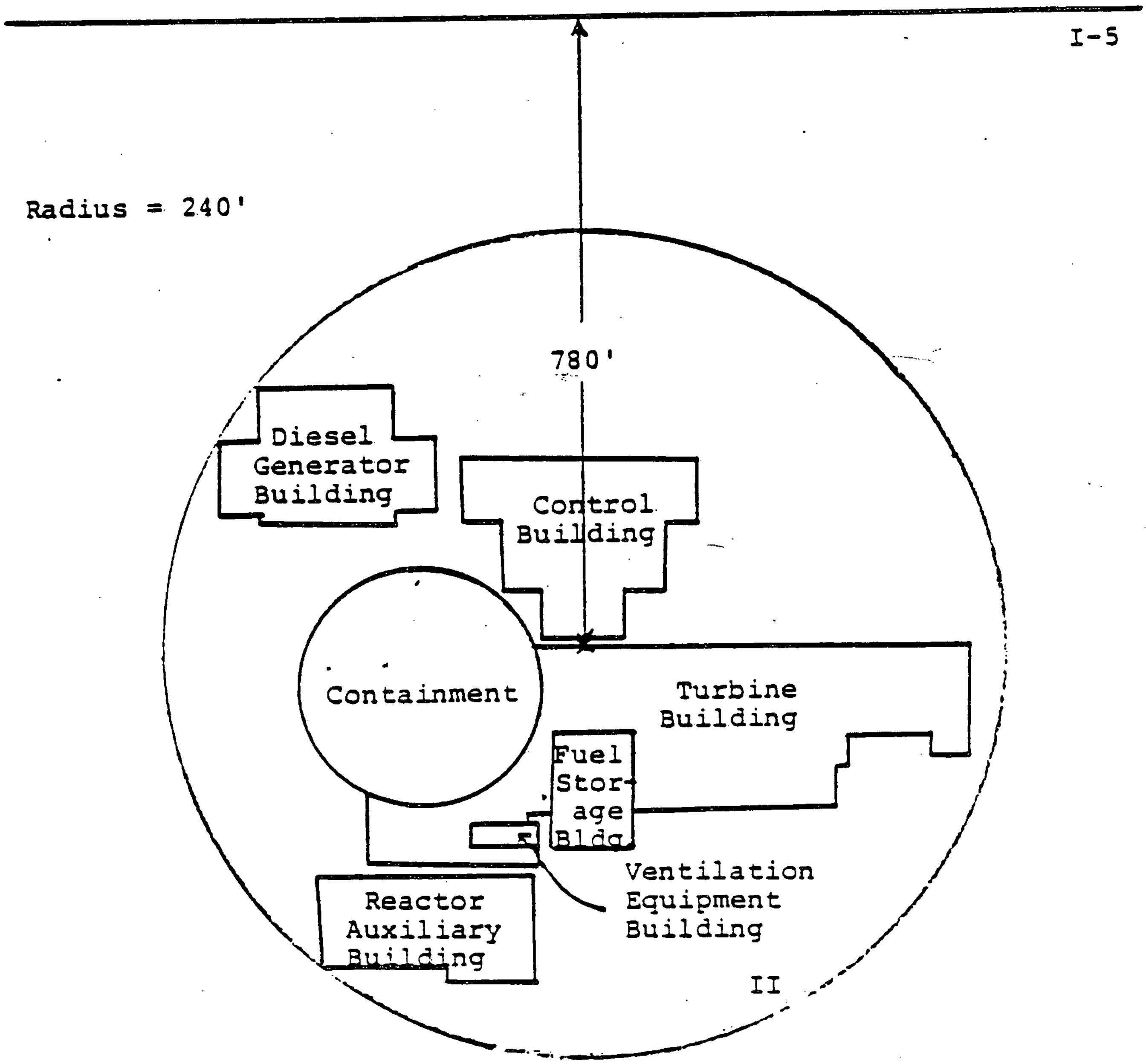


Figure 3

Table 1
HAZARDOUS CARGO TRAFFIC ESTIMATES (Sheet 1 of 2)

Cargo Type	Annual[a] Shipments	Average Shipment Size	Maximum[b] Shipment Size
Flammable Liquids			
Gasoline	17,000	8,600 gal	9.000 gal
Diesel oil	650	7,600 gal	7,900 gal
Jet fuel	910	8,000 gal	9,000 gal
Solvents (See table 2)			
Miscellaneous Petroleum Products (See table 2)			
Flammable Gasses			
Propane (LPG) and Butane	2,200	9,700 gal	10,100 gal
LNG	420	9,200 gal	9,200 gal
Hydrogen (liquid)	52	8,500 gal	
Hydrogen (gas)	260	38 - 219 ft^3 cylinders	75 - 219 ft^3 cylinders
Hydrogen (gas)	24[c]	10 - 11,400 ft^3 cylinders	10 - 11,400 ft^3 cylinders
Acetylene		10 - 330 ft^3 cylinders	

a. Estimate of annual shipments based on survey at truck weighing station except where shipper estimates exceeded that number.

b. Maximum size is based on the actual observed shipments.

c. Not actually observed, identified through a questionnaire survey of all chemical manufacturers in the region.

Table 2
INFREQUENT HAZARDOUS CARGO SHIPMENTS (Sheet 1 of 2)

Chemical	Shipment Size
Solvents	
Acetone[a]	7,600 gal
Diacetone	2,600 gal
Xylene (24 annual shipments[b])	7,500 gal
Shell SOL M-75	1,575 gal
TOLU-SOL-6	975 gal
Naptha	2,725 gal
Methanol[a]	1,000 gal
Ms 20H	8,000 gal
Pentachlorophenol	20,000 lb
Miscellaneous Petroleum Products	
Benzene	300 gal
Motor oil	34,000 lb (typical
Formaldehyde[a] (14 annual shipments[b])	6,000 gal
Weed oil	54,000 lb
Crude oil	7,600 gal
Hydraulic oil	3,900 gal
Perchloroethylene	4,000 gal
Methyl butyl ketone	1,000
Methylene chloride	3,800 gal
Methyl ethyl ketone	13,000 lb
Ethylene dichloride[a]	1,000
Butyl Acetate	22,000 lb
Epoxy	1,000 lb
Poisons and Pesticides	
Methyl bromide	3,500 lb
Corrosives	
Hydrochloric acid	40,000 lb
Surfuric acid	3,340 to 50,000 lb
Muriatic acid	3,120 lb
Nitric acid[a]	2,800 lb

a. Not actually observed; identified through a questionnaire survey of all chemical manufacturers in the region

b. Based on shippers estimate

Table 3A

SUMMARY OF DATA SUPPLIED BY CALIFORNIA DEPARTMENT OF TRANSPORTATION

Calendar Year	Truck Miles on I-5	Number of Accidents	Accidents per 10^6 Miles
1974	20.38×10^6	12	0.589
1975	19.88×10^6	9	0.453
1976	21.83×10^6	15	0.687
1977	22.65×10^6	12	0.530
Combined	84.74×10^6	48	0.566

Table 3B

U.S. DOT INTERCITY HIGHWAY TRUCK ACCIDENT RATES PER MILE

Year	Accident Reported If Over[a]	Accident Rate $\times 10^{-6}$	Injury Rate $\times 10^{-6}$	Fatality Rate $\times 10^{-6}$
1971	\$ 250	2.19	1.00	0.083
1972	\$ 250	2.31	0.996	0.081
1973	\$ 2000	0.952	1.02	0.071

a. Accident also reported if there was an injury or fatality.

Table 3C

NATIONAL TRUCK ACCIDENT RATES

Calendar Year	Total Intercity Vehicle Miles	Total Intercity Accidents	Accident Rate per 10^6 Miles
1968	11704×10^6	29209	2.50
1969	12461×10^6	30672	2.46
1970	12390×10^6	33203	2.68
1971	13951×10^6	30581	2.19
1972	15883×10^6	36682	2.31
Combined	66389×10^6	160347	2.41

Table 5
ASSUMED BOX CAR WEIGHT DISTRIBUTION OF ORDNANCE
TRANSPORTED BY RAIL PAST THE SAN ONOFRE SITE

Boxcar Shipments/yr	Net Explosive Weight/Boxcar (lb)
1	37,000
1	25,500
4	25,000
10	20,000
15	15,000
25	13,000
15	10,000
10	6,000
2	3,000
1	400
84 boxcars/yr	

Table 6
ASSUMED SHIPMENT WEIGHT DISTRIBUTION OF ORDNANCE
TRANSPORTED BY RAIL PAST THE SAN ONOFRE SITE

Munitions Train Shipments/Yr N_i	Total Net Explosive Weight/Shipment W_i (lbs)
1	62,500
2	50,000
5	40,000
7	30,000
1	28,000
12	26,000
7	20,000
1	16,000
4	12,000
1	9,000
1	3,400
42 shipments/yr	

TABLE 7

HIGHWAY MILITARY EXPLOSIVE
SHIPMENT SIZE DISTRIBUTION

Net Explosive Weight (lbs)	Number 7 Shipments	Length of I-5 of Interest (miles)
0-3400	559	0.783
3400-4400	6	0.820
4400-5400	6	0.886
5400-6400	5	0.942
6400-7400	5	0.993
7400-8400	4	1.038
8400-9400	3	1.080
9400-10400	3	1.118
10400-11400	3	1.154
	594*	

* The actual expected number of shipments per year is 592. This sum is greater because fractional shipments calculated from the size distribution were rounded up to the next higher number.