UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges

James P. Gleason, Chairman
Paul W. Purdom
Glenn O. Bright

In the Matter of	)	Docket Nos. 50-387-OL
	)	50-388-OL
PENNSYLVANIA POWER AND LIGHT COMPANY	)	
and	)	
ALLEGHENY ELECTRIC COOPERATIVE, INC.	)	
	)	
(Susquehanna Steam Electric Station,	)	
Units 1 and 2)	)	April 12, 1982

Appearances

Messrs. Jay Silberg, Esq., Matias F. Traviesco-Diaz, Esq.
and Bryan A. Snapp, Esq. for the Applicants

Dr. Judith Johnsrud, State College of Pennsylvania
for the Intervenor, Environmental Coalition
on Nuclear Power

Thomas J. Halligan, Berwick, Pennsylvania
for the Intervenor, Citizens Against Nuclear Dangers

Gerald Schultz for the Intervenor,
Susquehanna Environmental Advocates

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for the Nuclear Regulatory Staff

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INITIAL DECISION

OPINION

I. BACKGROUND

This is a decision on an application from the Pennsylvania Power and Light Company and the Allegheny Electric Corporation, Inc. (Applicants) for a license to operate a nuclear power plant. The application is for the operation of two boiling water nuclear reactors, Units 1 and 2, at the Applicant's Susquehanna Steam Electric Station site, in Luzerne County, Pennsylvania. Permits to construct the units, each of which has a rated output of 1,085 megawatts of electrical power were issued in November 1973.[1]

In addition to Applicants and Staff, the parties to this proceeding are the Commonwealth of Pennsylvania (Commonwealth), the Susquehanna Environmental Advocates (SEA), the Environmental Coalition on Nuclear Power (ECNP), the Citizens Against Nuclear Dangers (CAND) and Colleen Marsh (in behalf of herself and 11 other individuals). A Licensing Board originally approved the admission of 18 contentions for litigation purposes[2] and three additional contentions were subsequently accepted.[3]

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[1] 43 Fed. Reg. 35407.
[2] See Board Memorandum and Order, October 26, 1978.
[3] LBP-79-29, 20 NRC 586 (1979); Board Memorandum and Order of July 7, 1981. As a result of Commission action on Table S-3, (44 Fed. Reg. 45362), the Board permitted Technetium-99 to be considered in a contention dealing with the uranium fuel cycle.

The Board[4] conducted eight days of prehearing sessions. Limited appearance statements were received from members of the public on March 20-21, 1980 and October 8, 9 and 23, 1981.

As a result of the withdrawal of six contentions by party intervenors and the granting of summary disposition motions filed by the Applicant and Staff,[5] nine contentions remained at issue for the hearing:

Quantity and health effects of technetium[6] (Contention 1)

Need for power (Contention 4)

Evacuation (Contention 6)

Unresolved generic safety issue (Contention 7)

Decommissioning (Contention 9)

Storage of low-level radioactive waste (Contention 11)

Health effects of electric fields (Contention 17)

State and County emergency planning (Contention 20)

Scram discharge volume break (Contention 21)

The decisional record of this proceeding consists of a) the Commission's Notice of Hearing; b) the petitions and pleadings filed by the parties; c) the transcripts of the hearing, and d) the exhibits received into evidence.[6]

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[4]The Atomic Safety and Licensing Board appointed to consider this matter was reconstituted. (46 Fed. Reg. 18826)

[5]See Board Orders of March 16, 1981, May 20, 1981, July 27, 1981, August 31, 1981, September 23, 1981, September 29, 1981, October 12 and November 2, 1981. (Also see Tr. p. 1018 and p. 1834 on Contentions 14 and part of 2.)

[6]Part of Contention 1 was eliminated by stipulation between ECNP, Applicants and Staff. The stipulation, which was approved by the Board, provides that the Susquehanna operating license will be subject to the outcome of the consolidated radon proceedings currently pending before the Appeal Board.

This Board's jurisdiction is limited to a determination of findings of fact and conclusions of law on matters put into controversy by the parties to the proceeding or found by the Board to involve a serious safety, environmental or common defense and security question.[7] The Board has made no such additional determinations in this case.

II. CONTENTIONS

1. Health Effects of Nuclear Fuel Cycle

The sponsors of Contention 1 questioned the quantities and health effects of various isotopes released throughout the uranium fuel cycle. Following summary dispositions by the Board and a stipulation of the parties, the issue narrowed to the assessment of the quantity and health effect of Technetium (Tc-99) released during the fuel cycle as a result of the operation of Susquehanna and the impact of this assessment on the cost benefit balance.

Technetium Production and Releases

Tc-99 is produced by fission in the operation of a reactor such as Susquehanna. Reactor operation yields Tc-99 at a rate of 390 to 500 curies (Ci) per reference reactor year (RRY). Because the reactor fuel is encapsulated, essentially all of the Tc-99 produced is retained within the fuel assemblies until they are processed. The potential for release and the rate of release of Tc-99 from the spent fuel to the environment depends on the type of fuel cycle; in a once-through fuel cycle, the spent fuel stored at reactors or in interim facilities is packaged for ultimate disposal in a stable

[7] 10 CFR 2.760(a)

geologic repository. Proper design and siting will provide reasonable assurance of long term isolation. (Board Findings 4, 5, 6, and 8).

In the uranium-only recycle option, spent fuel is sent to a reprocessing plant. There uranium is separated from the fission products. The remainder of the Tc-99 goes to the high level liquid waste (HLLW) treatment facility and thence to a geologic repository. Except for minor releases to the atmosphere during solidification, essentially all the Tc-99 in the high-level liquid waste stream is contained in the solidified packaged material sent to the geologic repository. The Tc-99 accompanying the uranium is virtually all separated out and sent to a low-level, near surface burial facility. Small atmospheric releases of Tc-99 may occur during HLLW processing, during UF_6 conversion, and at the enrichment plant. In addition, there would be surface water discharges during the enrichment process. (Board Findings 7, 8, and 9).

Technetium Disposal

The intervenor, ECNP, claims that in the absence of certainty concerning permanent disposal of Tc-99 bearing wastes, the quantity and radiological health effects of TC-99 associated with Susquehanna have not been properly factored into the cost-benefit balance for the plant. The point is made by ECNP that no waste repository can be guaranteed to provide perfect containment for a million years and it objects to the fact that no selection of a geological medium or media for disposal has been made.

While it is true that no repositories have been selected, Applicants' witness testified that stable geologic repository sites capable of meeting proposed technical criteria do exist and he believes such a site, isolated from groundwater over long periods of time, will be obtained. For the purposes of his analysis, he used the criteria in the proposed 10 CFR Part 60,

which provides for containment package integrity for a minimum of 1000 years after which the maximum release rate would not exceed one part in 100,000 of the inventory per year thereafter. However, for this analysis, all of the Tc-99 was assumed dissolved in groundwater over a period of 100,000 years. The witness said he does not really believe that a mechanism exists for migration of the Tc-99 from the repository to surface water (Englehart, Tr. 1857).

The Board finds that there is no need to assume that the geologic repository will provide perfect containment for a million years, but rather that releases expected from the repository after 1000 years have been factored into the cost-benefit analysis to meet the requirements of 10 CFR Part 60. In view of the unrefuted testimony that geologic sites exist that meet the criteria, Applicant's assumption that sites will be made available is reasonable.

Assessment of Doses and Health Effects

ECNP argues further, that in the absence of summation of doses and health effects of all Tc-99 associated with the operation of Susquehanna 1 and 2 for the full detoxification period, it's quantities and health effects have not been adequately assessed.

The Applicant's expert on the environmental effects of the nuclear fuel cycle reviewed the basic assumptions and calculations for estimating the releases of Tc-99 for the fuel cycle associated with the operation of Susquehanna. Utilizing models for his calculations, the witness quantified Tc-99 releases attributable to Susquehanna and the radioactive dose commitments caused by such releases. The witness found the results in population doses insignificant compared with those from natural background.

The Staffs' expert witnesses presented independent calculations estimating the quantities of Tc-99 which would be released from a supporting fuel cycle for light water cooled reactors like Susquehanna and the health effects resulting from such Tc-99 releases. The conclusion was similar to the Applicants', namely, that population doses from Tc-99 releases were insignificant when compared with the natural background exposures and that its impact could not influence the cost benefit balance for the facility.

The releases of Tc-99 were computed for once-through and uranium-only recycle options by Applicants on an annual basis. These releases were the basis for calculations of doses expected from operation of Susquehanna. The Applicants assumed the maximum of 500 Ci/RRY is available for potential releases. The Staff computed releases independently and from these estimated doses and risks. The Staff made computations for 100 and 1000 years. Cumulative releases were computed for the first 2000 years and an annual release thereafter. Population doses similarly were estimated for the first 2000 years cumulatively and on an annual basis thereafter. Therefore, it would be untrue to say that the doses have not been calculated for the full detoxification period. A summation was not made because it was felt such calculations so far into the future would be meaningless because of uncertanties inherent in such projections.

ECNP is also concerned that the dose to a maximally exposed individual was not calculated and that calculations made were theoretical and hypothetical. ECNP further claims that natural background radiation and doses therefrom have nothing to do with the Susquehanna facility and its operations.

The Board finds, that Applicants have reasonably assessed the doses and health effects resulting from TC-99 releases associated with the fuel cycle for Susquehanna even though no summation has been made. This is so even

though exposure to the maximally exposed individual was not computed. The testimony shows that such an individual would receive nowhere near the population doses calculated, which were insignificant compared to natural background doses. (Englehart, ff. Tr. 1852 at pp. 20-21). The fact that computations were based on theoretical calculations and hypothetical assumptions is not in itself a basis for discrediting the estimates so long as there is a sound basis for them. There was no testimony in refutation of the testimony presented and cross-examination failed to discredit the witnesses and their computations and assumptions. Calculations and parameters were based on NUREG-0002, the Generic Environmental Statement on Mixed-Oxide Fuel (GESMO). While these proceedings have been interrupted, there was no suggestion that the models used were invalid.

ECNP also questions the assumption for residence time for Tc-99 in soil in view of the variability of this factor in different soils. The Applicants' witness used a factor of 15 years when a factor of 30 years for residence time was used in one of the references cited. The witness explained that he felt the residence time used would be appropriate for a mixture of inorganic and organic soils and if other times were used, it would alter other factors in a compensating way. The Board finds the approach taken by the witness is reasonable.

Finally, notwithstanding the Intervenor's objection, the Board accepts comparisons of doses with those experienced from natural background as reasonable. Other Boards have accepted such comparisons and so has the Appeal Board. Of course, the operation of Susquehanna does not enter into background doses, but it is significant to know the relative magnitude of Susquehanna's estimated doses in comparison with the radiation that humans experience and have experienced for generations.

Conclusion

The Board Finds the testimony of Applicants and Staff's witnesses consistent and the testimony is not refuted. Intervenors presented no direct testimony by experts and its cross examination failed to impeach the credibility and conclusions of these witnesses. While ECNP draws conclusions from this testimony at variance from the Staff and Applicants, the Board's review of the testimony in its entirety does not suggest that the concerns of ECNP form a valid basis for questioning the calculations and the findings of the Staff and Applicants based on them.

The Board finds the degree of scientific data presented by the Applicant and Staff is sufficient to conclude that the methods for calculations are adequate and that doses and health effects from Tc-99 from the fuel cycle for Susquehanna are shown to be insignificant. The Board finds the comparison(s) with natural background radiation a valid measure of the significance of doses. However, that is not the only basis for making such a conclusion. The doses themselves are very small and the potential effects will not be measurable.

2. Need for Power

The proponents of Contention 4 questioned the need for the Susquehanna facility on the grounds of a) low growth rate; b) electric capacity in excess of needs; c) inadequate conservation programs; and d) failure to consider alternatives such as solar energy. Prior to the hearing, the Board granted summary disposition motions filed by the Staff on 4c and 4d, but denied such motions on 4a and 4b.

Simply stated, the remaining parts of the contention alleges that Applicants' existing capacity can meet customers' needs for the next 30 years

(plant's useful life period), and that the output from Susquehanna will be available for sale outside the service areas of the Applicants. If this is true, the intervenors state, the cost-benefit balance is tilted against authorization of an operating license for Susquehanna.

Capacity and Growth

Testimony by Applicants and Staff shows that existing capacity can meet current needs of customers in the service areas. The forecast for annual rate of growth in demand has been revised downward by Applicants from 2.5 percent to 2.2 percent and peak demand growth rate from 2.2 percent to 2.0 percent. The Applicants and Staff concede that the addition of Susquehanna will provide a greater reserve margin than required. The Applicants project, however, that requirements for the winter peak of the Pennsylvania-New Jersey-Maryland Interconnection (PJM), in which they participate, mean the Applicants need additional capacity by the mid-1990s. Since lead time for construction is about 10 years, this capacity would have to begin construction in mid-1980s. This evidence contradicts that part of the contention that claims such facilities are not needed for the next 30 years.

Even though there appears to be no immediate need for additional capacity, the evidence show that Susquehanna will provide less costly operations than the plants whose operations will be replaced. These benefits will accrue to the Applicants customers. Hence, one of the justifications for operation of Susquehanna is that there will be operational cost savings that will benefit the customers. And conversely, it would be more costly to customers if Susquehanna is not permitted to operate. Witnesses for both the Applicants and Staff pointed to other actions besides revenue margin to be

considered in assessing costs and benefits including fuel diversity and conservation of oil as well as operating cost savings. (Board Finding 34.)

The Applicants estimated that, even with an assumption of no growth in demand, their customers would still benefit in less costly operations from the operation of the Susquehanna facility. The Staff's witness projected a saving even if a negative growth rate existed so that a benefit would still flow to its customers.

With respect to the portion of the contention that alleges electric power produced by Susquehanna will be available to sell outside the service areas of the Applicants, the Applicants deny the validity of the claim. The Susquehanna production, which is cheaper, will be the basis for billing customers of the Applicants in the service areas. More costly operation will not necessarily be shut down, but instead that production will be sold to PJM as needed where it is still cheaper than other capacity available to PJM. Such sales are also beneficial to the Applicants customers.

Costs of Abandonment

Evidence in the hearing, that was unrefuted, showed an abandonment of Susquehanna would cost, depending on conditions of growth, between $6.6 billion to $9.2 billion from 1983 to 1992. These costs, in terms of revenue requirements, were reduced to half if only one unit was abandoned.

Some costs for ratepayers may go up if and when Susquehanna goes on line because the utility is permitted to recover total costs, including capital costs. However, these costs are partially offset by lower fuel costs for Susquehanna and sales of other power output to PJM. (Board Finding 37.)

In this case, the Board has to determine if an operating license is to issue. Plant construction is virtually completed. It is idle speculation to

consider if a plant should have been built. It has been. Thus, the decision is between permitting the plant to operate or abandoning it. Most of the capital costs have been incurred and must be considered whether the plant is operated or abandoned. It deserves mention here that due to consideration of these kinds of issues, the Commission has removed the need for power issue from operating license proceedings effective April 26, 1982. (47 CFR 12940.)

Under these circumstances, the Board finds it appropriate to consider the savings in fuel costs resulting from operation of Susquehanna as compared with alternates with more expensive fuels. It is also appropriate to consider costs of abandonment in comparison with operation. The Board sees no objection to PP&L's plan to sell electricity from existing plants that are more expensive to operate than Susquehanna to other members of PJM.

Conclusion

Because of the lower operating costs and costs of abandonment versus operating, the cost-benefit balance is tilted in favor of issuing an operating license. The Board concludes that neither low growth nor excessive capacity nor both support the contention that a license should not be granted.

3. Evacuation Emergency Plan

Each of the four Intervenors in the proceeding proposed parts of Contention 6 relating to the Applicants' responsibilities to provide protective action in the event of a serious accident. In addition to raising an issue of the necessity of evacuating people outside the facilities low population zone, questions were raised over alleged lack of training for personnel participating in evacuation procedures and also the ability -- or

lack thereof -- of an important State agency, the Office of Radiological Health, to respond during an incident.

New Regulations

Prior to March 6, 1979, when the proposed contentions on this aspect of emergency requirements were accepted by the Board, evacuation considerations beyond the low population zone were not required by the Commission's regulations. See New England Power Company et al. (NEP Units 1 and 2), ALAB-390, 5 NRC 733, 747 (1977). Subsequent to the Three Mile Island occurrence, emergency imperatives for operating licenses were raised and upgraded. New regulations became effective on November 30, 1980. During the same time frame, a joint report of the Nuclear Regulatory Commission (NRC) and Federal Emergency Management Agency (FEMA) was adopted which established criteria to guide the preparation and evaluation of radiological response plans (i.e., emergency preparedness), in support of nuclear power facilities. Under the new scheme and regulations, FEMA reviews and determines the adequacy of all off-site nuclear planning and response (State and local government) and the NRC reviews and judges the Applicants' on-site emergency planning and the findings made by FEMA. It is clear the regulations contemplate the integration of off-site and on-site emergency plans and necessitate a close working relationship between State and local officials with the Applicant.

NRC's new regulations extend planning requirements to emergency planning zones surrounding a nuclear facility. These areas, with a radius of approximately ten miles and designated as the plume exposure pathway, Emergency Planning Zone (EPZ), are considered as a region where projected doses from traditional design basis accidents would not exceed Protective Action Guides outside of the zone. Emergency planning is deemed essential within the zone

to assure that prompt and effective actions can be taken to protect the public in the event of an emergency. The regulations bring out that operating licenses will not be issued absent a finding by the NRC that the state of emergency planning (off-site and on-site) provide a reasonable assurance that adequate protection measures can and will be taken in the event of a radiological emergency. (See Board Findings 49 and 50.)

Notification and Evacuation

The procedures for notifying the public in an emergency at Susquehanna involve, in a sequential pattern, actions by the licensee, the State and local government officials. (Board Findings 51 and 52.)

The Applicants' plan calls for the notification to be communicated to State and local government officials in the plume exposure planning zone within fifteen minutes of an initial declaration of any level of emergency. After assessment of the incident, recommendations for appropriate protective action are forwarded to the state Bureau of Radiation Protection (BRP) which, in turn, advises the Pennsylvania Emergency Management Agency (PEMA), the lead State agency for coordinating emergency responses. PEMA has the responsibility of initiating through County officials warning signals to the public as well as messages of instructions on actions to be undertaken. Alerting the citizenry to the existence of a serious incident occurring at a facility is accomplished through activating a system of sirens installed by the Applicant throughout the plume exposure pathway, EPZ. Siren tones are designed to alert the public to the communication of television and radio emergency broadcast messages. A supplemental notification activity in the twenty-seven (27) municipalities within the zone is planned for those who might fail, due to

hearing defects or other difficulties, to receive the emergency messages. (Board Finding 53)

In meeting the standards of the regulations and the recommended criteria of NUREG-0654, HMM Associates produced an evacuation time estimate study for the Applicants' emergency plan covering the plume exposure pathway, EPZ. It considered all segments of the population -- permanent, transient and special facility distributions -- and computed evacuation times. It used a highway network for evacuation based on State and local emergency plans and a network computer model which accounts for traffic congestion and route choices during evacuation. The study reviewed evacuation at different time periods and under adverse weather conditions and concluded that evacuation could be accomplished in normal weather in less than six hours and in less than nine during the most severe weather conditions modeled. (Board Findings 55-62.)

Narrow Roads and Adverse Weather Conditions

The Commonwealth of Pennsylvania (Commonwealth or State) contends Applicants' emergency plan, in the absence of written school evacuation plans, cannot provide reasonable assurance that adequate protection measures can and will be taken during a radiological emergency. It recommends in proposed findings that a full power license be denied until a condition is met that such plans are developed. The plan for evacuating school children and other members of the non-auto-owning population call for evacuation to be accomplished by the use of buses, the availability of which, the State contends, depends on written school plans. Such plans are not in existence yet, although PEMA has requested their preparation.

In commenting on these proposed findings, the Applicant and Staff question the legitimacy of this issue as being among the specific deficiencies

alleged to exist in Applicants' emergency plan by this part of Contention 6. We think otherwise. This not a matter where the Licensing Board is asked to decide a case on a theory different from the one on which it was tried. Niagara Mohawk Power Co. (Nine Mile Point Nuclear Station, Unit 2), ALAB-264, 1 NRC 347, 354 (1977). Here, all parties were put on notice that the school transportation issue was within the boundary of the contention, the testimony of the Commonwealth referred to the subject and Applicants' and Staff's witnesses commented on it extensively. Simply stated, the issue challenges the Applicant's burden of proof that its planning effort has been adequate in providing evacuation for all persons within the plume exposure pathway, EPZ, over narrow roads and under adverse weather conditions. Availability of an adequate number of buses and the time for them to reach schools was assumed by the HMM study, an assumption subject to contradictory testimony. Accordingly, the argument runs that if the availability of an adequate number of buses is not assured, there can be no reliable estimate of time for evacuating this segment of the population and as a consequence, the Applicants' plan is to that extent deficient.

The Applicant and Staff point out that neither the regulations nor criteria guidance establish maximum time allowances for evacuation but merely require the preparation of time estimates. It seems apparent, however, since evacuation is one option during a radiological emergency, that those responsible for making the appropriate choice need to be able to depend, in doing so, on the reliability of the time estimates submitted. We believe the Commonwealth makes an effective request. All parties interrogated on the question -- witnesses for the Commonwealth, Staff and Applicant -- agreed that written school plans would be preferable prior to operation of the facility. Although there is no specific recommendation in NRC guidelines for written

school evacuation plans, there is a guide which calls for written agreements or signatures to verify agreements among local agencies and other support organizations. This would appear to apply to the school plans in question. The Staff's witness indicated that the guidelines in this area were left somewhat general due to the great variations among States and local governments regarding their particular relationships with bus operations and facilities.

Capabilities of Office of Radiological Health

Testimony on this part of Contention 6 was received from witnesses for the Applicant, the Staff and the Commonwealth, none from any of the Intervenors. The witnesses included the Chief of the Division of Environmental Radiation who has the responsibility for BRP planning for accidents at nuclear facilities and routine surveillance of environmental radiation, a former Director of PEMA and now a consultant for the Applicant on emergency planning assistance and an emergency specialist employee from FEMA with responsibility for reviewing radiological emergency plans within the State of Pennsylvania.

The functions of the State's Office of Radiological Health were transferred some ten years past to the Bureau of Radiation Protection (BRP). The BRP exercises a major role in responding to radiological incidents. Its basic charter is to provide immediate assessments of such incidents to PEMA and to recommend appropriate protective actions for the State and local governments to implement. The Agency's plans in an emergency call for a prompt and continuing dialogue with Applicant's emergency personnel, evaluation of radiological data provided by the Applicant and subsequent confirmation by off-site monitoring measurements and liaison operations at Applicants' emergency operating facility. It is primarily looked to for

making vital recommendations to PEMA concerning matters of evacuation, public information and instruction. The BRP maintains seventeen (17) off-site but in-place monitoring instruments for routine measurements which are a part of a total grouping for reviewing environmental data that includes thirty-five (35) locations belonging to the NRC and sixty (60) to the Applicant. (Board Findings 70 and 71.)

The State's witness was examined extensively by an intervenor and the Board regarding its funding, personnel, equipment and operations. The evidence reflected that there has been a substantial increase in funding for the Office in the past two fiscal years, additional technical people have been hired to complement the scientific expertise on board, a twenty-four hour response capability has been developed and additional radiological monitoring and analytical equipment has been obtained. The representative from FEMA also gave testimony that the resource capability for BRP to respond to an incident at Susquehanna was adequate. (Board Findings 72-78).

Training Deficiencies and Inadequate Radiation Safeguards

Responsibility for training of emergency workers has been assumed by PEMA for off-site activities and for on-site by the Applicant. (Board Finding 80.) Testimony was received on the adequacy of the training efforts of both parties from witnesses for the Applicants, the State and the Staff.

The Applicants' on-site program for emergency workers includes training, maintaining site-specific equipment and interface operations. The training covers, as appropriate, emergency plan overview, dose calculations and projections, protection actions, basic radiation theory, plant layout and access control. In addition to fire, police and ambulance/rescue personnel,

relevant training is to be provided for State and local government and hospital complements. In total, Applicants' plans call for training several hundreds of members of various agencies. About two hundred police, fire and ambulance service personnel have already participated in training sessions and it was anticipated that the training program would be completed initially by the end of 1981 with an annual retraining effort being contemplated. The facilities' quality assurance organization will monitor implementation of the Applicants' training programs. (Board Findings 81 and 82.)

The Applicant is providing additional equipment on-site to augment response efforts and has developed fire pre-plans covering every section of the plant to expedite fire handling and to minimize radiation exposure. Radiation protection clothing and equipment, including a thermoluminescent dosimeter for each worker, will be provided and health physics personnel will accompany the workers to assume responsibility for their safety and minimize dangers from radiation hazards. If necessary to counteract radioiodine inhalation, a supply of potassium iodide will be available for controlled use. (Board Finding 83.)

The off-site training program is a responsibility of PEMA. Annex E of the State's emergency plan lists courses for training by title, target audience (prospective attendees), duration and organization sponsoring the course. The plan also sets out the undertaking of other State, County and facility organizations for training, drills and educational programs. An annual publication by PEMA lists the times and places where the courses will be conducted. FEMA provides some funds for these training sessions and the State's programs are frequently held in various local regions to minimize expenses. (Board Findings 86, 87 and 89.)

The Luzerne County plan lists the number of individuals it will provide for the training sessions provided by State and Federal agencies and the County has also undertaken to provide training for municipal emergency response people and police and fire personnel. In addition to relevant training for radiological emergencies, emergency workers off-site are to be provided with dosimetry as a protective measure to enable them to observe radiation data. (Board Findings 88 and 91.)

Both the Staff and FEMA witness testified to the adequacy of the emergency plans of Applicants, State and local government respectively on training of emergency workers and protections against radiation hazards. They also affirmed the plans conformity to the recommendations of the guidance of NUREG-0654.

Conclusion

Except for written school plans, the Board finds the emergency plans concerning notification, evacuation, training programs and radiation hazards adequately address the requirements, recommendations and standards of 10 CFR 50.47(b), 10 CFR Part 50, Appendix E and NUREG-0654. The Board finds further that the Bureau of Radiation Protection is able to adequately perform its responsibilities in the event of an accident.

4. Unresolved Generic Safety Issue

The intervenor, ECNP, proposed in Contention 7 to litigate a number of unresolved generic safety issues relevant to the Susquehanna facility. Summary disposition motions filed by the applicant were granted for those parts of the contention dealing with the pressure suppression containment

structure, BWR core spray nozzles and anticipated transients without scram (ATWS) system.

The remaining part of the contention questioned whether the problem of stress corrosion cracking in the stainless steel piping of the reactor had been solved. This problem, which has been known to industry and the NRC for several years, is one of a number of unresolved generic safety issues; so-called because of the difficulty of their absolute resolution. Absent such absolute resolution, it is necessary to demonstrate that even though not completely understood, sufficient measures are taken to assure that the phenomena do not constitute any undue risk either to the reactor or to the public.

Conditions for Cracking

In the instant case, a great deal of information has been obtained through analytical, field and laboratory efforts by both the NRC staff and industry on the causes of and solutions to the cracking problem. It has been determined that for such cracking to occur, three conditions must exist: a susceptible material, a tensile stress in excess of the local yield stress, and the presence of a corrosive atmosphere or medium. Elimination of any one of the conditions should eliminate the problem; elimination of all three, where feasible, is even more desirable.

It was determined early on that cracks occurred generally in areas immediately adjacent to welds (the heat-affected zone, or HAZ). This lead to a determination that the welding process in 304 stainless steel, in itself could produce sensitization and high levels of residual stress. Other very high stress levels could be avoided by designing systems to ASME Code

requirements but the HAZ problem required special treatment. (Board Findings 97-99.)

Solutions for Cracking Problem

A number of methods have been determined to be effective in either eliminating this cracking problem or rendering it insignificant. Solution heat treatment can be used for shop piping erections. Another method can be used in field fabrication -- a technique known as induction heating stress improvement. Use of high-ferrite, low-carbon stainless steel weld metal as cladding is effective. Use of weld metal with high ferrite content and use of low-carbon stainless steel piping is also effective.

All of the above methods, where feasible, have been used in the Susquehanna system. In addition, augmented inspection of welds in the reactor coolant boundary not replaced with corrosion-resistant metal will be performed. The reactor coolant itself will be deaerated so that free oxygen levels are very low, thus reducing the corrosiveness of the water. (Board findings 100-102.)

Finally, it is well documented, both experimentally and through experience, that austenitic stainless steel is highly ductile and not subject to sudden fracture. If a crack should develop in a pipe, it will leak before it breaks or before the crack propagates. A sensitive leak detection system has been installed in the Susquehanna plant to detect such leaks, in conjunction with detection of temperature and pressure changes and drain pump activities. The combination of augmented in-service inspection and leak detection instruments make it highly unlikely that any cracking will not be detected and corrected before any pipe rupture might occur. (Board findings 109-112.)

Conclusion

Based on the uncontroverted evidence in the record, the Board finds that, contrary to the allegation of the contention, stress corrosion cracking of stainless steel piping in coolant water environments is a well understood phenomenon; that adequate measures have been taken by the Applicants in accordance with NRC Staff guidance in NUREG-0313 to prevent or avoid the occurrence of such cracking at Susquehanna and that in the event such cracking were to occur, there is a high likelihood that it would be detected prior to the development of any significant safety hazard.

5. Decommissioning

Intervenors in Contention 9 attempt to discredit the validity of Applicants' costs for decommissioning. Basically their argument contends that the costs of decommissioning will equal at least the facility's construction cost and that charges for environmental hazards associated with decommissioning, particularly for workers, have not been reflected in its estimates. Intervenors argue that when these costs are properly assessed, they will tilt the cost-benefit balance against operating the facility and that the Applicants are not financially qualified to assume the decommissioning costs.

The process of decommissioning is one whereby, at the end of the plant's useful life, any residual radioactivity level is low enough to allow unrestricted use of the site. To date, three methods have been used: immediate dismantlement, safe storage followed by deferred dismantlement, and entombment, with immediate dismantlement being the most expensive. (Board Findings 115-116.)

Although conceding the fact that no plant of the size of the Susquehanna facility has been decommissioned and actual expenditures for such an

undertaking are therefore not available, the Applicants' evidence demonstrates that the tasks associated with decommissioning or dismantling a nuclear facility are a series of straightforward and relatively uncomplicated projects which are subject to accurate costs estimates. (Board Finding 117.)

Costs of Decommissioning

Applicants calculated the cost of decommissioning using the results of a Commission-funded study done by the Pacific Northwest Laboratory (PNL) of the Battelle Memorial Institute. With suitable adjustments for specific reference plants, the total cost of immediate dismantling of both Susquehanna units was put at $191 million (1980 dollars). The Staff performed a similar but independent calculation using somewhat different assumptions, and arrived at a cost of $157 million (1980 dollars).

To further substantiate the validity of these estimates, results from actual decommissionings were used, particularly that of the Elk River reactor. To ensure that immediate dismantlement was the most expensive mode, cost estimates using the PNL study were made on the other methods. (Board Findings 122-124.)

In challenging the accuracy of Applicants' decommissioning costs, Intervenors questioned the substantial construction costs increases since the facility's license permit was issued in 1973 and the unescalated amount provided by the Applicant for decommissioning. The Applicant's witnesses stated there had not been a substantial increase in dismantling costs over the years and indicated that future inflationary increases in decommissioning costs were not included because of a State's Public Utility Commission (PUC) requirement that such costs be reflected in terms of current dollars.

Radiation Hazards

A substantial amount of cross-examination was concerned with radiation hazards facing workers during plant decommmissioning. The PNL study included methods for estimating the radiological effects of decommissioning both to workers and the general public. For workers, the estimates were 3,690 man-rem for immediate dismantlement, 776 man-rem for safe storage and deferred dismantlement, and 3,146 man-rem for entombment. These amounts are on the order of, or less than would be received under normal operation of the plant, and within allowable Commission limits for worker exposure. (Board Findings 126-127.)

For the general public, the estimate for the 50-year radiation dose equivalent to the lung per unit for the maximum exposed individual are 0.041 mrem for immediate dismantlement, 0.0031 mrem for safe storage, and less than 0.038 mrem for entombment. Population doses for a population of 3.5 million within a 50 mile radius of the site are 0.05 man-rem, 3×10^{-4} man-rem, and 0.04 man-rem, respectively, for immediate dismantlement, safe storage and entombment. Therefore, decommissioning should present no serious radiation hazards to either the workers or the general public. (Board Finding 128.)

The PNL study reached its results, which have not been substantially criticized, by using examples of actual experience gained in various decommissionings, the use of carefully planned work procedures where possible, and the use of routine facility radioactive containment source terms based on acceptable modeling procedures. The study, in considering such contamination at a generic facility comparable to Susquehanna, includes an analysis where the contaminants were increased by a factor of three (3). It concluded that with proper remote procedures being utilized, decommissioning could take place without a significant increase in the occupational radiation dose. The PNL

study has been used in the Staff's generic environmental impact study on nuclear facility decommissioning, NUREG-0586, January 1981, (Feldman, ff. Tr. 1344 at pp. 4-5).

Conclusion

On the basis of uncontroverted evidence in the record, we find, contrary to the allegations in the contention, that the health cost and monetary cost of decommissioning the Susquehanna facility have been adequately assessed and that these costs when added to other monetary and health costs will not tilt the cost benefit balance against authorizing operation of the facility.*

6. On-Site Storage of Radioactive Waste

Contention 11 alleges the Applicants fail to meet Commission's standards for on-site storage of low-level radioactive wastes to provide safe storage of such waste for up to 10 to 15 years, and creating thereby an unreasonable risk to petitioners. Inasmuch as the regulations do not specify the amount of space to be provided, nor any definite length of time for storage, we cannot find the Commission's rules have been violated. We do, however, consider whether Applicants' proposed facility presents an undue risk to the health and safety of the public.

Applicants intend to ship all low-level radioactive wastes (LLRW) generated by the facility to a commercial disposal site, but believe that it is prudent to build a LLRW facility for on-site storage in case off-site

*See n. 1, Findings on Decommissioning, INFRA.

disposal is not available. Applicants do believe, however, that such off-site disposal will be available. (Board finding 132.)

The low-level radioactive waste holding facility (LLRWHF) is a reinforced concrete vault, meets the applicable seismic and flooding criteria, and can withstand tornado force winds, though not necessarily tornado induced missiles. It has a design life of 40 years, and if necessary, can accommodate the LLRW generated in four years of two-unit operation. Process wastes will be stored in solidified form; contaminated trash will be stored in 55-gallon steel drums. (Board Findings 133 and 134.)

Radiation Dose Exposure

The facility is designed to minimize exposure to operating personnel, and it is expected that worker exposure will be well within 10 CFR Part 20 and 40 CFR Part 190 limits.

An analysis of expected radiation dose received by an individual at the site boundary, assuming maximum radiation levels in the waste, with the facility completely full of waste and the continuous presence of the individual for one year, showed a dose of 1.1 mrem would be sustained under such conditions. This is well within 10 CFR Part 20 limits. A study of potential accidents at the LLRWHF shows that resulting radiation levels would be a small fraction of 10 CRF Part 100 guidelines. (Board Finding 140).

Conclusion

Based on the uncontroverted evidence in the record, the Board finds that the Applicant's proposed LLRW storage plan does not present an unreasonable risk to the health and safety of the public under either normal operation or

hypothetical accident conditions. Accordingly, we find the Applicant has provided adequately for safe on-site storage of low-level wastes.

7. Health Effects of Electric Fields

The 500 kV transmission lines serving Susquehanna will produce a calculated maximum electric field of 11 kV/m at the ground level at the point of minimum clearance on the right-of-way and 2.28 kV/m at the edge of the right-of-way. It is alleged by Contention 17 that these electrostatic fields will be harmful to living organisms in the vicinity of the transmission lines. (Board Findings 144-145.)

Testimony was presented concerning epidemiological studies of workers exposed to electric fields, experimental exposure of human subjects and test animals to electric fields, and theoretical analyses of the potential effects of exposure to electric fields.

Applicants presented prepared testimony concerning an extensive review and analysis of the literature concerning effects of electrostatic fields. This review was further elaborated in redirect examination. Staff presented a similar and generally consistent review and analysis with the addition of information from some on-going studies. Intervenors relied primarily on information from a case before the New York State Public Service Commission in 1976-78.

Epidemiological Studies

Several studies were cited from the United States and Europe of workers in the electric power industry. Populations exposed and unexposed to electric fields showed no differences in indicators used. The indicators used varied among the studies, and included such factors as state of health, physical,

mental, or emotional characteristics, medical visits and druggists bills. (Board Finding 148.)

Experimental Studies

In several experimental studies involving human subjects where they were exposed to 12 kV/m or higher electric fields, there were no detrimental effects. (Board Finding 151.) Various test animals have been exposed to electrostatic fields, including mice, rats, monkeys, and swine. The preponderance of evidence indicates that test animals exposed to electric fields of up to 100 kV/m do not experience significant harmful health effects. (Board Finding 152.) Some results indicate physiological and/or behavioral responses. These were criticized as having poor experimental design or poor control of experiments, fail to be reproducible, are not statistically significant, have internally inconsistent results, experienced concurrent interfering factors (such as a disease outbreak among test animals), and lack of hazard significance. (Board Finding 154.) Responses to questions, however, reveal that some of the tests that showed no significant effects had such small numbers of test animals that they, too, were not statistically significant, for example tests using monkeys.

There is ongoing research funded by the Department of Energy on transmission line effects. It is guided by an Interagency Advisory Committee on Electric Field Effects. Thus far, some statistically significant effects have been observed in mice and rats exposed to field strengths of 4-20 kV/m. These effects are so subtle and small in magnitude, however, that further research is needed to determine if they have any biological significance. The levels of long term exposure to the general population from Susquehanna lines

would be less than 2 kV/m, well below those values where effects have been observed in these studies. (Board Finding 159.)

Theoretical Evidence

Theoretical evidence suggests that currents produced within the body by Susquehanna lines could be on the order of 0.1 to 1 milliamperes per square meter. These are well below the level of perception. They cannot produce sufficient heating of tissues or molecular polarization or deformation to cause significant biological effects. (Michelson, ff. Tr. 1046 at p. 6.)

While some writers have postulated behavioral and central nervous system modification from such exposures, a mechanism to cause these effects is unknown. The Board found Applicants' witness, Dr. Michaelson, to be thoroughly familiar with the pertinent scientific studies and capable of making judgments as to their validity and significance and the Staff witness, Mr. Gears, generally corrobated Dr. Michaelson's testimony. The intervenors witness, Mr. Armory, relied primarily on the record of a hearing before the New York State Public Service Commission for his direct case and to discredit Dr. Michaelson's credibility. The Board notes the New York State Public Service Commission found in favor of a position contrary to that cited by Mr. Armory.

Analysis of Tests

The Board notes that high voltage electric fields have been shown to produce some effects in test animals although some studies may be ruled out because of poor experimental design or lack of statistical significance. However, there remain some valid studies that appear to show statistically significant effects. The question is do these effects have any biological

significance for the test animals and, in turn, people. The Board adopts Dr. Michaelson's position that there can be a stimulus from an electric field that causes a measurable effect without this effect necessarily being considered adverse or hazardous to the health of test animals or people. Because of the judgment involved in determining hazard, interpretations may be controversial. The Board concurs with the Staff's witness, Mr. Gears, that where results vary, effects are small and subtle, the applicability to field conditions questionable, and human effects speculative, the preponderance of evidence has to be considered.

The Board finds the epidemiological evidence to be convincing that no harmful effects to the general population are anticipated as a result of exposure to the Susquehanna lines. Human experiments, theoretical explorations and animal experiments support this conclusion. Some tests do show results that could be interpreted as adverse, but these are so flawed that the results are inconclusive. Valid ongoing tests have not shown effects at the levels produced by Susquehanna lines, although there have been some observations at higher levels that require further research to define their significance from a biological standpoint.

The Susquehanna lines would meet the only standards known to exist, namely Soviet standards. The Soviets have established standards that limit electric fields to 12 kV/m at points where lines cross roads and 15 kV/m elsewhere along unpopulated sections. (Board Finding 150.) The Applicants have stated that they would take steps, if necessary, to limit exposures at ground level at highway crossings to 7.5 kV/m. (Board Findings 160-161.)

The Board recognizes the Applicant's hesitancy to put conclusions in absolute terms. It is difficult, if not impossible, to prove a null hypothesis. However, where current research results tend to be negative, the Board

believes this is a reasonable factual basis for decision. Should future research find positive results, appropriate action may and can be taken at that time.

Conclusion

The Board finds that the epidemiological evidence indicates that the electric fields to be generated by the Susquehanna 500 kV transmission lines will not cause adverse health effects to people, and the preponderance of the evidence reflects that there will be no adverse effects to animals, plants or people. Accordingly, there is no basis for requiring a modification in the transmission lines or its right-of-way.

8. State and County Emergency Planning

Contention 20 was sponsored by the Susquehanna Environmental Advocates (SEA) and was based on drafts of State and County emergency plans filed before 1981. As accepted for litigation, however, its allegations were evaluated against the plans currently under review: the State plan of February 1981 and the plan of Luzerne County of August 20, 1981. (Swiren, ff. Tr. 2671 at p. 3); also see SEA motion for allowance of new contentions dated May 6, 1981 and Board Order of July 7, 1981.) Testimony was submitted by the Applicants, the Staff and the Commonwealth of Pennsylvania, and the Board also sponsored two witnesses from Luzerne County. None of the Intervenors offered direct testimony. Exhibits were accepted into evidence from the Staff and the Commonwealth and are referred to, as appropriate, in the findings of fact.

Several developments relating to emergency planning occurred during the evidentiary hearing and deserve comment here. The first involved Intervenor CAND's withdrawal from participation in the consideration of Contentions 6 and

20 on grounds that the emergency plan of Columbia County, which was not placed in evidence, was a necessary ingredient to litigating these contentions. Part of that County is within the plume exposure pathway, EPZ. Commission regulation and guidance on emergency planning contemplate the integration and coordination of the Applicants, State and local government plans but deficiencies in plans must, for purposes of addressing such controversies in a hearing forum, be specifically alleged. Here, Contention 6 involves the Applicants' plan and Contention 20 is concerned with shortcomings in the plans of State and Luzerne County. Columbia County's plan was not in issue. It should also be noted that there was testimony that Columbia County's draft plan was in the same state of completion as Luzerne County's and the plan was made available to all parties prior to the evidentiary proceeding.

The second development concerns a motion made by SEA and denied by the Board, to keep the record of the proceeding open until the governments emergency plans were completed. At the time of the evidentiary hearing, neither the State nor Luzerne County plan had been submitted to FEMA for final review. The Intervenor was advised that outside of issues raised sua sponte, Licensing Boards are restricted to adjudicating only those matters raised by the contentions. See 10 CFR 2.760a. A decision as to any other matters which need to be considered prior to issuance of an operating license is the responsibility of the NRC Staff. Consolidated Edison Co. of N.Y., Inc. (Indian Point Nuclear Generating Station, Units 1, 2 and 3) ALAB-319, 3 NRC 188, 190 (1976).

Based on evidence submitted on the plans as they existed at the time of the hearing, the Intervenor failed to demonstrate to the Board that completion of the emergency plans was essential to consideration of those inadequacies alleged in Contention 20.

During the hearing, there was substantial cross examination participated in by various representatives of SEA, and by Counsel for the State, the Applicant and the Staff as well as members of the Board. The findings of fact, infra, cover each section of NUREG-0654 which the contention challenges as being ignored or not complied with by the emergency plans of the State or County (Luzerne) or both. Here, we discuss our resolution of those issues which received material discussion in the proceeding.

Communication of Information

Questions were raised in the hearing whether the State and Luzerne County plans conformed to the recommended criteria on information that was to be made available to the permanent and transient adult population within the plume exposure pathway EPZ. Doubts were raised over the subject matter, its method of delivery, the obligation for costs of printing and distribution and the time period that such information should be in possession of those who were to receive it. The thrust of these inquiries challenge the adequacy of planning for public information which is required to meet the standards of the regulations that call for making vital information available to the public on a periodic basis. The Commonwealth of Pennsylvania has suggested in proposed findings that absent a pre-emergency dissemination of public information, there should be no finding as is required by the regulation of reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency.

However, testimony at the hearing provides relevant and acceptable responses to the issues raised in this regard. (See Hearing Transcript pp. 2547-55, 2605-07, 2616-18, 2627-33, 2674.) There was a clear demonstration that the State and County had given extensive consideration to their

public information responsibilities. What was not as obvious, however, is the complementary relationship important to a proper exercise of those responsibilities. Although the public information guidance of NUREG-0654 reflects that the recommended criteria are applicable to State and local governments, as they are to the nuclear facility organization as well, we do not conclude that this calls for duplication in effort or programs. One of the fundamental principles of NUREG-0654, as we see it, is the integrated development of emergency response plans. (See NUREG-0654 FEMA-REP-1 Rev. 1, pp. 23-24). This integration was recognized, in part, by PEMA's own public information officer who testified that the public information responsibilities were a joint and cooperative responsibility of the State, the County and utility. (Comey, Tr. p. 2628.)

A consideration of all the testimony makes evident the respective sharing of these obligations. The plans for public information contemplate the publication of printed information containing, among other items, material on radiation and evacuation routes to be distributed by means of brochures and possibly telephone directories to members of the permanent and adult transient population. Although no decision had been made, the Applicant's major witness expressed an opinion, that, following a similar undertaking at the Three Mile Island Facility, the Applicant would assume responsibility for financing the public information costs. This possibility is reinforced to a degree by suggestions of assistance contained in the funding and technical assistance section of the federal guidance. (NUREG-0654, p. 25.)

With respect to the necessity of implementing public information prior to the facilities' operation, we subscribe to its accomplishment but fail to comprehend the Commonwealth's concern. This is particularly so where, as here, FEMA's representative (a major reviewing factor in the Applicants'

effort to obtain a license) testified that such information should be distributed prior to the plant's operation. Since all parties, concur in this aspect of the program for informing the public, we can reliably assume it will materialize as expected. Accordingly, no justification exists for the condition requested by the State.

Traffic Control

Arguably, no more critical item in emergency planning exists than that which deals with the movement of people and vehicles during an evacuation. Traffic control raises issues of policing the activity, the manpower forces assigned to it and the manner in which they are expected to operate. Contention 20(2)(d) alleges that the Luzerne County plan provides an outline for traffic control under "Police group" and does not list the units to be available for the operation.

The Country plan places responsibility for the execution of traffic control plans on the Luzerne County Police Group chief, in cooperation with the Pennsylvania State police and municipal police forces. In the evacuation highway network, a number of access control and traffic control points have been identified and designated to be controlled by the State Police. (Board Finding 173.) The State Police Traffic Control Plan, which is referenced in the County's plan, proposes the availability of 200 State Police officers to man such points and backup assistance is to be provided by the Pennsyvlania National Guard. Municipal police are obligated to assure the flow of traffic within their municipalities. The review by FEMA of these plans indicates that the County plan needs additional specification in the allocation of State police manpower for access and traffic control points and also the manner in which local policy resources are to be utilized. We concur as due to its unique

level of importance, proper planning in traffic control for evacuating an area of over 50,000 people requires precise operations. To that extent, the potential for problems is minimized and the proper development of the range of protective responses recommended by NUREG-0654 is assured. (See Hearing Transcript, pp. 2679-91.)

Notification to the Public

An essential element in planning for radiological emergencies is the development of a procedure for notification of such an incident to members of the public. Both the Commission's standards and criteria require the establishment of means to provide for both early notification and clear instructions. The method for accomplishing this in connection with an emergency at the Susquehanna facility is through the initiation of a system of sirens covering most and eventually all of the plume exposure pathway area. The siren warnings are designed to lead people to turn to television and radio sets for the reception of appropriate messages of instruction through an emergency broadcast system. (Board Finding 176.)

Under the County's response plan, municipal officials are designated as being responsible for insuring the receipt of warning information to the resident and transient population, as well as industries and institutions, within the muncipalities' boundaries. The method proposed for performing this responsibility is through a door-to-door type procedure using speech amplification equipment. Contention 20(3)(a) questions the procedure on the basis that details for its execution are missing in the plan and letters of agreement with political subdivisions to assume responsbility for door-to-door notification are not in existence.

Although the County plan calls for utilization of municipal police and fire departments to carry out the notification procedure, there is testimony to the effect that such a warning program is viewed as only a backup to the siren system and that a backup notification procedure is not required. We do not agree. The fundamental obligation of a warning notification system is communication to all segments of the public. By definition, this covers individuals with hearing impairment and those who for a variety of causes fail to near siren signals as for example, due to surrounding noise conditions or certain sleeping environments. We do not see such a notification procedure in terms of a backup except in a circumstance where a breakdown of the siren system has occurred. We must conclude -- and we believe this to be the plan's intent -- that the notification program within municipalities is not only a supplement but an integral part of the warning system for disseminating appropriate information to be public as recommended by the regulations. That being so, this part of the notification procedure must be contained with the plan before operation, to the same degree as is required of the siren system itself. (See Commonwealth Ex. No. 9, Annex C; also Swiren ff. Tr. 2671 at p. 14).

School District and Municipality Plans

There was substantial disagreement in this proceeding, as we indicated earlier, over the issue of transportation (availability of buses) to handle the evacuation needs of school children and other non-auto owning members of the population. The State's witnesses indicated that the availability of an adequate number of buses for this purpose could not be ascertained until written school emergency response plans were completed. Acknowledging the need for such plans, witnesses for the Applicant and Staff nevertheless

subscribed to a belief that operation of the Susquehanna facility could proceed without them. The foundation for those judgments rested on the experience already accumulated by school districts in handling early school departures during snow storms and other conditions of inclement weather. Additionally, the view was expressed that other nuclear facilities were operating without apparent difficulty within the State in the absence of written school plans. The implication here, presumably, is that imposing a condition for such plans at the Susquehanna plant would represent unfair and inequitable treatment.

An additional aspect of this controversy relates to the current status of municipal emergency response plans. In addition to the provision for evacuating all school children by bus, the County plan calls for the evacuation of non-auto owning persons by bus from selected pick-up points in various municipalities. The identification of transportation needs and pick-up points is a municipal responsibility under the County plan. However, neither of these objectives are capable of accomplishment since all municipal plans have not been developed to this point. Although the testimony is conflicting on the question of whether an adequate number of buses exists to evacuate school children without a return trip, it is clear that resolution of this matter and therefore the availability of buses for both groups cannot be resolved without prepared school plans which will define and disclose school requirements. (Board Finding 185.)

Written School Plans

In our prior comments here, we concluded that written school plans were a necessity. We support that judgment with our belief that completion of municipal emergency plans must also be assured prior to operation of the

facility. When several large groups of individuals depend for evacuation purposes on a single source of transportation, it would be difficult to determine in the light of the present status of planning that there is a reasonable assurance that adequate protective measures in this area can and will be taken in the event of a radiological emergency. The fact that PEMA has encouraged the dispatch of letters to all district school Superintendents to facilitiate the preparation of such plans and the fact that most municipalities have completed their planning up to this point are considerations that suggest the planning efforts in both area will be completed in the near future. If the opinion of the majority of witnesses that support this conclusion is correct, no harm will result from our protective rendering here.

Availability of Dosimeters

The Commonwealth has requested the Applicant's operating license be made subject to an NRC finding that an adequate number of dosimeters are available for distribtuion to off-site emergency workers. There is no disagreement that State and County plans require these workers be equipped with three dosimeters, two self-reading and a third, a thermoluminescent (TLD) type or that the State's supply is inadequate. Nor is there substantive disagreement that federal guidance only recommends a requirement for emergency workers to have two dosimeters -- one self-reading and the other a TLD. The dispute centers instead on the question of whether the federal government has the responsibility to furnish the necessary equipment. Unfortunately, that dispute cannot be resolved here since it presents a matter beyond our domain. In operating license proceedings, a hearing Board's jurisdiction is limited to the issues placedin controversy by the parties and to matters raised sua sponte by the Board. 10 C.F.R. Part 2, Appendix A, VIII(b). The question of responsibility

for supplying dosimeters cannot, as the State argues in its proposed findings, be considered as within the boundary of Contentions 20(5b) or 20(8)(a) although those contention do, in fact, relate to such equipment. Even though a State's position in Commission proceedings is a protected one and its participation is unfettered by many requirements imposed on other parties, it must observe, nevertheless, the same procedural necessities applicable to other participants. This includes advancing issues it wants litigated in such a time framework that opposing parties will be able to respond in a meaningful manner. See Gulf States Utilities Company (River Bend Station, Units 1 and 2) ALAB-444, 6 NRC 760, 768 (1977). Here, the State did not advance the dosimetry matter in its responses of August 10 and October 5, 1981 in complying with our request for the Commonwealth to delineate its concerns. It was only during cross examination of FEMA's representatives during the evidentiary proceeding that the State first raised the dosimetry issue to the status of a controversy. However, that is too late for either the parties' or the Board's consideration.

Reception and Mass Care Centers

SEA's contention 20(7)(e) invites some confusion due to changes in name designations in State and County plans of relocation centers as reception centers, host areas as support counties or areas and shelter areas as mass care centers. The criteria of NUREG-0654 propose that relocation (reception) centers and shelter areas (support mass care centers) be located on maps with evacuation routing as part of the emergency plans of State and local governments to implement protective response measures. Four support counties are listed in the Luzerne County plan but their response plans, required by the State, have not been finalized. Accordingly, the mass care facilities which

are to be located partly in these areas have not been identified as yet. As a result of this status of things, the County plan currently identifies the location of reception centers but only those mass care centers located within Luzerne County. The Luzerne County plan reflects that reception centers are considered as pass-through facilities where evacuees merely obtain information and directions to mass care facilities. The County has entered into a written memorandum of understanding with local chapters of the American Red Cross through which these organizations have undertaken to handle the mass care centers in the event an emergency requires their utilization. (Board Finding 188.)

Traffic Congestion

Questions were raised in the proceeding concerning a lack of identification in State or County plans of traffic impediments on evacuation routes and their failure to deal with such restrictions by not including contingency measures. As we indicated in our comments on Contention 6, the time estimate evacuation study performed by HMM Associates utilized a computer model which was designed to allow for traffic congestion. The highway network used in the study was also physically inspected for problem areas. To control the flow of traffic in an evacuation operation, the State and local plans recognize the basic responsibility of the State Police who will man both traffic access points and previously designated traffic control points where bottlenecks to traffic flow would normally occur. As an aid in assisting in the elimination of impediments, the State Department of Transportation is charged with removing obstacles to the flow of traffic and the Pennsylvania National Guard is also given an assignment of complementing duties. This array of manpower should be adequate to the success of this mission if the

need should arise, as well as the handling of traffic if the traffic light system through a loss of power ceases functioning. This latter possibility was suggested by intervenors during the hearing.

Ingestion Exposure Pathway

An allegation concerning the ingestion exposure pathway (fifty mile radius around a nuclear facility) raises questions regarding the State's plan to comply with the recommendation of NUREG-0654, J. 11. In essence, the criticism was made that the plan fails to (1) identify procedures for detecting contamination; (2) identify procedures for imposing protective action measures such as impoundment, decontamination, processing, decay, product diversion and preservation; (3) mention maintenance of maps for recording data on surveys and monitoring, land uses, dairies, food processing plants, watersheds and facilities, crop information, and (4) include up-to-date lists of milk and food processors of products originating within the ingestion zone but located elsewhere. The State's plan for handling protection responses in the ingestion pathway involves the coordinated activity of a number of State agencies, principally the Department of Agriculture, the Department of Health and the Department of Environmental Protection with its key office, referred to earlier, the Bureau of Radiation Protection (BRP). Simply stated here, samples of milk, produce, and water are to be tested for contamination and responses to protect the public's food supply and water are then recommended to PEMA.

The BRP plan includes protective action guides (PAG) for food, milk and water by which levels of contamination are correlated with protective responses and protective action options are included in the Department of Agriculture's plan. Currently, the State's plan for the ingestion exposure

pathway is being revised and a complete appendix will be published providing a detailed specification of governmental responsibilities in this area including the establishment of means to protect the public from contaminated food and water and to provide guidance to farmers for protection of livestock and harvested crops. Maps have been prepared for the purpose of recording essential information and data on land uses and crop information and up-to-date lists of processors of food, agricultural items and milk products originating in the ingestion pathway are obtainable.

Medical Services

In contention 20(9)(a and b), SEA challenged the adequacy of State and County plans on the arrangements made for medical services for contaminated individuals. NUREG-0654 L. 1 and L. 3 recommends that lists of hospitals be compiled which are considered capable of providing such medical support and also that arrangements be made for local and backup hospitals and medical services that can provide radiation exposure evaluation and handling of contaminated individuals. The State plan lists all hospitals within the State having 'radiation treatment capability' and the Luzerne plan lists such hospitals in the area surrounding the Susquehanna facility, citing some as support hospitals and others as back-up support. (Board Finding 194.) The state plan indicates that a list of site specific and back-up hospitals for the plan was being developed. We would assume that these designations when finally developed will have met in a meaningful manner the criteria of NUREG-0654 L.1 so that "arrangements" with those hospitals for the required support would have been concluded as a result.

Conclusion

Based on the evidence of record, the Board finds that contrary to the Intervenors' contention, the emergency response plans of the Commonwealth of Pennsylvania and Luzerne County, except as they fail to assure the availability of plans from Municipalities and School Districts, are in substantial conformance to the recommendations and guidance of NUREG-0654. The Board finds further that those planning areas requiring further development will be addressed over the next several months. The deficiencies in the plans concerning Municipalities and School Districts will be addressed in the Boards' Order herein.

9. Scram Discharge Volume Break

Contention 21, sponsored by both the Susquehanna Environmental Advocates and the Citizens Against Nuclear Dangers, alleges that a break in the scram discharge volume (SDV) will release radioactive water which can disable the major safety cooling systems in a brief period of time. This would result from the released water flowing into the reactor basement where the cooling system pumps are located, thus flooding and rendering them inoperative.

The SDV is basically a tank which receives reactor coolant displaced by insertion of the reactor control rods. The coolant enters the SDV through the scram exhaust valves, which open upon receipt of a scram signal and close when the scram is reset. Scram reset also opens the SDV vent and drain valves which are closed upon receipt of a scram signal. The contained coolant is then discharged to the building sump, and the SDV is thus prepared for the next scram actuation. A break in the SDV with the scram exhaust valves open

would result in release to the building of water at reactor temperature and pressure. (Board Finding 204.)

Staff Evaluation

The Staff has evaluated this problem generically and has issued its findings in NUREG-0803. It identifies three general areas of concern: integrity of the SDV piping; emergency procedures to successfully mitigate a leak or break; and the environmental qualification of equipment needed to detect and mitigate the consequence of an SDV break. It also proposes a series of site-specific recommendations to which Applicants have committed themselves. (Board Finding 206.)

Probability of SDV Break

The SDV systems are designed and fabricated in accordance with high quality standards, such that they are highly resistant to cracking, fatigue, corrosion, brittle fracture and other failure mechanisms. They are also in-service inspected according to ASME code requirements. Operating experience shows that no SDV leaks or breaks have been reported in 20 years of BWR operation. These factors strongly support an argument that a break in the SDV system is a very low probability occurrence.

SDV System Breaks

If a break in the SDV system should occur, resetting the scram will close the scram exhaust valves, thus terminating the coolant flow to the SDV. If the scram cannot be reset, the leak must be identified and isolated. A leak can be identified by a number of indicators; existence of a leak is therefore

not dependent upon a single instrument. The reactor is then depressurized to limit the amount of coolant released to the building and manually operated isolation valves are utilized to stop any further leakage. (Board Finding 209.) While a radiological field of some strength will exist in the building, appropriately equipped personnel will be able to enter the containment to close the isolation valves without exceeding 10 CFR Part 20 dose limits. (Board Finding 212.)

Adequate core cooling must be maintained during this period. While the system is pressurized, the main feedwater pumps, the condensate pumps and the condenser will be used. These are located in the turbine building and are not subject to flooding. When the system is depressurized, the residual heat removal (RHR) system provides low-pressure coolant injection. If the RHR pumps, which are located in the reactor basement, should be flooded, the RHR service water pumps, which are located in the emergency service water pumphouse and not subject to flooding, can deliver water directly from a 25 million gallon spray pond. (Board Findings 213-214.)

At Susquehanna, all of the emergency systems located in the reactor basement are in compartments which are watertight with respect to each other. The stairwells are also equipped with watertight doors. The basement sump pump should also remain in service. However, even if all these measures were defeated, it would take several hours to flood the basement to a one foot depth. Inasmuch as all motors driving emergency core cooling system pumps are six feet above the basement floor, loss of these motors would not occur until many hours after the onset of the accident, if at all. (Board Findings 218-219.)

Conclusion

On the basis of the uncontroverted evidence in the record, we find that a break in the scram discharge volume of the control rod drive system is unlikely and that if such a break should occur, its consequences could be mitigated before major safety systems would be damaged. Accordingly, we find that contrary to the allegations of the contention, a break in the scram discharge volume of the Susquehanna facility cannot disable major safety systems.

The matters examined during the evidentiary hearing which are not discussed in this Opinion were considered by the Board and found either to be without merit or not to affect our decision herein. Findings of fact and conclusions of Law which are annexed hereto are incorporated in the Opinion. In preparing its findings of fact and conclusions of law, the Board reviewed and considered the entire record and the findings of fact and conclusions of law proposed by the parties.[8] Those proposed findings not incorporated directly or inferentially in this Initial Decision are rejected as being unsupported by the record of the case or as being unnecessary to the rendering of this decision.

According, for all the foregoing reasons it is this date April 12, 1982 ordered that the Director of Nuclear Reactor Regulation is authorized to issue

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[8] Proposed findings were submitted on all contentions by the Applicant and Staff; on Contentions 6 and 20 by the Commonwealth and on Contention 1 by ECNP. No other party filed proposed findings.

operating licenses to the Applicants for Units 1 and 2 at the Susquehanna Steam Electric Station, subject to the conditions being complied with as stated.

FINDINGS OF FACT

III. CONTENTIONS

Health Effects of Nuclear Fuel Cycle (Contention 1)

1. This contention was modified by the Board on March 27, 1980, to treat technetium-99 (Tc-99) similarly to radon-222, following the Commission's amendment of Table S-3 of 10 CFR §51.20 (44 Fed. Reg. 45362, August 12, 1979).

2. The Applicants, Staff and intervenor ECNP stipulated that a condition will be imposed on operating licenses for the Susquehanna units, making the licenses subject to the outcome of the consolidated radon proceedings currently before the Appeal Board. Except for the quantities and health effects of technetium, and the stipulation regarding radon, the parts of this contention concerned with other isotopes were dismissed by the Board through granting motions for summary disposition filed by the Applicant and Staff.

3. Contention 1, as litigated, reads as follows:[9]

> 1. The quantity of technetium-99 which will be released from waste management or reprocessing activities resulting from

[9]Applicants presented testimony of Richard W. Englehart, Ph.D., a Senior Executive Consultant and Manager, Radiological Programs Department, Environmental Service Division, NUS Corporation. The Staff's witnesses were Fred D. Fisher, Ph. D., leader of the Environmental Radiation Emergency Support Section, Uranium Fuel Licensing Branch, Division of Fuel Cycle and Material Safety, Office of Nuclear Material Safety and Safeguards, NRC; Dr. Edward F. Branagan, a Radiological Physicist and Dr. R. K. Struckmeyer, an Environmental Analyst in the Radiological Assessment Branch, Office of Nuclear Reactor Regulation. The Intervenors presented no direct testimony.

operation of the Susquehanna facility, has not been, but should be adequately assessed. The radiological health effects of technetium should be estimated and these estimates factored into the cost-benefit balance for the operation of the plant.

4. Technetium, which is produced by fission of uranium-235 and by neutron activation of molybdenum-98, has no stable isotopes and is rarely found in nature. Tc-99's half-life is 220,000 years and it decays to stable ruthenium-99 by emitting low energy beta particles. Because of its low beta energy, it poses no significant external exposure hazard, and the potential health hazard associated with Tc-99 is from possible ingestion or inhalation (Englehart, ff. Tr. 1852 at pp. 2-3).

5. During operation, Tc-99 is produced at the rate of 14.3 Ci/MT of uranium or 500 Ci/RRY and essentially all of the isotopes produced by fission remains in the encapsulated spent fuel. No releases occur in storage at the reactor or in interim storage facilities. (Ibid. p. 3.)

6. Under the once-through fuel cycle (no reprocessing), the stored spent fuel is packaged for ultimate disposal in a stable geologic formation. Containment package integrity for a minimum of 1,000 years is required by the proposed 10 CFR Part 60 with a maximum release rate of one part in 100,000 per year thereafter. For the analysis by Applicants' witness, all of the Tc-99 is assumed to be dissolved in groundwater over a period of 100,000 years. (Ibid. pp. 4-5.)

7. In the uranium-only recycle operation, the spent fuel is dissolved in hot nitric acid forming a non-volatile stable pertechnetic acid and no Tc-99 releases are expected at this stage. The nitric acid solution is subjected to a series of solvent extraction cycles to separate the uranium from the fission products and in this partitioning, over the long term, it is estimated that 8 to 25 percent of the Tc-99 will remain with the uranium

product stream with the balance going to the high-level liquid waste (HLLW) stream. The HLLW stream goes to a treatment process and, potentially, to environmental releases. In the uranium-only recycle fuel cycle, there is a separate plutonium waste stream that would contain 1 percent, more or less, of Tc-99, but because of the future uncertainty of plutonium recovery, it was conservatively assumed that the Tc-99 will be apportioned only between the uranium stream and the HLLW stream. (Ibid. pp. 6-7.)

8. In the conversion of the uranium product stream of fuel, some Tc-99 is contained in low-level solid waste (LLW) produced which is buried in a shallow facility. At some future time, some fraction of 40 - 125 Ci/RRY may be available for human intake because of groundwater intrusion and conveyance. (Ibid. p. 10.)

9. In the re-enrichment process, direct emission of Tc-99 to the atmosphere is estimated to be 6.6×10^{-3} Ci/RRY and to surface water, 8.5×10^{-2} Ci/RRY. (Ibid. p. 11.)

10. The predominant dose pathway for atmospheric releases of Tc-99 is soil deposition, root uptake, and human ingestion. The pertechnetate ion, which is the most stable chemical form of Tc-99 in aqueous solution, is weakly retained in non-organic soils and strongly retained by organic soils. Consequently, uptake by vegetation is site dependent. For inorganic soils, a conservatively high residence time is one year and for organic soils it would be much longer. For the calculations done by Applicant's witness, an average residence time of 15 years was used and a soil-to-plant transfer factor of 50 pCi/g fresh vegetable weight per pCi/g dry soil weight, both of which are characterized as conservative. (Ibid. p. 13.)

11. Using models and calculations of Roddy, et al., population doses were estimated. However, since Roddy, et al., used a soil-to-plant transfer

factor of 0.25 pCi/g instead of 50, Roddy's calculations were scaled up by a factor of 140 to account for the difference in transfer factors. As adjusted, and using a source term of 0.0066 Ci/RRY, annual population doses from atmospheric releases are calculated to be in man-rem/RRY: total body, 6.8 x 10^{-4}; bone: 0.0016; kidney: 0.031; and gastronitestional (GI) tract: 0.134. Annual population thyroid doses based on factors from Killough, et al., are less than 0.1 man-rem/RRY. (Ibid. p. 14.)

12. Doses resulting from surface water releases from enrichment processes are estimated to be in man-rem/RRY; 8.2 x 10^{-3} total body, 0.12 GI tract, and 0.52 thyroid. (Ibid. p. 15.)

13. A model developed by Adam and Rogers for the Maxey Flats commercial low-level waste disposal facility was used by Applicants' witness for computation of groundwater releases from shallow burial sites. This model assumes a groundwater transport distance of 800 meters to a surface stream. Population doses result downstream from use before the stream reaches the ocean. The Maxey Flats pathway is one of the longest potential fresh water paths of any LLW site in the United States. The exposed population is assumed as 5.7 x 10^{6}. For a shallow land burial of 125 Ci/RRY, calculated annual population doses are in manrem/RRY; 0.0012 total body, 0.018 GI tract, and 0.077 thyroid, and it is assumed these rates will continue over 10,000 years. (Ibid. pp. 15-16.)

14. Calculations of Tc-99 from high-level waste repositories are based on the NRC proposed technical criteria which after 1,000 years of isolation would restrict the annual release rate to 1 x 10^{-5} of the inventory (or 0.005 Ci/RRY from an inventory of 500 Ci/RRY). (Ibid. p. 17.)

15. Assuming, very conservatively, that the liquid pathway for deep repositories followed that of shallow burial sites, after 1,000 years of

isolation the expected annual population dose would be four-tenths that of shallow sites or a maximum of 0.00048 whole body, 0.0072 GI tract, and 0.0308 thyroid, man-rem/RRY. (Ibid. pp. 17-18.)

16. According to the Applicants' witness, the major potential for population doses from release of Tc-99 would result if this material were to be released to groundwater from waste burial sites or repositories for either spent fuel or reprocessed wates. It would be expected that such releases would not exceed 10^{-4} of the inventory per year for LLW sites, or 10^{-5} for HLLW sites. Yearly doses resulting from operation of Susquehanna from buried high level wastes based on a once through fuel cycle would be approximately in man-rem: 0.031 whole body, 0.46 GI tract, and 1.97 thyroid. For the uranium-only recycle option, the atmospheric releases over the life of the plant from enrichment process in man-rem are: .043 whole body, 1.97 kidney, 8.58 GI tract, and 6.4 thyroid; and for surface water releases: 0.52 whole body, 7.7 GI tract, and 33.2 thyroid. The Low Level Waste Storage for the recycle option release to groundwater over 10,000 years results in population doses of in man-rem/year: 0.77 whole body, 1.15 GI tract, 4.93 thyroid. High Level Waste Storage doses for this option would be the same as for the once-through fuel cycle. (Ibid. pp. 18-19.)

17. The Applicants' witness considers the releases of Tc-99 attributable to Susquehanna to be an insignificant increment to the natural background dose of the affected population. The population dose from natural sources per year is assumed to be 100 millirem per person per year. This would be an annual dose of 570,000 man-rem for a population of 5.7 million downstream from disposal site. From a shallow land burial of the yearly releases of Tc-99 at Susquehanna, the increase per person in an average thyroid dose would be 8.6×10^{-4} mrem, the whole body dose increase would be

1.3 x 10^{-5} mrem, and from a high level waste repository, the individual dose would be 3.5x 10^{-4} mrem, or less than one-thousandth of a percent of the annual dose due to natural background radiation. (Ibid. pp. 20-21.)

18. The Staff's witness, Dr. Fisher, testified on the quantities of Tc-99 releases from the supporting fuel cycle for light-water-cooled reactors. He considered operation without recycle and with recycle of uranium or uranium and plutonium. Using the ORIGEN burn-up code, the witness estimated that 391 Ci of technetium-99 will be contained in the spent fuel from one year of operation of a plant like Susquehanna. In calculating releases from this amount of Tc-99, Dr. Fisher then assumes total and prompt releases (less than 100 years) to surface waters of technetium-99 disposed of with low-level wastes by shallow land burial. For geologic repository disposal, it is assumed waste packaging will retain its integrity for 1000 years, that groundwater required 1000 years to reach surface waters, and that the leach rate of waste form is not more than 0.0001 per year. For reprocessing, the estimates of releases were developed by combining data on the properties of Tc-99 with operating performance characteristics and typical equipment used. Liquid releases associated with spent fuel storage were calculated to be 3.2 x 10^{-5} Ci/RRY in both cases, i.e., with and without recycle. There are no airborne releases without recycle, but there are with reprocessing. Liquid releases are computed from shallow land burial of low level wastes associated with recycle and the geologic repository for high level wastes in both cases. (Fisher, ff. Tr. 1808 at pp. 1-5.)

19. The testimony of Staff witnesses Branagan and Struckmeyer dealt with the radiological health effects of Tc-99 releases from the fuel cycle. Doses were computed in three steps and the quantities of Tc-99 released per RRY were taken from Dr. Fisher's testimony. RABGAD and LADIAP computer codes

were used to estimate population doses per Ci of Tc-99 to the air and water and the parameters used in codes were taken from the Generic Environmental Statement for Mixed-Oxide Fuels (GESMO), NUREG-0002. Population doses were estimated for 100 years and 1000 years and were estimated per RRY by multiplying the quantities released in gaseous and liquid form by the population doses per Ci of Tc-99 released. Cumulative releases were computed for the first 2000 years and an annual release thereafter. (Branagan and Struckmeyer, ff. Tr. 1894 at pp. 1-3.)

20. Potential health effects were computed by multiplying the population dose per RRY by somatic (i.e., cancer) and genetic risk estimators. The risk estimators used by the Staff were based on the BEIR I Report. These were: about 140 potential deaths from cancer per million person-rem and about 260 potential cases of genetic disorders per million person-rem. The cancer fatality risk estimates are based on the "absolute risk" model in BEIR I rather than the "relative risk" model which would produce higher estimates by a factor of four. The BEIR III Report estimates 1.5 to 2 times as many potential non-fatal as fatal cancers. (Ibid. pp. 4-5.)

21. The total body risk equivalent population dose is about 5 person-rem/RRY for prompt releases. The annual total body risk equivalent population dose is about 4×10^{-3} person-rem/RRY and is about 1000 times less than the total body risk equivalent population dose for the first 2000 years (i.e., 5 person-rem/RRY). The total body risk equivalent population dose for both 100 year and 1000 year environmental dose commitment times are about the same because almost all of the population doses are received in the first 100 years. (Ibid. p. 6.)

22. There may occur about 0.0007 cancer fatalities/RRY due to prompt releases of Tc-99. The number of potential cancer fatalities from each

assumed annual release of TC-99 from a high level waste repository for time periods beyond 2000 years (i.e., about 5 x 10^{-7} potential fatal cancers/yr/RRY) is about 1400 times less than the cumulative value for prompt releases during the first 2000 years (i.e., about 7 x 10^{-4} potential fatal cancers/RRY). (Ibid. p. 7.)

23. There may occur about 0.00006 genetic disorders/RRY due to prompt releases of Tc-99. The number of potential genetic disorders from each assumed release of TC-99 from the fuel cycle for the time periods beyond 2000 years (i.e., about 2 x 10^{-8} potential genetic disorders/yr/RRY) is about 3000 times less than the cumulative value for prompt releases during the first 2000 years (i.e., about 6 x 10^{-5} potential genetic disorders/RRY). This analysis indicates that the total body risk equivalent dose from TC-99 is about 5 person-rem/RRY. In the FES (p. 4-33), it is stated that the population dose should not exceed 100 person-rem/RRY, a more conservative estimate. (Ibid. p. 7.)

24. The population dose per RRY (i.e., about 5 person-rem, total body risk equivalent) from TC-99 releases from the fuel cycle is about one percent of the population dose (i.e., about 640 person-rem, total body) for the rest of the fuel cycle. Consequently, the radiological impacts from exposure to TC-99 releases from the fuel cycle have an insignificant effect on the cost-benefit balance. (Ibid. p. 9.)

2. Need for Power (Contention 4)

25. As a result of a successful motion for summary dispostion filed by the Staff, only the following parts of this contention were considered during the hearing:[10]

> 4. The Susquehanna facility (or, at least, Unit 2 thereof) is not needed, and as a result, the cost-benefit balance is tilted against authorization of operating licenses (or at least, a license for Unit 2), for the following reasons:
>
> a. Information supplied in the Applicants' ER shows that, at the very low growth rate scenario, the entire output of both units will be available for sale outside the service areas of the Applicants as the units come on line (ER, Table 1.1-15).
>
> b. The electric capacity of the lead Applicant in 1977 was 40 percent greater than customer needs and demands from existing facilities. Latest projections of energy use and requirements during the next 30 years for the Applicants' service area, the period equal to the projected plants' "useful life," show that the Applicants can meet the needs of their customers through existing facilities and sources.

26. PP&L prepared a demand forecast in October 1980, which was revised on September 28, 1981. (McNair, ff. Tr. 1957 at p. 1.) The current forecast includes conservation and new technology events likely to occur in the next 20 years. A net reduction of 1000 MW of load is expected from conservation and new energy technologies, and 400 MW from shifting on-peak loads to off-peak.

27. PP&L has forecast loads using econometric models, traditional or judgment methods, probability band forecasts, short-term, and peak load

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[10] The Applicants' witnesses, both from the Pennsylvania Power and Light Company were Greyson E. McNair, V.P. Consumer Services, who testified on the development of sales and peak load forecasts and Wm. F. Hecht, Mgr. of Systems Planning, who testified on the need for energy and capacity from Susquehanna. The Staff's witness was Dr. Raghaw Prasad, an economist with the Argonne National Laboratory, who testified on the benefits to be derived from operation of the Susquehanna facility No intervenor put on direct testimony.

forecasts. The econometric model uses historic values to measure interrelationships of key variables. Assumptions were developed by Data Resources, Inc. and were used to develop a 25 year macroeconomic outlook. Forecasts of future energy use were made for various components of the residential, commercial and industrial sectors. The DRI forecast selected by PP&L to produce the base case evaluation was called Cyclelong 2005. It assumed a moderate real national output growth for an annual average GNP growth rate of 2.3 percent. The expected values for real annual increases in prices through the year 2000 were 2 percent for coal, 2 percent for oil, and 6 percent for natural gas. The forecast for real electric price increases was 0.2 percent annually. The econometric point estimate forecast for the year 2000 is 35,000 million kWh. Varying real electric price increase from 1 percent to -3 percent and keeping oil and gas constant gives a range from 39,7000 GWh to 56,000 GWh. (Ibid. pp. 4-9 and see Graph 1, Rev. 1, p. 11.)

28. The traditional or judgment method of forecasting allows the forecaster a freer hand to employ relationships that cannot be formulated as equations. All factors that would push consumption up are lumped together, whether consistent or not, and then the same is done for factors that would push consumption down. Adjustments are made for conservation, throwover (i.e., substitution of fuel sources), and residential conversions of energy systems. A band of forecasts are produced with an upper and lower boundary. The forecasts are based on detailed estimates for various components of the specific sectors. Adjustments are made based on assumptions for economic growth and prices. The results are a forecast of 34,000 GWh to 59,000 GWh. If cogeneration is considered, the range is 27,000 to 54,000. (Ibid. pp. 12-18.)

29. Long-term judgment forecasting is improved by forming consistent sets of assumptions for estimating most probable outcomes. A refined probability band forecast is developed. This method predicts a continuation of conservation to 1986, followed by an era of throwover from oil and perhaps natural gas to coal and nuclear to 1997. The final three years to 2000 will experience maturation of alternate renewable fuels and energy sources. Under this method, the year 2000 demand varies about 32,000 GHw to 44,000 GWh. (Ibid. pp. 20-22.)

30. Normally, short-term forecasts are made for 18 months. The 1980 short-term forecast was extended to 1986 using long-term judgment forecast information. In addition, information was obtained from local home builders, commercial operations, and industrial customers regarding their expectations relative to new construction, additions and/or layoffs of workers, production increases and conservation accomplishments. Past experience has shown that these statements of expectations tend to be overly optimistic and have to be adjusted downward before they can be used to forecast effects on electrical loads. Furthermore, because of the cyclical nature of the economy, a depression was hypothesized to occur during the forecast period. Other economic assumptions were included. A 1981 short-term forecast has subsequently been made for 1982 and 1983. The latest figures for a 1982 forecast were 23,771 x 10^6 kWh and for 1983, 24,400 x 10^6 kWh. (Ibid. pp. 24-26. Also see Table 3A, p. 26.)

31. Plant capacity required is based on peak load, i.e., maximum hourly demand for electricity. Peak load demand is developed by research on use by each rate class, i.e., customers paying the same rate schedule to define historical load characteristics. Assumptions are factored into forecasts relative to the level of economy, fuel price levels, conservation

and new technologies. PP&L has peak loads in the summer and winter with the annual peak load occurring in January. A winter peak forecast of 6,850 MW for 1995, a sales growth to 1995 of 2.5 percent per annum and a 2.4 percent peak load growth are forecast. For planning purposes, a range of growth rates of 1 percent and 3.5 percent were investigated. (Ibid. pp. 27-29 and see Graph 5, p. 32.)

32. The Applicants' witness, McNair, explained the recent changes in the company's forecasts. The new forecast was approved September 28, 1981 and was lower than previous ones. The new compound growth forecast is 2.2 percent compared with the prior one of 2.5 percent and the new compound growth rate for peak load is 2.0 percent, rather than 2.2 percent. These changes are attributed to a slower growth in the economy, a lower number of new dwelling units, and lower annual use of electricity in electrically heated dwellings. (See McNair supplemental affidavit, ff. Tr. 1950 at pp. 1-2).

33. Electricity generated by Susquehanna will have the lowest operating costs of any facility on the PP&L system other than hydroelectric ones. Susquehanna will displace other plants that use more costly fuels such as oil and coal and the generation capacity freed thereby will, in turn, be used to displace other even more costly generation on the PJM interconnection. Thus, that part of the contention is inaccurate that states "the entire output of both units will be available for sale outside the service area." When Susquehanna is placed in service, PP&L will credit energy generated by these units to its customers. (Hecht, ff. Tr. 2049 at pp. 3, 5.)

34. The Applicants concede that capacity with Susquehanna added may be greater than required, but reserve margin is only one factor in analyzing the "appropriateness" of new capacity. Other factors are diversity of fuel sources, conservation of oil and overall economics. Operation of Susquehanna

will result in significant operating cost savings, fuel diversity, conserve substantial quantities of oil, and also provide a supplemental margin of service reliability for unexpected contingencies. (Ibid. p. 4.)

35. By PJM agreement, PP&L must maintain a reserve margin of about 10 percent over its winter peak. PJM has an overall peak in the summer but this is tending to change to a winter peak which is forecast for the late 1990's. As this occurs, the reserve margin requirement is projected to increase to 20 percent. Because the lead time for new construction is 10-12 years, PP&L would not be able to meet its reserve margin obligation in the mid-1980's unless other facilities were added that have relatively high operating costs, such as oil and gas-fired combustion turbines. The addition of Susquehanna will substantially benefit the reserve margin. (Ibid. pp. 7-8.)

36. Coal is considered vulnerable to a coal miner's strike and oil supplies are vulnerable to embargoes and other supply problems. The present mix of capacity by fuel sources is about 63 percent coal, 33 percent oil, and 4 percent hydro and the addition of Susquehanna will result in 49 percent coal, 26 percent oil, and 22 percent nuclear. (Ibid. pp. 8-9.)

37. Some costs will go up when Susquehanna goes on line because the utility is permitted to recover the total costs of providing service. These costs include capital-related costs (depreciation, return on investment, and taxes) and operating and maintenance costs (i.e., wages, material, contract engineering and labor, etc.), to operate and maintain its units. These increased costs are partially offset by lower fuel costs and increased sales to other members of PJM. The fuel costs for electricity used by PP&L's customers will be less with Susquehanna. Operation and maintenance costs include a calculated cost for decommissioning of $191 million for a total

annualized cost of $18.5 million. For purpose of calculations, a pessimistic lifetime capacity factor of 50 percent, as well as an optimistic factor of 80 percent are used. (Ibid. pp. 9-10 and p. 24.)

38. The calculations show that without Susquehanna, PP&L's revenue requirements for fuel and interchange costs would increase. The January 1982 present worth of those costs would be $3.6 billion for low growth (1 percent) and $4.7 billion for high growth (3-1/2 percent). (Ibid. p. 21.)

39. If Susquehanna were abandoned, PP&L's revenue requirements between 1983 and 1992 would be $6.6 billion (low growth) to $9.2 billion (high growth) higher than if the plant were to be placed in service as scheduled. The January 1982 present worths of those increases are $2.6 billion to $3.6 billion. A year's delay would increase revenue requirements for 1982-92 by $400 million to $800 million. (Ibid. pp. 21-24.)

40. The effect of an assumed growth rate of zero in energy sales and peak load even if combined with a 50 percent capacity factor shows a benefit of $3.15 billion in the first 10 years with a present net worth of $1.32 billion. (Hecht, supplemental affidavit, ff. Tr. 2051 at p. 2.)

41. The NRC Staff determination of benefit is not limited to conclusions regarding reliability or growth in electrical energy requirements. The benefit from operation of Susquehanna is the assurance of a low cost supply of electrical energy through minimization of production costs achieved through a substitution of electricity generated by this facility for electricity generated by more expensive units. Any reduction in total demand would not alter this condition. (Prasad, ff. Tr. 2196 at pp. 2-3.)

42. Only 2 percent and 23 percent of the capacity available to PP&L and PJM in 1982 can generate electricity at a cost equal to or lower than will be provided at Susquehanna, and this capacity is hydro or other nuclear. The

remaining 98 percent of PP&L's capacity is coal (64 percent) or oil (34 percent). The remaining 77 percent of PJM's capacity is coal (34 percent), oil (26 percent), or combustion turbines (17 percent) (oil or gas). If Susquehanna is not operated, replacement energy would come from these more expensive fossil fuels. (Ibid. pp. 4-5.)

43. Even assuming that demand would decline so low that generation from 43 percent of PJM's capacity is not required, and that Susquehanna will operate at 60 percent capacity, and also considering fuel costs and inflation, the fuel cost savings in the first full year of operation of Unit 1 is $30 million, and in 1983 with both units in operation, $64 million. (Ibid. p. 6.)

44. An analysis by the U.S. Department of Energy estimated fuel replacement costs for Susquehanna in 1982 at $162 million per year, based on equal replacement by coal and oil. The Applicants' witness analyses were based on an unusually low demand where coal would be the only replacement fuel. In either case, however, substantial savings from operation of Susquehanna exist. (Ibid. p. 7.)

45. The Board finds that the operation of Susquehanna will result in fuel diversity, conservation of oil and lower fuel costs of operation. The Board finds it will be more costly at this stage to abandon the plant than to operate it.

46. The Board finds that the plant is not needed at present to meet current reserve margin requirements, but it will help meet reserve requirements of the PJM power pool sometime between the mid-1980's and early 1990's.

47. The Board finds that operation of Susquehanna will permit its output to be substituted for more expensive operations in meeting its customer's needs.

3. Evacuation Emergency Plan[11] (Contention 6)

48. ECNP, in part and SEA, in part sponsored this contention, which, as admitted for hearing purposes, read as follows:

> 6. The emergency plan proposed by the Applicants is not sufficient to assure prompt notification and evacuation of all areas in which persons may be exposed to radiation doses in excess of those permitted by existing radiation exposure standards for the general public and Protective Action Guides. Specifically: a. The plan fails to account adequately for narrow roads and adverse weather conditions in the vicinity of the site. b. There is considerable question of the ability of Pennsylvania's Office of Radiological Health to fulfill its assigned functions in the event of an emergency. The Director of that office stated at a public meeting that his staff would not be able to respond at all hours to an accident at a nuclear facility. He has also, by affidavit, denied having made such a statement. This question must be resolved. Furthermore, the office has been unsuccessful in obtaining the amount of funding required to provide adequate qualified staff and equipment to be able to expand its capability to monitor and respond to a radiation emergency situation at Susquehanna. c. The plan includes insufficient information with respect to either the training of or the adequacy of radiation hazard safeguards to protect local emergency units which may be required to participate in emergency evacuation procedures or which may be required to deal with on-site situations. The plan does not state whether the public or the utility will provide the training in protection and procedure required by local emergency units to coordinate a safe, systematic evacuation.

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[11]The Applicants' witnesses were Scott T. McCandless, Project Mgr., HMM Associates, who testified on a time evacuation study; Oran K. Henderson, V.P., Emergency Management Services, Inc. on the capabilities of the Bureau of Radiation Protection and off-site training; Robert M. Carroll, consultant, Emergency Management Services, Inc. on school evacuation and Steven H. Cantone, Mgr., Nuclear Support, Pennsylvania Power and Light Co. on on-site training; the Staff's witnesses were Stephen H. Chestnut, NRC Emergency Preparedness Branch, who testified on on-site emergency planning and Bruce J. Swiren, Federal Emergency Management Agency on off-site emergency planning; the Commonwealth's witnesses were Margaret A. Reilly, Bureau of Radiation Protection who testified on the capabilities of BRP and a panel composed of Adolph Belser, Kenneth Lamison, Ralph Hippert, and John Comey, officials with Pennsylvania Emergency Management Agency who gave testimony on State and County emergency planning. No direct testimony was introduced from any intervenor.

49. Applicants for facility operating licenses are required by NRC regulations to submit emergency plans and the standards and requirements for such plans are address in 10 CFR 50.47 and 10 CFR Part 50, Appendix E.[12] The regulations refer to NUREG-0654 FEMA-REP-1 Rev. 1, a document prepared to provide guidance and acceptance criteria for the development of emergency plans.[13]

50. NRC regulations and NUREG-0654 establish standards and criteria for the development of procedures to be followed by the Applicants in notifying State and local response organizations of radiological emergencies. The emergency plans must also provide for early and prompt communications with the public.[14]

51. For any radiological emergencies, responsibilities have been assigned and procedures established by the Applicant for the prompt notification of State and local response organizations. (SER Supp. 1, App. D, pp. 5-6 and SER Supp. 2, App. D, p. 3. See also Commonwealth Ex. 8, App. 3.)

52. Emergency response plans of the State and local county government provide for notification, communication of emergency warnings and instructions to members of the public. (Belser et al. ff. Tr. 2586 at pp. 1-3, Commonwealth Ex. 1, pp. 17-18; Commonwealth Ex. 8, Commonwealth Ex. 9.)

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[12] See 10 CFR 50.34(b)(6)(v).

[13] 10 CFR 50.47(b) n.1.

[14] "Procedures have been established for notification, by the licensee, of State and local response organizations and for notification of emergency personnel by all organizations; the content of initial and follow-up messages to response organizations and the public has been established: and means to provide early communication and clear instruction to the populace within the plume exposure pathway Emergency Planning Zone have been established." 10 CFR 50.47(b)(5).

"Provisions exist for prompt communications among principal response organizations to emergency personnel and to the public." 10 CFR 50.47(b)(6). Also see NUREG-0654 II.E. pp. 43-48.

53. Specific messages for the public that relate to various levels of emergency have been included in local government response plans and the Applicants have developed a system for prompt alerting of the public to receive such messages through radio and television. For those with hearing difficulties or a lack of reception capabilities, the notification system will be supplemented by local police and fire forces in selected areas. (Commonwealth Ex. 9, Annex D, App. 1-5, pp. D1-D5. SER Supp. 1, App. D, p. D-6. Also see Commonwealth Ex. 9, Annex C., p. C-1. Belser et al. ff. Tr. 2586 at p. 2.)

54. In addition to requiring notification and instruction to the public within the plume exposure pathway, an area of about ten (10 miles in radius, emergency planning zone plans must include "A range of protective actions ... for the plume exposure pathway EPZ for emergency workers and the public.[15] And they also require the license applicant to provide an analysis of the time required to evacuate and for taking other protective actions for various sectors and distances within the plume exposure pathway EPZ for transient and permanent populations. However, maximum time allowances for evacuation are not required.[16]

55. The Applicant has provided an evacuation time estimate study for the plume exposure pathway EPZ prepared by HMM Associates. (McCandless Testimony, Tr. 2250 et seq.)

56. The evacuation time estimate study calculated the time required to evacuate from the plume exposure pathway EPZ, all permanent residents, transient population and special facilities containing school students,

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[15] 10 CFR 50.47(b)(10).
[16] 10 CFR Part 50, App. E, IV. See also NUREG-0654, p. 61 and App. 4.

hospital patients and nursing home residents, as well as inhabitants of non-automobile-owning households. (Ibid. p. 6).

57. HMM Associates used a computer evacuation simulation model to develop time estimates that has been validated by field data and a Federal Highway Administration model. The model has been used previously to estimate evacuation times for eight (8) nuclear power plant sites. (Ibid. p. 4.)

58. The highway network in the time estimate study for evacuation was taken from State and County emergency plans and validated for use by field inspections. (McCandless, Tr. pp. 2277-78; Belser et al., ff. Tr. 2586 at pp. 3-4, 27.) Major evacuation routes were selected by PEMA in conjunction with the Commonwealth's Department of Transportation. (Belser, Tr. pp. 2638-39.)

59. Field inspections of intersections and links in the highway network and traffic controls were undertaken for information in the time estimate study. (McCandless Tr. pp. 2252-53 and 2278-80.) Only outbound links of the highway network were used, so that evacuation traffic could bypass accident obstacles without excessive delay. (Ibid. p. 2264.)

60. The evacuation time analysis considered several different time periods, different populations, and adverse weather conditions (snow or rainfall, flooding of Susquehanna River, icing and winter storm) in meeting the recommendations of NUREG-0654. (McCandless ff. Tr. 2250 at pp. 8-11; also see NUREG-0654, App. 4.)

61. The assumptions used for evacuation mobilization and preparation times of different population groups were based on discussions with County officials. (McCandless ff. Tr. 2250 at p. 7.)

62. The Applicants' time evacuation study calculated the entire plume exposure pathway EPZ could be evacuated with six hours or less during

weekdays, five hours or less during weekends or night periods and in less than nine hours under the adverse weather conditions reviewed. The time estimates are comparable to those at other nuclear power plants studied by HMM. (Ibid. pp. 8-12.)

63. The Commonwealth of Pennsylvania and HMM agree that if buses are required to make two trips to accommodate evacuation of the non-auto-owning population, another hour and 40 minutes should be added to the weekday time period. (McCandless Tr. p. 2260; Belser et al., ff. Tr 2586 at p. 27.)

64. In the event of a nuclear emergency, it is planned that all students in school will be evacuated and will not be sent home. (Carroll, Tr. p. 2333.)

65. Both the Commonwealth of Pennsylvania and local plans contemplate the use of school buses for evacuation of students where required. (Commonwealth Ex. 8, p. 15 and Ex. 9, Annex N, p. N-1.)

66. The evacuation of students by buses is assumed to start ninety minutes after an evacuation signal is communicated. (McCandless, ff. Tr. 2250 at p. 7.)

67. Although there is no specific requirement to have written school evacuation plans in meeting the recommendations of NUREG-0654, there is general agreement among the parties that written school emergency plans should be prepared prior to the facilities' operation. (Carroll, Tr. p. 2317; Belser, Tr. pp. 2607-2608; Swiren, Tr. pp. 2675-76.) It should also be noted that the Luzerne County Plan refers to "the development of protective action plans" being a responsibility of school officials. (See Commonwealth Ex. 9, App. N.)

68. There are no written evacuation plans by schools within the plume exposure pathway EPZ at the present time. (Carroll, Tr. p. 2317; Henderson ff. Tr. 2546 at p. 28.)

69. NUREG-0654 recommends written agreements among Federal, State, and local agencies and other support organizations having emergency response roles within the Emergency Planning Zone. (Staff Ex. 7, p. 32.)

70. The functions of the Office of Radiological Health named in the contention have been transferred to the Bureau of Radiation Protection, a part of the Commonwealth's Department of Environmental Resources. (Tr. 2348.)

71. The Bureau of Radiation Protection (BRP) has the responsibility of assessing an emergency at a nuclear facility and advising the lead State Agency the Pennsylvania Emergency Management Agency (PEMA) on protective actions that should be taken. It also serves as a primary source for providing technical guidance to limit radiological exposures of emergency workers, and for providing assistance to State agencies and local governments on radiation exposure, detection, decontamination, and protective actions. (Commonwealth Ex. 8, p. 15; Reilly ff. Tr. 2434 at pp. 2-3.)

72. Since the Three Mile Island incident in March 1979, the funding level for BRP has increased from $600,000 to $990,000. (Henderson, ff. Tr. 2340 at p. 2; Reilly, Tr. p. 2485.)

73. Personnel and equipment available to BRP in the event of a nuclear emergency is adequate for the implementation of its responsibilities. (Reilly Testimony, Tr. p. 2496; ff. Tr. 2434 at p. 3; Swiren ff. Tr. 2519 at pp. 3-4.)

74. The BRP is capable of responding to an emergency on a twenty-four hour basis. (Reilly, ff. Tr. 2434 at p. 3.)

75. In recommending immediate protective actions, the BRP would rely on the Applicants' off-site and on-site data. (Reilly, ff. Tr. 2434 at p. 2; Testimony, Tr. p. 2452.)

76. During an emergency, the BRP will establish direct communications with the Applicants' facility and PEMA on dedicated phone lines. (Reilly Testimony, Tr. p. 2455, Henderson, ff. Tr. 2340 at p. 2.)

77. The BRP has the capability of establishing six monitoring teams at the Susquehanna facility within three hours of notification. (Reilly, ff. Tr. 2434 at p. 2; Tr. 2454. Also see Swiren, ff. Tr. 2519 at p. 3.)

78. Off-site monitoring stations, which are used to confirm radiological data, include seventeen BRP locations, thirty-five NRC and sixty locations by the Applicant. These are not used to decide immediate protective actions. (Commonwealth Ex. 2; Reilly Testimony, Tr. pp. 2450-2451.)

79. Radiological response training is required by NRC regulations and criteria for those who may be called to assist in emergencies.[17]

80. The responsibility for on-site training is exercised by the Applicants and for off-site by the State. (Beaser et al., ff. Tr. 2586 at p. 4; Cantone, ff. Tr. 2383 at p. 2.)

81. The Applicant provides training for police, fire, and ambulance personnel who may come on site during ar emergency. Further training is available for hospital personnel and state and local officials who have an emergency management role. Training covers emergency planning overview, calculations and projection, protective actions, basic radiation theory, plant layout, contaminated injury and access control. (Ibid. pp. 2-5.)

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[17] 10 CFR 50.47(b)(15) NUREG-0654, pp. 75-77.)

82. Parts of the training program have been initiated and it is intended to have it completed before the end of 1981 and certainly prior to operation of the facility. Annual retraining is contemplated. (Cantone Testimony, Tr. pp. 2395-96.)

83. Members of off-site responding agencies will receive dosimeters to record radiation exposure and protection equipment, including clothing, where required. Supplies of potassium iodide will be available to mitigate the consequences of any release of radioactive iodine. (Cantone, ff. Tr. 2386 at p. 6.)

84. Fire, contaminated injury and full-scale emergency plan drills will test the training program periodically. (Ibid. p. 5.)

85. The Applicants' quality assurance organization will audit the emergency plan to assure that the response training program is implemented. (Cantone Testimony, Tr. p. 2417.)

86. The State's Disaster Operations Plan establishes responsibilities for development and implementation of training programs. (Commonwealth Ex. 8, Annex E, App. 10 and Section VII.)

87. Appendix 10 of the State's plan indicates the availability of training programs sponsored by Federal and State agencies. (Ibid. Annex E.)

88. The draft emergency plan of Luzerne County, one of the two counties in the plume exposure pathway EPZ, enumerates the number of persons that will participate in the State's training program. (Henderson, ff. Tr. 2358, at p. 3.)

89. Some funding for training programs is provided to the State by the Federal Emergency Management Agency (FEMA) and the State attempts to schedule its training courses in areas close to the region of the attendees. (Henderson Testimony, Tr. pp. 2364, 2366.)

90. The criteria of NUREG-0654 recommends that for radiation exposure control both self-reading and permanent record type dosimeters should be distributed to emergency workers. (Staff Ex. 7., K.3.A, p. 67.)

91. Although there is no requirement in NRC regulations, both State and local government plans call for three dosimeters to be distributed to emergency workers. (Belser et al., ff. Tr. 2586 at p. 19; Swiren Testimony, Tr. pp. 2698-99.)

92. The State has identified a shortage of dosimeters statewide. (Belser Testimony, Tr. p. 2607; Swiren Testimony, Tr. p. 2679.)

93. In order to obtain the necessary number of dosimeters, the State will either have to purchase them or the Applicant will, or they will have to be obtained on a loan basis. Another alternative is to allocate the existing limited State supply to provide an approximate amount of coverage. (Swiren Testimony, Tr., pp. 2672-73.)

94. An adequate supply of dosimeters should be distributed prior to the existence of an emergency. (Ibid. pp. 2676-77.)

4. Unresolved Generic Safety Issue (Contention 7)

95. The contention was sponsored by the Environmental Coalition on Nuclear Power (ECNP) and states that:

> 7. The Nuclear Steam Supply Systems of Susquehanna 1 and 2 contain numerous generic design deficiencies, some of which may never be resolvable, and which, when reviewed together, render a picture of an unsafe nuclear installation, which may never be safe enough to operate. Specifically, (b) the cracking of stainless steel piping in BWR coolant water environments due to stress corrosion has yet to be prevented or avoided.

96. Only the Applicants and the NRC Staff presented direct cases on the contention.[18]

97. Intergranular stress corrosion cracking (IGSCC) generally occurs in areas immediately adjacent to welds attaching the piping to elbows or fittings. The location of the cracks indicates that the phenomenon is produced by the welding process. (Lemaire, ff. Tr. 1915, at para. 13.)

98. The incidence of IGSCC at BWRs has been low as only 267 out of approximately 34,000 weld heat-affected zones have experienced it in 400 reactor-years of experience. (Ibid., para. 11.) As a result of analytical, field and laboratory efforts by industry and the NRC Staff, the causes of, and solutions to, the IGSCC problem are well understood. (Ibid. paras. 7, 8; Litton, ff. Tr. 1927 at p. 2.)

99. In order for IGSCC to occur in a pure, high temperature water environment such as is used in Susquehanna, three concurrent conditions must be present: a susceptible material, a tensile stress in excess of the local yield stress, and the presence of a corrosive atmosphere or medium such as dissolved oxygen in the coolant. (Lemaire, ff. Tr. 1915, at paras. 14-21, 26-28; Litton, ff. Tr. 1927 at pp. 2-3; Litton Testimony, Tr. p. 1930.)

100. Based on an understanding of the causes of IGSCC, General Electric developed a program to identify and qualify remedies for the cracking. (Lemaire, ff. Tr. 1915, at para. 29.) Several methods qualified by

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[18]The Applicants' witnesses were: Joseph C. Lemaire, a materials expert with the General Electric Co., and Walter J. Rhoades, a Supervisor of the Mechanical-Nuclear Group with Pennsylvania Power and Light Company. Their testimony analyzed the problem and procedures for remedying it at Susquehanna. The Staff Witness, Felix B. Litton, a Senior Materials Engineer with the NRC testified on Staff guidance to resolve the problem and actions taken thereto by the Applicant. No direct testimony was put on by any intervenor.

General Electric's program for preventing or mitigating IGSCC, have been used at various locations at Susquehanna. (Ibid. paras. 32-42.)

101. In NUREG-0313, Rev. 1 (NRC Staff Ex. 6), the NRC Staff set forth the methods which it considers acceptable for reducing the susceptibility of BWRs to IGSCC. (Litton, ff. Tr. 1927, p. 3.) Applicants have followed the guidance of NUREG-0313 and undertaken an extensive program to reduce the potential for IGSCC. (Ibid, p. 3; Rhoades, ff. Tr. 1939, at para. 4; Bd. Ex. 3, p. 1.)

102. One method of avoiding IGSCC is solution heat treatment of piping after fabrication. This procedure eliminates sensitization and residual stress and makes the material immune to IGSCC. (Lemaire, ff. Tr. 1015, at para. 33.) At Susquehanna, the recirculation system riser piping shop welds have received solution heat treatment. (Rhoades, ff. Tr. 1939, at para. 7; Bd. Ex. 3, p. 2.)

103. Corrosion resistant cladding consisting of austenitic stainless steel weld metal containing more than 8% ferrite in the final fabricated condition is effective in preventing IGSCC. (Lemaire, ff. Tr. 1915, at para. 34.) At Susquehanna, low carbon, corrosion resistant cladding has been applied to field-welded portions of the recirculation system riser piping. (Rhoades, ff. Tr. 1939, at para. 8; Bd. Ex. 3, p. 2.)

104. Weld metal with a ferrite level of 5% or more is not susceptible to IGSCC initiation. (Lemaire, ff. Tr. 1915, at para. 39.) At Susquehanna, all weld metal and all Type 304 and Type 316 castings in the reactor pressure boundary have at least 5% ferrite content. (Rhoades, ff. Tr. 1939, at para. 9; Bd. Ex. 3, p. 3.)

105. A technique known as induction heating stress improvement ("IHSI") can be used to reduce greatly the residual tensile stress produced in

the region adjacent to the weld by the welding process and increase resistance to IGSCC. (Lemaire, ff. Tr. 1915, at para. 38.) At Susquehanna, welds in the piping constituting the reactor coolant boundary not replaced by IGSCC resistant material will receive IHSI and/or augmented in-service inspection. (Rhoades, ff. Tr. 1939 at para. 11; Bd. Ex. 3, p. 4; Litton, ff. Tr. 1927 at p. 4.)

106. Use of low carbon stainless steel materials, such as limited carbon Type 304 stainless steel with less than or equal to 0.030% maximum carbon and Type 304L stainless steel (0.035% maximum carbon), will reduce the possibility of IGSCC. (Lemaire, ff. Tr. 1915, at paras. 40-42.) There is successful operating experience with these low carbon stainless steel materials. Low carbon stainless steel has been used in selected applications, and there are hundreds of welds in place made out of low carbon stainless steel without ever experiencing a cracking incident. (Lemaire Testimony, Tr. pp. 1923-24.) At Susquehanna, materials susceptible to IGSCC have been replaced, where practicable, with materials that are substantially less subject to IGSCC. Among others, the recirculation system discharge valve bypass lines, all piping in the head spray system, almost all piping in the instrument piping and bottom drain line, have been replaced with Type 304L stainless steel or with limited carbon Type 304 stainless steel having a maximum carbon content of 0.03%. (Rhoades, ff. Tr. 1939, at para. 10; Litton, ff. Tr. 1927, at pp. 3-4; Bd. Ex. 3, p. 1.) Also, the control rod drive hydraulic return line, which was Type 304 stainless steel, was removed and the design modified. (Rhoades, ff. Tr. 1939, at para. 12; Bd. Ex. 3, p. 2.)

107. Another way to protect against IGSCC is to reduce the stress to which the piping is subjected. All pipe components at Susquehanna are

designed in accordance with ASME Code requirements that stresses be kept below specified values. (Lemaire, ff. Tr. 1916, at para. 43.)

108. The margin against IGSCC can be increased by reducing the oxygen content of the coolant water during startup and shutdown conditions. (Ibid. para. 26.) At Susquehanna, the control rod drive pump intake has been relocated to allow use of CRD water with the lowest oxygen concentration available. (Bd. Ex. 3, p. 2.) During all other phases of operation/shutdown, oxygen levels are reduced at Susquehanna by use of a mechanical vacuum deaerator which is expected to maintain the oxygen content in reactor coolant water below 0.25 ppm. (Rhoades, ff. Tr. 1939, at para. 5; Bd. Ex. 3, p. 2.)

109. Finally, the material subject to IGSCC, austenitic stainless steel, is highly ductile and thus not susceptible to sudden fracture. Therefore, any cracks that develop as a result of IGSCC will most likely be detected prior to leaking or while the leakage rate is small. (Lemaire, ff. Tr. 1916, at para. 9.) This principle has been verified in the laboratory through detailed analysis and metallographic examination of crack samples. (Ibid. para. 10.) It has also been demonstrated in operating experience, for no pipe has ever suffered a severance at a BWR due to IGSCC. (Ibid. para. 9.)

110. A continuous on-line leak detection system has been implemented at Susquehanna. The system, which conforms with the requirements of NUREG-0313, consists of temperature, pressure and flow sensors with associated instrumentation and alarms. The system detects and annunciates leakages in the following systems: main stream lines, reactor water cleanup system, residual heat removal system, reactor core isolation cooling system, feedwater system, and high pressure coolant injection system. (Susquehanna Steam Electric Station Final Safety Analysis Report ("FSAR"), p. 5.2-40, ff. Tr. 1943; Rhoades, ff. Tr. 1939 at para. 13; Bd. Ex. 3, p. 4.)

111. The leak detection system at Susquehanna is capable of monitoring flow rates with an accuracy of 1 gallon per minute ("gpm"). Small leaks (5 gpm and less) in the reactor coolant piping are detected by temperature and pressure changes and drain pump activities. (FSAR § 5.2.5.1, pp. 5.2-40 to 5.2-42, ff. Tr. p. 1944.) Once unidentified leakage in an area increases by more than 1 gpm during a given hours, or if there is unidentified leakage of 5 gpm in a 24-hour period, the plant must be shut down to perform inspections and identify the leakage. (Rhoades Testimony, Tr. pp. 1940-41.)

112. In-service inspections are to be performed on reactor coolant pressure boundary welds at Susquehanna in accordance with the ASME Code and NUREG-0313. In some areas, the inspection frequency has been increased from what the Code requires in order to compensate for the inability to replace the sensitized stainless steel. (Ibid. at pp. 1941-42; Litton, ff. Tr. 1927 at p. 4.) This augmented in-service inspection program will provide a high likelihood of detecting cracks before leakage occurs. (Litton, ff. Tr. 1927 at p. 4; Litton Testimony, Tr. 1931.) The leak detection system at Susquehanna will further asure that any IGSCC that might occcur will be detected and corrected before pipe rupture can take place. (Lemaire, ff. Tr. 1916, at para. 45.)

5. Decommissioning* (Contention 9)

113. This contention as approved and litigated states:

> 9. The Applicants have underestimated both the health costs and the monetary costs of decommissioning the Susquehanna facility. The monetary costs estimates are derived from an industry-sponsored study which is obviously biased, with cost estimates far below what the actual cost of decommissioning will be. Such cost will at least

*Effective March 30, 1982, the Commission has eliminated issues concerning financial qualifications including decommissioning costs from operating license proceedings . Accordingly, no further consideration can be provided to Contention 9(b) herein.

be equal to the cost of construction. Further, the statement by the Applicant that it is "generally agreed" that the decommissioning of a large nuclear power facility poses no new occupational or environmental hazards is erroneous. There are serious radiation hazards, particularly for workers. As a result:

(a) These costs, when added to other monetary and health costs of the facility and the nuclear fuel cycle, tilt the cost-benefit balance against authorizing operation of the facility;

(b) The Applicants are not financially qualified to assume the monetary costs of decommissioning.

114. Only the Applicants and the NRC Staff presented direct cases on this contention.[19]

115. At the end of the Susquehanna units' operating life, termination of their operating licenses will be requested by Applicants. Applicants will be required at such time to submit a plan to the Commission for decommissioning the units, i.e., decontaminating the facilities so that the level of any residual radioactivity remaining at the site is low enough to allow unrestricted use of the site. (FES, p. 8-26; Weinstein, ff. Tr. 1259, at p. 1; Weinstein Testimony, Tr. pp. 1265-66; Feldman Testimony, Tr. pp. 1347-48.)

116. Reactors decommissioned to date have used one of three decommissioning modes: (1) immediate dismantlement; (2) safe storage followed by deferred dismantlement; and (3) entombment. Immediate dismantlement is the most expensive mode of decommissioning large nuclear facilites. (Weinstein, ff. Tr. 1259, at p. 1; Feldman Testimony, Tr. 1347-48; FES, pp. 8-27.)

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[19]The Applicants' witnesses were: A. N. Weinstein, Mgr. of Engineering of S. M. Stoller Corp. who testified on methods and costs of decommissioning; and G. F. Vanderslice, V.P. and Comptroller of Pennsylvania Power and Light Co., who testified on the Applicants' financial plan for decommissioning. The staff's witnesses were: Dr. Carl Feldman who testified on radiation hazards; Dr. Raghaw Prasad on costs of decommissioning compared to construction costs; and M. L. Karlowicz on the financial qualifications of the Applicants to handle decommissioning costs.

117. Considerable experience exists in decommissioning nuclear reactors. It is expected that even more experience will have accumulated in the next 30 to 40 years before the Susquehanna units are due for decommissioning. Decommissioning is a straightforward engineering operation which can be accomplished with a minimum of difficulty, and whose costs can be estimated with a fair degree of accuracy. (Weinstein, ff. Tr. at pp. 1-2 and Testimony, Tr. 1327-28.)

118. Under contract to the Commission, the Pacific Northwest Laboratory ("PNL") of Battelle Memorial Institute recently completed a comprehensive study of the methods and costs of decommissioning a reference BWR. PNL developed detailed work plans based on the reference plant design and expected levels of activation and contamination based on typical BWR experience. (Weinstein, ff. Tr. 1259, at p. 2; Feldman Testimony, Tr. p. 1363.) PNL developed cost estimates for each cost element as well as an overall estimate of the cost of decommissioning the facility for each of the three modes of decommissioning. (Weinstein, ff. Tr. 1259, at p. 2. Also see Tables 3, 5, 6, and 7, pp. 7, 31, 32, 35.)

119. The PNL study was based on the decommissioning of a plant similar in design and power output to the Susquehanna units. PNL's estimates of the costs of decommissioning represent a reasonable approximation of the anticipated cost of decommissioning the Susquehanna facility. (Weinstein, ff. Tr. 1259 at p. 5 and Testimony, Tr. pp. 1263, 1272, 1294, and 1320.)

120. Applicants estimated the costs for immediate dismantlement of Susquehanna based on the PNL Study, adjusted to reflect design differences. This estimate came to $89 million (1980 dollars) for one unit and $176 million for both units done concurrently. The estimate was then adjusted by adding a 100% contingency to disposal charges, to account for the regulatory

uncertainties in this area. With this added contingency, the cost of decommissioning both Susquehanna units by immediate dismantlement was given as $191 million (1980 dollars). (Weinstein, ff. Tr. 1259, at pp. 5 and 28.)

121. The NRC Staff also estimated, on the basis of the PNL Study, the cost of immediate dismantlement of the Susquehanna units. The NRC Staff computed a total of $157 million (1980 dollars) for both units. (FES, pp. 8-26; Prasad, ff. Tr. 1525, p. 3.) The NRC Staff has adopted Applicants' estimate of $191 million as the more conservative. (Karlowicz, ff. Tr. 1401, at pp. 2-3; SER, p. 20-4.)

122. Another estimate of the costs of decommissioning the Susquehanna units was prepared by extrapolating costs experienced in previous decommissionings, particularly the Elk River reactor. Applicants developed various scaling factors for the Elk River costs to take into account the differences between Elk River and Susquehanna. Applying the Elk River decommissioning costs and appropriate scaling methodology to the Susquehanna configuration, Applicants obtained estimated costs (in 1980 dollars) of $108 million for the decommission of a single Susquehanna unit, and $215 million for both units done concurrently. (Ibid. p. 5; Weinstein, ff. Tr. 1259, at pp. 2, 5, and 23, Table 4.)

123. The Elk River-based estimte was then adjusted to account for potential overestimation of the scaling factors. With those adjustments, the cost in 1980 dollars of decommissioning both Susquehanna units by immediate dismantlement on the basis of Elk River costs would be $184 million, which is within 4% of the $191 million PNL-based estimate. (Weinstein, ff. Tr. 1259, at pp. 28-29.)

124. Cost estimates for the other two methods of decommissioning were also developed by Applicants based on PNL's study. The total cost of

accomplishing a deferred dismantlement of both Susquehanna units, taking into account the time value of the deferred expenditures, would be $109 million (1980 dollars). (Ibid. pp. 29-33.) Similarly, the estimated cost of entombment of the Susquehanna units (assuming the reactor internals are left in place and surveillance continues for 100 years), considering the deferred expenditures for annual surveillance, would be $131 million. (Ibid. pp. 33-36.)

125. Both occupational radiation exposures and exposures to the general public result from decommissioning. PNL's study of the decommissioning of a large (1200 MWe) BWR estimated the occupational radiation doses that will be received by the workers engaged in decommissioning work, and by the general public, for the three decommissioning alternatives. (Feldman, Tr. ff. 1344, at pp. 2-3.) PNL's estimates of the total exposure for decommissioning activities were obtained by examining each decommissioning task, evaluating the radiation field associated with the task and the man-hours required to accomplish it, and determining the resulting doses. (Weinstein Testimony, Tr. p. 1262; Feldman Testimony, Tr. pp. 1351-55; Feldman, ff. Tr. 1344, at p. 4.)

126. Based on PNL's estimates, occupational worker exposures as analyzed by Staff and Applicants, respectively, for immediate dismantlement of both Susquehanna units would be 1,845 to 3,690 man-rem over a three to four year period. (Feldman, ff. Tr. 1344, at p. 3; Weinstein, ff. Tr. 1259, at pp. 36, 40-41.) For safe storage followed by deferred dismantlement, the dose for both units would be 385 to 770 man-rem over the two to three years of preparation for safe storage and 6 man-rem when dismantlement was accomplished. (Ibid. pp. 36, 40-41; Feldman, ff. Tr. 1344, at p. 3.) Finally, for the entombment case, 1,573 to 3,146 man-rem would be received by workers

during the three to four years needed to entomb the units. (Weinstein, ff. Tr. 1257, at pp. 36, 40-41; Feldman, ff. Tr. 1344, at p. 3.)

127. The annual radiation doses that will be received by workers during the decommissioning of Susquehanna would be on the order of, or less than, those received under normal operation of the plant and within allowable Commission limits for worker exposure. This is true even if higher than anticipated levels of contamination exist in the facility at the time of decommissioning if proper decontamination procedures are utilized. (Weinstein Testimony, Tr. p. 1261; Feldman Testimony, Tr. pp. 1359-60; Feldman, ff. Tr. 1344, at pp. 3-5.)

128. Sources of exposure to the general public during decommissioning arise from gaseous and liquid effluent releases, direct radiation from the plant, and direct radiation due to transportation of spent fuel and radioactive waste to reprocessing or burial facilities. For the maximum exposed individual, estimated 50-year radiation dose equivalents to the lung per unit are: 0.041 mrem for immediate dismantlement; 0.0031 mrem for safe storage; and less than 0.038 mrem for entombment. Population doses for a population of 3.5 million within a 50-mile radius of the site are 0.05 man-rem, 3×10^{-4} man-rem, and 0.04 man-rem, respectively, for immediate dismantlement, safe storage and entombment. (Weinstein, ff. Tr. 1257, at pp. 40-41.) Therefore, decommissioning large reactors, such as the Susquehanna units, should pose no serious radiation hazards to either radiation workers or the general public. (Feldman, ff. Tr. 1344, at pp. 2, 5; FES, p. 8-26.)

6. Storage Of Low-Level Radioactive Waste (Contention 11)

129. As the result of the Board's granting of a motion for summary disposition of that part of the original contention which related to on-site storage of spent fuel, only that section of the contention relating to on-site

storage of low-level radioactive wastes was litigated in the evidentiary hearing. As modified, the contention states that:

> 11. The proposed project creates an unreasonable risk of harm to the health and safety of petitioners and their private property, and violates the Commission's standards for protection against radiation in 10 CFR §§ 20.1 and 20.105(a), in that the applicants have failed to provide adequately for safe on-site storage, for periods of up to 10 to 15 years, of low-level radioactive wastes.

130. Intervenor Marsh was the sole sponsor of this contention as it was admitted to the proceeding. She did not appear at the evidentiary hearing.[20]

131. NRC regulations do not require a specific amount of space or capacity or the ability to store low-level radioactive waste (LLRW) for any specific period of time. NRC guidance to Applicants suggests that space to accommodate at least 30 days of waste at normal generation rates be provided and that the storage be indoors. Traditionally, the amount of space provided has been that which will enable a licensee to accumulate a full shipment for off-site disposal. (Staff Ex. 1 pp. 11-14, 11-15; Loysen, ff. Tr. 1655 at p. 2.) The Board considers therefore only whether Applicants' proposed LLRW storage mode presents an unreasonable risk of harm to the health and safety of the public.

132. Applicants intend to ship all low-level radioactive wastes generated at the Susquenanna facility to a commercial LLRW disposal site and

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[20] The Applicants' witnesses were Messrs. Harold W. Keiser, PP&L's Superintendant of Plant for the Susquehanna facility and Richard J. Tosetti, Chief Nuclear Engineer for Nuclear Fuel Operations, Bechtel National, Inc. The Staff's witnesses were A. L. Bangart, Leader of the Systems Analysis Section in the Effluent Treatment Systems Branch, Office of Nuclear Reactor Regulation of the NRC and Peter Loysen, a Senior Chemical Engineer in the Advanced Fuel and Spent Fuel Licensing Branch, Division of Fuel Cycle and Material Safety of the NRC.

have a contractual agreement with Hittman Nuclear and Development Corporation for transporation and disposal services. Because Applicants have no guarantee that off-site disposal capacity will be available when it is needed they have decided to construct an on-site interim LLRW Holding Facility. It is intended to be used only if off-site disposal becomes unavailable. (Keiser, ff. Tr. 1572 at pp. 1-2).

133. The storage capacity of the on-site LLRW Holding Facility will accommodate the LLRW generated during four years of operation of both units. The building stands separate from the reactor facility and the LLRW is to be stored in solidified form. The Low-Level Radioactive Waste Policy Act as enacted by the U.S. Congress in 1980 and current actions of the Governor of Pennsylvania in response to that Act, leads to the conclusion that action is being taken to increase the off-site disposal capacity available. (Keiser testimony, Tr. pp. 1580, 1583, 1589-1590, 1594.)

134. The LLRWHF is a separate building located within the security fence approximately 1000 feet from the Turbine Building at a grade elevation which is 152 feet above the probable maximum flood that may be experienced at the Susquehanna site. It consists of a reinforced concrete storage vault within a steel-framed, metal-side structure. The LLRWHF meets the seismic requirements of the Uniform Building Code, and its vault is capable of withstanding tornado-force winds, although not necessarily tornado induced missiles. (Tosetti, ff. Tr. 1598 at pp. 1-2: Tosetti Testimony, Tr. p. 1612.)

135. LLRW stored in the LLRWHF will be solidified process wastes and contaminated trash. Process wastes are solidified by incorporating material into a cement matrix, and dewatered; they are contained within steel liners approximately 3/8 inches thick. The anticipated corrosion rate of the liners

(0.001 to 0.003 inches per year) is a small fraction of the liner thickness, hence the storage of waste will not affect the integrity of the liners. The liners will be designed to 10 CFR Part 71 requirements and will not support combustion. (Tosetti, ff. Tr. 1598 at p. 4.)

136. The other kind of LLRW generated at Susquehanna consists of dry solids (trash) contaminated with radioactive materials. The solids will be packaged in 55-gallon steel drums and large (100 cubic feet) steel boxes. This waste is very low in radioactivity. (Ibid. p. 5; Bangart, ff. Tr. 1648 at p. 3.)

137. Each form of waste will be stored separately at the LLRWHF, with solidified process wastes being stored within the concrete vault. All waste material stored in the LLRWHF will be packaged in a form suitable for off-site shipment and permanent disposal. (Tosetti, ff. Tr. 1598 at pp. 3-5.)

138. The LLRWHF has a design life of 40 years and can store waste safely for at least that period of time. (Tosetti Testimony, Tr. pp. 1599, 1611.) However, such prolonged storage of waste should not be necessary. New off-site disposal capacity should begin to be available in about five years. (Loysen, ff. Tr. 1655, at p. 3.)

139. If off-site disposal capability is not available while the LLRWHF is being filled up, Applicants will have several years in which to address the problem. During that period of time, there will be activity both at the national level to establish additional sites and by Applicants to remedy the problem, including (if necessary) construction of another interim holding facility on-site. (Keiser Testimony, Tr. pp. 1592, 1594.)

140. The LLRWHF will be occupied only during loading and unloading periods. The facility is designed to minimize exposure to operating personnel; this is accomplished by providing appropriate shielding and suitable

administrative controls, so as to keep worker radiation exposure within the limits of 10 CFR Part 20 and 40 CFR Part 190. (Tosetti, ff. Tr. 1598 at pp. 6-7.)

141. An estimate of the radiation exposure at the Susquehanna site boundary assuming maximum radiation levels in the waste, a facility completely filled with waste, and continuous presence by an individual at the site boundary, was only 1.1 mrem per year, well within 10 CFR Part 20 permissible exposure limits. (Ibid. p. 8.)

142. A study of potential accidents at the LLRWHF demonstrated that resulting radiation levels were a small fraction of 10 CFR Part 100 guidelines. (Ibid. p. 8; Tosetti Testimony, Tr. pp. 1606-1608.)

7. Health Effects of Electric Fields (Contention 17)

143. The Board in its order of March 6, 1979, admitted Contention 17, as follows:

> 17. The Applicants' plans for transmitting electricity generated by the Susquehanna facility utilize ultra-high voltage (UHV) transmission lines, which produce noise pollution, cause electrical shock from flashovers, create television and radio interference, create strong electrostatic and electromagnetic fields that adversely affect living organisms along the UHV transmission right-of-way and beyond, and generate dangerous levels of ozone that will cause more injury to vegetation than any other pollutant and can also have harmful effects on human health. For that reason, the Applicants should be barred from transmitting electricity from the facility, if and when it becomes operational, over UHV lines and should be required to use lines in the range of 138,000-230,000 volts maximum. Alternatively, the Applicants should be required to place the UHV lines underground, using compressed gas as an insulator.

144. Applicants filed a motion for summary disposition of the part of this contention that dealt with ozone emissions and a subsequent motion for summary disposition of the remaining portions. The Board granted those motions except for the health effects of electric (electrostatic) fields on living organisms in the vicinity of a 500 kV transmission line. Since that

item was left open, a decision on the transmission line modes was also postponed.

145. Applicants' witness[21] based his assessment on a calculated maximum electric field of 11 kV/m at ground level at the point of minimum clearance on the right-of-way of the Susquehanna lines and 2.28 kV/m at the edge of the right-of-way. Living organisms respond to many stimuli, but their effects are not considered hazardous unless they impair the organism's ability to function properly or the recovery capability of the organism. There are no substantiated effects of exposure to electric fields of the magnitude and frequency in the Applicants' transmission lines which can be considered hazardous. (Michaelson, ff. Tr. 1043 at pp. 2-4.)

146. The electric fields produced by the Susquehanna lines cannot produce sufficient heating of tissues or molecular polarization or deformation to cause significant biological effects. (Ibid. pp. 4-5.) The currents produced within the body are on the order of 0.1 to 1 milli-amperes/square meter, well below the level of perception. (Ibid. p. 6.)

147. While some writers have postulated that behavioral and central nervous system modifications result from exposure to high voltage electric fields, these are not amenable to explanation using traditional theoretical analysis. If they exist, they are caused by some unknown biophysical mechanism. (Ibid. p. 7.)

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[21] Applicant's witness was S. M. Michaelson; a Professor of the University of Rochester Medical Center, who testified on the health impact of electric fields on humans and animals. The Staff's witness, Gerald E. Gears; a Senior Land-Use Analyst and NRC's member on the Interagency Advisory Committee on Electric Field Effects, gave testimony on electric field research efforts and results. CAND's witness James Armory, a farmer with some technical background in mathematics and engineering, testified in support of the contention.

148. A study by Johns Hopkins University scientists of 11 long-line maintenance workers for 42 months on a 345 kV system showed no change in physical, mental, or emotional characteristics. (Ibid. pp. 8-9.) An investigation by Strumza of exposed (25 m from 200-400 kV) and unexposed (more than 125 m) populations showed no significant difference in medical visits and druggists bills. (Ibid. p. 9.) No adverse health symptoms were observed in a study by Roberge of 56 switchyard workers (735 kV) for years. (Ibid. p. 9.) In an East German study, 110 linemen (110-380 kV) were compared to a control group of electrical maintenance men (at less than 5 kV/m) with no difference reported in state of health. (Ibid. pp. 9-10.)

149. Some Soviet studies indicate biological effects on switchyard workers exposed to high voltage electric fields, such as headaches, fatigue, digestive disruptions and cardiovascular changes. There are methodological faults in these studies and extraneous factors could be involved. The Soviets have 150,000 kilometer-years of 500 kV transmission line operation, producing fields of 12-15 kV/m near ground level, without identifying any biological effects from the lines' electric fields. (Ibid. pp. 10-12.)

150. Soviet standards limit electric fileds to 12 kV/m at points where lines cross roads and 15 kV/m elsewhere along unpopulated sections of the line routes. (Ibid. pp. 12-13.)

151. In three experimental studies invclving human subjects exposed to conditions equivalent to high voltage lines with a ground strength of 12 kV/m or higher electric fields, no detrimental effects were observed. (Ibid. pp. 14-16.)

152. Results of ongoing animal research projects, with studies of mice, rats, monkeys, and swine, have so far been consistent with previous reports in finding no significant effects which would adversely influence the

health of animals exposed to low-frequency fields up to 100 kV/m. (Ibid. pp. 16-25.)

153. There is no reason to believe that people with neurological disorders would be more sensitive than others because there has been no decrement of performance in test animals at very high levels of exposure. (Michaelson testimony, Tr. p. 1117.)

154. Magnetic fields can be discounted as a cause of cancer. Electrostatic fields may provide nonhazardous stimuli to animals or people, but tests for hazardous conditions, such as cardiovascular and immunologic changes have been negative. It is conceded that negative results may not be as meaningful statistically as positive results. (Ibid. pp. 1138-1140; 1140-47; 1152.)

155. The testimony of CAND's witness was based on hearings before the New York State Public Service Commission (1976-1978). In the belief that there are potentially harmful human effects from electric fields if a 500 kV line is utilized, the witness proposed an expansion of the right-of-way so that maximum field strength at the edge would be limited to 0.1 kV/m, and a requirement that Applicants inform people living near the right-of-way of potential hazards with respect to biological effects. Proposing a limit on field strength based on a safety factor of 100, the witness cites several studies referred to in the New York PUC cases in support of his position. (Armory, ff. Tr. 1206 at pp. 1-3 and testimony Tr. pp. 1211-12).

156. During redirect examination, the Applicants' witness reviewed the studies mentioned by CAND and pointed out their lack of statistical significance, poor experimental design, lack of reproducibility, inapplicability or lack of hazard significance. (Michaelson testimony, Tr. pp. 1227-37.)

157. The FES contains the Staff's conclusion that there is no evidence to date that the operation of 500 kV power lines will have any significant biological effects on humans. The Applicant will install a phasing arrangement and increase structure height at highway crossings, if necessary, to limit the electrostatic field strength at ground level to 7.5 kV/m. A worst case gradient will be no greater than 7.83 kV/m and at the edge of the right-of-way, 2.4 kV/m or less. Adverse health effects on switchyard workers have been reported, but not for transmission line workers exposed to gradients well above 7.5 kV/m. There is no evidence to date indicating hazardous effects to plants or animals from present levels of fields generated from existing transmission line technology. (Staff Ex. No. 4, p. 4-9 and App. C, p. C-7.)

158. The values for electric field strength gradients of 11 kV/m on the right-of-way and 2.28 kv/m at the edges are acceptable since the fields are not strong enough to cause excessive tissue heating. A small number of studies have observed physiological and/or behavioral effects that may indicate possible adverse health effects in people. These studies have been challenged, however, because of poor experimental design and inadequate treatment of results. (Gears, ff. Tr. 1379 at pp. 4-5.)

159. The Interagency Advisory Committee on Electric Field Effects is guiding ongoing research funded by the Department of Energy on transmission line effects. This research has produced statistically significant results in areas of neonatal development, endrocrinology, hematology, neurophysiology, neurochemistry, urine volume and chemistry, sympathetic nervous system, and behavior in tests on mice and rats where exposed for 120 days at scaled field strengths of 4-20 kV/m. While some data indicate statistically significant results in animals, the effects are so subtle and small in magnitude that

further research is needed to determine if these effects are biologically significant and will adversely affect the test organisms. The general population would receive a long-term exposure of less than 2 kV/m, which is below the 4-20 kV/m reported above to cause statistically significant effects in rats and mice. (Ibid. pp. 5-7.)

160. The Applicants' 500 kV lines would be permitted by the Russian general population guidelines. (Ibid. p. 8.)

161. No evidence exists to date that the operation of 500 kV power lines will have an adverse biological health effect on humans. If ongoing research concludes protective measures are warranted, a variety of actions are available including increasing right-of-way widths, limiting field strengths at the edge and using shield wires or retrofitting techniques. (Ibid p. 9.)

162. Results of research on electric fields' effects on growth and development of plants and animals indicate that neither adverse injuries nor abnormalities were apparent from a 50 kV/m field; however, some barely perceptible physical damage was observed in some plants at 25 kV/m and above. No changes in the Applicants' transmission line design are warranted. (Ibid. pp. 9-10.)

163. The 11 kV/m estimated by Applicants is in the realm of a maximum limit for a 500-525 kV line. (Gears Testimony, Tr. pp. 1381-82.)

164. There is insufficient evidence to believe transmission lines would have an adverse health effect on people. The Staff cannot prove conclusively there are no effects from electric fields, but do show that there is a preponderance of evidence to date showing that there have been no effects. (Gears Testimony, Tr. pp. 1386-89 and 1395-96.)

8. State and County Emergency Planning (Contention 20)

165. This contention challenges a number of the provisions of the emergency plans of the Commonwealth of Pennsylvania and Luzerne County. It alleges the previsions do not meet the recommendations and guidance of NUREG-0654 or some acceptable alternative.[22]

166. No operating license for a nuclear power reactor will be issued unless a finding is made by NRC that the state of off-site emergency plans provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. The finding and determination that State and local emergency off-site plans are adequate and capable of being implemented is the responsbility of FEMA and these findings and determinations are reviewed by the NRC. Off-site emergency plans must meet NRC standards and criteria. (See 10 CFR 50.47(a)(1) and (2) and n. 1, and NUREG-0654 FEMA-REP-1, Rev. 1., Staff E:: No. 7.)

167. Contention 20(1)(a):[23] The concept of operations in the emergency plan of Luzerne County (County) is set forth in detail and includes

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[22]Contention 20: "The emergency evacuation plans submitted by Luzerne County and the Commonwealth of Pennsylvania do not comply with the planning standards of 10 CFR Part 50.47(b) in that the recommendations and guidance of NUREG-0654 have not been satisfied as specified in Attachment A, nor has compliance been demonstrated through some other acceptable alternative means."

[23]20(1)(a): NUREG-0654 REV. 1 (section A. 1, b.) recommends that each organization and suborganization having an operational role shall its concept of operations, and its relationship to the total effort. Luzerne County Civil Defense's local plan gives merely an outline of concept, leaving blank important information (page 6 of the Luzerne County plan) about telephone and dispatcher communications. Moreover, the Luzerne County plan (page 5; section 5) states that the "county conducts program of public education, training and exercise of emergency forces and posts route signs and evacuation." But the plan fails to mention when, where, and how the public education and exercises will take place. Nor does the plan mention where signs will be posted. The plan further states that the "radiological thyroid blocking chemicals are stocked." The plan fails to mention where and how the public will be informed of thyroid blocking chemicals or where they will be stored.

information on its communication capability. The plan includes specific information on public education and training programs and exercises, but not route signs, which are not specifically recommended by NUREG-0654. Provisions concerning thyroid blocking chemicals are included in the plan. (Commonwealth Ex. 9 and Annexes B, D, M, R, and S; Henderson, ff. Tr. 2456 at pp. 1-3; Belser et al, ff. Tr. 2586 at pp. 6-8; Swiren, ff. Tr. 2671 at pp. 3-7.)

168. Contention 20(1)(b):[24] The Commonwealth (State) and County plans contain block diagrams that describe the interrelationships of organizations having an operational role. (Comm. Ex. 8, App. 3 and Ex. 9, App. 3; Henderson ff. Tr. 2546 at p. 4; Belser et al, ff. Tr. 2586 at p. 8; Swiren, ff. Tr. 2671 at pp. 7-8.)

169. Contention 20(1)(c):[25] The County plan recognizes the overall responsibility of the County Commissioners and their appointment of a Director/Coordinator of Civil Defense to act for them in matters involving an emergency response. (Comm. Ex. 9, p. 5; Henderson, ff. Tr. 2546 at p. 5; Belser et al., ff. Tr. 2586 at p. 9; Swiren, ff. Tr. 2671 at p. 8.)

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[24] 20(1)(b): ...The state, and [Luzerne County plans] - do not meet the guidelines of NUREG-0654 REV. 1 (section A. 1. (c)) that requires each plan to illustrate these interrelationships [of organizations having an operational role] in a block diagram.

[25] 20(1)(c): NUREG-0654 (Section A. 1, d) recommends that each organization shall identify a specific individual by title who shall be in charge of the emergency response. The Luzerne County Civil Defense Plan states no such individual.

170. Contention 20(2)(a):[26] The Luzerne County Chamber of Commerce is not mentioned or relied on in any way in the County emergency plan. (State Ex. 9, Annex C; Henderson, ff. Tr. 2546 at p. 6; Belser, et al., ff. Tr. 2586 at pp. 9-10; Swiren, ff. Tr. 2671 at p. 6.)

171. Contention 20(2)(b):[27] The County plan contains a detailed public information section in annex D. It provides for distribution of pre-emergency protective action brochures, prepared statements to be broadcast during an emergency over an Emergency Broadcast System and the establishment of a news media center to brief the media, with responsibility being assigned to the person or persons to handle briefings and releases on emergency matters. Additional public information procedures are being considered. (State Ex. 9, Annex D; Henderson, ff. Tr. 2546 at p. 7, Testimony pp. 2547-55;

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[26] 20(2)(a): NUREG-0654 (section A. 2, a) recommends that: "Each organization shall specify the functions and responsibilities for major elements and key individuals by title of emergency response, including the following: Alerting and Notification; Communication, Public Information; Accident Assessment; Public Health and Sanitiation; Social Services; Fire and Rescue; Traffic Control....
Luzerne County Civil Defense plan (page 11) states "see Annex E" for communications and goes on to state (page 11) they will notify Luzerne County Chamber of Commerce to pass to business and industry in affected area." Plan does not state how Chamber of Commerce would assume this responsibility. There is no such organization called Luzerne County Chamber of Commerce. Moreover, the plan does not suggest what will happen if a nuclear incident occurs when the Chamber of Commerce is not there to pass to business and industry, i.e., if accident occurs after 5:00 P.M. when offices would be closed.

[27] 20(2)(b): Public Information in Luzerne County Civil Defense plan is merely an outline (page 17 of LCCD plan). It lists in 4 brief lines:

1.	Develop media release	(Plan does not state who will do this nor for what purpose)
2.	Brief local media	(Plan does not state what media will be briefed about)
3.	Operate various control centers	(What does this have to do with public information)
4.	Monitor Media	(Plan does not state what media will be monitored about)

Belser et al. ff. Tr. 2586 at pp. 10-11, Testimony Tr. pp. 2605-06, 2616-18, 2628-33; Swiren, ff. Tr. 2671 at pp. 10-11).

172. Contention 20(2)(c):[28] Responsibility for public health at the County level is assigned in the plan to the medical/health group and radiological decontamination group and for sanitation to the engineering group. These groups will be represented at the emergency operating facility. Training, participation in drills and exercises and relocation plans for fire and rescue companies are also provided for in the County plan. (State Ex. 9, VI p. 9, par. 5 and 7; Henderson, ff. Tr. 2546 at p. 8; Belser et al., ff. Tr. 2586 at pp. 11-12; Swiren, ff. Tr. 2671 at pp. 12-13.)

173. Contention 20(2)(d):[29] The County plan assigns responsibility for traffic control to State and Municipal police. The plan references a State Police Radiological Response Plan for the Susquehanna facility. The number of police and equipment in each municipality within the plume exposure pathway EPZ is listed and access and traffic control points assigned to State police are also indicated. (State Ex. 9, Annex F and App. 3, Annex K and App. 1; Henderson, ff. Tr. 2546 at p. 9; Belser, et al, ff. Tr. 2586 at pp. 12-13; Swiren, ff. Tr. 2671 at p. 14).

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[28] 20(2)(c): Public Health and Sanitation is not mentioned in LCCD plan. Fire and Rescue: Utility plant (page 5-8) states there will be one drill per calendar quarter and (page 8-3) states local fire and rescue companies will be invited to participate in a training program. LCCD plan (page 13) merely outlines "Fire & Rescue Group" in 3 sentences, stating "units evacuating from affected area will report to facilities in Annex D." Annex D is not included in plan, nor is there any clear delineation of who the fire companies are.

[29] 20(2)(d): ...Traffic Control: Luzerne County Civil Defense plan gives an outline of traffic control under "Police Group." It does not list what "units" are available for traffic control.

174. Contention 20(2)(e):[30] The County plan lists the number of ambulances available within the County, the hospital and nursing homes that can be evacuated and a list of hospitals in the surrounding area capable of providing radiation treatment. The dispatching of ambulance resources is under the direction of the County's Communication Center. Evacuation places for ambulatory and nonambulatory persons are shown. The relocation site for St. Stanislaus Home has not been selected as yet. (Comm. Ex. 9, Annexes G and I; Henderson, ff. Tr. 2546 at p. 10; Belser et al., ff. Tr. 2586 at pp. 13-14; Swiren, ff. Tr. 2671 at p. 15)

175. Contention 20(2)(f):[31] The plan contains a chart of primary and support responsibilities. (State Ex. 9, App. 2, p. 2-1; Henderson, ff. Tr. 2546 at p. 20, Belser et al. ff. Tr. 2586 at p. 16; Swiren, ff. Tr. 2671 at p. 16).

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[30] 20(2)(e): ...Luzerne County Civil Defense plan gives a mere outline of responsibilities of medical groups. (Page 15 of LCCD plan.) There are no names of medical organizations who would be involved in an evacuation. Under LCCD's "general evacuation," it states they will evacuate Saint Stanislaus Home to _____ and evacuate invalids whose evacuation requires use of ambulance. The LCCD plan does not tell us who the ambulance associations are nor if they are equipped to handle such an emergency.

[31] 20(2)(f): NUREG-0654 (section A. 2a) cites the description of these [emergency response] functions shall include a clear and concise summary such as a table of primary and support responsibilities. None of the above, from Communications to Emergency Medical -- fulfills this recommendation.

176. Contention 20(3)(a):[32] There is no responsibility assigned in the County plan to the Chamber of Commerce. Primary notification or alerting is to be accomplished through the use of sirens which cover most of the plume exposure pathway EPZ. Municipal response plans, most of which are completed, are to contain door-to-door notification procedures. Separate letters of agreement between municipalities and the County are not planned. (State Ex. 9, Annex C; Henderson, ff. Tr. 2546 at pp. 12-13; Belser et al. ff. Tr. 2586 at pp. 14-15; Swiren ff. Tr. 2671 at pp. 17-19).

177. Contention 20(3)(b):[33] The County plan provides a procedure for notification and message verification and describes the information that will be communicated to the public during an emergency. The Chairman of the County Board of Commissioners or his designee is to be the spokesperson during an emergency and briefings are to be provided that person by PEMA's Information Officer. There is a provision for coordinating information and also updating

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[32] 20(3)(a): NUREG-0654 REV. 1 "Notification Methods and Procedures" (page 43) recommends "the content of initial and follow-up messages to response organization and the public has been established and means to provide early notification and clear instruction to the populace." Luzerne County Civil Defense plan (page 6) cites under both selective evacuation and general evacuation that "County will notify Chamber of Commerce to pass on notification to business and industry." There is no clear outline of how this will be accomplished and no letters of agreement appear between Civil Defense and Chamber of Commerce. Cited under general evacuation (Luzerne County plan, page 6), political subdivisions will be responsbile for door to door notification within political boundaries. There is no mention of how this notification would be executed within political subdivision(s) nor who would be responsbile for such notification if a general evacuation is called. There are no letters of agreements with political subdivisions to assume that responsibility of notification.

[33] 20(3)(b): NUREG-0654 (section E. 1., page 43) recommends that procedures for notification includes means for verfication of messages. Luzerne County plan makes no mention of any verification of messages. Luzerne County plan does not meet the recommendations of NUREG-0654 (appendix 3 page 3-2) which states "plan should give a description of the information that would be communicated to the public under given circumstances, for continuing instruction on emergency actions to follow, and updating of information."

information. (State Ex. 9, Annex C, App. 4 and Annex D and App. 1-6; Henderson, ff. Tr. 2546 at p. 14; Belser et al. ff. Tr. 2586 at pp. 16-18; Swiren, ff. Tr. 2671 at pp. 18-21).

178. Contention 20(4)(a):[34] Both the State and County plans propose periodic dissemination of information to the public including information on radiation, protection measures, and needs of the handicapped. The County plan provides for the advance release of public information, designates a spokesperson in the County and also provides for the coordination of the dissemination of information to the public through assignment of responsibilities, briefing procedures and establishment of messages to be broadcast over the emergency broadcast system. (State Ex. 9, Annex D, Ex. 8, App. 15; Henderson, ff. Tr. 2546 at pp. 15-17; Belser et al. ff. Tr. 2586 at pp. 16-18; Swiren, ff. Tr. 2671 at pp. 20-21.)

179. Contention 20(5)(a):[35] Both the State and County plans call for monitoring off-site to be performed by the BRP. (State Ex. 8, Annex M and

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[34] 20(4)(a): NUREG-0654 (section G. 1. page 49) recomends that each organization shall provide a coordinated periodic dissemination of information to the public. It shall include:
(a) education information on radiation
(b) protection measures
(c) special needs of the handicapped.
Neither the State plan or the Luzerne County Civil Defense plan gives any mention to periodic dissemination of information to the Public. Luzerne County Civil Defense plan doesn't meet NUREG-0654 section G 2 (Requirement) to see that the public information program should include provision for written material that is likely to be available in a residence during an emergency. Nor does Luzerne County plan meet NUREG-0654 (section G.4.a.) recommendation designating a spokesperson who should have access to all necessary information. Luzerne County plan gives no provision for the planning standard of NUREG-0654 (Section G), which states "procedures for coordinated dissemination of information to the public are established." Luzerne County plan gives 4 brief lines to "Public Information."

[35] 20(5)(a): NUREG-0654 Rev. 1 (H 7, p. 54) states that "each organization, where appropriate, shall provide for off-site radiological monitoring equipment in the vicinity of the nuclear facility." The Luzerne County plan makes no provision for such equipment.

Ex. 9, p. 28; Henderson, ff Tr. 2546 at p. 18; Swiren, ff. Tr. 2671 at p. 22; Belser et al. ff. Tr. 2586 at p. 18).

180. Contention 20(5)(b):[36] The State plan provides for the number of sets of radiological monitoring equipment and reserves at its area offices. It prescribes that emergency equipment is to be inspected and operationally checked at least annually and provides for inventories to be taken after each use. (State Ex. 9, App. 8, p. 24; Henderson, ff. Tr. 2546 at p. 19; Reilly, ff. Tr. 2586 at p. 4; Swiren, ff. Tr. 2671 at p. 23).

181. Contention 20(5)(c):[37] Nether the State nor County plan identify emergency kits by general category. PEMA does maintain an inventory of all equipment that would be available in the event of an incident. The County has an inventory of radiological monitoring sets it has on hand. (State Ex. 8, App. 6, Annex M; Henderson, ff. Tr. 2546 at p. 20; Belser et al. ff. Tr. 2586 at p. 20; Swiren, ff. Tr. 2671 at pp. 23-24.)

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[36] 20(5)(b): NUREG-0654 REV. 1 (H 10, p. 54) recommends that "each organization shall make provisions to inspect, inventory and operationally check emergency equipment/instruments at least once each calendar quarter and after each use. There shall be sufficient reserves of instrument/equipment to replace those that are removed from emergency kits for calibration or repair." The State plan does not meet this recommendation since it does not mention inspection, inventory, or checking of such equipment, nor does it mention reserves....

[37] 20(5)(c): NUREG-0654 REV. 1 (H 11, p. 54) recommends that "each plan shall, in an appendix, include identification of emergency kits by general category (protective equipment and emergency supplies)." The State plan and (Luzerne) County plan both fail to meet this recommendation since they do not include this information in an appendix or elsewhere.

182. Contention 20(6)(a):[38] Under State and County plans, field monitoring is to be performed by the BRP. The type of equipment that will be utilized and reference to the location of monitoring sites is included in Appendix 8 of the State plan. (State Ex. 8; Henderson, ff. Tr. 2546 at p. 21; Belser et al, ff. Tr. 2586 at pp. 20-21; Swiren, ff. Tr. 2671 at p. 25).

183. Contention 20(6)(b):[39] The State has the capability for detecting and measuring radioiodine concentrations at a greater capability than the guidance of NUREG-0654. (Henderson, ff. Tr. 2546 at p. 21; Reilly, ff. Tr. 2434 at pp. 5-6; Swiren, ff. Tr. 2671 at p. 25.)

184. Contention 20(6)(c):[40] The State plan refers in Appendix 8 to the procedures for determining contamination levels, dose rates and water and

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[38] 20(6)(a): NUREG-0654 Rev. 1 (I 7, p. 57) recommends that "each organization shall describe the capability and resources for field monitoring within the plume exposure Emergency Planning Zone which are an intrinsic part of this concept of operations for the facility." The Luzerne County plan makes no provision for such monitoring. The State plan provides for such monitoring, but omits specifics such as type of equipment, number of fixed monitoring sites or their location. With respect to in-place surveillance, the State plan (DER, p. XIV-1) states that "Generally these include air samplers and TLD's" which is too vague to comply with the NUREG recommendations.

[39] 20(6)(b): Referring to the ...state, NUREG-0654, REV. 1 (I 9, p. 58) states "each organization shall have a capability to detect and measure radioiodine concentrations in air in the plume exposure EPZ as low as 10^{-7} uCi/cc (microcuries per cubic centimeter) under field conditions." ...(The) State (plan does not mention whether (it has) this capability.)

[40] 20(6)(c): NUREG-0654, REV. 1 (I 10, p. 58) recommends that the ...State "establish means for relating the various measured parameters (e.g. contamination levels, water, and air activity levels) to dose rates for key isotopes" and provide "for estimating integrated dose from the projected and actual dose rates and for comparing these estimates with the protective action guides." The recommendation states that the "detailed provisions shall be described in separate procedures." (The plan) fail(s) to meet this recommendation by being too vague about the procedures to be used, failing to mention specific isotopes, and not referring to detailed provisions in separate procedures. The State plan (DER, p. XIII-2) says "estimates of direct population exposure from the passing cloud and from ground deposition are made from in place air samples (sic) and from energy compensated TLD's."

contamination levels and comparing those parameters to EPA Protection Action guides. Dose projections for specific isotopes are detailed in a separate BRP procedure. The State plans to use the U.S. Department of Energy capability to track from the air and to maintain a computer record for periodic estimation of total population exposure. (State Ex. 8 and Ex. 4; Reilly, ff. Tr. 2434 at pp. 8-10; Henderson, ff. Tr. [illegible]46 at p. 23; Swiren, ff. Tr. at pp. 26-27).

185. Contention 20(7)(a):[41] As already stated, the plan does not rely on the Chamber of Commerce. Maps with monitoring locations have been prepared and due to size are referenced as to location in the State plan. A map with mobile air sampling locations is still in preparation. A list of bus contacts and some pickup points for persons without automobiles is included in the County plan. Availability of buses and additional pickup points await completion of written school and municipal plans. A map showing reception center locations is the County plan and the map showing mass care centers is

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[41] 20(7)(a): The Luzerne County plan would not adequately protect the public in the plume exposure pathway EPZ, as required by NUREG-0654 Rev. 1 (J), in part because the County plan has in some cases assigned tasks to organizations that do not exist or are not aware of having been assigned such tasks:

1) The County plan states (pp. 6, 11, 12) that in the event of a decision to take cover or evacuate, the County will notify the "Luzerne County Chamber of Commerce" to pass notification to business and industry. No organization by this name exists.

2) The County plan states (p. 7-8) "individuals with no transportation may request same through local fire companies. Commercial buses will be dispatched to local fire stations in the affected area to transport these individuals." The County did not consult either the fire companies or bus companies before including this procedure in the plan, or inform them of having included it.

Maps are not provided by ... the ... County (or) State showing, "preselected radiological sampling and monitoring points, relocation centers in host areas, and shelter areas" as required by NUREG-0654, Rev. 1 (J 10a, p. 61).

still under development. (State Ex. E, App. E, Part 4; Henderson ff. Tr. 2456 at pp. 24-25; Reilly, ff. Tr. 2434 at p. 11; Swiren, ff. Tr. 2671 at p. 29).

186. Contention 20(7)(b)[42] and (7)(c):[43] The State plan provides for the stockpiling, distribution and administering of thyroid blocking agents and for the predistribution of such agents and lists the organizations and quantities they are to receive. The Commission does not plan to issue these drugs to the general public. (State Ex. 8, App. I; Ex. 9, Annex M; Henderson, ff. Tr. 2546 at p. 26; Reilly testimony, Tr. 2469-73; Belser et al. ff. Tr. 2596 at pp. 23-24; Swiren, ff. Tr. 2671 at p. 30).

187. Contention 20(7)(d):[44] The means of evacuating school children and those without transportation await the completion of written school plans.

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[42] 20(7)(b): In the State plan (PEMA, p. 10) assigning to the State Department of Health the responsibility to "Develop procedures for stockpiling, in adequate supply (distributing), and administering thyroid blocking agents and such other radiological health materials as may be required" does not meet the requirement either as it states that (1) thyroid blocking chemicals are to be stocked (p. 5), (2) the county medical officer will coordinate the distribution with the State Department of Health (p. 7), and (3) the county medical group will assist the State Department of Health to their distribution (p. 15) but gives no more specifics.

[43] 20(7)(c): Neither the State or (Luzerne) County plan meet the requirements of NUREG-0654, Rev. 1 (J 10f, p. 63) that "State and local organizations' plans should include the method by which decisions by the State Health Department for administering radioprotective drugs to the general public are made during an emergency and the pre-determined conditions under which such drugs may be used by offsite emergency workers." Neither plan addresses these decision making issues at all.

[44] 20(7)(d): The State and (Luzerne) County plan meet the recommendation of NUREG-0654, Rev. 1 (J 10g p. 63) that they specify the "means of relocation." The County plan (pp. 7-8) states "individuals with no transportation may request same through local fire companies. Commercial buses will be dispatched to local fire stations",...[but does not] specify the logistics of the procedure. It states (p. 7) "schools will be evacuated by school authorities with school bus transportation to designated schools outside the 10-mile area," but does not name the schools outside the 10-mile EPZ, name the designated schools to which the children are to be evacuated, or specify whether the capacity of the schools' buses are sufficient to evacuate the students without making return trips.

School pickup points and reception centers are identified in the County plan. (State Ex. 9, Annex N and Annex J; Adler, Tr. 2674-76; Board, Tr. 2691-94; Swiren ff. Tr. 2671 at pp. 33-34).

188. Contention 20(7)(e):[45] The State plan places a responsibility on support counties to provide mass care facilities. The County plan identifies four support Counties and lists mass care facilities and their capabilities within Luzerne County. The County plans include mass care facilities for fifty (50) percent of those evacuating and assigns the number of individuals to be accommodated in each mass care County. Agreements have been executed with the County for the local Red Cross Chapters to operate the mass care facilities and agreements are being executed with the support Counties. (State Ex. 8, p. 29 and Ex. 9, Annexes I and T; Henderson, ff. Tr. 2546 at pp. 29-30; Belser, et al. ff. Tr. 2586 at pp. 26-27; Swiren, ff. Tr. 2671 at p. 25).

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[45]The State and (Luzerne) County plans do not meet the recommendation of NUREG-0654, Rev. 1 (J 10h, p. 63) that they include "relocation centers in most areas" since neither plan names specific relocation centers. The County plan (p. 7) states "Red Cross will open reception centers at _____, _____, _____, and mass care centers in County to accommodate 18,000 persons." The capacity of 18,000 persons is inadequate since the population of the 10-mile EPZ is 47,171 (PEMA, Appendix 1a, p. 1). The plant does not state that the Red Cross is capable of staffing adequate relocation centers.

189. Contentions 20(7)(f),[46] (7)(g)[47] and (7)(h)[48]: The Applicant has completed an evacuation time study which will be incorporated into the State and County plans. The study is based on a road network provided by State and local officials and traffic capacities under different time scenarios and climatic conditions. The study considers traffic impediments and traffic control points are identified which State Police will handle to overcome potential bottlenecks. The National Guard also will be used to help remove obstacles and control traffic if necessary and the State Department of Transportation has the basic responsibility for removing obstacles to traffic flow on main evacuation routes. (State Ex. 8, VIIA pp. 23, 24; Henderson, ff. Tr. 2545 at pp. 31-33; Belser, et al., ff. Tr. 2586 at pp. 27-29; Swiren, ff Tr. 2671 at pp. 36-38).

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[46] 20(7)(f): Neither the State or (Luzerne) County plan includes "projected traffic capacities of evacuation routes under emergency conditions" as required by NUREG-0654, Rev. 1 (10i, p. 63).

[47] 20(7)(g): Neither the State or (Luzerne) County plan includes "identification of and means for dealing with potential impediments (e.g., seasonal impassability of roads) to use of evacuation routes, and contingency measures", as required by NUREG-0654, Rev. 1 (J 10k, p. 63). The only such references in the State plan are (PEMA, p. 13) "identification of and means for dealing with potential restrictions to the use of evacuation routes to include alternates" is assigned to the Department of Transportation, and DER, Bureau of Radiation Protection's plan states (p. VIII 4) "bad weather will also obviously influence the feasibility of evacuation, thereby making sheltering and other options attractive." The County plan only states (p. 7) that "based primarily on police and PennDot advice, modifications and detours will be made to evacuation routes as situations develop."

[48] 20(7)(h): Neither the State or (Luzerne) County plan include "time estimates for evacuation of various sectors and distances based on a dynamic analysis (time-motion study under various conditions) for the plume exposure pathway emergency planning zone" as recommended by NUREG-0654, Rev. 1 (J 101, p. 63). The State plan only assigns to PEMA the function "continue to assess time estimates for protective action responses and update procedures with an objective of reducing actual response times to the extent possible" (PEMA, p. 12).

190. Contention 20(7)(i):[49] The BRP is responsible for assessing the incident and recommending appropriate protective action to responsible State authorities. The basis for the choice of actions is set forth in the State plan and the time analysis results for evacuation as a possible choice of action will be incorporated into the State plan. (State Ex. 8, App. 8; Henderson ff. Tr. 2546 at p. 34; Reilly ff. Tr. 2434 at pp. 12-13 and Testimony, Tr. pp. 2460-64; Belser, et al. pp. Tr. 2586 at p. 29).

191. Contention 20(7)(j):[50] Responsibility for registering and monitoring evacuees is provided for in State and County plans. (State Ex. 5 and Ex. 8, App. 16 and Ex. 9, Annexes L and M; Henderson, ff. Tr. 2546 at p. 35; Belser, et al. ff. Tr. 2586 at pp. 29-30; Swiren, ff. Tr. 2671 at pp. 39-40).

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[49] 20(7)(i): The plans of the ... State do not adequately meet the recommendation of NUREG-0654, Rev. 1 (J 10m, p. 64) that they contain "the bases for the choice of recommended protective actions from the plume exposure pathway during emergency conditions. This shall include expected local protection afforded in residential units or other shelter for direct and inhalation exposure, as well as evacuation time estimates."

[50] 20(7)(j): Neither the State or (Luzerne) County plan meet the recommendation of NUREG-0654, Rev. 1 (J 12, p. 65) that "each organization shall describe the means for registering and monitoring of evacuees at location centers in host areas." The State plan (PEMA, p. 10) only assigns to the State Department of Environmental Resources the responsibility to "provide for the monitoring of evacuees at relocation centers." The County plan mentions (p. 14) initiating a "human locator system for transients in area" but does not mention registering or monitoring other evacuees.

192. Contention 20(7)(k):[51] The State plan contains a procedure that provides for the collection and analysis of environmental samples and comparison with protective action guides for food, water and milk so that appropriate protective responses can be evaulated and recommended. The Pennsylvania Department of Agriculture revised its plan to include implementing protective measures in the ingestion pathway and this will be included in the State's plan. The BRP has maps of monitoring locations and the revision of the Department of Agriculture's plans include maintaining site specific maps in the ingestion exposure pathway EPZ with relevant information on livestock,

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[51]20(7)(k): The State plan does not adequately specify protective actions for the ingestion exposure EPZ. In particular, it fails to meet the following recommendations of NUREG-0654, Rev. 1 (J 11, p. 64):

1) The recommendation that "the plan shall identify procedures for detecting contamination" is not met by the plan stating "collection and analysis of environmental materials will be useful in evaluating the ingestion pathway." (DER, p. XIV-2).

2) It is recommended that the plan "identify procedures ... for imposing protective procedures such as impoundment, decontamination, processing, decay, product diversion, and preservation." The plan discusses the protective procedures mentioned, but fails to specify mechanisms for imposing and enforcing any of them. It states, "protocol for the implementation of any protective action involving dairy products or any agriculture product will require the evaluation of the circumstances with the appropriate agency of the Pennsylvania Department of Agriculture." (DER, p. IX-1).

3) For the 50-mile ingestion pathway EPZ (there is no) mention (of) "maps for recording survey and monitoring data, key land use date (e.g., farming), dairies, food processing plants, water sheds, water supply intake and treatment plants and reservoirs" except to state that "a map of diary herd locations is given in the specific site plan" (DER, p. XIV-2), which is not included.

4) The plan does not include or mention "up-to-date lists of the name and location of all facilities which regularly process milk products and other large amounts of food or agricultural products originating in the ingestion pathway emergency planning zone, but located elsewhere."

food processors and water supply systems. Lists of names and locations of milk, food, and agricultural product processors are available for use. (State Ex. 6, and Ex. 8, App. 7 and 8; Henderson, ff. Tr. 2546 at p. 36-39; Reilly Testimony, Tr. pp. 2474-76; Belser, et al., ff. Tr. 2586 at pp. 30-31; Swiren, ff. Tr. 2671 at pp. 40-42).

193. Contention 20(8)(a-f):[52] The State plan in Appendix 16 and County plan in Annex M provide procedures for radiation exposure control for emergency workers. They require reading times of dosimeters and the recording of dose information. Both plans establish procedures for limiting exposures and the County plan provides a specific method for authorizing work above an acceptable dose level. The State plan in Appendices 8 and 16 and the County in Appendix I to Annex M establish the same action level for requiring decontamination monitoring. Decontamination is a County responsibility but the State provides guidance and procedures in Appendix 16. The County plan

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[52] 20(8)(a-f) Section K - Radiological Exposure Control

(a)	3.b.	No mention of how this should be done in ... (the State or Luzerne County) plans. In State plans it is generally stated that the Department of Environmental Resources shall be in charge of radiological protective and health matters but nothing specific.
(b)	4.	No such decision chain in any of the plans.
(c)	5.a.	The DER, Bureau of Radiation Protection, is to provide guidance in all such matters, but there is no specific plan. No mention in ... (Luzerne) County plans.
(d)	b.	Same as above.
(e)	6.a.b.c.	No mention.
(f)	7.	No mention.

for decontamination is in Annex M and will be carried out by trained personnel in mass care centers. Medical facilities for those requiring it are identified in Annex G. The recommendations of NUREG-0654 as they apply to Contentions 20(d-f) are not in issue since those provisions apply to the licensee (Applicants) alone. (State Ex. 8, App. 8 and 16, and Ex. 9, Annex M; Henderson, ff. Tr. 2546 at pp. 40-45; Belser, et al., ff. Tr. 2586 at pp. 32-34; Swiren ff. Tr. 2671 at pp. 42-45).

194. Contention 20(9)(a-b):[53] Lists of hospitals capable of providing evaluation and medical support services for contaminated individuals are listed in State and County plans. Primary and support hospitals are named and the bed capacity indicated (State Ex. 8, App. 9 and Ex. 9, App. 3; Henderson, ff. Tr. 2546 at pp. 46-47; Belser, et al., ff. Tr. 2586 at pp. 34-35; Swiren, ff. Tr. 2671 at pp. 45-46).

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[53] 20(9)(a-b): The State and (Luzerne) County plans do not adequately make arrangements for medical services for contaminated injured individuals. Specifically, they do not meet the following recommendations of NUREG-0654, Rev. 1 (p. 69):

(a) "L1) Each organization shall arrange for local and backup hospital services having the capability for evaluation of radiation exposure and uptake, including assurance that persons providing these services are adequately prepared to handle contaminated individuals.

(b) L3) Each state shall develop lists indicating the location of public, private and military hospitals and other emergency medical facilities within the State or contiguous states considered capable of providing medical support for any contaminated individual.

195. Contention 20(10)(a):[54] The County's plan in Annex P contains a detailed procedure for reentry and recovery operations which generally follows the same procedure as that used for evacuation. (State Ex. 9, Annex P, Henderson, ff. Tr. 2546 at p. 48; Belser, et al., ff. Tr. 2586 at p. 35; Swiren, ff. Tr. 2671 at pp. 46-47).

196. Contention 20(10)(b):[55] The State plan provides for implementing a reentry and recovery operation. (State Ex. 8, App. 17; Henderson, ff. Tr. 2546 at p. 49; Belser, et al., ff. Tr. 2586 at pp. 35-36; Swiren, ff. Tr. 2671 at pp. 47-48).

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[54] 20(10(a): The Luzerne County plan fails to adequately meet the reentry and recovery planning recommendation of NUREG-0654, Rev. 1 (M, p. 70). Beyond stating that Pennsylvania Department of Environmental Resources Bureau of Radiological Health "will establish and disseminate appropriate reentry criteria" (p. 18), the only other reference to reentry and recovery in the County plan (p. 7) "reentry to evacuated areas will be denied to all but residents who will be accompanied by mobile patrol, Pa. driver's license will be used as identification, and police cordon blocking enetry to evacuated area will make maximum use of local police to facilitate identification of area residents" and (p. 19) "reentry will be based on advise (sic) of BRH, DER. Evacuated area will be denied to individuals not holding Pa. driver's license showing them to be a resident of the area. Residents of the area will be allowed entry accompanied by mobile patrol only with the exception granted by Chief Police Group Luzerne County CD. Emergency services of the area for a period of time before reentry to the general public is authorized."

[55] 20(10)(b): The plans of the ... State do not (meet) the NUREG-0654, Rev. 1, recommendation (M 3, p. 70) that "each ... State plan shall specify means for informing members of the response organizations that a recovery operation is to be initiated, and of any changes in the organizational structure that may occur."

197. Contention 20(11)(a-b):[56] The County plan provides for drills and exercises and the State plan provides for night-time exercises, unannounced exercises and exercises under various weather conditions. (State Ex. 9, Annex S and Ex. 8; App. 14; Henderson, ff. Tr. 2546 at pp. 50-51; Belser, et al., ff. Tr. 2586 at p. 36; Swiren, ff. Tr. 2671 at pp. 48-49).

198. Contentions 20(11)(c-e):[57] The State plan calls for quarterly testing of communications between Federal emergency response organizations and States within the ingestion exposure Pathway EPZ. The State plan calls for an annual testing of communications between the nuclear facility, State and local emergency operation centers and field assessment teams. Communication drills

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[56] 20(11)(a): NUREG-0654 Rev. 1 recommends (N, p. 71) that "periodic exercises are (will be) conducted to evaluate major portions of emergency response capabilities, periodic drills are (will be) conducted." The Luzerne County plan fails to meet this recommendation, as it makes no mention of exercises or drills, except to list an annex entitled "Training and exercises," which is not included.

20(11)(b): NUREG-0654 Rev. 1 (N 1b) recommends that "each organization should make provisions to start an exercise between 6:00 p.m. and midnight and another between midnight and 6:00 a.m. once very 6 years." The plans of the ... State fail to make this provision. NUREG-0654 Rev. 1 (N 1b, p. 71) "exercise should be conducted under various weather conditions." The plans of the State both fail to specify this. NUREG-0654 Rev. 1 (N 1b) states "some exercises should be unannounced." The state plan makes no mention of having some unannounced exercises....

[57] 20(11)(c): The state plan (PEMA, Rev. 6/80) states (p. 14-1) that "communication with federal emergency response organizations and states within the ingestion pathway shall be tested annually," whereas NUREG-0654, Rev. 1 (N 2a) recommends this is to be done quarterly.

20(11)(d): NUREG-0654 Rev. 1 (N 2a, p. 72) states that "communications between the nuclear facility, state and local emergency operations centers, and field assessment teams shall be tested annually." ... (T)he state plan ... (does not) mention the involvement of field assessment teams in exercises or drills.

20(11)(e): NUREG-0654 Rev. 1 (N 2a, p. 72) states "communication drills shall also include the aspect of understanding the content of (messages)." ... (T)he state's plan ... (does not) mention including this aspect in drills.

also contain a message content understanding requirement. (State Ex. 8, App. 14; Henderson, ff. Tr. 2546 at pp. 52-54; Belser, et al., ff. Tr. 2586 at pp. 36-38; Swiren, ff. Tr. 2671 at pp. 49-50).

199. Contentions 20(12)(a-d):[58] The State and County plans provide for radiological response training for emergency response personnel. The State's plan does not mention retraining but it is referred to in the County plan. (State Ex. 8, App. 10 and Ex. 9, Annex R; Henderson, ff. Tr. 2546 at p. 55; Belser, et al., ff. Tr. 2586 at pp. 38-41; Swiren, ff. Tr. 2671 at pp. 50-51).

200. Contentions 20(13)(a-i):[59] The County plan provides training of those responsible for the planning effort, for the individuals responsible for training and for the designation of an emergency planning coordinator with responsibility for developing, updating and coordinating emergency plans with State and utility plans. The State has assigned responsibility for maintaining and updating the State plan and for distributing changes to the State

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[58] 20(12)(a-d): Section O - Radiological Emergency Response Training

(a)	1.	State plan just gives general objectives in Appendix 10. In the (Luzerne) County plan, Annex M is listed "Training and Exercises" but there is no Annex M (see p. 21).
(b)	1.b	Same as above for state and county plans.
(c)	4.a-j	Same as above for state and county plans.
(d)	5.	Same as above for state and county plans.

[59] 20(13): Section P - Responsibility for the Planning Effort: Development, Periodic Review and Distribution of Emergency Plans

(a)	1.	(Luzerne) County plans same as in Section O.
(b)	2.	(Luzerne County plans do not) mention.
(c)	3.	(Luzerne County plans do not) mention.
(d)	4.	State plan fails to mention that they will "certify it to be current on an annual basis."
(e)	5.	(N)o mention in state plan.
(f)	6.	(N)o mention in state plan.
(g)	7.	(N)o mention in state plan.
(h)	8.	(N)o mention in state plan.
(i)	9.	(N)o mention of this in ... (state or Luzerne County) plans.

plan. It lists only some of the implementing procedures required to implement the plan and contains an appendix which however does not reference the sections of the plan to be implemented by each procedure. The plan does contain a specific table of contents with a cross reference to NUREG-0654. The recommendations of the planning standards and criteria of P. 9 of NUREG-0654 do not apply to Contention 20(13)(i) since the guidance of that section is only for the licensee, and not the State or County. (State Ex. 9, Para. V.A. p. 5 and Annex R and Ex. 8, para. VI B and C, p. 8 and para X, p. 30 and App. 18; Henderson, ff. Tr. 2546 at pp. 56-64; Belser, et al., ff. Tr. 2586 at pp. 41-44; Swiren, ff. Tr. 2671 at pp. 51-54).

9. Scram Discharge Volume Break (Contention 21)

201. This contention, sponsored by intervenors SEA and CAND, reads as follows:

> 21. There is a potentially dangerous flaw in the Applicant's reactor in the design of the primary cooling system inasmuch as radioactive water from a break in the scram discharge volume subsystem can disable the major safety systems including the residual heat removal system, the reactor core isolating cooling system, the core sprays and the high pressure coolant injection pumps in a brief period of time.

202. Only the Applicants and NRC Staff presented direct cases on this contention.[60]

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[60] Applicants' witness was Mr. Thomas M. Crimmins, Jr., Manager, Nuclear Plant Engineering, for Pennsylvania Power and Light Company, who directs engineering and design activities and systems and safety analyses for the Susquehanna Steam Electric Station, Unit 1 and 2. The NRC Staff's witness was Mr. Kenneth T. Eccleston, a Project Manager in the Division of Licensing, Office of Nuclear Reactor Regulation, who was responsible for coordinating the final review of the safety concerns associated with pipe breaks in the BWR scram system and the issuance of NUREG-0803, Generic Safety Evaluation Report Regarding Integrity of BWR Scram System Piping.

203. The SDV is part of the Control Rod Drive ("CRD") system. The CRD system at Susquehanna is used to implement a reactor scram by inserting control rods into the reactor core. Upon actuation of the scram signal, water from the volume above each of 285 CRD pistons is discharged into a CRD withdrawal line, goes through a scram exhaust valve, and is ultimately collected in one of the two SDVs. (Crimmins, ff. Tr. 1685, at pp. 2-3).

204. The scram exhaust valves are normally closed, and hence, the system downstream is normally dry and not pressurized. They open upon receipt of the scram signal and remain open until the scram signal is reset. As the scram exhaust valves open, water is discharged through the CRD withdrawal lines into the SDVs. Each SDV has vent and drain valves, both of which are normally open but close upon receipt of a scram signal. The SDVs partially fill with the water discharged during the scram; when the scram system is reset by the operator, the scram exhaust valves close and the SDV vent and drain valves open, draining the contents of the SDV into the reactor building sump. The SDV then drains and returns to atmospheric pressure, ready for reuse in the next scram. (Ibid. pp. 3-4).

205. In an NRC Staff study on pipe breaks in BWR scram systems (NUREG-0785), a sequence of events was postulated in which a pipe break in the SDV could result in loss of all emergency core cooling systems ("ECCS"). This result assumed that the fluid discharged from the SDV break would flow to the reactor building basement through a variety of paths, including floor drains, stairways and hatchways above the ECCS equipment. The ECCS failure was assumed to be caused by cascading of water onto the ECCS pump motor assemblies or due to general flooding of the ECCS pump rooms, which are located in the reactor building basement. (Ibid. pp. 1-2.)

206. An evaluation of the problem on a generic basis was provided recently by the NRC Staff in NUREG-0803 which identified three general areas of concern with respect to SDV piping breaks: (1) integrity of the SDV piping; (2) emergency procedures to successfully mitigate a leak or break in the SDV or elsewhere in the secondary containment; (3) environmental qualification of equipment needed to detect and mitigate the consequences of an SDV break. The guidance proposed a series of site-specific responses. Applicants have committed to comply with the recommendation NUREG-0803, and are committed to have submitted a detailed response by December 29, 1981. (Bd. Ex. 1, p. 1; Crimmins Testimony, Tr. p. 1758; Eccleston Testimony, Tr. 1776; Eccleston, ff. Tr. 1772, at pp. 3, 5.)

207. The initiating event, a break in the SDV piping, has a very low probability of occurrence. The SDVs are designed to high material quality and fabrication standards, and are subjected to in-service inspection in accordance with ASME code requirements. (Crimmins, ff. Tr. 1685, at pp. 3-4). The SDVs at Susquehanna are highly resistant to cracking, fatigue, corrosion, brittle fracture and other anticipated mechanical failure mechanisms. (Ibid. pp. 3-4; Staff Exhibit No. 5, pp. 3-3 to 3-6).

208. Assuming an SDV break does take place, if the scram is reset through operator action, no adverse consequences will occur because resetting terminates the flow of liquid to the SDV and hence the release of water to the reactor building sump. Under certain conditions (e.g., drywell high pressure, main steamline high radiation), the scram signal cannot be quickly cleared by the operator and further measures will be required to mitigate an SDV break. However, experience to date indicates that inability to reset the scram is unlikely to occur. (Crimmins Testimony, Tr. pp. 1767-68; Staff Ex. No. 5, pp. 4-9 and 4-10; Crimmins, ff. Tr. 1685 at p. 5).

209. If scram resetting does not take place, it becomes necessary to identify and isolate the leak and, if required, depressurize the system. An SDV leak or break at Susquehanna would be detected and brought to the attention of the operators by the leak detection system. Indication of a leak would be given by one or more of the following: area radiation monitor alarms, reactor building sump level alarm, reactor building exhaust vent high radiation alarms, loss of reactor building ventilation alarms, ECCS and reactor core isolation cooling system ("RCIC") pump room level alarms, control rod drive high temperature alarm, reactor building differential pressure indicator, and control rod position indicator. (Crimmins, ff. Tr. p. 1685, at pp. 4-5; Staff Ex. No. 5, pp. 4-3, 4-4; Crimmins Testimony, Tr. pp. 1761-62).

210. While some of these alarms and indicators may not establish unambiguously that an SDV break exists, taken in combination (as they are most likely to occur in the event of a significant leak) they would provide an unmistakeable warning that a leak was originating from the SDV. This would be sufficient to produce remedial actions by the operators. (Crimmins Testimony, Tr. pp. 1695, 1763-64; Eccleston, Tr. 1787, 1815; Staff Ex. No. 5, pp. 4-4 to 4-7).

211. If the scram cannot be reset, operating procedures include depressurizing the system and proceeding to isolate the leak manually. The aim of depressurizing the reactor system is to reduce the rate of leakage and minimize inventory losses and radioactive releases to the containment environment. (Crimmins, ff. Tr. 1685, at p. 5; Crimmins Testimony, Tr. pp. 1699, 1762; Staff Ex. No. 5, p. 4-10).

212. By the time depressurization is completed, personnel would be able to enter the containment building to isolate the SDV manually. A radiological field of some strength will exist in the building as a result of the leak, but

appropriately equipped personnel will be able to enter the building and manually close the isolation valves without receiving doses in excess of 10 CFR Part 20 limits. (Crimmins Testimony, Tr. pp. 1707, 1756; Eccleston Testimony Tr. 1793-95, 1818.)

213. While corrective actions are being taken to eliminate the leak from the SDV break, the operators' prime goal will be maintaining adequate core cooling. As long as the reactor remains pressurized, the preferred method for providing core cooling is through the main feedwater pumps, the condensate pumps and the condensor. All of these systems are located in the turbine building and are physically isolated from the location of the break, hence, they would not be subject to flooding. (Crimmins, ff. Tr. 1685, at p. 5.)

214. Following depressurization, the residual heat removal ("RHR") system provides low-pressure injection. The RHR pumps are located in the basement of the reactor building and theoretically could be subject to flooding; however, there are RHR service water pumps located in the emergency service water pumphouse, physically isolated from the reactor building and therefore not subject to flooding. Thus, if all other sources of makeup water (including the RHR system) were depleted or unavailable, the RHR service water pumps could deliver water from the 25 million gallon spray pond. (Ibid. pp. 4-5; Crimmins Testimony, Tr. pp. 1764-65).

215. Both the main feedwater pumps and the RHR service water pumps are controlled remotely from the control room. Together, they provide adequate, independent, and physically remote capability to preserve core cooling following an SDV break. (Crimmins, Testimony, ff. Tr. 1685, p. 5.)

216. Other systems capable of maintaining adequate core cooling are the high pressure coolant injection system ("HPCI") and the RCIC system, both of which provide independent core cooling capability at high pressure. After

depressurization, in addition to the RHR system, the low pressure core spray ("LPCS") system can provide adequate core cooling capability. (Crimmins, ff. Tr. 1685, at pp. 4-6; Staff Ex. No. 5, pp. 413 to 4-15.)

217. The HPIC system pump, the RCIC system pump, the four RHR system pumps, and the four LPCS pumps are all located in the reactor building basement at Susquehanna. Any of these 10 pumps can provide sufficient coolant to make up for the inventory loss following an SDV break. (Crimmins, ff. Tr. 1685 at pp. 4-6; Staff Ex. No. 5, pp. 4-14, 4-15).

218. At Susquehanna, all of the above systems, including their respective pumps, are located in compartments which are watertight with respect to each other. In addition, the stairwells are also provided with watertight doors which isolate them from the equipment. Therefore, even if flooding of the reactor building basement occurs, it would be a localized event that will not disable all safety systems located in the basement. (Crimmins, ff. Tr. 1685, at p. 5.)

219. If, in spite of the watertight condition of the reactor building basement rooms and stairwells at Susquehanna, general area flooding were to occur, it would take several hours to flood the basement to a one-foot depth, even assuming that leak tightness is defeated, the reactor building sump pumps are inoperative, and no leakage reduction results from depressurization. (Crimmins, ff. Tr. 1685, at p. 6; Eccleston testimony, tr. pp. 1829-30.)

220. All motors driving emergency core cooling system pumps at Susquehanna are six feet above the basement floor. Therefore, the level of flooding that would result from an SDV break, even under very conservative assumptions, would not result in loss of those motors until many hours from the onset of the accident, if at all. (Crimmins, ff. Tr. 1685 at p. 6; Eccleston Testimony, Tr. p. 1829; Crimmins Testimony, Tr. p. 1702.)

IV. CONCLUSIONS OF LAW

221. The Board has considered all of the evidence submitted by the parties and the entire record of this proceeding. Based on the findings of fact set forth herein, which are supported by reliable, probative and substantial evidence in the record, this Board, having decided all matters in controversy, concludes that, pursuant to 10 CFR 2.760a and 10 CFR 50.57, the Director of Nuclear Regulation should be authorized to issue to the Applicants, upon making requisite findings with respect to matters not embraced in this Initial Decision, licenses that authorize operation of the Susquehanna Steam Electric Station, Units 1 and 2.

ORDER

222. Wherefore, it is ordered that the Director of Nuclear Reactor Regulation is authorized, upon making requisite findings with respect to matters not embraced in this Initial Decision, in accordance with the Commission's regulations, and upon making the findings required in paragraph 228, 1 and 2, to issue to Applicants, operating licenses for a term of not more than forty (40) years, authorizing operation of the Susquehanna Steam Electric Station, Units 1 and 2, at steady-state power levels not to exceed 3293 megawatts thermal. Such licenses may be in such form and content as is appropriate in light of such findings, provided that such licenses are consistent with the conclusions of the Licensing Board herein.

223. The aforementioned operating licenses shall contain the following conditions:

1. The licenses will be subject to the ultimate outcome of the consolidated radon proceeding currently underway before the Appeal Boards in Docket Nos. 50-277, 50-278, 50-320, 50-354, and 50-355.

2. The licenses will be subject to a finding by the Director of Nuclear Regulation, in consultation with the Federal Emergency Management Agency, that all school districts within the plume exposure pathway emergency planning zone for the Susquehanna Steam Electric Station have completed written emergency plans to respond to fixed nuclear facility accidents.

3. The licenses will be subject to a finding by the Director of Nuclear Regulation, in consultation with the Federal Emergency Management Agency, that all municipalities within the plume exposure pathway emergency planning zone have completed their emergency response plans on transportation resources and program.

224. It is further ordered that this Initial Decision shall constitute the final action of the Commission forty-five (45) days after the issuance thereof, subject to any review pursuant to 10 CFR 2.760, 2.762, 2.764, 2.785, and 2.786.

225. Exceptions to this Initial Decision may be filed within ten (10) days after its service. A brief in support of the exceptions shall be filed within thirty (30) days thereafter and forty (40) days in the case of the Staff. Within thirty (30) days of the filing and service of the brief of the Appellant, and forty (40) days in the case of the Staff, any other party may file a brief in support of, or in opposition to, the exceptions.

IT IS SO ORDERED.

FOR THE ATOMIC SAFETY AND
LICENSING BOARD

Paul W. Purdom
ADMINISTRATIVE JUDGE

Glenn O. Bright
ADMINISTRATIVE JUDGE

James P. Gleason, Chairman
ADMINISTRATIVE JUDGE

Dated at Bethesda, Maryland,

this 12th day of April, 1982.

APPENDIX

1. Exhibits received into evidence:

Staff No. 1 -- Safety Evaluation Report, Susquehanna, Units 1 and 2, NUREG-0776.

Staff No. 2 -- Safety Evaluation Report Supplement 1, NUREG-0776.

Staff No. 3 -- Safety Evaluation Report Supplement 2, NUREG-0776.

Staff No. 4 -- Final Environmental Statement, Susquehanna, Units 1 and 2, NUREG-0564.

Staff No. 5 -- Generic Safety Evaluation Report, BWR Scram System Piping, NUREG-0803.

Staff No. 6 -- Technical Report on Material Selection and Processing Guidelines for BWR Coolant Pressure Boundary Piping, NUREG-0313, Rev. 1.

Staff No. 7 -- Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power plants, NUREG-0654, FEMA-REP-1, Rev. 1.

Commonwealth No. 1 -- State Bureau of Radiation Protection Plan for Nuclear Power Generating Station Incidents, Revision 3.

Commonwealth No. 2 -- Susquehanna Steam Nuclear Power Plant Sampling Locations.

Commonwealth No. 3 -- Field Airborne Iodine Sampling Procedure.

Commonwealth No. 4 -- Estimation of Radiological Consequences of Airborne Radioactive Material for Ground Level Sources.

Commonwealth No. 5 -- Pennsylvania Emergency Management Directive No. 32, Development of a Mass Care Operational Program.

Commonwealth No. 6 -- Ingestion Exposure Pathway Emergency Planning Zone, Appendix 17.

Commonwealth No. 7 -- Schools and Colleges Emergency Plans, Appendix 11.

Commonwealth No. 8 -- Commonwealth of Pennsylvania Disaster Operations Plan, Annex E, Fixed Nuclear Facility Incidents.

Commonwealth No. 9 -- Draft Luzerne County Radiological Emergency Response Plan for Incidents at the Susquehanna Steam Electric Station, Berwick, Pennsylvania, August 1981.

Board No. 1 -- Letter to Staff, dated September 17, 1981, committing Applicants' compliance with NUREG-0863 by December 29, 1981.

Board No. 2 -- Letter to Staff, dated June 30, 1981, containing Applicants' response to NRC generic letter 81-03 and NUREG-0313.

Board No. 3 -- Letter to Staff, dated September 15, 1981, containing Applicants' response to NRC generic letter 81-03 and NUREG-0313.

2. Professional Qualifications of Witnesses received into evidence:

Applicant		Staff		Commonwealth		CANDs	
Witness	Transcript page	Witness	Transcript page	Witness	Transcript page	Witness	Transcript page
Michaelson	1043	Fel man	1344	Reilly	2434	Amory	1206
Keiser	1570	Ka lowicz	1401	Lamison	2586		
Tosetti	1596	Prasad	1525	Belser	2586		
Vanderslice	1619		2195	Comey	2586		
Crimmins	1684	Bangart	1648	Hippert	2586		
Englehart	1849	Loysen	1655				
Lemaire	1915	Eccleston	1772				
Rhoades	1938	Fisher	1880				
McNair	1948	Branagan	1892				
Hecht	2049	Struckmeyer	1892				
Henderson	2309	Litton	1927				
Cantone	2382	Chestnut	2517				
McCandless	2248	Swiren	2519				
Carroll	2308						