Joint Report of Limerick Ecology Action, Staff and Applicant

In its July 26, 1983 Second Special Prehearing conference Order, the Board ordered the parties to include in the submission of SARA/EROL section 7 contentions a joint report on the course, status and results of discussions regarding the identification of issues and the proper course of litigation of those issues.

The parties have, in two conference calls, discussed the general thrust and intent of the contentions being filed. They have also discussed the goals and timing of litigation. Due to time constraints inherent in the decision-making process required for the City of Philadelphia to decide whether or not to file SARA contentions (which it very recently decided not to do), it was not possible for LEA to discuss in detail the wording of contentions -- rather, time was spent coordinating LEA's filing with contentions the City was contemplating filing.

Further discussions will be held among the parties once Staff and Applicant's experts have had an opportunity to review the written contentions carefully. Meetings among the parties may follow, if it appears they would be productive.

At this time, both the Staff and Applicant reserve comment on LEA's position that consideration of alternatives to reduce or avoid environmental impacts from severe accidents is required under the Commission's regulations, and on the course of litigation. Their positions on these matters will be filed with their written responses to the individual contentions.

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Anticipated Course of Litigation

In its July 26, 1983 Second Special Prehearing Conference Order, the Board expressed its concern over the "scope, nature, and practicalities of useful litigation of 'bottom line' risk contentions based on chapter 7 EROL analysis in the context of the total NEPA environmental analysis." Slip op. at 9, (footnote).

The National Environmental Policy Act of 1969 (NEPA) and the Commission's Statement of Interim Policy on Nuclear Power Plant Accident Considerations Under the National Environmental Policy Act of 1969 (Interim Policy on Severe Accidents Under NEPA) mandate an accurate disclosure of the environmental risks of severe accidents posed by Limerick operation.

The accuracy of the risk assessment depends upon the appropriateness of the methodology and assumptions employed in the calculations. Therefore, litigation concerning the accuracy of the numbers used to express the environmental risk of severe accidents, numbers that will be factored into the Staff's NEPA cost-benefit analysis, must necessarily focus upon the methodology and assumptions chosen.

Once accurate bottom-line risk numbers have been ascertained, both the Applicant and Staff are required to include them in a cost-benefit analysis that balances the environmental (and other) effects of the facility and the alternatives available for reducing or avoiding adverse environmental (or other) effects. (See contention SARA-6). There is no

requirement that the risk of severe accidents tip the cost-benefit analysis against licensing, for the consideration of alternatives to reduce or avoid adverse effects to come into play. As this Board has noted, "Although the overall cost/benefit balance for a plant may be favorable, the National Environmental Policy Act (NEPA), 42 U.S.C. §§4332 et seq. (1976), authorizes the Commission, and Licensing Boards in particular, to impose license conditions to minimize particular impacts. Detroit Edison Co. v. NRC, 630 F.2d 450 (6th Cir., 1980)..." Partial Initial Decision (On Supplementary Cooling Water System Contentions), slip op. at 8. In fact, the Commission itself has in essence made the threshold determination regarding the significance of the risk of severe accidents by issuing its Interim Policy On Severe Accidents Under NEPA and requiring their consideration in Staff environmental impact statements. At least a consideration of alternatives to reduce or avoid impacts follows, from the Commission's regulations regarding the contents of such impact statements. (Again, see Contention SARA- 6).

In summary, intervenors anticipate development of accurate risk values through litigation on the methodology and assumptions used in SARA. Such risk numbers will then be factored into the cost-benefit balance for the plant, which includes exploration of possible mitigative/preventative alternatives to the design, mode of operation, procedures and/or number of reactors proposed in the licensing application.

Since ultimately it is the Staff that must satisfy the requirements of NEPA, even though intervenors are required to file severe accident-related environmental contentions before the DES/FES are issued [see, Duke Power Company, (Catawba Nuclear Station, Units 1 and 2), CLI-83-19, 18 NRC ____,_____ (July 1, 1983), slip op. at 12-13], litigation of such contentions prior to issuance of those documents would generally be premature and inappropriate. There may be instances in which the Staff position on a contention has been made clear prior to issuance of the DES/FES and that position is in agreement with the position of the Applicant, that is, opposed to the contention. Early litigation may under those circumstances be appropriate, and even wise. Since the supplement to the DES, which will include the Staff's severe accident analysis, is scheduled for October of this year, the timing of litigation of environmental contentions may be moot in any case.

Catawba Balancing Test For Late-filed Contentions

In its July 26, 1983 Second Special Prehearing Conference Order, the Board directed Limerick Ecology Action (LEA) to address the factors set forth in the Catawba decisions,[1] which factors the Board will then balance in determining whether or not so-called "late-filed" contentions are admissible. The five factors of 10 CFR §2.714(a)(1) are as follows:

(i) good cause, if any, for failure to file on time;

(ii) the availability of other means whereby the petitioner's interest will be protected;

(iii) the extent to which the petitioner's participation may reasonably be expected to assist in development of a sound record;

(iv) the extent to which the petitioner's interest will be represented by existing parties;

(v) the extent to which the petitioner's participation will broaden the issues or delay the proceeding.

The three-part test overlayed by the Appeal Board in Catawba (and affirmed by the Commission as appropriate in an admissibility determination) is that the contention:

(a) is wholly dependent upon the content of a particular

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1. Duke Power Co. (Catawba Nuclear Station, Units 1 and 2), ALAB-687, 16 NRC 460, 469-70 (1982); Duke Power Co. (Catawba Nuclear Station, Units 1 and 2), CLI-83-19, 18 NRC ____, _____, slip op. at 5-6 (July 1, 1983).

document;

(b) could therefore not be advanced with any degree of specificity (if at all) in advance of the public availability of the document; and

(c) is tendered with the requisite degree of promptness once the document comes into existence and is accessible for public examination.

LEA is submitting SARA/EROL section 7 contentions at this time, and addresses the five 2.714(a)(1) factors as overlaid by the three-part test.

The EROL section 7 consideration of severe accidents (and the backup document SARA) were prepared by the Applicant , in response to a request by the NRC Staff, after preparation and submission of the remainder of its application, and therefore were not available to intervenors for review at the time contentions were originally due in this proceeding. Consequently LEA has good cause for failure to file its SARA contentions at that time -- the documents upon which the contentions are based were not available.

LEA's contentions are either based wholly on those documents or are contentions partially or totally carried over from PRA contentions previously submitted. (The Board and parties are all well aware of the evolution of the severe accident analysis from the Limerick PRA to SARA, and that need not be reiterated here.) Thus, in fact, some of LEA's SARA contentions are not "new" in the sense addressed in the

Catawba decisions.

Since the EROL section 7/SARA severe accident analysis was not available for review when contentions were originally submitted, those of LEA's SARA contentions that challenge the assumptions and methodology of SARA could not have been advanced at all, let alone with any specificity (again, with the exception of those related partially or wholly to the PRA, in which case they were filed previously).

The contentions are now being "tendered with the requisite degree of promptness," since they are being submitted according to the schedule agreed to by the Board and parties.

LEA has no other means to protect its interests as stated by these contentions, in that no other regulatory or judicial body has jurisdiction to hear these matters, either at the federal, State or local level. It is the NRC's duty, under its licensing authority, to review all safety matters and to issue an adequate environmental impact statement related to licensing and operation of the facility, and that authority cannot be usurped by any other body.

Nor will LEA's interests be adequately protected by any party currently participating in this proceeding. None of the governmental entities participating presently can reasonably be expected to adequately represent LEA's interests, considering the nature of the competing political and other interests that influence their decision-making. Only two other intervenors have the resources available to them to be represented

by counsel, and the scope of their interests (for Del-AWARE, the matter of Point Pleasant, and for the Graterford prisoners, their own health and safety during an emergency at the Limerick facility) is very narrow.

LEA's participation in contentions related to SARA/EROL section 7 can be expected to assist in developing a sound record, in that many of the issues LEA raises it has raised previously, in the context of the PRA. Thus LEA has demonstrated an interest in pursuing its issues to their conclusion. In addition, LEA has obtained expert assistance for pursuing many of its contentions, which, while not required for licensing proceedings, is an aid to the Board as well as to LEA.

Admission of LEA's SARA contentions will broaden the issues and delay the proceeding only in the broadest sense. Certainly, if the environmental risk numbers in SARA are not litigated, litigation time for this proceeding will be shortened. However, LEA has not raised in these contentions any truly new issues. Rather, the focus of litigation has turned from the PRA to SARA, due to changes in the "rules of the game"--due to new policy statements issued by the Commission. However, it is still LEA's intention to focus on mitigation/prevention of accidents during operation of the facility. In that sense nothing has changed and the scope of the proceeding would not be broadened by admission of SARA contentions.

For the reasons set forth, LEA believes that it is appropriate for the Board to admit its SARA/EROL section 7 contentions.

SARA-1 (LEA)

SARA modelling of internally initiated sequences was not realistically performed.

(a) In its quantification of accident sequences, the applicant underestimated interfunctional dependencies by failing to link together functional fault trees corresponding to different functions (including dependencies arising from support systems that service more than one frontline system, and those arising from equipment hardware shared among frontline systems).

(b) Errors of logic were made in some system fault trees that sugnificantly affect system unavailability values.

(c) Some Limerick support systems were not considered at all in the accident sequences. Some of these may be important in that functional dependencies would be uncovered that significantly affect the probability of core melt.

Unless modelling of accident sequences is performed properly, SARA will not be useful in an analysis of potential mitigation schemes for Limerick, nor will SARA accurately reflect the environmental effects of operation as required by NEPA.

BASIS

A Review of the Limerick Generating Station Probabilistic Risk Assessment, NUREG/CR-3028, BNL-NUREG-51600, Brookhaven National Laboratory, February 1983. Partial correction of errors in (a) and (b) alone, made by Brookhaven in its review, increase the core melt frequency by a factor of five. See chapters 3 and 5.

Also see PWR Severe Accident Delineation and Assessment, NUREG/CR-2666, UCLA-ENG-8284, section 7 on Limerick.

SARA-2 (LEA)

The procedure used in SARA for binning of internally initiated accident sequences was improper -- accident sequences were improperly classified, containment event trees were improperly constructed, and failure modes were grouped into too few release categories. Because the release categories do not contain enough detail, it is necessary to smooth the release category probabilities, as was done in WASH-1400. PECO did not do so, and thus SARA does not accurately reflect the risk of severe accidents during opration, as required by NEPA.

BASIS

A Review of the Limerick Generating Station Probabilistic Risk Assessment, NUREG/CR-3028, BNL-NUREG-51600, Brookhaven National Laboratory, February 1983. Smoothing by Brookhaven increased acute fatalities by a factor of 5.5 and latent fatalities by a factor of 3.25. See chapter 6.

NOTE:

In making its decision to resubmit two of its PRA methodology contentions as SARA contentions, LEA carefully reviewed the Board's comments in its July 26, 1983 Order regarding lack of specificity and vagueness, as well as its general discussion regarding the evolution and uncertainty of PRA methodology.

LEA submits that the methodology challenged in these two contentions is in large part in opposition to accepted risk assessment modelling methodology. Furthermore, LEA respectfully submits that to the risk assessment-trained eye, its allegations are as specific as they can reasonably be without reproducing chapters 3, 5 and 6 of the Brookhaven review upon which LEA relies. LEA requests that the Board review or have

reviewed those chapters prior to making its admissibility determination. While LEA has no reason to believe that the Staff will not incorporate the Brookhaven corrections into its own risk assessment calculation for the DES/FES, LEA wishes to protect its interest by filing the contentions, with the understanding that they may be dropped at a later time, after the DES/FES have been issued.

SARA-3 (LEA)

The use of a special "sheltering zone," between radii of 10 and 25 miles from the plant, in which people are assumed to engage in normal activity and then are "rapidly relocated" (SARA, p. 10-11), is improper and without foundation in fact. Use of the model improperly decreases the prediction of health consequences in SARA.

BASIS

No planning exists or is presently contemplated for such a "rapid relocation." While NRC emergency planning guidance contmeplates the possibility of ad hoc response beyond the approximate 10-mile plume exposure EPZ, in the case of Limerick the ad hoc "rapid relocation" of the population between the 10 and 25-mile radii of the plant is impracticable. The population in the year 2000 between 10 miles and 20 miles from the reactor is 821,103 (SARA, Table 10-3, p. 10-34). The population between 20 and 25 miles is 2,728,550 (SARA, Table 10-2, p. 10-33) -- the total being 3,549,653. No precedent exists for the "rapid relocation" of such a large population, and the model's assumption is implausible.

SARA-4 (LEA)

The consequence model employed by the Applicant in SARA is deficient because it fails to employ site-specific emergency response data, and instead employs a generic emergency response model that is at variance with the available site-specific data.

BASIS:

Severe Accident Risk Assessment, Limerick Generating Station, NUS Report 4161 (1983); Limerick Generating Station Emergency Plan, Appendix H, "Limerick Nuclear Generating Station Preliminary Evacuation Time Estimates", NUS-3552 (July, 1980).

While SARA partially resolves the source of greatest error in the PRA consequence model, as it separates evacuation delay time from traveling time and attempts to provide a distribution of population delay times and a more realistic evacuation speed, the generic model used in SARA is at variance with site-specific data and employs a questionable data base.

The site-specific evacuation times in Appendix H of the Emergency Plan include a calculation of "highway movement time". LEA has contended earlier that the evacuation time study is defective in a number of respects, some of which relate to the calculation of highway movement time. See,

"Supplemental Petition of Coordinated Intervenors", LEA contention VIII-6, pp 85-87 (Nov. 1981).

However, even accepting this calculation of highway movement time, the actual evacuation speed for the Limerick plume exposure EPZ is 2.5 mph. (See, SARA, p 10-10). Despite the availability of actual site evacuation speed information, SARA employs a "generic" 10-mph evacuation speed, which is at variance with the site information.

Calculation of accident consequences is sensitive to evacuation speed assumptions. See, generally, Aldrich, David and Jones, Richard, "A Model of Public Evacuation for Atmospheric Radiological Releases", SAND 78-009, Sandia Laboratories (June 1978); NUREG/CR-2300 "PRA Procedures Guide", (Review Draft), (Sept. 1981), Appendix E.

The use of the 10-mph "generic" evacuation speed rather than the site-specific 2.5 mph speed therefore results in an understatement of consequences.

The use of the 3 hour notification time for seismically induced accidents is also an understatement, since site-specific notification time for Limerick in the absence of a 15 minute warning capability (which would be absent in the

event of a seismic event of magnitude exceeding a safe-shutdown earthquake) was calculated to be 5 hours, as opposed to three hours.

The "generic" delay time calculation and distribution depends upon an inadequate data base, and its application to a specific site was improper. See attached excerpt from, Sholly, Steven, "Report on Review of Severe Accident Risk Assessment, Limerick Generating Station", UCS, (August 1983).

Finally, the generic model fails to consider that a percentage (from 6-50%) of the population ordered to evacuate will not do so. See, Hans and Sell, "Evacuation Risks-An Evaluation", EPA-520/6-74-002, US EPA (June, 1974).

V.2 Use of Generic Evacuation Modeling Assumptions

The SARA (pages 10-10 through 10-11) makes use of the Sandia generic evacuation modeling parameters of delay times of 1, 3, and 5 hours with a probability of 30, 40, and 30%, respectively, at a radial evacuation speed of 10 mph. This model was derived in a 1978 Sandia publication [20; 21] and was derived from the same report [22] from which the original WASH-1400 evacuation model was derived.

The EPA report upon which both models and the SARA report rely evaluated evacuation data for 64 evacuations which occurred between 1959 and 1973. It should be noted that the purpose of the report was not to create a model of evacuation for reactor accidents; rather, the report was intended to assess the risk of death, injury and economic damage associated with the evacuation of the population surrounding a fixed nuclear facility [22, page x]. The events evaluated did not represent a statistically random sample, but were selected on the basis of judgment [22, page 5]. Of the 64 evacuations evaluated, only twelve involved more than 10,000 persons (there was no data on another evacuation) [22, page 10]. Only four of the evacuations studied involved the movement of more than 100,000 persons. Further, based on a review of Appendix B of the EPA report, 50% of the evacuations studied were to five miles or less (just over 35% were to one mile or less) and there were no data for evacuation distance for just over 14% of the evacuations.

The WASH-1400 model was based only on transportation accidents. Of the 64 total evacuations studied in the EPA report, only twelve involved transportation accidents. Of these twelve transportation accidents, only ten had enough data to permit analysis [WASH-1400, Appendix VI, pages 11-6 and J-8]. The WASH-1400 model included delay time within the definition of effective speed, whereas the revised model from Sandia separates the two. However, both models are based on an analysis of the data from the same ten evacuations due to transportation accidents.

A review of these ten accident evacuations is most enlightening. Only one of the ten involved the evacuation of an area larger than 15 square miles (the rough size of the EPZ is 314 square miles). Only three of these accidents involved the evacuation of more than 5,000 persons (one involved 7,500, one involved 35,000, and the third involved 150,000 persons). Of the ten transportation accident evacuations, only four involved a travel distance of 10 or more miles (two of these evacuations involved 2,000 and 7,500 persons).

The largest transportation accident evacuation involved the evacuation of a portion of Baton Rouge, Louisiana, due to a chlorine barge accident in which no chlorine was released. The conditions for the evacuation involved a clear, dry day, and the use of expressways for the evacuation which occured in August 1965. The area evacuated was 8 square miles and required two hours [WASH-1400, Appendix VI, page J-8, Event Number 36]. The data summary for the ten transportation accident evacuations used as the data base is attached to this review and comes from page J-8 of Appendix VI to WASH-1400.

WASH-1400 summarized its analysis of the ten transportation accident evacuations and modeled evacuation generically as a 30-40-30% weighting of effective speeds of 0, 1.2, and 7.0 mph (effective speed in this case includes delay time before evacuation) [WASH-1400, Appendix VI, page 11-6]. The revised Sandia treatment separates out delay time, and models evacuation generically (as indicated above) as a 30-40-30% weighting of delay times of 1, 3, and 5 hours at an average speed of 10 mph. While this is conceptually more realistic (that is, it is more realistic to separate out delay time and

transit time), in practice the specific parameters used are dependent upon the same ten transportation accident evacuations as the original WASH-1400 analysis.

I consider the Sandia generic treatment to be extremely weak. Its application to Limerick is ludicrous. The 1980 NUS evacuation time estimate study [23] derived evacuation transit times for the Limerick EPZ of four hours under fair weather conditions and five hours under adverse weather conditions. Assuming for the sake of argument that these results are correct, and assuming a nominal 10-mile EPZ, these evacuation times translate (in the CRAC2 evacuation model terms) into evacuation speeds of 2.5 and 2.0 mph (1.12 m/sec and 0.89 m/sec), respectively. This is in contrast to the 10 mph assumed in the CRAC2 generic model and in the SARA.

Moreover, the notification times provided in the NUS evacuation time estimate study [23, page 1-3] are useful to provide an indication of the possible notification times under circumstances where the planned alert and notification system (sirens) would not be functional. These results indicate warning times for the entire EPZ of five hours under fair weather and six-and-a-quarter hours under adverse weather. These results should be contrasted with the uniform three hours notification time assumed in the SARA for seismic-initiated accidents [SARA, page 10-15].

The difference between a three and five hour delay time may be significant. The Sandia siting study [24] contained a sensitivity study for the impact of delay time on early fatalities for an evacuation speed of 10 mph (the sensitivity will be different for slower evacuation speeds). These results [24, page 2-47], for a 10-mile EPZ, show that increasing from a three-hour delay to a five-hour delay causes: (a) a 52% increase in mean early fatalities; and (b) a 25% increase in 99th percentile early fatalities.

In summary, the treatment of evacuation modeling for Limerick in the SARA consequence analysis, based on generic data, is wholly inadequate. Site-specific values should have been used where they are available. Moreover, the basis for the generic data is very scanty indeed, and its acceptance for sites in general should be with an extreme dose of skepticism. Its application in the SARA to a specific site was improper, and seems to have been done more for the sake of convenience than for any other reason.

One final item arises in conjunction with the EPA report. The EPA report found that 6% of the population will refuse to evacuate, even if a mandatory order is given. The EPA report also cited other studies which suggest that the non-evacuating fraction of the population can be higher than 50% under some circumstances [22, page 48]. Significantly, the EPA report concluded, ". . . people will not evacuate an area, regardless of the danger, if their family group is separated, unless they know that members of their family are safe, accounted for, and that arrangements have been made for them to evacuate" [22, page 49]. This has obvious implications for emergency planning and evacuation time estimate studies.

V.3 Frequency of Adverse Weather and Impact on Consequences

The SARA [pages 10-10 through 10-11] states that adverse weather conditions occur about 4% of the time and that their contribution to risk is "not likely to be large" as a justification for not modeling evacuation separately for adverse weather conditions. The SARA also asserts that the Sandia evacuation model considered adverse weather conditions in its data base. It should be noted that of the ten evacuations which constitute the data upon which the Sandia model is based, only two involved adverse weather

(one rain and one snow). The rain event involved the evacuation of 4,000 persons from a 0.35 square mile area a distance of one mile and required 3 hours (in response to a chlorine barge accident; Event Number 34 in the EPA report). The snow event involved the evacuation of 3,000 persons from a 1.8 square mile area a distance of 2 miles and required 4 hours (in response to a chlorine barge accident; Event Number 38 in the EPA report). The average evacuation speeds for these events were, based on the Sandia evacuation model format, 0.33 mph for Event Number 34 and 0.50 mph for Event Number 38.

It is clear that such events are different from the average event modeled by the Sandia generic model with an evacuation speed of 10 mph. Indeed, these speeds are a factor of 2-3 less than the evacuation speed assumed in the SARA for seismic events which is 1.12 mph (0.5 m/sec) [SARA, page 10-15]. Thus, the justification of SARA for not modeling adverse weather situations with different evacuation parameters than for fair weather situations is quite weak to non-existent.

Adverse weather cannot be considered to be uncommon for Limerick. The site receives more than 30 inches of snow per year, experiences 35 thunderstorms on 28 days per year, and experiences other days of rain (number undetermined) [LGS EROL, NUREG-0974 draft, and 22]. The failure to couple the calculation of consequences for accidents under such conditions to realistic evacuation model parametesr is not acceptable practice.

11. D.M. Ericson, Jr., et al., "Nuclear Power Plant Design Concepts for Sabotage Protection", NUREG/CR-1345, SAND80-0477, Volumes 1 and 2, prepared by Sandia National Laboratory for the U.S. Nuclear Regulatory Commission, January 1981.

12. P. Lobner, "Nuclear Power Plant Damage Control Measures and Design Changes for Sabotage Protection", NUREG/CR-2585, SAND82-7011, prepared by Science Applications, Inc., for Sandia National Laboratories under contract to the U.S. Nuclear Regulatory Commission, May 1982.

13. L.A. Goldman and P.R. Lobner, "A Review of Selected Methods for Protecting Against Sabotage by an Insider", NUREG/CR-2643, SAND82-7036, prepared by Science Applications, Inc., for Sandia National Laboratories under contract to the U.S. Nuclear Regulatory Commission, August 1982.

14. A.M. Kolaczkowski and A.C. Payne, Jr., "Station Blackout Accident Analyses (Part of NRC Task Action Plan A-44)", NUREG/CR-3226, SAND82-2450, prepared by Sandia National Laboratories for the U.S. Nuclear Regulatory Commission, May 1983.

15. Letter dated 5 August 1981 from P.R. Clark (Jersey Central Power and Light) to H.R. Denton (Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission), Subject: "Oyster Creek Nuclear Generating Station Emergency Procedures and Training for Station Blackout Events".

16. Advisory Committee on Reactor Safeguards, "Report on the Integrity of Reactor Vessels for Light-Water Power Reactors", WASH-1285, U.S. Atomic Energy Commission, January 1974.

17. M. Weschler, "The Radiation-Embrittlement of Pressure-Vessel Steels and the Safety of Nuclear Power Reactor Pressure Vessels", Oak Ridge National Laboratory, May 1970; cited in, H.W. Kendall, Director, "The Risks of Nuclear Power Reactors: A Review of the NRC Reactor Safety Study WASH-1400 (NUREG-75/014)", Union of Concerned Scientists, Cambridge, Massachusetts, August 1977.

18. D.P. Wagner, et al., "ESP and NOAH Computer Programs for Flood Risk Analysis of Nuclear Power Plants", NUREG/CR-2677, prepared by JBF Associates for the U.S. Nuclear Regulatory Commission, July 1982.

19. A.D. Swain and H.E. Guttman, "Handbook of Human Reliability Analysis With Emphasis on Nuclear Power Plant Applications", NUREG/CR-1278, Draft Report for Interim Use and Comment, prepared by Sandia Laboratories for the U.S. Nuclear Regulatory Commission, October 1980.

20. D.C. Aldrich, R.M. Blond, and R.B. Jones, "A Model of Public Evacuation for Atmospheric Radiological Releases", SAND78-0092, prepared by Sandia Laboratories for the U.S. Nuclear Regulatory Commission, June 1978.

21. D.C. Aldrich, L.T. Ritchie, and J.L. Sprung, "Effect of Revised Evacuation Model on Reactor Safety Study Accident Consequences", SAND79-0095, prepared by Sandia Laboratories for the U.S. Nuclear Regulatory Commission, February 1979.

22. J.M. Hans, Jr., and T.C. Sell, "Evacuation Risks -- An Evaluation", EPA-520/6-74-002, U.S. Environmental Protection Agency, June 1974.

23. J.H. Berkley, Jr., C.Y. Li, and F.M. Quinn, "Limerick Nuclear Generating Station Preliminary Evacuation Time Estimates", NUS-3552, NUS Corporation, Inc., prepared for Philadelphia Electric Company, July 1980.

24. D.C. Aldrich, et al., "Technical Guidance for Siting Criteria Development", NUREG/CR-2239, SAND81-1549, prepared by Sandia National Laboratories for the U.S. Nuclear Regulatory Commission, December 1982.

SARA-5 (LEA)

All significant consequences of severe accidents at Limerick must be disclosed and factored into the Limerick cost-benefit analysis for purposes of compliance with the National Environmental Policy Act of 1969. The consequence analysis in SARA improperly fails to consider certain consequences that will result from severe accidents at Limerick.

BASIS

Among the consequences improperly omitted are:

(1) total latent health effects due to both initial and chronic radiation exposure, other than those resulting in fatalities, including genetic effects, non-fatal cancers, and sterility;

(2) cost of permanent land interdiction;

(3) the total land area from which people are permanently interdicted (greater than 30 years);

(4) total land area in which crops are interdicted;

(5) total land area in which milk is interdicted;

(6) cost of disposal of contaminated milk and crops;

(7) costs associated with monitoring and decontaminating the evacuated and relocated populations;

(8) compensation required for health effects induced by radiation exposure;

(9) incremental costs of replacement power;

(10) indirect effects associated with possible reduction in productive capacity of industries located outside the area directly affected by the accident;

(11) job losses caused by the accident;

(12) loss of the power plant due to the accident;

(13) cost of medical treatment;

(14) loss of important resources such as livestock, mineral resources, water resources, health care facilities, scenic and aesthetic resources.

A more inclusive, but still incomplete, calculation of financial consequences has been performed for Limerick. See, NUREG/CR-2723, "Estimates of The Financial Consequences of Nuclear Power Reactor Accidents," Sandia National Laboratories (Sept. 1982),especially p. A-65.

SARA-6 (LEA)

The environmental risk of accidents during operation of the Limerick facility as proposed for licensing is significant, and preventative and/or mitigative alternatives to the design, mode of operation, procedures, and /or number of reactors presently proposed must be considered for purposes of compliance with the National Environmental Policy Act of 1969 and with 10 CFR §§51.20(b), 51.21, 51.23(c) and 51.26. None have been considered.

BASIS

At the construction permit stage, the environmental review of proposed plant operation did not include a comprehensive review of the risk posed by severe accidents at Limerick, pursuant to Commission policy of that era. The Commission's Statement of Interim Policy, "Nuclear Power Plant Accident Considerations Under the National Environmental Policy Act of 1969," 45 FR 40101 et seq. (Interim Policy on Severe Accidents Under NEPA), altered that policy and mandated a review of the "environmental risks (impacts) attributable to accidents at the particular facility." Id. at 40103.

By issuing its Interim Policy Statement on Severe Accidents Under NEPA, the Commission has in effect made the threshold determination regarding the significance of the risk of severe accidents. From the requirement to include such consideration in its NEPA review flows the requirement to consider alternatives to reduce or avoid impacts. 10 CFR §§51.20(b), 51.21, 51.23(c) and 51.26.

In any case, in its Interim Policy Statement on Severe Accidents Under NEPA, the Commission directs the Staff to "take steps to identify additional cases that might warrant early consideration of either additional features or other actions which would prevent or mitigate the consequences of serious accidents." Id. at 40103. Limerick has been so identified, due to the abnormally large population surrounding the site -- Philadelphia Electric Company is the first applicant for an operating license to have been required, as part of its application, to submit a severe accident risk assessment (PRA/SARA).

The risk at Limerick exceeds that posed by the Reactor Safety Study BWR. See, "A Review of the Limerick Generating Station Probabilistic Risk Assessment," NUREG/CR-3028, BNL-NUREG-51600, Brookhaven National Laboratory, Feb. 1983. Correction of those errors that were discovered by Brookhaven that were carried over from the PRA to SARA, as well as additional errors in SARA itself (see other attached contentions) will result in the calculation of more accurate (and more severe) risk numbers. Intervenors contend that the risk is significant enough, even with only the Brookhaven corrections, and certainly with the additional SARA corrections, to warrant a detailed examination of alternatives to the present facility design and operation proposed for licensing, as required by 10 CFR §§51.20(b), 51.21, 51.23(c) and 51.26, and by NEPA. 10CFR §§51.20(b) and 51.23(c), respectively, require that the applicant's environmental report and the Staff's environmental

impact statement "include a cost-benefit analysis which considers and balances the environmental (and other) effects of the facility and the alternatives available for reducing or avoiding adverse environmental (or other) effects." (Emphasis added.)

There exists in the literature information concerning design alternatives which reduce the adverse environmental effects of severe accidents. See, e.g., Beyea, Jan, and VonHippel, Frank, "Nuclear Reactor Accidents: The Value of Improved Containment," Center for Energy and Environmental Studies, Princeton University, (PU/CEES Report #94), Jan. 1980. Facility-specific studies of mitigative design alternatives have also been performed. See, e.g., "Preliminary Assessment of Core Melt Accidents at the Zion and Indian Point Nuclear Power Plants and Strategies for Mitigating Their Effects," NUREG-0850, Vol. 1, (Nov. 1981). An examination of cost-effective alternatives which would reduce the adverse environmental consequences of the licensing action is therefore feasible, and mandated by the Commission's regulations, and by NEPA as well. See, In re Kansas Gas and Electric Co., (Wolf Creek #1), 5 NRC 1 (1977). "[The decision in Wolf Creek] emphasized that NRC authority to review such off-site effects goes beyond merely factoring them into a final cost/benefit balance ... and includes as well the authority 'where necessary [to] impose license conditions to minimize those impacts.'" In re Public Service Co. of New Hampshire, (Seabrook Units 1 and 2), 5 NRC 33 at 83.

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The SARA does not include a consideration of the whole range of accident scenarios necessary to produce a reliable and realistic cost-benefit analysis, and thus does not comply with NEPA, the Commission's Interim Policy Statement on Severe Accidents Under NEPA, or 10 CFR §§51.20(b), 51.21, 51.23(c) and 51.26.

BASIS

(a) Sabotage, both externally and internally initiated, during both construction and operation, was not included. (See, attached exerpt from Sholly, Steven, "Report on Review of Severe Accident Risk Assessment, Limerick Generating Station," UCS, August, 1983).

(b) Human errors of commission during accident or transient mitigation were not included.

I.1.C Risk from Internal Sabotage

One of the ironies of performing a publicly available PRA study for a particular plant such as Limerick is that the results of the analysis provide a great deal of information to an intelligent potential saboteur. Indeed, PRAs will identify the minimum set of equipment and/or structures required to be damaged in order to produce a core melt and subsequent release of radioactive materials to the environment. This feature of PRAs is well-recognized in the business, but little discussed for obvious reasons.

There are two sources to be considered when attempting to evaluate sabotage risk: external and internal sabotage. External sabotage would involve perpetrators who are not working at the site. External sabotage threats have been studied in some detail, particularly in the context of a "subnational" terrorist group. In particular, the "Generic Adversary Characteristics Report" includes considerable information, even though significant deletions are present in the publicly available version [7]. A violent external assault on a nuclear power plant in the U.S. is generally not considered to be very likely and, if it should occur, would have considerable difficulty in breaching vital areas within the plant and successfully carrying out sabotage. External sabotage would not be impossible; indeed considerable information is available to potential external saboteurs to facilitate planning for such an attempt, such as the Sandia National Laboratories "Barrier Technology Handbook" [8]. Certain types of external sabotage, such as a deliberate aircraft crash as mentioned above, could be quite effective in causing a very serious reactor accident.

A much more likely type of sabotage, however, is insider sabotage -- sabotage involving utility and/or contractor employees. NRC's physical security regulations (10 CFR 73.55) limit consideration of security measures to a single insider. Of course, potential saboteurs are not bound by NRC's

regulations; one instance of sabotage involving two persons has already occurred at the Surry reactor (two employees dumped a caustic substance onto fresh reactor fuel).

According to a recent NRC report [9], at least eleven acts of insider sabotage were committed at licensed U.S. commercial power reactors between 1971 and 1981. (Moreover, the frequency of sabotage attempts at NRC-licensed facilities is greater than at DOE facilities.) This statistic answers the oft-repeated assertion that insider sabotage risk cannot be calculated because the frequency of sabotage attempts cannot be estimated. It should be noted that we now have more data points for sabotage attempts than for many events routinely analyzed in PRAs (such as ATWS, for instance).

Being unduly generous, if one assumes that the eleven instances alluded to above represent all of the sabotage attempts at nuclear power reactors to date, one can derive a frequency of sabotage attempt by dividing the number of reactor years of experience (632.8 reactor-years for all facilities through 31 December 1981) by the number of attempts (11). Thus, one obtains a frequency of 1:57.5 or roughly 1:60 per reactor-year for insider sabotage attempts.

From here on, the analysis would become more involved; one would have to derive a conditional probability of successful sabotage (none of the eleven attempts have been successful). One would also need to estimate the frequency with which various systems would be affected. While this would in theory be difficult, in practice it would be prudent to assume that the potential saboteur knows which systems to concentrate on. In this regard, the most likely systems would be support systems (such as component cooling water, reactor coolant pump seal water injection, and plant batteries) and emergency systems (such as diesel generators, emergency feedwater, emergency core cooling systems, containment spray, containment fan coolers, and scram systems). Indeed, a published report gives the minimal cut set of systems which must be protected for a BWR/6 Mark III reactor [10], and such a list could also be constructed for the Limerick reactor without too much difficulty using the LGS PRA and the methodology layed out in reference #10. The obvious use of this list is that, in addition to identifying the systems that must be protected, it identifies the list of systems that a saboteur would be most interested in damaging. In addition, other reports [11; 12; and 13] give details of possible insider protection strategies which could help saboteurs to block interdiction efforts.

I consider that a sabotage risk analysis could be performed. Such a study would obviously have large uncertainties. To the extent that it would be necessary to evaluate plant security systems and procedures, portions of the report would have to be withheld from public disclosure. The analysis should be performed on a "best estimate" basis to ascertain the degree to which sabotage risks contribute to risk at Limerick. If the uncertainty bounds of this analysis extend into the combined results from LGS PRA and SARA, then a more detailed analysis would be warranted to more precisely identify the approximate magnitude of the risk and to explore possible means of mitigating this risk (by design and/or procedural changes).

One final matter that should be evaluated within the context of a sabotage risk analysis. A recent Sandia National Laboratories report on "station blackout" [14] (i.e., complete loss of AC electrical power, both offsite and onsite) concludes that it is possible that plant security systems could hamper recovery efforts since if AC power completely fails it may be impossible to open doors within the plant, or such recovery efforts could be so delayed as to become meaningless to risk. This issue is a highly sensitive security issue, but one which must be examined on a plant-specific basis.

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