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July 6, 1983

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

Docket Nos. 50-352
50-353

Subject: Limerick Generating Station, Units 1 and 2 Request for Additional Information from the Auxiliary Systems Branch (ASB)

Reference: Telecon between J. N. Ridgely (ASB Reviewer), T. G. Szonntagh (PECo), and D. A. Klein (Bechtel) on July 5, 1983

Dear Mr. Schwencer:

In response to the requests made by Mr. J. N. Ridgely in the reference telecon, enclosed are the draft revisions to the response to questions 410.10 and 410.12.

These responses will be incorporated into the FSAR revision scheduled for August, 1983.

Sincerely,

Eugene J. Bradley

Copy to: See Attached Service List

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QUESTION 410.10 (Section 3.5.1)

Provide a discussion of an analysis for each rotating component which verifies that if an internally generated missile were generated, the casing would be capable of retaining the missile. For each rotating component whose casing cannot retain the internally generated missile and the missile could damage safety-related equipment, provide (1) a discussion of the methods used to protect the safety-related train and its redundant train and other safety-related structure, systems and components in the path of the missile and (2) a drawing showing the component, missile paths, means of protection for other equipment, and the redundant safety-related train. This applies to both inside and outside containment.

1. Verify that no secondary missiles will be generated from any internally generated missile.

2. Verify that any internally generated missile from safety-related equipment will not affect the redundant safety-related train.

3. Provide the basis for concluding that "...other rotating components..., such as fans, do not have sufficient energy to (be)...considered missile hazards."

RESPONSE

1. The bases for considering it unlikely for rotating components, other than those identified in Section 3.5.1, to break through their casings and adversely impact safety-related equipment are the following:

   A review of event reports on file at Small the Nuclear Safety Information Center, Oak Ridge National Laboratory, concerning failures of fans and missile generation indicated that no fan failures have resulted in generation of missiles in safety-related areas of a nuclear facility. Pump failures resulting in generation of missiles, are considered more improbable than fan failures resulting in generation of missiles because pump casings are generally thicker than fan casings and pump speeds are generally lower than fan speeds. Even in the unlikely event that a rotating component does break through its casing, much of the component's kinetic energy would be dissipated in moving through the casing, thereby decreasing the probability of the component adversely damaging a safety-

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related component. Therefore, generation of secondary missiles from the internally generated missiles described above is not considered credible. It is an even lower probability that a rotating component would adversely affect redundant safety-related systems because redundant equipment is generally located in different areas or separated by barriers.

Protection for potential missiles from large pumps is discussed in Section 3.5.1. Potential missile sources identified outside primary containment are the residual heat removal and core spray pumps whose impeller sections are surrounded by concrete, and the HPCI and RCIC turbines whose missiles would be contained by their concrete compartment walls. These compartment walls would also retain any secondary generated missiles. Failure of the recirculation pump or motor (located inside containment) would not result in damage to the containment or vital equipment, as discussed in Section 3.5.1.2. Other rotating components inside containment are unlikely to produce missiles capable of penetrating their casing.

2. As discussed in Section 3.5.1, the internally generated missiles described above will not affect the redundant safety-related train.

3. The bases for concluding that "... other rotating components ..., such as fans, do not have sufficient energy to (be) ... considered missile hazards," are the reasons discussed in Item 1 above and as described below.

Insert A

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The possibility that any pump or fan, other than those identified in Section 3.5.1, will fail at Limerick and generate a missile which has sufficient energy to penetrate a component casing is remote. A review of the analyses of internally generated missiles PERFORMED for Palo Verde and San Onofre verified that postulated missiles from pumps and fans (e.g., a pump impeller or fan blade) typically do not have sufficient energy to penetrate the component casings. Since Limerick uses pumps and fans which are generally designed and constructed in accordance with the same recognized industry codes and standards as those installed at Palo Verde and San Onofre, results of the rigorous analyses conducted for those plants are indicative OF THE STRUCTURAL INTEGRITY OF LIMERICK EQUIPMENT.

~~It was further verified that no internally generated missiles will cause loss of function of any REDUNDANT systems required for safe shutdown.~~

INSERT A. Continued

All HVAC fans located in safety-related enclosures are listed in Table 410.10-1, along with the reason why they are not credible missiles which could adversely affect redundant equipment needed for safe shutdown. For many fans, there are barriers which separate the potential fan blade missiles from essential systems. These barriers consist of walls, floors and ceilings which totally enclose the potential missile and are sufficiently thick to prevent spalling. All redundant f s needed for safe shutdown are separated by adequate barriers.

The only fan blades which have the potential for damaging redundant components needed for safe shutdown, if they escape through their casing, are the drywell area unit cooler fans. A study was performed for these fans which demonstrated that the fan blades do not have sufficient kinetic energy to penetrate their casings.

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Table 410.10-1

Potential HVAC Fan Missiles

Fan #	Description	Area	El	Comment
OAV-109	Standby gas treatment exhaust	8	350	(b)
OAV-127	Control room emergency fresh air supply	8	304	(a)
OCV-126	toilet room exhaust air fan	8	322	(b)
1AV-206	Reactor encl. equip. comp. air exhaust	15, 16	313	(b)
OAV-132	Drywell purge exhaust	8	350	(b)
OAV-131	Standby gas treatment room gas exhaust	8	350	(b)
1AV-213	Reactor encl. air recirc.	15	313	(b)
OAV-120	Aux equip. room air return	8	304	(b)
OAV-121	Control room a/c return exhaust fans	8	304	(b)
1AV-512	Diesel gen encl. vent air exhst	DG	Bldg	
1AV-201	Refueling floor air supply	15	313	(b)
1AV-202	Reactor encl. air supply	16	313	(b)
1AV-204	Refueling floor air exhaust	16	313	(b)
1AV-205	Reactor encl. air exhaust	16	331	(b)
OAV-124	Battery room air exhaust	8	304	(b)
OAV-114	Aux equip rm air supply	8	304	(b)
OAV-116	CR air supply	8	313	(b)
OAV-118	Emer. SWGR and battery rm	8	217	(b)
1AV-208	RCIC pump rm unit cooler	15	177	(c)
1AV-209	HPCI pump rm unit cooler	15	177	(c)
1AV-210	RHR pump rm unit cooler	15	177	(c)
1HV-211	Core spray pump rm unit cooler	11, 12	177	(c)
1HV-212	Drywell area unit cooler	15C	246	(d)
OAV-140	SGTS room unit cooler	8	332	(b)
OAV-141	SGTS room access area unit cooler	8	332	(b)
OAV-542	Spray pond pump structure air supply	Spray pond		(c)

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Table 410.10-1 (cont.)

(a) These potential missiles ~~are installed in equipment which~~ ARE ONLY USED during ACCIDENT SITUATIONS. They are not considered credible potential missiles BECAUSE INTERNAL MISSILE GENERATION IS NOT POSTULATED TO OCCUR CONCURRENTLY WITH OTHER ACCIDENTS

(b) These potential missiles are either remote from or separated by adequate barriers from all essential systems. Therefore, essential systems are protected from these potential missiles.

(c) INSERT B

(d) The casing thickness is sufficient to prevent penetration by a loose blade.

INSERT B

(c) The potential missiles are enclosed in compartments which separate redundant systems from one another. Even if an internal missile was generated in one of these compartments, damage would not occur to all redundant systems and safe shutdown could be achieved even when assuming an additional single active failure. This conclusion is based on failure analyses performed for high and moderate energy pipe breaks, in which all essential systems in these compartments are assumed to be lost as a direct result of the pipe break, and an additional single active failure is assumed.

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QUESTION 410.12 (Section 3.5.1)

Your tornado missile spectrum does not conform to the guidelines of the standard review plan (NUREG-0800 July 1981) Section 3.5.1.4 nor does it conform to the guidelines of standard review plant (NUREG-75/087, May 1980) Section 3.5.1.4. Revise the FSAR to include the following tornado missiles at all elevations:

1. steel rod, 1 inch diamter x 3 feet long, weight 8 pounds (velocity = .6 x total tornado velocity);

2. steel pipe, 6 inch diameter x 15 feet long, schedule 40, weight 285 pounds (velocity = .4 x total tornado velocity);

3. steel pipe, 12 inch diameter x 15 feet long, schedule 40, weight 743 pounds (velocity = .4 x total velocity);

and to include the following tornado missiles at all elevations up to 30 feet above all grade elevations within 0.5 miles of the facility structures;

4. utility pole, 13.5 inch diameter x 35 feet long, weight 1490 pounds (velocity = .4 x total tornado velocity); and

5. Automobile, frontal area 20 square feet, weight 4000 pounds (velocity = .2 x total tornado velocity)

RESPONSE

Limerick was originally designed for the three tornado missiles listed below: wood plank (4 in. x 12 in. x 12 ft), steel pipe (3 in. diameter x 10 ft, schedule 40), and an automobile (not more than 25 feet above ground). This design basis was accepted by the NRC at the construction permit stage, June 1974. ← Insert 1

The exterior walls and roof thicknesses have been evaluated for the tornado-resistant enclosures listed in Table 3.3-2 and are capable of withstanding all of the missiles listed in ~~the above~~ Table 3.5-4 ~~question~~. The 4000 psi strength concrete walls and roofs have minimum thicknesses of 24 inches and 18 inches, respectively (Table 3.5-8). This exceeds the minimum acceptable missile barrier thickness requirements specified in Table 1 of Standard Review Plan (NUREG-0800, July 1981) section 3.5.3.

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Insert 1

The design basis was subsequently updated, as shown in Revision 17 of the FSAR, to include the five missiles listed above. The spectrum of missles for which LGS has been assessed is now expanded to 7 missiles as shown in revised table 3.5-4.

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Insert 2

Where necessary to protect safety-related components, the doors in these enclosures have been designed to withstand the 1-inch steel rod and utility pole in addition to the original three design basis missiles. Table 3.5-4 has been changed to include these additional two missiles. This design is in accordance with the November 1975 version of the Standard Review Plan (NUREG 75/087), section 3.5.1.4.

Insert A

For the following cases of the doors not analyzed for 6-inch or 12-inch diameter steel pipes, certain openings in the tornado-resistant enclosures not analyzed for tornado missiles (e.g. blowout panels), certain yard structures (e.g., manhole covers, valve pit roofs) not analyzed for tornado missiles, the probability of tornado missiles going through any of these features, adversely impacting safety-related components, and preventing safe shutdown is considered sufficiently low for the following reasons:

a. The total area of the nontornado-resistant features that have safety-related components located behind them is extremely small compared to the total area of the tornado-resistant portions of the enclosures.

b. To penetrate a nontornado-resistant feature and travel a sufficient distance to impact a safety-related component, a missile would need to strike the feature at a perpendicular angle.

c. Much of the missile's kinetic energy would be dissipated in breaking through the nontornado-resistant feature, which reduces the possibility of the missile adversely damaging a safety-related component even if it strikes one.

d. Redundant safety-related components are normally located in different areas of the plant or yard or are separated by walls so that a single tornado missile would not damage both redundant systems.

Insert B

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Q 410.12

Insert 2

Where necessary to protect safety related components, the doors in these enclosures have been designed to withstand the 1-inch steel rod, the utility pole, the 6-inch steel pipe and the 12-inch pipe in addition to the original three design basis missiles. This design is in accordance with the standard review plan (NUREG-0800 July 1981).

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INSERT "A"

¶ The probability of any of the above tornado missiles penetrating any of the openings and structures (not specifically designed to be resistant to the above missiles) and then adversely impacting safety-related components, such that safe shutdown is prevented, is considered low for the following reasons:-

INSERT "B"

¶ Evaluations have been carried out considering all SEVEN (7) tornado missiles listed IN TABLE 3.5-4 and their penetration / impact on the openings and non-tornado designed structures of the plant including manhole covers and valve pit roofs. Our findings ARE that, even though some singular safety-related components may be affected, damage would not occur to all redundant systems and safe shutdown could be achieved, even when assuming an additional single active failure. 2

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TABLE 3.5-4

TORNADO-GENERATED MISSILE PARAMETERS

	MISSILE	WEIGHT (lb)	IMPACT AREA (ft^2)	VELOCITY (mph)/(ft/sec)	KINETIC ENERGY (ft-lbs)
1.	Wood plank (4 in. x 12 in. x 12 ft)	200	0.333	300/440	6.01×10^5
2.	Steel pipe (3 in. dia x 10 ft, schedule 40) (SEE NOTE 3)	78	0.067 ~~0.063~~	144/211 ~~100/147~~	5.39 ~~2.62~~ $\times 10^4$
3.	Automobile ~~(not more than 25 ft above ground)~~ (See Notes 2 and 3)	4000	20	72/106 ~~50/73.5~~	6.98 ~~3.36~~ $\times 10^5$
4.	Steel rod (1 in. dia x 3 ft)	8	0.007	216/317	1.25×10^4
5.	Utility pole (13-1/2 in. dia x 35 ft, not more than 30 ft above all grade elevations within one-half mile of the plant)	1490	1.266	144/211	1.03×10^6
6.	Steel pipe (6 in. dia x 15 ft, schedule 40)	285	.259	144/211	1.97×10^5
7.	Steel pipe (12 in. dia x 15 ft, schedule 40)	743	.886	144/211	5.14×10^5

Notes:

1. The design basis for Limerick included only missiles 1, 2, 3, 4, and 5. All safety related structures and openings in structures have been assessed for the effects of missiles 6 and 7.
2. Limerick was originally designed for a postulated auto missile not more than 25' above grade for all safety-related structures. All safety-related structures have been reassessed for the effect of the automobile at elevations up to 30' above all grade levels within one-half mile of the plant.
3. LIMERICK WAS ORIGINALLY DESIGNED FOR POSTULATED MISSILE VELOCITIES EQUAL TO 100 MPH FOR THE 3 INCH DIAMETER STEEL PIPE AND 50 MPH FOR THE AUTOMOBILE. ALL SAFETY RELATED STRUCTURES HAVE BEEN REASSESSED FOR THE REVISED VELOCITIES SHOWN IN THE TABLE.