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June 14, 1983

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

SUBJECT: Limerick Generating Station Units 1 & 2
NRC Draft Safety Analysis Report (DSER)
Open Review Items from the Accident
Evaluation Branch (AEB)

REFERENCE: (1) Letter, A. Schwencer to E. G. Bauer, Jr., Dated March 11, 1983

(2) May 25, 1983 Meeting between AEB and Philadelphia Electric Co., Bethesda, Maryland

FILE: GOVT 1-1 (USNRC)

Dear Mr. Schwencer:

The reference (1) letter transmitted, among others, four AEB open review items related to control room habitability, the resolution of which were discussed at the reference (2) meeting. This letter transmits the information requested by AEB at the reference (2) meeting to resolve these open review items, as follows:

AEB 1: FSAR Table 15.10-3 is being changed (enclosure 1) to provide the clarification necessary to resolve this item.

AEB 2 & 3: FSAR Section 2.2 is being changed (enclosure 2) to provide the information requested by AEB at the reference (2) meeting to resolve these items.

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B001 1/1

AEB 4: FSAR Section 6.4.4.2.3 is being changed (enclosure 3) to provide the information requested by AEB at the reference (2) meeting to resolve this item.

The information contained in these draft FSAR page changes will be incorporated into the FSAR, exactly as it appears in the enclosures, in the revision scheduled for July, 1983.

Very truly yours,

Eugene J. Bradley

HDH/cw/30
Enclosures
Copy to: See Attached Service List

cc:	Judge Lawrence Brenner	(w/o enclosure)
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	Atomic Safety and Licensing Board Panel	(w/o enclosure)
	Docket and Service Section	(w/o enclosure)

TABLE 15.10-3

BREATHING RATES
FOR OFFSITE DOSE CALCULATIONS

TIME PERIOD (hr)	BREATHING RATE (m^3/sec)
0 - 8	3.47×10^{-4}
8 - 24	1.75×10^{-4}
24 - 720	2.32×10^{-4}

TABLES (Cont'd)

(1) These tables are provided separately from the FSAR.

that the larger of the two lines (20") ruptures at the point where the pipeline passes closest to the Unit 2 reactor (approximately 3000 feet). It is further assumed to be a double-ended rupture (complete separation of the pipe at the point of rupture).

A portion of the cloud downwind within flammable limits is assumed to ignite and deflagrate. The radiant heat load at the Unit 2 reactor enclosure is calculated to be about 70 Btu per square foot per hour (Ref. 2.2-5) for a short time. This level would cause a slight warming of the outer layer of concrete.

2.2.3.1.3 Exposure to Hazardous Chemical Releases

Exposure of control room personnel to hazardous chemical vapors could potentially result from an accident involving a chemical spill. Such spills could occur on the rail line, one of several highways close by, nearby industrial facilities, or from onsite chemical storage. A chemical is considered a potential hazard if it is stored or transported nearby in such quantities that its concentration at the control room air intake following a spill could exceed the toxic incapacitation concentration. Acceptable toxic incapacitation levels were based on compliance with the Regulatory Guide 1.78 requirement of 2 minutes for operator protective action, NUREG/CR-1741 incapacitation models (Ref. 2.2-8), OSHA exposure limits, and ACGIH concentration criteria.

Potential chemical hazards were identified by first compiling a list of toxic chemicals that could pose a vapor hazard based on Regulatory Guide 1.78, NUREG-0570, and other sources. Surveys were conducted to determine which of these are actually stored or shipped within 5 miles of the Limerick site, with what frequency, and in what quantities. For the railroads, ConRail provided information on which of these are shipped. Shipment frequency and quantity for those chemicals determined to be a hazard to control room operators are indicated in Table 2.2-6. Per Regulatory Guide 1.78, chemicals shipped less than 30 times per year are disregarded. For the highways, no centralized information source exists to determine what chemicals are shipped. A manufacturers and users survey was therefore conducted to ascertain potential shippers and receivers of hazardous chemicals. Various directories were used to identify such manufacturers in Pennsylvania and the surrounding states and users in the local area. Based on geographic location, competing highways, and direct routes, those manufacturers and users who would reasonably use the three highways near the site were

contacted regarding chemicals shipped or received, routes, and container sizes. An analysis was then conducted to determine which of these chemicals, if spilled, could exceed toxic incapacitation levels in the control room. These are listed in Table 2.2-6, along with container sizes.

The analysis assumed complete release of the contents of a single container or tank. In accordance with Regulatory Guide 1.78, it was assumed that after an initial puff of vapor, any remaining liquid spreads over the ground and evaporates. The methodology of Regulatory Guide 1.78 and NUREG-0570 was used to model the initial puff and subsequent plume transport and dilution to the control room air intake.

Insert (1)

The consequences of an accidental release of phosgene gas, a combustion product of vinyl chloride, resulting from a fire in conjunction with an accident involving spillage of vinyl chloride were also evaluated. The phosgene concentration in the control room was calculated using the models of NUREG-0570 and the heat rise models of J.A. Briggs (Ref.2.2-9).

Chemicals stored onsite include carbon dioxide, chlorine, nitrogen, and sulfuric acid, in quantities and at locations listed on Table 2.2-5. Analysis of accidents involving onsite chemicals resulted in identification of chlorine spillage as potentially hazardous to control room personnel.

Replace with Insert 2

As a result of the analyses, 6 potentially hazardous chemicals were identified, as listed on Table 2.2-6.

The Limerick toxic chemical analysis complies with the intent of Regulatory Guide 1.78. The analysis goes beyond the methodologies outlined in this guide in the following areas:

a. In addition to the chemicals listed on Table C-1 of Regulatory Guide 1.78, other chemicals were investigated to determine if potential hazards existed. A total of 153 chemicals were evaluated.

b. The models of NUREG-0570 were used to determine the concentrations of hazardous chemicals in the control room.

c. The more stringent TLV levels were initially used instead of the Regulatory Guide 1.78 Table C-1 toxicity limits to determine which chemicals were potentially hazardous. Table C-2 of Regulatory Guide 1.78 was not used to determine which chemicals were hazardous.

INSERT 1, PG. 2.2-8

The control room concentrations were determined using the following control room parameters:

a. Control room envelope volume of 126,000 ft^3, as defined in Section 6.4.2.1

b. 2100 cfm of incoming/outgoing air, based on the design outside air flow rate supplied by the normal control room HVAC system, as described in Sections 6.4.3.1 and 9.4.1.1.

c. air intake 36.5 meters above ground, as indicated on Figures 1.2-27 and 6.4-2

d. inleakage rate of 0.25 air changes per hour, during isolation, as discussed in Section 6.4.2.3

e. 40 seconds time delay in the ductwork between the detectors at the control room intake PLENUM and the isolation valve at the entry into the control room air space, based on the air velocity in the duct during normal operation.

INSERT 2, PG. 2.2-8

As a result of the analyses, 6 potentially hazardous chemicals requiring monitoring were identified, as listed on Table 2.2-6. A brief description of each chemical and its effects on humans/or laboratory animals are presented below:

Ammonia, NH_3

Ammonia is a colorless gas with sharp, intensely irritating odor. It has an odor threshold of 46.8 ppm for humans (Ref. 2.2-13). Complaint levels of 20-25 ppm were first observed. Human effects such as eye irritation sometimes with lacrimation, nose, throat and chest irritation (coughing, edema of lungs) were found at concentrations up to 700 ppm, depending on exposure time (Ref. 2.2-10, 2.2-11 & 2.2-12). The chemical then becomes lethal starting at 2,000 ppm concentration even for exposures at very short duration (Ref. 2.2-10).

Chlorine, Cl_2

Chlorine in its gaseous form is greenish-yellow in color. It has a disagreeable, suffocating and irritating odor readily detectable at 3-5 ppm. Its effects on humans depend on the concentration. Irritant effects to eyes, nose, throat and/or face were noted at low concentrations. Effects on the upper and lower respiratory tracts and pulmonary edema were reported on exposures at high concentrations. It becomes highly dangerous to be exposed for 30 minutes at 40-60 ppm, fatal at concentrations of 833 ppm if breathed for 30-60 minutes and rapidly fatal after a few breaths at 1,000 ppm (Ref. 2.2-10). There were reports on effects of concentrations around 5 ppm ~~covering~~ CAUSING respiratory complaints, corrosion of teeth, inflammation of mucous membranes of nose and increased tuberculosis susceptability (Ref. 2.2-14).

Ethylene Oxide, C_2H_4O

Ethylene Oxide, a suspected carcinogen, is a colorless gas, sickening and nauseating at moderate concentrations and irritating at high concentrations. Humans exposed even to low concentrations showed delayed nausea and vomiting and at continued exposure, numbing of the olfactory sense. Inhalation at high concentrations resulted in general anesthetic effects as well as coughing, vomiting and irritation of eyes and respiratory passages leading to emphysema, bronchitis and pulmonary edema (Ref. 2.2-10). The lowest toxic concentration by inhalation on humans is 12,500 ppm for 10 minutes with irritant effects observed only (Ref. 2.2-12). Odor threshold is 50 ppm for this chemical (Ref. 2.2-13).

Formaldehyde, HCHO

Formaldehyde, a suspected carcinogen, is detectable by most people at levels below 1 ppm from References 2.2-11 and 2.2-14, 0.8 ppm from Reference 2.2-13. Humans experienced irritant effects on the eyes, nose, throat and upper respiratory tract at concentration ranges of less than 1 ppm to 12 ppm. At high concentrations, a severe respiratory tract irritation which lead to death was reported on humans (Ref. 2.2-14). Inhalation study on rats and mice showed that formaldehyde has a carcinogenic effects on rats. Rats developed nasal cavity squamous cell carcinomas after 12-24 months' exposure to 15 ppm and with deaths during this period. Fatalities on rats were observed also at exposures to 81 ppm concentration (Ref. 2.2-14).

Vinyl Chloride, CH_2 CHCl

Vinyl chloride is a colorless, highly flammable gas at room temperature and atmospheric pressure with a pleasant, sweet odor at high concentrations (Ref. 2.2-10). It is toxic and evidence has shown it to be a carcinogen to persons exposed over extended periods of time (Ref. 2.2-10). Exposure through inhalation at 200 ppm for 14 years showed occurrence of tumors on humans, carcinogenic effects at 500 ppm for 5 years (Ref. 2.2-12). At concentrations above 1,000 ppm, vinyl chloride was reported to slowly effect mild disturbance on humans such as drowsiness, blurred vision, staggering gait, and tingling and numbness in the hand and feet (Ref. 2.2-10). The odor threshold for this chemical is 260 ppm (Ref. 2.2-13).

Phosgene, $COCl_2$

Phosgene is a colorless, nonflammable, highly toxic gas at ordinary temperature and pressure and with a musty hay like odor detectable at 0.5 to 2 ppm. It is a strong lung irritant and causes damage to the alveoli of the lungs. Inhalation of phosgene produces catching of breath, choking, immediate coughing, tightness of the chest, lacrimation, difficulty and pain in breathing and cyanosis (Ref. 2.2-10). Humans experience throat irritation at 3 ppm, immediate eye irritation at 4 ppm and coughing at 4.8 ppm. Brief exposure at 50 ppm may be rapidly fatal (Ref. 2.2-11).

INSERT 2 (CONT'D)

To insure adequate protection of control room personnel, control room operators will be trained and periodically tested on their ability to put on breathing apparatus within 2 minutes after initiation of the toxic chemical alarm. Subsequently, the operators will manually isolate the control room as described in Section 6.4.3.2.3. If chlorine is detected, automatic isolation of the control room occurs as described in Section 6.4.3.2.1.

d. Potentially hazardous chemicals were re-evaluated using the incapacitation models of NUREG/CR-1741 (Ref. 2.2-8) to determine if control room operations would be incapacitated. This analysis is an amplification of Regulatory Position C.4 of Regulatory Guide 1.78.

2.2.3.1.4 Fires

In addition to the flammable vapor clouds discussed earlier, fire hazards may also exist due to a burning tank car on the railroad, a fire subsequent to a ruptured pipeline, or a nearby forest/brush fire. Potential adverse effects of such fires are radiant heat load on plant structures and smoke generation.

To estimate the effects of a railroad fire, an accident is hypothesized in which a railroad tank car derails, ruptures, and releases a cargo of 62 tons of liquified propane. A 62-ton car is typically the largest size used for propane, and from a fire standpoint liquified propane represents one of the most severe materials transported by rail. The site of the hypothetical derailment is the closest point of approach to the Unit 1 reactor enclosure, about 600 feet. The tank car propane is assumed to be released into the drainage ditch alongside the eastern side of the right of way, where it pools and is subsequently ignited. The vapor pressure of liquid propane is sufficiently high at ambient conditions that there will be an adequate supply of gaseous propane for ignition, after which the fire is self-propagating. The fire duration is assumed to be 20 minutes, based on experience with this material.

Assuming 19,600 Btu per pound of propane and 62 tons being consumed in 20 minutes, the radiant heat load on the reactor enclosure may be calculated using the relationship (Ref 2.5-5):

$$D = (FQ/12.57K)^{1/2} \qquad (2.2\text{-}1)$$

where:
- D = distance, feet
- F = fraction of heat that is radiant
- Q = heat release, Btu per hour
- K = radiation load, Btu per square foot per hour

The result of this calculation indicates a radiant heat load of approximately 500 Btu per square foot per hour for 20 minutes at

b. Toxic Chemical Spill

1. Control Room - detection and isolation capability is provided for the 6 chemicals identified as constituting a hazard, as discussed in Section 6.4.

2. Diesel Generators - The manufacturer of the emergency diesel generators has determined that the chemicals identified in Tables 2.2-5 and 2.2-6, when present in concentrations and for time spans calculated using the methodology described in Section 2.2.3.1.3, would have no adverse effects on diesel generator operation.

c. Propane tank car fire - the radiant heat load from such a fire is evaluated as having no adverse effect on safety-related structures. The bulk of the heat load would be absorbed by the pre-cast panels on the face of the structures, which do not serve a safety function.

d. ARCO pipeline fire - smoke detectors in the control room intake alarm, and the operator can manually isolate the control room ventilation system, as discussed in Section 9.4.1.

2.2.4 REFERENCES

2.2-1 Department of the Army, Navy, and Air Force, Structures to Resist the Effects of Accidental Explosions, TM5-1300, June 1969.

2.2-2 United States Nuclear Regulatory Commission, Safety Evaluation Report, Hartsville Nuclear Plants, Dockets STN 50-518 through STN 50-521 (April, 1976).

2.2-3 N. I. Sax, Dangerous Properties of Industrial Materials, 4th Ed., Van Nostrand Reinhold, New York (1975).

2.2-4 M.G. Zabetakis, Safety with Cryogenic Fluids, March 1967.

2.2-5 American Petroleum Institute, Guide for Pressure Relief and Depressuring Systems, API RP521, September, 1969.

2.2-6 American Conference of Governmental Industrial Hygienists, TLV's, Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1978.

2.2-7 United States Environmental Protection Agency, Compilation of Emission Factors, AP 42, 3rd Ed., (July, 1979).

2.2-8 NUREG/CR-1741, "Models for the Estimation of Incapacitation Times Following Exposures to Toxic Gases or Vapors", Gordon J. Smith, David E. Bennet, Sandia National Laboratories, Dec. 1980.

2.2-9 D.H. Slade, Meteorology and Atomic Energy 1968, U.S. Atomic Energy Commission, July 1968.

2.2-10 Effects of Exposure to Toxic Gases - First Aid and Medical Treatment by Braker, Mossman and Siegel — Second Edition

2.2-11 Patty's Industrial Hygiene and Toxicology by George D. Clayton and Florence E. Clayton, Volumes 2A, 2B + 2C — Third Edition

2.2-12 1979 Registry of Toxic Effects of Chemical Substances, Volumes 1 + 2, U.S. Dept. of Health and Human Services, Sept. 1980

2.2-13 Dept of Transportation, Coast Guard CHRIS Hazardous Chemical Data, Oct. 1978

2.2-14 Documentation of the Threshold Limit Value, Fourth Edition, 1980, American Conference of Government Industrial Hygienists Inc.

TABLE 2.2-6

POTENTIALLY HAZARDCUS CHEMICALS REQUIRING MONITORING ~~[illegible]~~

CHEMICAL	Monitor Setpoint (ppm)	MAXIMUM CALCULATED CONCENTRATION (No Control Room Isolation) (ppm)	Monitor Delay (Sec)	Incapacitation Time (min)	Incapacitation Model[5]	SHIPMENT MODE	FREQUENCY (Carlods/yr)	AMOUNT[1]
Ammonia	25	2700	<40	2.7	A	Rail	500-1000	54 tons/carload
Chlorine	0.5	200/730[4]	8	9.4/4.3[3][4]	A	Storage/Rail	500-1000	74 tons/carload
Ethylene Oxide	50	1200	<40	2.6	B	Rail	500-1000	75 tons/carload
Formaldehyde	5	48	<40	9.2	A	Rail	30-99	87 tons/carload
Vinyl Chloride	10	12,000/3300[4]	<40	17.4/25[4]	D	Storage/Rail	500-1000	92 tons/carload
Phosgene	0.4	320	<40	15.3/2.9[4]	B	(2)	--	--

(1) Rail shipments are average weights. No additional chemical hazards were identified when the maximum weight of 90 tons/carload was considered.
(2) Phosgene is a combustion product of vinyl chloride.
(3) For chlorine, data presented are based on automatic isolation of control room.
(4) First value is for storage/Second value is for Railroad
(5) Incapacitation model types, are taken from NUREG/CR-1741.

ENCLOSURE 2, Pg. 11/11

If the concentration of any monitored gas should exceed the selected limits, alarms will be automatically triggered at the analyzer and annunciated in the control room. In addition to the concentration alarms, the system will indicate any malfunction related to electronics, optical system or loss of flow by local indication.

The equipment has built-in test features. A part of the self-test program is automatically performed each time the analyzer is zeroed. The complete functional test can be requested by the operator.

Calibration of the detection system can be verified at any time by using a closed loop calibration system.

No special maintenance is required.

6.4.4.2.3 Respiratory Protection

Full-faced PRESSURE DEMAND self-contained breathing apparatus RATED FOR ONE HOUR PER CYLINDER and protective clothing are available for control room operators.

~~Respiratory equipment designs and capabilities are constantly improving. For this reason, specific equipment has not yet been selected for Limerick. When specific equipment is selected, consideration will be given to these improvements, as well as to reliability, durability, and serviceability.~~ The number of respiratory devices shall, as a minimum, provide a six hour air supply for six individuals. Consistent with the provisions of Regulatory Guide 1.95, one extra respiratory device will be provided for every three devices needed to meet the minimum capacity.

INSERT:

A six hour onsite bottled air supply is provided by charged cylinders maintained for backup fire protection and health physics use. Offsite replenishment is provided by compressors (fill capacity greater than 30 cylinders per hour) located at the Barbadoes and Peach Bottom Stations of PECo, located approximately 16 miles and 50 miles, respectively, from Limerick.

ENCLOSURE 3, PG. 2/2

Control room operators are included in the provisions of the Respiratory Protection Program. The Respiratory Protection Program includes training in the method of donning the equipment, proper use and care of the equipment, equipment limitations, and verification of individual capability to achieve and maintain a proper facial seal. ~~Personnel familiar with the equipment should be able to don and start use of the respirator within two minutes.~~

A program for periodic inspection of control room operator respiratory equipment will be established. The program will address inspection for defects, storage conditions, and, as found to be necessary, cleaning, disinfecting, and repairing. In addition, the equipment will be cleaned, disinfected, and inspected after each use. Replacements and repairs will be done only by trained personnel using parts designed for that equipment. The equipment will be stored to protect against dust, sunlight, extreme heat or cold, excessive moisture, and damaging chemicals.

6.4.5 TESTING AND INSPECTION

The control room HVAC emergency system filtration components are tested in a program consisting of the following classifications:

a. Predelivery tests and factory component qualification tests to ensure the quality of the manufactured product

b. Preoperational tests in accordance with the requirements of Chapter 14

c. Periodic tests in accordance with the requirements of Chapter 16

The frequency of tests and inspections is selected to ensure the continued integrity of the system. Charcoal testing frequency is in accordance with Regulatory Guide 1.52 for the efficiency claimed and the bed depth specified.

CONTROL ROOM OPERATORS WILL BE PERIODICALLY TESTED TO CONFIRM THEIR ABILITY TO DON AND START USE OF RESPIRATORY EQUIPMENT.