

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

DOCKETED
USNRC

ATOMIC SAFETY AND LICENSING BOARD

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Before Administrative Judges:
Herbert Grossman, Chairman
Dr. Frank F. Hooper
Gustave A. Linenberger

OFFICE OF SECRETARY
DOCKETING & SERVICE
BRANCH

In the Matter of)

SERVED AUG 4 1982

SOUTH CAROLINA ELECTRIC AND)
GAS COMPANY, ET AL.)

Docket No. 50-395 OL

(Virgil C. Summer Nuclear Station,)
Unit 1))

August 4, 1982

SUPPLEMENTAL PARTIAL INITIAL DECISION

Appearances

On behalf of the Applicants:

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On behalf of the State of South Carolina:

Richard P. Wilson, Esq., Assistant Attorney General,
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On behalf of the NRC Staff:

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On behalf of the Intervenor:

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On behalf of the Federal Emergency Management Agency (FEMA):

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SUPPLEMENTAL PARTIAL INITIAL DECISION
(Remaining Issues--Nonseismic Issues)

I. INTRODUCTION

This matter is a contested operating license proceeding within the meaning of 10 C.F.R. § 2.4(n). This partial initial decision considers the application for issuance of a facility operating license to the South Carolina Electric & Gas Company ("SCE&G") and the South Carolina Public Service Authority ("SCPSA") (hereinafter "Applicants") to authorize the operation of the Virgil C. Summer Nuclear Station, Unit 1. The facility consists of a single pressurized water reactor located on SCE&G's site in Fairfield County, South Carolina. The reactor is designed to operate at core power levels up to 2785 thermal megawatts, with a net electrical output of approximately 900 megawatts. The facility is adjacent to Monticello Impoundment, an SCE&G-owned and operated pumped storage hydroelectric project (Federal Energy Regulatory Commission Project 1894), about one mile east of the Broad River and approximately twenty-six (26) miles northwest of Columbia, South Carolina.

In a Partial Initial Decision issued on July 20, 1982, covering the seismic issues in dispute, we discussed the course of these proceedings. We will not repeat that discussion. We found in favor of plant safety on those seismic issues subject to Applicants' meeting certain conditions during the plant's first year of

operation. Those conditions involved continued seismic monitoring and a confirmatory program involving seismic safety margins of plant equipment and components.

In this Supplemental Partial Initial Decision, we cover the remaining issues: anticipated transients without scram (ATWS); financial qualifications; emergency preparedness; quality control; and health effects. We resolve these matters in favor of plant safety, subject to certain other conditions which must be met.

We authorize the granting of an operating license subject to all of these conditions.

II. SUMMARY DISPOSITION MOTIONS

On May 7, 1981, the NRC Staff filed motions for summary disposition of Intervenor Brett A. Bursey's Contentions 2, 3 and 4(b). On the same day, Applicants filed motions for summary disposition of Intervenor's Contentions 3 and 10. On May 27, 1981, Staff and Applicants filed responses supporting each other's motions. On May 28, 1981 and June 2, 1981, Intervenor Bursey filed responses in opposition to the May 7, 1981 motions of Staff and Applicants.

In our Order of June 19, 1981, we granted summary disposition only on Contention 3, regarding anticipated transient without scram (ATWS), and denied summary disposition on all of the other contentions. Because the evidentiary hearing had been scheduled to begin on June 22, 1981, we decided these matters with minimal discussion, stating that our reasons would be fully discussed in the Initial Decision following the conclusion of the hearing. That discussion follows.

A. Financial Qualifications

Contention 2 states that:

- (a) The Applicant lacks the financial qualifications necessary to safely operate and decommission the Summer station in compliance with NRC rules and regulations;
- (b) The sum allocated by the Applicant for decommissioning of the Summer Plant (less than \$10 million) is grossly inadequate and does not conform to the requirements of 10 C.F.R § 50.33(f).

Staff's motion met the requirements of 10 C.F.R. § 2.749 with respect to the form and content for summary disposition motions. Its affiant, M. L. Karlowicz, Jr., whose professional qualifications seem to be appropriate, appended Section 20 of Supplement 1 of the Staff's Safety Evaluation Report (NUREG-0717, dated April, 1981) which he prepared, and in which the Staff concluded that Applicants are financially qualified to operate and decommission the Summer facility.

Mr. Bursey's opposing response, while meeting the requirements of 10 C.F.R. § 2.749, appended the affidavit of Dr. J. C. Ruoff, whose qualifications do not support his implied expertise in financial analysis. Despite this, however, the affidavit raised matters that seemed to controvert or place in question portions of Staff's affidavit. For this reason, the Board decided that it was desirable to test the reasonableness of Applicants financial posture through examination at the evidentiary hearing. Accordingly, Staff's motion was denied.

Although this contention was heard, the Commission's recent amendment to its regulations eliminated consideration of financial qualifications in operating license proceedings for power reactors. (Elimination of Review of Financial Qualifications of Electric Utilities in Licensing Hearings for Nuclear Power Plants, 47 Fed. Reg. 13250, March 31, 1982.)

On April 7, 1982, Staff filed a motion to dismiss Contention 2 on the basis of the amended regulation. Applicants filed a response on April 21, 1982 supporting Staff's motion.

We grant Staff's motion and make no findings on this issue.

B. Anticipated Transients Without Scram

Contention 3 states that:

The Applicant has not met the requirements of the NRC Staff to assure that the probability of occurrence of an anticipated transient without scram (ATWS) event is acceptably small.

Staff's and Applicants' motions met the requirements of 10 C.F.R. § 2.749. Staff appended the affidavit of one of its project managers, W. F. Kane, who participated in and supervised the preparation of Section 15.3.5 of the Staff's SER (NUREG-0717, dated February, 1981), wherein Staff opined that the Summer facility can operate without undue risk from ATWS events. Staff's opinion was based on the existence of specific operator training for mitigating the consequences of such events, the imposition of any plant modifications that may be required resulting from the Commission's rulemaking on ATWS, and the Staff's finding that there is an acceptably small risk from ATWS events in PWR's of the Westinghouse design. (Kane affid., pp. 2-3; NUREG-0717, p. 15-13.)

Applicants' affiants R. W. Steitler and O. S. Bradham similarly attested to the performance following an ATWS event in the Summer facility's Westinghouse NSSS, as well as the special operator training to mitigate its consequences. Affiant Steitler presented the results of an analysis of the Westinghouse NSSS response

following a bounding or limiting ATWS event for which it was assumed that control rods were never inserted. The analysis was reported to the NRC by Westinghouse, in its report NS-TMA-8182, of December, 1979. Three figures from that report accompanied the Steitler affidavit and presented the time dependency of core heat flux, average coolant temperature, and pressurizer pressure. These variables were found to remain within acceptable limits. From this it was concluded that no unacceptable pressure or temperature values would be reached. Affiant Steitler then discussed why the consequences of an ATWS event in Summer would be less severe. Finally, the Steitler affidavit explained how the Summer facility will meet all NRC requirements for the mitigation of ATWS. (Steitler affid., accompanied by three attached figures.)

Intervenor Bursey's response ignored the requirements of 10 C.F.R. § 2.749, and offered only the unsupported and conclusional allegation that ATWS mitigation measures will be inadequate. The Bursey response thus failed to controvert any portion of Staff and Applicants' statements of material facts for which there are no litigable issues. These statements were found to be supported by the appended affidavits. We concluded that Staff and Applicants had met their burdens and were entitled to the relief sought as a matter of law. Cleveland Electric Illuminating Company, et al. (Perry Nuclear Plant Units 1 and 2), ALAB-443, 6 NRC 741 (1977). Accordingly, the motions of Staff and Applicants with respect to summary disposition of Mr. Bursey's Contention 3.

C. Monitoring of Site Seismicity

Contention 4(b), as amended states that:

The plans for monitoring site seismicity are inadequate in that they do not consider the seismic effect of filling the reservoir. Site seismicity monitoring conducted after the filling of the reservoir should be continued through 1983.

The Staff's motion satisfied the requirements of 10 C.F.R. § 2.749 and appended the affidavit of W. F. Kane, who is Staff's project manager for the Summer station operating license application. The affidavit described the seismic monitoring efforts of Applicants and the USGS, and noted the Applicants' commitment to continue such monitoring through 1982. Mr. Kane further stated that Staff will condition an operating license such that Applicants may not discontinue seismic monitoring without written approval from the Staff. Finally, Mr. Kane offered, without support, the Staff's belief that there is no "present justification to impose an absolute requirement that seismic monitoring be continued through 1983." (Kane affd. pp. 1-3.)

In the Board's view, the duration of further monitoring could only be established after reviewing evidence relating to the expected course of future seismicity. We noted that the SER (Stf. Ex. 1 at 2-26) indicated that the largest reservoir-induced earthquakes, generally occur up to 10 years after impoundment and that at Lake Jocassee, S.C., another Piedmont reservoir, the maximum event occurred six years after impoundment. Neither of those benchmarks would occur before the end of 1983.

Without more, we were not persuaded by Staff. Accordingly, we denied Staff's motion, and Contention 4(b) remained an issue for litigation. See Perry, ALAB-443, supra.

D. Health Effects

Contention 10 states that:

The following effects - on a long term basis - have been sufficiently underestimated by the Applicant and the Staff so as to compromise the validity of the favorable Benefit-Cost balance struck at the construction permit phase of this proceeding:

- (a) The somatic and genetic effects of radiation releases, during normal operation, to restricted and unrestricted areas, said releases being within the guidelines and/or requirements of 10 C.F.R. Part 20, and Appendix I to 10 C.F.R. Part 50;
- (b) The health effects of the uranium fuel cycle, given the release values of the existing Table S-3 of 10 C.F.R. Part 51.

Applicants' motion met the requirements of 10 C.F.R. § 2.749 and included affidavits of L. D. Hamilton, M.D. and Dr. J. H. Barker, Applicants' staff health physicist. Dr. Hamilton defended the results of the BEIR I, UNSCEAR and BEIR III reports and the Staff's dependence upon these reports in its evaluation of acceptable radiological impacts resulting from normal operation of the Summer facility within the guidelines of NRC regulations. He reviewed the various studies and research results, from which Intervenor's affiants concluded that the risk of health effects had been underestimated at all radiation levels, and pointed out deficiencies and/or inaccuracies that invalidated those conclusions. Dr. Barker attested to the reasonableness of Applicants' and Staff's population dose projections which were used, in conjunction with BEIR risk

estimators, to conclude that radiation risks have not been underestimated.

Intervenor's affiant, Dr. K. Z. Morgan, defended his thesis that the dose-response model of the BEIR reports underestimates radiation risks to human health. He also criticized the strong reliance of the BEIR reports upon results of studies of Hiroshima-Nagasaki survivors, and pointed to a recently reported study that questions whether a proper assessment of the relative importance of neutron versus gamma radiation source terms had been used in evaluating the Hiroshima-Nagasaki data. Thirdly, he criticized as excessive the amount of exposure allowed to be received by uranium miners and nuclear power plant workers. (Morgan affid. May, 1981.)

The professional qualifications of the three above-mentioned affiants adequately attested to their expertise and to the weight to be afforded their respective affidavits. Because of the conflicting contents of these affidavits, we were unable to find that either party had met its burden. We concluded, therefore, that evidentiary presentations would be necessary in order to resolve the matter. Accordingly, Applicants' motion for summary disposition of Contention 10 was denied.

III. EMERGENCY PREPAREDNESS

A. INTRODUCTION

Intervenor Bursey's contention on emergency preparedness states that "[t]he Applicant has made inadequate preparations for the implementation of [its] emergency plan in those areas where the assistance and cooperation of state and local agencies are required."

Under 10 C.F.R. § 50.47(a)(1), no operating license for a nuclear power reactor may be issued unless the NRC finds that the state of on-site and off-site emergency preparedness provides reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. Other portions of the regulations require licensees and applicants to coordinate their plans with state and local response agencies over whom NRC does not have jurisdiction.

Section 50.47(a)(2) provides that NRC will base its findings as to the adequacy of the off-site emergency plans on a review of the Federal Emergency Management Agency (FEMA) determinations as to whether state and local emergency plans are adequate and capable of being implemented, and that NRC itself will assess the adequacy and capability of implementation of an Applicant's on-site emergency plans. The section also provides that the FEMA finding constitutes a rebuttal presumption on the question of adequacy.

The detailed emergency plans of the Applicant, the State of South Carolina and those of the four counties (Newberry, Richland, Lexington and Fairfield) within which the 10-mile emergency planning zone lies were received in evidence. Appli. Ex. 11-14, 15(a) and (b), 30(a). FEMA's audit of the off-site plans and their implementation

during an emergency exercise conducted on May 1, 1981 was also admitted. Stf. Ex. 5. Staff's evaluation of Applicant's plans was presented in Supp. No. 2 to the Summer Safety Evaluation Report. Stf. Ex. 1(b). A joint Staff-FEMA critique of the emergency exercise based on the regulations and NUREG-0654, was received as an attachment to prefiled testimony sponsored by a witness from Staff and a witness from FEMA. Kevern testimony, ff. Tr. 3281, at Attachment C; Richardson testimony, ff. Tr. 3287, at Attachment C.

Staff's critique of Applicant's on-site plan concluded that, subject to Applicant's meeting certain commitments regarding deficiencies in the plan, the plan "will provide an adequate training basis for an acceptable state of emergency preparedness and will meet the requirements of 10 C.F.R. Part 50 and Appendix E thereto." Stf. Ex. 1(b), Appendix A, at A-13. Staff's subsequent critique of the May 1, 1980 emergency exercise concluded "...that the state of emergency preparedness provides reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency." Kevern testimony, ff. Tr. 3281, Attachment C, at para. 22. Correction of the deficiencies noted will be verified through subsequent routine NRC inspection. Id. at para. 20.

Similarly, FEMA's critique of the emergency exercise concluded, as follows (Richardson testimony, ff. Tr. 3287, Attachment C, at para. 19):

While improvements are needed, and specific lessons were learned, South Carolina and the affected local counties are capable of executing site-specific REP plans for the V. C. Summer Nuclear Station.

Intervenor Burseley focused on the following specific emergency planning topics: shape of the emergency planning zone; decontamination and medical services; public alerting; transportation; public education; Applicants' emergency information brochure; public notification; greater-than-design-basis accidents; and crop and livestock contamination. The Board's findings cover these topics.

B. FINDINGS OF FACT

Shape of the Emergency Planning Zone

1. The Kelly Miller school, an elementary school, is located a few hundred yards outside of a 10-mile radius from the Summer Nuclear Plant. The Greenbriar Headstart school is a short distance down the road from the Kelly Miller school. Neither school was included in the 10-mile EPZ (emergency planning zone). Tr. 2174-76.

2. The Fairfield County Council recognized the importance of the evacuating the schools in the event of a radiological emergency at the Summer plant and has voluntarily included them in its emergency evacuation plans for the C-2 sector. The decision to include the schools was a "common sense decision" that a heavily populated community such as a school lying near the fringe of the EPZ should be evacuated if the plume were going in that direction. Tr. 2174-79, 2194-98.

3. The official charged with the emergency planning responsibilities for Fairfield County was unable to assure the Board that the inclusion of the two schools in the plan on a voluntary basis

would not be subject to reversal by the County Council at some future time. Ibid.

4. In other instances, the EPZ did not follow a strict 10-mile radius but, pursuant to 10 C.F.R. § 50.47(c)(2), was adjusted to take into account demography, topography, land characteristics, access routes, and jurisdictional boundaries. Tr. 2173-74, 2177.

5. The area of Lexington County within the 10-mile EPZ is relatively small. It has a population of approximately 712 inhabitants. They are located generally in what is known locally as the Chapin area. Tr. 2121.

6. Included within the EPZ in Lexington County is the town of Chapin and Chapin High School, which has approximately 670 students. Tr. 2122.

7. The Chapin Elementary School has between 900-1,000 students and is located approximately one mile from the Chapin High School. It is not included in the EPZ and is presently not included in any plans for evacuation in the event of a radiological emergency at the Summer plant. The possibility of including the Chapin Elementary School in emergency plans in the future is being considered. Tr. 2122-24.

8. When Chapin Elementary School is in session, there are no school buses parked on its premises. Apparently, students are transported by the same buses used for the Chapin High School, which are parked at Chapin High School during the day. The emergency plans contemplate using these buses to evacuate Chapin High School in a radiological emergency. In the event that it becomes necessary to evacuate children

near the Chapin Elementary School, the authorities would have to supplement the school bus transportation with other buses that would have to be made available by South Carolina Electric and Gas Company. Tr. 2125-28.

9. In the event of a radiological emergency that would require the evacuation of Chapin High School, the only reason for not evacuating the Chapin Elementary School is that it was not included in the EPZ. Ibid.

10. The Board finds that the emergency plans for the Summer nuclear site are deficient in their failure to include the Kelly Miller, Greenbriar Headstart, and Chapin Elementary schools in the EPZ. The failure to include those schools is contrary to the requirements of 10 C.F.R. § 50.47(c)(2) and does not realistically take into account the exigencies of a radiological emergency. The Board finds further, pursuant to 10 C.F.R. §50.47(c)(1), that the deficiencies in the plan are not significant (especially in light of the voluntary inclusion of the Kelly Miller and Greenbriar schools in the evacuation plan). so as to require a withholding of the operating license. The Board directs that the EPZ be expanded to include the three schools and that the emergency evacuation plans be adjusted accordingly within the first year of the plant's operation.

Decontamination and Medical Services

11. In the event of a radiological emergency, Richland, Fairfield and Newberry county personnel will determine the need to decontaminate persons coming into their evacuation centers. However, Newberry County,

presently lacking the manpower to decontaminate individuals, will refer contaminated persons to the State Emergency Preparedness Agency. Tr. 2009-12, 2074-76, 2182. Lexington County lacks sophisticated detection equipment and hence will rely upon State facilities. However, the majority of its ambulance drivers, advanced medical technicians with radiological monitoring training, can recognize the more obvious cases of contamination. Tr. 2132-3, 2145-48.

12. The following number of decontamination showers are available: Lexington County, 72 showers; Richland County, 69 showers; Newberry County, 40 showers; and Fairfield County, 25 showers. Tr. 4446. Additional portable facilities are available at the Fort Jackson complex. Tr. 4446-47.

13. Hospital facilities within the Richland County area can treat the following numbers of radiological patients: Providence Hospital--14 patients, Richland Memorial Hospital--24 patients, and Moncrief Army Hospital at Fort Jackson--25 patients. Newberry County has facilities for an unspecified number, but at least 1. There are up to 28 additional hospitals in the state which could each receive one or more contaminated or injured individuals in case of a radiological emergency, and mobile hospital units containing approximately 400 cots. Finally, if the need arose, the neighboring states of North Carolina, Georgia and Tennessee, each of which has nuclear power facilities of its own, could be called upon to provide backup hospital facilities. Tr. 4440-47.

14. Considering the small number of people residing within the 10-mile EPZ, the Board finds decontamination and medical treatment facilities are available in the event of a radiological emergency.

Public Alerting

15. A siren acoustical alerting system is being installed to meet the requirements of NUREG-0654. A backup method of alerting will be available through the use of emergency vehicle sirens and emergency personnel going from door to door. Applicant testimony, ff. Tr. 3002, at 23; Tr. 6059-60.

16. The Sheriff of Richland County stated that, while his organization on its own could sound vehicular sirens in one to two hours, he felt that proper evacuation notification, on a door-to-door basis, would require six to ten hours, if performed by his agency without assistance. The Sheriff's testimony assumed that his organization would have to alert (by siren) as well as instruct (by door-to-door notification) all county residents within that county's portion of the ten-mile EPZ. Tr. 6024-51. Other agencies are also available to assist with the backup method of siren alerting. Applicant testimony, ff. Tr. 6061, at 2-3; Tr. 6059-60.

17. The vulnerability of the siren alerting system to power failure was questioned. An alternate system exists that features thirty minutes of battery-powered operation in the event of power failure. The equipment-only cost differential for such a system would be an

additional \$200 thousand. Tr. 6057-58, 6123. The siren alert system being installed receives power from four different utilities (including SCE&G) via numerous circuits with outage averages of not more than 3.1 per year. Spinning reserves, interties and two-way feeds to substations minimize the threat to the siren system from outages. Loss of power from the Summer facility would not adversely affect the distribution circuits that supply power to the sirens. Appl. testimony, ff. Tr. 6097.

18. Based upon the foregoing and on the assumption that the siren alerting system being installed performs satisfactorily, the Board finds that the method of alerting the public within the ten-mile EPZ is adequate, and that the vulnerability of this system to power failures is acceptably small. Because the purpose of the siren system is to alert residents to turn on their radios for broadcasts of emergency instructions, the Board finds that door-to-door evacuation notification is unnecessary. See NUREG-0654 at 3-2.

Transportation

19. In late 1980, Applicants contracted with a Columbia, S. C. based firm to perform an evacuation time study for the ten-mile EPZ, using the guidelines set forth in Appendix IV of NUREG-0654. Appl. testimony, ff. Tr. 3002 at 12-13. The report describing the study and its results (Appl. Ex. 30(b)) stated that for people with cars about 81 minutes would be required to get the last car out of the plume EPZ in favorable weather conditions. Tr. 3160-64.

20. The report postulated the use of buses from each county involved to transport those people that are without cars including students. Tr. 3171-72. Although it had been ascertained that there is an adequate number of school buses available for this purpose, the study report did not explicitly address where the buses might be when needed, nor how they would be deployed, other than to have the buses driven by their regular student drivers. These drivers take the buses to their homes after school use is over. Tr. 3166-69.

21. Newberry, Lexington and Fairfield counties consider that the use of student drivers for bus transportation of evacuees is a cause for concern and could require alternative arrangements. Tr. 2021, 2154, 2180-81. In some instances, a school is located outside of the ten-mile EPZ but some of the students of that school reside within the EPZ. Partial evacuation of such schools will be undertaken: those students residing within the EPZ will be taken directly to processing or relocation centers. Tr. 3175-80.

22. Fifty-nine power company (SCE&G) buses are available to assist with evacuation. A signed agreement with SCE&G and Richland County committed the utility to provide transportation, food and shelter to evacuees. Lexington County also will request the use of SCE&G buses, if needed. Fairfield County has additional vehicles from other county services available to assist with evacuation. Tr. 2062-63, 2128.

23. The maximum ten-mile EPZ bus evacuation time under adverse weather conditions is 199 minutes. Appl. Ex. 30(b) at 42; Tr. 3197. Intervenor noted that a five-mile per hour wind could carry a

radioactive plume a distance of ten miles in two hours. Tr. 3198-99. The study report overlooked the fact that school bus travel speed is limited by state law and mechanical governors to 35 miles per hour (Tr. 3203), and used a speed of 45 miles per hour. Appl. Ex. 30(b) at 30. Adverse weather, for the purpose of evacuation time analyses, was taken to be icy roads which reduced travel speed to 75% of normal. Id. at 40.

24. The Board finds that there exists an adequate supply of vehicles - primarily school buses - to accommodate school students and residents needing transportation for evacuation purposes. However, the evacuation time study seems to have assumed an optimum utilization or deployment of buses without regard to whether organized plans for their deployment exist. The study assumed an unrealistic speed of travel for the school buses. It used a 25% speed reduction to compensate for icy road conditions and provided no basis for believing this to be a realistic reduction. The fact that schools are in session for perhaps a considerably fewer number of hours per year than the plant may operate, coupled with concerns about use of student drivers, emphasizes the need for a well organized plan of bus and driver deployment that was not described in the record. Finally, bus evacuation of certain sectors during adverse weather was shown by the study to require more time than would be required by a radioactive plume to overtake the evacuees, assuming a five-mile per hour wind blowing along that sector. We find that these defects in transportation planning deserve further attention during the first year of operation of the Summer facility.

Public Education; Applicants' Emergency Information Brochure; Public Notification^{1/}

25. The Intervenor and his witness on emergency preparedness expressed concerns about whether the local population's knowledge about nuclear plant accidents is sufficient for them to respond properly and without panic to an emergency. Tr. 2138, 3912.

26. The Staff's opinion is that educational emphasis must be placed upon how to implement emergency plans and follow instructions regarding what to do in an emergency rather than upon radiation effects or plant accident parameters. Bus drivers, for example, should be following instructions rather than analyzing the progression of an accident in order to make independent judgments as to what each driver should do. Tr. 4250-52. County officials took a similar position. Tr. 2016-17, 2135-38, 2162-63.

27. Applicants are cooperating with Richland County civil defense officials on the preparation of educational information for public dissemination. Tr. 2067-69. Historical accounts of public behavior following serious accidents indicate orderly response to emergency measures on the part of the public and medical personnel. Tr. 4237-43, 4592.

^{1/} We distinguish, in this discussion, between public alerting (i.e., the siren alerting system discussed elsewhere) and public notification, the latter consisting of making the public aware of what has occurred and instructing them on what protective action should be taken.

28. Applicants' emergency information brochure (Int. Ex. 4) is one of the means of educating the public about the plant and how to respond to an emergency. Tr. 3003-36. It was alleged to have understated the possible effects of radiation on people, overstated (during normal operation) the cleanliness of the secondary loop of the facility, provided insufficient information about how the public will be notified and evacuated if necessary, and generally played down the potential seriousness of an accident. Tr. 3003-36. There is room for improvement to the brochure, and several areas of improvement were identified for a future revision. Applicants will sample the knowledgeability of the general public within the ten-mile EPZ and use this information as guidance for future brochure changes. Appl. Panel testimony, ff. Tr. 3001. None of the criticisms negated the brochure's fulfillment of the requirements of NUREG-0654 and 10 C.F.R. § 50.47. Tr. 3036-72.

29. Each of the four counties which encompass the ten-mile EPZ have communication equipment to activate the emergency plans, including the radio broadcast of emergency messages that will instruct the public on what to do. Tr. 2014, 2055-56, 2130, 2161-62. The Governor's office is assisting with radio broadcast efforts aimed at public awareness and notification. Tr. 1941-46. Applicants' emergency information brochure (Int. Ex. 4) identifies the radio stations that will carry instructions to the public. In addition to radio messages to the public, an educational television channel is equipped to broadcast live and taped instructional messages. Tr. 1857-59, 2067. The State's Department of

Wildlife and Marine Resources has the ability to contact people in remote areas and to conduct search and rescue operations in support of the emergency plan. Tr. 1871-73.

30. We find that additional public education regarding the characteristics and consequences of nuclear accidents is not necessary for the emergency preparedness plan to function effectively; nor is the Applicants' emergency information brochure sufficiently flawed to impair its usefulness. Communication equipment and plans for its use in instructing the public at risk appear to be adequate.

Greater-Than-Design-Basis Accident

31. Intervenor submitted prefiled testimony on the inadequacy of emergency preparedness plans to cope with a greater-than-design basis accident. Tr. 3899-3914. The Board admitted only that portion of this testimony that postulated a hypothetical Class 9 accident (initiated by a large break LOCA followed by an ECCS failure) and post accident emergency responses, for which it was alleged that emergency plans are inadequate. Tr. 3893-94. The NRC-FEMA emergency preparedness standards were not contested but rather the ability to implement them. Tr. 4036. It was alleged that State and local personnel responsible for implementing the plans and the population at risk in the plume EPZ were poorly educated regarding the nature of reactor accidents and their radiological consequences. Thus, widespread panic would develop and cause a serious breakdown of emergency response efforts. Tr. 3912.

32. Intervenor's witness asserted that despite the experience at TMI-2, malfunctions have subsequently occurred at numerous other facilities (Tr. 3909), and that a cascading of trivial accident events can ultimately lead to an accident so serious as to defy analysis. Tr. 3923-27. Nonetheless, the witness' postulated accident initiating event is a PWR-3 (consistent with Table 6-2 of Staff Ex. 3); it does not represent the most serious accident that has been considered for accident analysis purposes. Id. at 6-8 to 6-9; Tr. 3928-30.

33. Applicants testified that Intervenor's postulated post-accident response sequence is unrealistic and unreasonable and that it ignores numerous identified improvements, including TMI lessons learned, that would militate against the credibility of such a postulated sequence. Tr. 4174-76, 4811-97. According to Applicants it is not valid to assume, as did Intervenor's witness, that evacuation would not be initiated considerably in advance of a major release of radioactivity because of the many post-TMI improvements that have significantly improved the ability of control room personnel to recognize quickly the type and potential seriousness of a malfunction that has occurred. Tr. 4111-4407 (passim), 4245-47. Applicants further testified that the initiating event (large break LOCA and subsequent ECCS failure) of the postulated response sequence is one easily identified by a control room operator, enabling a relatively rapid recognition of the onset of a general emergency. Tr. 4522, 4554-55.

34. A post-accident emergency response sequence (Appl. Ex. 39) representing Applicants' version of how the response to a Summer Station general emergency would proceed was reviewed. Tr. 4419-26, 4505-07.

That sequence is as follows: (a) 12:06-12:20 p.m. - the determination that a general emergency exists is made; (b) 12:11-12:35 p.m. - local, state and federal agencies are notified and evacuation of 2-mile radius and 5-mile sector downwind is recommended; (c) 12:16-12:50 p.m. - the public alerting system (siren) and emergency broadcast system is activated; (d) 12:20-1:10 p.m. - evacuation of 2-mile radius and 5-mile downwind sector is initiated; (e) 1:00-1:15 p.m. - evacuation of 3-mile radius and 10-mile downwind sector is recommended; (f) 1:36-3:18 p.m. - evacuation of 2-mile radius is completed; (g) 1:40-4:27 p.m. - evacuation of 5-mile downwind sector is completed; (h) 2:29-4:26 p.m. - evacuation of 5-mile radius (those individuals with transportation) is completed; and (i) 2:25-4:13 p.m. - evacuation of 10-mile downwind sector (those individuals without transportation) is completed.^{2/}

35. By comparison, the post-accident response sequence postulated by Intervenor does not reach the general emergency declaration until 3:00 p.m. - based upon the TMI-2 event (Tr. 4014) - nor initiate off-site evacuation warnings until 5:00 p.m. Tr. 3911-12.

36. Planning regulations and the role of NUREG-0654 were reviewed by Staff. Significant improvements in emergency planning as the result of TMI have been made; the requirement for periodic exercises of all plans and the continuing improvements to these plans arising out of

^{2/} Evacuation times were based upon a study of population distribution versus evacuation time, contracted for by Applicants. Appl. Ex. 30(b).

deficiencies has been imposed. Tr. 4571-81. Staff's version of the response activity sequence, subsequent to Intervenor's postulated initiating events (ff. Tr. 4603) was analagous to, and in general agreement with, Applicants' version. Tr. 4605-08; 4633-37.

37. The Board finds that, while the initiating events postulated by Intervenor reflect a credible possibility, the postulated post-accident sequence of response activities is not consistent with the level and depth of planning, the results of the Summer exercise of these plans, and current state of knowledge about response to, and control of, accidents. Intervenor's proposed accident scenario has not pointed up any inadequacies in the post-accident response plan.

Crop and Livestock Contamination

38. Part II of NUREG-0654 at paragraph J.9 provides that:

Each State and local organization shall establish a capability for implementing protective measures based upon protective action guides and other criteria. This shall be consistent with the recommendations of EPA regarding exposure resulting from passage of radioactive airborne plumes, (EPA-520/1-75-001) and with those of DHEW (DHHS)/FDA regarding radioactive contamination of human food and animal feeds as published in the Federal Register of December 15, 1978 (43 FR 58790).

Appendix I to the South Carolina Technical Radiological Emergency Response Plan (Applicants' Exhibit 15(b)) contains protective action guides for milk and food. These list contamination levels for various radioactive isotopes as protective action indicators. The Plan requires, among other things, that the Bureau of Radiological Health of the Department of Environmental Control analyze food stuffs produced in

the ingestion zone EPZ and recommend interdiction of items exceeding the stated limits. The Plan further provides that the Bureau of Radiological Health will recommend sheltering of dairy animals in the event of a release of iodine, cesium or strontium; fodder will be analyzed to determine the need to provide stored feed for these animals.

Id. See. J-4.

39. In addition, Appendix II of the State Technical Radiological Emergency Response Plan contains a description of offsite radiological monitoring equipment and programs. These include, among other things, monitoring of particulate and gaseous air samples, surface water samples, ground water samples, potable water samples, raw milk samples, soil and/or bottom silt samples, fish and/or shellfish samples, and vegetation samples.

40. The Agricultural Extension Service of Clemson University has support responsibilities that include: advising as to the location of possible acreages of edible crops, berries, and fruits in the contamination area; advising as to the location and size of dairies in contaminated area; advising as to the location and number of livestock and poultry in the contaminated area; advising as to on-farm storage of grain and edible agricultural products in the contaminated area; advising as to available shelter for livestock in the contaminated area; advising as to wholesale distribution sources for agricultural products in the contaminated area; advising as to availability of stored grain and other feed and silage for animals in the contaminated area; furnishing information and inspectors for assessing damage to farms; providing

guidance and assistance to agencies who are responsible for evacuation and care of livestock; identifying, establishing and coordinating evacuation reception areas for livestock and effecting return of such animals to the owners; assisting in the decontamination or disposal of livestock, feed, milk and other contaminated farm products; assisting in the control of livestock and agricultural products exposed to radiation or contamination; providing informational and educational material to farmers, ranchers, and others on protective measures for themselves and their property against hazards associated with disasters; and finally, providing advice on clean-up of damage to property, sanitation precautions, insect controls, food preparation in disasters, recovery actions for damaged farms and renovation of damaged equipment or property. Tr. 1803-04.

41. A list of dairy producers, agricultural producers and agricultural water resources in the four-county area nearest to the nuclear plant has been assembled. Tr. 1807. However, the role of the Extension Service is educational and advisory only and the Service has no organized plan for instructing farmers about what to do in an emergency. Tr. 1814, 1818.

42. A farmer who resides approximately 10 miles from the plant was not aware of how his crops, livestock and milk should be handled in the event of a radiological emergency. Tr. 1821-26; Coleman affid., ff. Tr. 1828.

43. Richland County officials recognize the need of dairy farmers to return to evacuated areas to care for livestock. Tr. 2060.

44. We find that existing educational and surveillance resources along with protective action guides are adequate for coping with the diagnostic needs of the agricultural communities potentially at risk. However, the record is unclear about the existence of organized plans to implement remedial and preventive measures for consumer protection against food pathway contamination. If organized plans for such measures exist, the record indicates that they were not well communicated to the agricultural community. If the plans do not exist, they should be formulated. The Board will require as a license condition that plans to implement remedial and preventive measures for consumer protection against food pathway contamination be formulated and communicated to the agricultural community during the first year of reactor operation.

Intervenor's Proposed Requirements

45. In his proposed findings on the emergency preparedness contention, Intervenor recommended the imposition of six specific requirements upon the Applicant. These recommendations exceed the scope of Contention 8 and the Commission's emergency planning requirements and lack any evidentiary justification. The six recommendations, and Licensing Board's findings thereon, are as follows:

46. First, the Intervenor recommended that a clearer chain of management responsibility be established to cope with a serious accident. The Commission's regulations require, in part, that: primary responsibilities for emergency response by the nuclear facility licensee are assigned; on-site facility licensee responsibilities for emergency

response are unambiguously defined; adequate staffing to provide initial facility accident response in key functional areas is maintained at all times; and the interface among various onsite response and offsite support and response activities are specified. 10 C.F.R. § 50.47(b). The evidence of record indicates that these standards have been met in the Applicant's emergency plan. Stf. Ex. 1b, Appendix A § 2(A), (B); Appl. testimony, ff. Tr. 3001, at 9, 27.

47. Second, the Intervenor recommended that the Applicants undertake a "serious education effort" for state, local and hospital officials to acquaint them with unspecified post-TMI reactor considerations. The Commission's regulations require the provision of radiological emergency response training to those who may be called upon to assist in an emergency and require that periodic drills be conducted to develop and maintain key skills. 10 C.F.R. § 50.47(b). The evidence demonstrates that the Applicant has satisfied these requirements. Stf. Ex. 1b, Appendix A, § 2(N), (O); Staff Exhibits, ff. Tr. 3281, Attachment D at 3, 16-18; Staff testimony, ff. Tr. 3287, Attachment C at 3-5, 12-13; Appl. testimony, ff. Tr. 3001, at 4-7, 9-10, 24-25, 27-28, 33-35.

48. The Intervenor's third recommendaton is that the Applicants undertake a door-to-door public notification and education campaign. This recommendation goes beyond the scope of Contention 8. In any event, the Commission's regulations require that information be made available to the public on a periodic basis on how they will be notified and what their initial actions should be in an emergency. 10 C.F.R.

§ 50.47(b)(7). The evidence indicates that this requirement has been satisfactorily met. Stf. Ex. 1b, Appendix A, § 2(g); Staff testimony, ff. Tr. 3281, at 5, 13-15; Staff testimony, ff. Tr. 3287, at 6; Appl. testimony, ff. Tr. 3002, at 11-12.

49. The fourth and fifth recommendations are that backup battery power be provided for the siren system and that radioactivated "black boxes" be installed in the homes of those residing in the EPZ. These recommendations are beyond the scope of Contention 8 and the applicable Commission regulations. The Commission's regulations require establishing means to provide early notification to the populace within the plume exposure pathway EPZ. 10 CFR § 50.47(b)(5). The evidence shows that this requirement is being satisfied through the installation of an acoustic alerting system (sirens). If the siren system is inoperative or unusable, alternative means of notification exist, including a sheriff department airplane equipped with loud speakers, enforcement vehicles with sirens, and volunteer fire department and community organizations' cooperation. Stf. Ex. 1b, Appendix A, § 2(E); Stf. testimony, ff. Tr. 3281, at 11; Appl. testimony, ff. Tr. 3002, at 22-23; Tr. 2066-67.

50. Recommendation six addresses the education of farmers within the EPZ relative to emergency response measures. This segment of the population is already the object of a specific educational program being conducted through the Clemson University Agricultural Extension Program. This program includes advice on what to do with agricultural products and livestock in the event of a radiological emergency. Tr. 1802-05.

51. Based upon the entire evidentiary record of this proceeding, and upon the foregoing Findings of Fact, the Board finds that, subject to the conditions imposed by the Board which may be implemented during the first year of operation, the Applicants have made adequate preparations to implement their emergency plan. The six recommendations of Intervenor's proposed findings are rejected.

IV. QUALITY ASSURANCE - QUALITY CONTROL

A. INTRODUCTION

Quality control (QC) was contested by Intervenor's Contention 9, which stated:

The quality control of the Summer plant is substantially below NRC standards as evidenced by consistently sub-standard workmanship, in several aspects, during the construction of the plant.

Intervenor based his case upon his Exhibits 1, 2 and 3 (involving an NRC inspection report and worker allegations of poor construction practices) and his examination of witnesses for Applicants and Staff. Applicants' case was based upon the testimony of a panel of several witnesses, and Exhibits 5, 6, 7, 8, 9(a-c) and 10(a-c). The thrust of Applicants' case was twofold: the organizational and functional characteristics of Applicants and their contractors enabled them to meet the requirements of the NRC in areas of QC and quality assurance (QA); and its responses and corrective actions taken to improve and/or eliminate all unsafe and/or undesirable conditions known or alleged to have occurred during construction. The Staff also presented a panel of witnesses and Exhibits 1, 1(a) and 1(b). The Staff's case comprised its appraisal of Applicants' quality programs and their implementation, a review of the efforts and findings of the Division of Inspection and Enforcement (I&E), and a review of the Applicants' resolution of unsatisfactory situations.

B. FINDINGS OF FACT

52. Management for the lead Applicant (SCE&G) recognized as early as 1971 (and before the filing of the construction permit application) the (then) AEC's serious emphasis on the great importance of QA and QC. Functional and organizational measures were adopted to assure that employees at all levels were indoctrinated concerning the importance of an effective QA/QC program and management's dedication to the implementation of that program. The program was organized to remove it from the pressures of construction schedules and cost concerns. A continuing program of employee training and retraining was established and maintained. Additionally, a management audit function was set up to continually review the effectiveness of the quality program to detect trends and root causes indicative of the need for program changes, and to evaluate training effectiveness. Because at one time it lost confidence in the effectiveness of its constructor's QC program, SCE&G initiated its own parallel inspection program and demanded more effective performance by its constructor. To minimize problems that might impair construction quality on safety-related structures, SCE&G took the added precaution of imposing safety-related specifications to nonsafety related materials and construction activities. Appl. testimony, ff. Tr. 1388 and ff. Tr. 2672; Tr. 2652-55.

53. Applicants detailed how their QA and QC efforts are organized, how QA/QC functions, and why QA/QC has been effective in achieving management's objectives. The following points were highlighted:

- Use of design specifications in excess of requirements in order to provide additional safety margins;

- Repetitive training (for skills) and indoctrination (for attitude) of craftsmen (especially welders) to increase the likelihood that work will be performed properly;
- Detailed documentation of all off-normal situations, and follow-up through final resolution;
- Close liaison with vendors at their shops and with contractors at the plant site;
- Direct access by workers to utility management, with provisions for anonymity if the worker desires;
- Detailed follow-up of all allegations of off-normal quality;
- Stop work authority vested in three levels (including on-site) of the QA/QC organization.

Applicants investigated numerous allegations of three on-site craftsmen employed by Applicants' constructor. These allegations were set out in Intervenor's Exhibits 1, 2 and 3, and formed the bases of his Contention 9. Careful investigations were undertaken to determine whether each allegation was supported by facts; which ones, if supported, had safety significance; and which ones were followed by corrective actions. Where corrective actions would entail extraordinary difficulty, worst-case assumptions were made about the condition of the affected structure or hardware and analyses were made to determine whether unacceptable safety implications were involved, including any code violations. None of the allegations identified problems which would have been difficult to remedy because of construction progress. In fact, these allegations identified only a minimal number of safety

related concerns, all of which have been or are in the process of being resolved to Applicants' and NRC's satisfaction. Illustrative of the extent to which these allegations were systematically investigated and identified problems corrected was the allegation that socket welds with undersized weld fillets were approved. Although nearly 14,000 socket welds had been performed, a 100% reinspection program was undertaken followed by reworking and reinspection of all welds (whether or not safety related) if fillet size was questionable. At the time the testimony was presented, less than 100 socket welds designated for rework remained to be completed. All rework and reinspection to that time had been accepted by the NRC. A few socket welds imbedded in concrete, were stress analyzed to show that, if they passed hydrostatic testing, they were acceptable because of the reinforcing and restraining action of the concrete. Applicants' architect/engineer found that conservatism in specifying pipe sizes was such that, even if undersized fillets had gone undetected, they would probably not be a source of safety concern. Whereas the raw numbers of nonconformance items showed that the Summer project was about on par with other utility nuclear projects (a fact that Applicants were not proud of), Applicants expressed great confidence that they will have a high quality facility because of their thoroughness in detecting and correcting off-normal situations, and the accompanying improvement in training and surveillance. Applicants further noted that they had received no violation notices from NRC. Appl. testimony, ff. Tr. 1388; Tr. 1390-1491, 2660-94; Appl. supplemental testimony, ff. Tr. 2672.

54. A Staff panel of personnel from the Office of Inspection and Enforcement (I&E), testified that I&E had verified that Applicants' construction QA/QC program met NRC objectives. This verification was achieved through I&E's "...examination of management controls, including quality assurance and quality control manuals, work procedures, records and documents and by the observation of work in progress. Work in progress was inspected for quality workmanship, conformance to control procedures and conformance to codes. Records were examined to verify that purchased materials and equipment met quality standards and that quality control inspections were performed throughout construction." These inspections entailed 501 man days of effort by experienced inspectors over the time period from May, 1971 through March, 1981, during which time there were no violations, twenty-two infractions, eleven deficiencies, and two deviations. Both the Applicants and NRC analyzed the safety significance of these items; and SCE&G instituted measures to preclude recurrence. Proper and acceptable corrective measures were confirmed through I&E inspections. I&E undertook a detailed follow-up of worker allegations and, where nonconformances could be identified, reviewed the corrective measures taken. These measures were judged to be satisfactory. Stf. testimony, ff. Tr. 2814.

55. Cross-examination of the initial I&E witnesses indicated that they lacked direct knowledge of I&E's follow-up of certain discrepant construction activities identified by workers. Staff produced

additional witnesses to cover the items in question. Tr. 2815-41. Their principal points were:

- I&E has not closed out its follow-up on all discrepant items at the plant and will not permit full-power operation until all remaining open items have been resolved;
- There have been fewer noncompliances at Summer than generally found at other facilities within Region II;
- Subjectively, I&E judges the quality of construction at Summer to be slightly above average as compared with other facilities in Region II;
- I&E, based upon the assumption that all currently open discrepant items will be satisfactorily resolved, has no concern about the safety of the plant and recommends the granting of an operating license. Tr. 3499-3572.

56. The Board notes that the examination of the I&E panel concerning the allegations of improper construction practices did not in all cases yield unequivocal responses. For example, the significance of nonconforming socket welds in safety-related piping seemed to have been deemphasized because of large mechanical safety factors inherent in their as-built configurations and the observation that historically no socket weld discrepancies have ever been found to be the cause of pipe failures. (It would appear that if weld requirements are overly conservative, they should be relaxed rather than downgraded in significance.) The allegation of on-site use of drugs and alcohol was investigated and confirmed by I&E. It was found not to be widespread,

nor to have significantly affected safety-related work, nor to be unusual in large construction efforts. Tr. 3529-30. (The evidence is not clear whether NRC policy is that such practice is not to be tolerated, or that it is to be tolerated in moderation so long as safety is not compromised.)

57. Despite such examples of soft testimony, however, we find from the evidence adduced that there is reasonable assurance there will be no uncorrected safety-related inadequacies in the as-built Summer facility, and that the quality control of the construction of the Summer plant is acceptable.

V. HEALTH EFFECTS
(Contention 10)

The following effects - on a long-term basis - have been sufficiently underestimated by the Applicant and the Staff as to compromise the validity of the favorable Benefit-Cost balance struck at the construction permit phase of this proceeding:

(a) The somatic and genetic effects of radiation releases, during normal operation, to restricted and unrestricted areas, said releases being within the guidelines and/or requirements of 10 C.F.R. Part 20 and Appendix I to 10 C.F.R. Part 50:

(b) The health effects of the uranium fuel cycle, given the release values of the existing Table S-3 of 10 C.F.R. Part 51.

A. INTRODUCTION

1. Applicants' Motion for Summary Disposition

The Applicants moved for summary disposition of this contention on May 7, 1981. On May 27, 1981, the NRC Staff filed a response in support of the action, based on the FES (Virgil C. Summer Final Environmental Statement, dated May 1981, Stf. Ex. 3) and an accompanying affidavit. Intervenor Bursey filed an opposition to this motion on May 28, 1981. The Applicant's supporting affidavit relied heavily on health effects' information contained in the BEIR (Biological Effects of Ionizing Radiation) Committee reports. Dr. Morgan, the Intervenor's witness, contended that the BEIR results were unreliable because they relied heavily upon studies of radiation exposure from Hiroshima and Nagasaki which (1) were biased because of the population sampled, and (2) underestimated the gamma radiation dose to the population.

In our Order of June 19, 1981, we denied the motion for summary disposition because we recognized an unresolved issue in the validity of the data used in the evaluation of health effects.

2. Nature of the Evidence

The Intervenor's direct case on the contention was the testimony of Dr. Karl Z. Morgan.^{3/} Testimony ff. Tr. 1545. Dr. Leonard D. Hamilton testified on behalf of the Applicants. Testimony ff. Tr. 2380. Staff's direct case consisted of pertinent portions of the FES (Stf. Ex. 3) which was received into evidence by stipulation of the parties (Tr. 2385), and the testimony of Dr. Edward F. Branagan who had prepared Sections 4.5 and 4.7.5 of the FES. Dr. Branagan also submitted written rebuttal testimony (ff. Tr. 2406) and testified at the July 17 hearing session (Tr. 3822-37) to clarify earlier testimony. Applicants' case consisted of the prefiled (ff. Tr. 2380) and oral (Tr. 2321-2484) testimony of witness Hamilton, and the oral (Tr. 3847-3862) and prefiled (ff. Tr. 3846) testimony of witness Barker.

3. Overall Position of Parties

The Intervenor's position is that the Applicants and Staff have chosen risk values that would depreciate the risk rather than exaggerate the risk, and that Dr. Morgan's projection of 39 fatal cancers, 70 cancers and 1700 genetic disorders during the life span of the plant was unrefuted. Int. Prop. Finds. at 4.

The Staff's position is that where individual doses associated with exposures are controlled according to the limits of 10 C.F.R. Part 20 for the exposure of workers and the general public, the risk to individuals will be extremely small. Stf. Ex. 3 at 4.5.5. The risks to

^{3/} The Intervenor submitted prefiled testimony of two other witnesses, Drs. Helen Caldicott and Michio Kaku. The Board excluded Dr. Kaku's testimony as repetitious of Dr. Morgan's testimony. Tr. 1690-91. Dr. Caldicott never appeared to testify.

the general population will be similarly small because no health effects, somatic or carcinogenic, have been detected at the doses estimated in the FES. See Id. at 4-28; Stf. Prop. Finds. 50.

The Applicants argue that Dr. Morgan's latest estimates of risks were outside the accepted range and those endorsed by the Commission in Public Service of Oklahoma (Black Fox Station, Units 1 and 2), CLI-80-31, 12 NRC 264 (1980) even though his earlier published health effect estimates were within the range of these given by the Staff in the FES. Applicants further argue that (1) Dr. Morgan had no recommendation against operation of the plant based upon estimated health effects, and (2) since Dr. Morgan did not clarify the record on his estimates of genetic effects, the Staff's testimony stands and there is no real controversy on estimates of genetic effects. Thus Applicants argue that given the uncertainties involved, there is no material disagreement between Staff and Applicants' witnesses, and Dr. Morgan. Appl. Prop. Finds. 226.

B. FINDINGS OF FACT

Risk Estimators

58. The health effects from the low-level ionizing radiation that would result from normal operation of the Summer facility were estimated by the Staff in the FES by multiplying the dose commitment (in units of person-rem) by an appropriate risk estimator. Branagan Rebuttal Testimony, ff. Tr. 2407, at 1-3. The risk estimators used in the FES are based on the linear dose response and the absolute risk projection model described in the BEIR I Report. Id. at 2-3; Tr. 2394. For a somatic risk estimator, the Staff used 140 potential cancer fatalities

per million person-rem ($140/10^6$ person-rem) and for all forms of genetic disorders used 260 potential cases per million person rem ($260/10^6$ person-rem). Tr. 2459-60; Stf. Ex. 3 at 4.5.5.

59. These risk estimators are comparable to, and consistent with, values recommended by the 1980 BEIR Committee Report (BEIR III), BEIR I, the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the National Council of Radiation Protection and Measurements (NCRP), and the International Commission on Radiological Protection (ICRP). These organizations represent the views of the overwhelming majority of the scientific community. Tr. 2395.

60. The FES contains a second set of somatic cancer death risk estimators based on a relative risk model and the assumption that risk prevails for the duration of life. These values are about four times higher (approximately 500 potential cancer mortalities per million person-rem) than the above estimates. The range for the cancer risk estimator could also include zero. Stf. Ex. 3 at 4-25; Tr. 2394.

61. The genetic risk estimator used by the Staff has a range of uncertainty of a factor of about 6 above and a factor of 4 below the 260 potential case value. This would give a range of 60 to 1500 cases per million person-rem. Stf. Ex. 3 at 4-25.

62. Applicants' witness Dr. Hamilton concurred with the risk estimators used in the FES. Tr. 2332, 2334. He based his risk estimates on BEIR I and BEIR III, and on UNSCEAR reports. Tr. 2326.

63. Intervenor's witness Dr. Morgan used 900 potential cancer fatalities per million person-rem as the risk estimator for somatic health effects. He acknowledged that this value was substantially above

values used by the major radiation protection organizations.

Tr. 1645-49.

64. Dr. Morgan's risk estimator is also beyond the range of the values considered in the FES (140 to $500/10^6$ person-rem). Stf.

Ex. 3 at 4.5.5.

65. Dr. Morgan's genetic risk estimator appears to be 44,000 potential genetic defects per million person-rem. Tr. 2495-96. He maintained that his estimator was derived from Table 4, page 57 of the BEIR I Report. Tr. 2499.

66. However, the 44,000 defects were far above the highest value (1500) that can be derived from Table 4. Tr. 3727-28. Thus, Dr. Morgan has not established a bases for his genetic risk estimator.

Predicted Health Effects from Operation

67. Drs. Hamilton and Branagan found that 1300 person-rem per year is a conservative estimate of dose for the calculation of health effects because it is the highest exposure observed at any plant and is not the average exposure. Tr. 2467-68.

68. Dr. Morgan used this dose to compute the health effects from operation since it was comparable to his estimate of 1500 person-rem for annual population dose. Tr. 2489-93. He multiplied the 1300 person-rem/year figure by his somatic risk estimator (900 cancers per million person-rem) and by 30 (years) to obtain an estimate of 35 potential lethal cancers and 70 potential non-lethal cancers during plant operation. Tr. 2494.

69. Dr. Branagan estimated that there would be 15 potential cancer deaths for a 30-year operation of the plant. Tr. 2463.

70. Dr. Branagan did not calculate the potential non-lethal cancers, but the FES noted that the BEIR III Report estimates that the number of non-fatal cancers would be 1.5 to 2 times the number of potential fatal cancers. Stf. Ex. 3 at 4-25.

71. The risk of potential premature cancer death to the individuals of the general public living within 50 miles of the plant from exposure to radiation release is less than one percent of the risk to the maximum individual. Stf. Ex. 3 at 4-28. This risk is insignificant in comparison to the risk of premature death from cancer from exposure to other sources of radiation in the U.S. Id., Hamilton Affidavit, ff. Tr. 2380, at 2.

73. Dr. Hamilton estimated that 16 potential cancer deaths could result from 30-year operation of the plant and the uranium fuel cycle. Tr. 2410.

74. Since the dose estimate used in evaluation of potential cancer deaths was the same for all 3 witnesses, the substantial difference in estimated deaths between Dr. Morgan on one hand and Drs. Branagan and Hamilton on the other, lies in the somatic risk estimator used.

75. The Staff arrived at a figure of 0.3 genetic disorders in all future generations of the exposed workforce population due to one year of operation by multiplying their genetic risk estimator (260 potential genetic disorders per million person-rem) by the annual plant worker dose. Stf. Ex. 4 at 4.5.5.

76. For 30 years of operations the result would be 9 potential genetic disorders. The highest value for a genetic risk estimator from

BEIR I would yield approximately 60 potential genetic defects.

Tr. 3827-28.

76. From his genetic risk estimator of 44,000 genetic defects per million person-rem, Dr. Morgan calculated 1700 genetic disorders from plant operation over the life of the plant. Tr. 2496.

Basis for Disagreement on Estimation of Risk

77. Dr. Morgan stated that the risks of low-level exposure to ionizing radiation are greater than indicated by Applicants and Staff because they relied upon reports which underestimated risk. These reports included those from the National Council on Radiation Protection and Measurement, the International Commission on Radiological Protection, the United Nations Committee on the Effects of Atomic Radiation, and the BEIR Committee I, II and III reports. Tr. 1548-49. Dr. Morgan testified that in evaluating genetic effects these organizations relied largely on animal data and on the general assumption that there is a dose rate effect factor at very low doses which makes the genetic risk about one-sixth of that at high doses. Tr. 1550. Dr. Morgan believed it best to assume that there is no dose rate effect and thus genetic damage would increase with an increase in dose. Tr. 1551. He argued that it is difficult to go from animal data to human health effects without reaching false conclusions due in part to the heterogeneity of the human population versus the animal population. Tr. 1560-65. Dr. Morgan testified that somatic effects in animals are similar to those in man but genetic effects are different. Tr. 1674-75.

78. Dr. Hamilton testified that animal studies are useful in calculating the genetic risk to man in the absence of direct human

evidence since they can reveal the shape of dose-effect curves and the mechanisms by which radiation induces cancer or lesions. Tr. 2361-64. For example, animal studies have shown that a dose spread over a long period of time is not as harmful as the same dose given over a short period because the experiments have shown that repair mechanisms affect radiation damage. Id.; Tr. 2466. Dr. Hamilton agreed with Dr. Morgan that in calculating genetic effects one assumes for conservatism that there is no repair mechanism; therefore, one would not apply the dose rate effect factor of 6. Tr. 2362-63. The Staff also did not use a dose rate effect factor in its estimates of health effects. Tr. 2399.

79. Dr. Morgan argued that the super linear dose model would give the most appropriate risk estimates of low-level radiation because it recognizes that there are radiosensitive subgroups in the population. Tr. 1564. The super linear model of dose response gives a higher cancer rate (the number of potential cancers per rem) at low doses than at high doses. Tr. 1664. Dr. Branagan noted that a General Accounting Office Report which was published subsequent to the BEIR III Report also selected the super linear hypothesis as the best fit for certain data. Tr. 1570-71. Dr. Morgan commented that the linear risk model received a mixed review in the BEIR III Report because some members argued that the linear response model overestimates the risk while others argued it underestimated the risk. Tr. 1570.

80. Applicants and Staff's witnesses rejected the claim that the linear model underestimated health effects. See e.g., Tr. 2422, 2394. They offered several reasons for rejecting the super linear model to

estimate health effects. Dr. Hamilton testified that he would not place more weight on the January, 1981 GAO Report than on the 1980 BEIR Report solely because the former had a later publication date. Tr. 2420. He commented that he would not equate a report prepared for budgetary purposes with a scientific document such as BEIR or UNSCEAR. Ibid. In Dr. Hamilton's opinion the greater heterogeneity of the human population does not lead to the conclusions that the super linear model is best. Tr. 2421-22. The super linear model would be better only if a substantial number of people were supersensitive to radiation; Dr. Hamilton believes that there is nothing to support the idea that there are a substantial number of supersensitive people. Tr. 2421-22. Smokers are not supersensitive because smoking only adds to the risk of cancer. Tr. 2424. The BEIR III Report also concluded that the greater genetic diversity in humans than in inbred laboratory animals would favor a linear dose effect. Tr. 2367-68.

81. Dr. Morgan argued that the Applicants refused to consider the research and conclusions of Drs. Stewart, Mancuso, Bross and Najarian. Morgan Affidavit, ff. Tr. 1545, at 14.

82. Drs. Hamilton and Branagan agreed that the BEIR III Report had thoroughly reviewed the works of Dr. Bross who attempted to identify groups with increased susceptibility to radiation, and concluded that Dr. Bross had not revealed any evidence to show that risks were greater than conventional estimates. BEIR III also reviewed the Mancuso, Stewart and Kneale data on cancer risks and the Najarian and Colton study and found that the conventional risk estimates were not affected. Tr. 2481-83; Hamilton Affidavit, ff. Tr. 2380, at 7-9.

83. Dr. Hamilton admitted that the BEIR I and III Reports have some inconsistencies in each report, but those inconsistencies do not affect the major conclusion regarding risk estimates. Tr. 2447.

84. Drs. Branagan and Hamilton both emphasized that the absolute risk model was advocated in BEIR I, BEIR III, UNSCEAR 1977, UNSCEAR 1972 and ICRP Publication 26 for low-LET radiation, the type of radiation emitted from nuclear power reactors. Tr. 2478.

Validity of Human Risk Estimations

85. In its denial of the Applicants' motion for summary disposition on this contention, the Board recognized that Dr. Morgan contested the reliability of human risk estimates used by the standard-setting bodies because (1) the population samples used in the health effects studies reviewed by the BEIR Committee for Hiroshima and Nagasaki and for ankylosing spondylitis were statistically biased and hence yielded unreliable results; and (2) a recently reported study of the atomic bomb dosimetry indicated that earlier reports relied upon by the BEIR Committees underestimated the gamma radiation to which the populations at Hiroshima and Nagasaki were subjected.

86. Dr. Morgan testified that the BEIR Report which Applicants and Staff used in their risk estimates relies primarily on the atomic bomb data. Morgan Affidavit, ff. Tr. 1545, at 5; Tr. 1552-53. The studies of the survivors of Hiroshima and Nagasaki had errors in dosimetry and thus health effects were underestimated, due to the high doses involved, the inadequate length of the study, and the failure of the BEIR Committee to correct for the effects of trauma and fire blasts. Id. at 3-8; Tr. 1556-57.

87. Dr. Hamilton also testified that risk estimators are based almost entirely on human data which were thoroughly reviewed by UNSCEAR and BEIR committees, and that the most useful data for deriving quantitative dose estimates are the Hiroshima and Nagasaki data. Tr. 2326. Dr. Hamilton noted that Dr. Baum had tried to manipulate the Hiroshima-Nagasaki data to challenge the linear dose response curve for risk estimates, however, the BEIR I Report reviewed the data and maintained its support for the linear dose response curve. Tr. 2365-67.

88. Dr. Morgan argued that the Japanese survivors were a select population because they died of common diseases before they could contract cancer. Dr. Morgan viewed a May 22, 1981 article in Science (Attachment 3 to Branagan Rebuttal Testimony, ff. Tr. 2407) as evidence that the doses at Hiroshima and Nagasaki were seriously overestimated. In Dr. Morgan's opinion, an overestimate of dose would yield fewer cancers per person-rem. Hence, the linear model for dose response and the risk estimators that were derived from the atomic bomb data underestimate the health effects. Morgan Affidavit, ff. Tr. 1545, at 3-8.

89. Drs. Hamilton and Branagan disagreed with the assertion that the Japanese data were unreliable and stated that the data were in general agreement with other human studies. Tr. 2343, 2396. Dr. Branagan also pointed out that the BEIR committee, contrary to Dr. Morgan's claim, had considered the effects of fire blast and trauma. Tr. 2396-97; Branagan Rebuttal Testimony, ff. Tr. 2407, at 6. Both witnesses also rejected the May Science article as evidence that risk

estimates should be changed. Both referred to a June 19, 1981 article in Science (id. at Attachment 4) that rebuts the conclusion drawn in the May article by indicating that the majority of the scientists in attendance at the conference reported in the June article felt the change in risk estimates would be slight. Id. at 7-9; Tr. 2340-42. Both witnesses also noted that some of the principal authors of the studies reevaluating the atomic bomb data had written letters to the editor of Science to complain that the May article was misleading. Drs. Hamilton and Branagan did not consider the May article which appeared in the "News and Comment" section of Science to be the kind of material on which experts would rely. Ibid. Dr. Branagan also testified that the BEIR report had found Dr. Morgan's hypothesis that a high infection rate existed in Hiroshima and Nagasaki was not supportable because, to the contrary, there were no widespread epidemics in Hiroshima and Nagasaki. Tr. 2397.

90. Both Dr. Branagan and Hamilton testified that the major radiation protection organizations considered a wide body of data to derive their risk estimates. Tr. 2415, 2396-97. Dr. Hamilton rebutted Dr. Morgan's hypothesis that most of the patients suffering from ankylosing spondylitis died of common diseases before developing cancer and noted that studies have shown that spondylitics have the same incidence of cancer as the normal population. Tr. 2356-61, 2449-57. Dr. Branagan further testified that according to the BEIR III Report, risk estimators based on exposure to high doses (e.g., the spondylitic data) may possibly overestimate the risks. Branagan Rebuttal Testimony, ff. Tr. 2407, at 7.

Risks from the Uranium Fuel Cycle

91. The Staff estimates of health effects from the uranium fuel cycle were based upon the release values in Table S-3 and an analysis of radon releases. The Staff considered the short-term effects of mining, milling and active tailings, and the potential long-term effects from unreclaimed open-pit mines and stabilized tailings. The estimated health effects as a result of radon releases of a 1000-MW light water reactor operating at 80% capability for 30 years would be 3.3 to 5.7 cancer fatalities in a span of 100 years, 5.7 to 17 in 500 years, and 36 to 60 in 1000 years. These estimated health effects from radon-222 and other nuclides released from the fuel cycle, are, however, a small fraction of those from natural background radiation. The Staff concluded that health effects from the uranium fuel cycle are insignificant in comparison to the potential health effects to the U.S. population from all background sources of radiation. Stf. Ex. 3 at 4.7.5.

92. Dr. Branagan testified that the favorable cost-benefit balance reached in the FES would not change if the radon release values adopted by the Appeal Board in the Peach Bottom proceeding were used. He noted that the radon release rate of 6600 curies per annual fuel requirement used by the Appeal Board was comparable to the 5190 release rate used in the FES. The long-term release rate of 91 curies per annual fuel requirement per year (Ci/AFR/yr) where the tailings are covered and the mines are left unsealed would not cause health effects significantly different from those resulting from the variable releases estimated in the FES (38 Ci/AFR/yr for the first 100 years, 47 Ci/AFR/yr for the next

400 years and 137 Ci/AFR/yr for periods beyond 500 years).

Tr. 3829-30.

93. Dr. Hamilton agreed with the Staff that the dose to the public from the uranium fuel cycle is small in comparison to background. Tr. 2378-79; Hamilton Affidavit, ff. Tr. 2380, at 2. He estimated that the increased individual cancer mortality risk, based upon a 900 MW electric plant operating at 80% capacity would be minute (5.13×10^{-11}). Prefiled Testimony Concerning the Health Effects of Uranium Mining and Milling, ff. Tr. 2380, at 6-7. He concluded that the incremental cancer risk from the uranium fuel cycle attributable to the Summer facility was very small, particularly in comparison to natural background. Id. at 7-9.

Principal Findings

94. Considering all the evidence, the Board finds that the Applicants and Staff have not underestimated health effects. The Board gave considerable weight to the large body of evidence supporting the risk estimators used by the Staff and Applicant contained in BEIR I Report which are in substantial agreement with those published by other highly regarded organizations such as the ICRP, NCRP and UNSCEAR. We accept Dr. Branagan's statement that these organizations represent the views of the overwhelming majority of the members of the scientific community. Branagan Rebuttal Testimony, ff. Tr. 2407, at 3.

95. Dr. Morgan's arguments that the A-bomb survivors were a selected population are met by the BEIR III Report which argues that these risk estimates have survived the test of consistency with other human data. We are not persuaded that ankylosing spondylitis data

represented a selected population and underestimate risk because other factors such as difference in dose and dose rate have not been taken into account. Since actual dose and dose rates to individuals in the vicinity of the Summer plant will be much less than in these patients, this may result in the risk estimator in the FES (which is based in part on ankylosing spondylitis) actually overestimating risk. Id. at 7.

96. The Board finds it is premature to give much weight to Dr. Morgan's opinion that a May 22, 1981 article in Science indicating that an overestimate of dose in the A-bomb studies will result in risk greater than that concluded in the BEIR III Report. These data are preliminary and await further evaluation. However, even if we accept the opinion of the minority and more conservative members of the scientific community who have commented upon these new results (e.g., Dr. Bradford) it appears that the adjusted risk estimates are consistent with those used in the FES. Id. at 9.

97. The Staff weighed the benefits of plant operation against a variety of costs and concluded that the "environmental and social costs of the plant are acceptable, and the total costs (including economic) are outweighed by the benefits of added capacity, energy produced, potential cost savings and increased reliability." Stf. Ex. 3, at 9.7.

98. Dr. Morgan did not offer substantial evidence to challenge the favorable cost benefit. Nor does his testimony change the conclusion (Stf. Ex. 3, at 9.4) that the radiation releases of normal operation will not have a measurable impact on humans. See Stf. Ex. 3, at 4.5.5; Tr. 2465. As Dr. Morgan candidly stated, a dose of one millirem--approximately the estimated maximum individual annual dose to

any organ from operation of the Summer facility--adds a risk of dying of cancer, but it is a risk that is extremely small and should be balanced against the benefits. Tr. 1644-45, 1655.

99. The Board finds that the radiological effluents during plant operation are not expected to cause a measurable impact on the human population and that the cost-benefit balance struck at the construction permit stage is in favor of plant operation. We find that the impact of the uranium fuel cycle is insignificant in comparison to health effects in the U.S. population which result from all background sources. See Stf. Ex. 3 at 9.7.

VI. UNRESOLVED GENERIC SAFETY ISSUES

The only generic safety issue that was placed in controversy was that introduced by Intervenor's Contention 3, namely, anticipated transients without scram. As discussed in Part II, above, this contention was dismissed through summary disposition. Having been advised of the Board's interest in the status of generic issues (Tr. 320-321), the Staff included a discussion of generic safety issues applicable to this proceeding in Appendix C of Supplement No. 1 to the Summer SER. Stf. Ex. 1(a), NUREG-0717, April, 1981. Therein, the Staff reviewed each of the relevant unresolved safety issues identified through early 1981 and the associated Task Action Plans that address their resolution. For each of the issues, the Staff concluded that the operation of the Summer facility need not await its ultimate resolution. Id. at C-7 thru C-19. The Board reviewed this discussion and found no areas requiring further evidentiary discussion. We concur with the Staff's conclusion and find that Staff has taken the generic safety issues into account in a plausible manner.

VII. CONCLUSIONS OF LAW

Based upon the entire evidentiary record in this proceeding, and upon the foregoing findings of fact, the Board reaches the following conclusions:

1. Subject to the conditions set forth in our Order, below, Applicants have made adequate preparations for the implementation of its emergency plan in those areas where the assistance and cooperation of state and local agencies are required.

2. Where Applicants have not yet met the conditions set forth in our Order, below, and have, therefore, failed to meet the standards of 10 C.F.R. § 50.47(b), the deficiencies in the emergency plans are not significant, within the meaning of 10 C.F.R. § 50.47(c)(1), to prevent plant operation.

3. Staff is insuring that all deficiencies noted by FEMA and NRC for the May 1, 1981 emergency exercise are being remedied.

4. Quality control has been adequate and acceptable during the construction of the Summer plant.

5. The long-term health effects from radiation releases during normal operation, and from the uranium fuel cycle, have not been sufficiently underestimated, if at all, to compromise the favorable cost-benefit balance struck at the construction permit.

VIII. ORDER

WHEREFORE, in accordance with the Atomic Energy Act of 1954, as amended, and the Rules of Practice of the Commission, and based on

the foregoing Findings of Fact and Conclusions of Law and this Board's Partial Initial Decision and Supplemental Partial Initial Decision, IT IS ORDERED THAT the Director of Nuclear Reactor Regulation is authorized, upon making such additional findings on all other matters specified in 10 C.F.R. § 50.57(a) as may be necessary, to issue a full-term operating license consistent with the terms of this Initial Decision, subject to the following conditions:

1. That seismic monitoring be continued at least until December 31, 1983, and that Staff reevaluate at that time the need for further monitoring to be made an additional licensing requirement;
2. That Applicants successfully complete during the first year of operation the confirmatory program on plant equipment and components, within the guidelines established in the Partial Initial Decision Findings, to demonstrate to Staff's satisfaction that explicit safety margins exist for each component necessary for shutdown and continued heat removal in the event of the maximum potential shallow earthquake;
3. That plume exposure EPZ is to be expanded to include the Kelly Miller, Greenbriar Headstart and Chapin Elementary schools and the emergency evacuation plans are to be adjusted accordingly within the first year of operation of the Summer facility;
4. That the defects in transportation planning discussed in Finding 24, supra, be remedied during the first year of operation of the Summer facility.

6. That plans to implement remedial and preventive measures for consumer protection against food pathway contamination are to be formulated and communicated to the agricultural community during the first year of operation of the Summer facility;

7. That the completion of installation and satisfactory testing of Applicants' siren alerting system must be accomplished prior to operation of the Summer facility above 5% of full power;

8. That the following three items related to emergency preparedness must be completed by Applicants (to the satisfaction of the Staff), consistent with NUREG-0717, Supp. 2, at A-13:

minimum shift manning requirements,
emergency response facilities, and
meteorological and dose assessment capability.

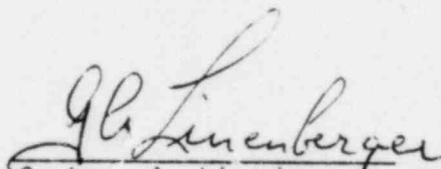
9. That final NRC approval of the state of emergency preparedness for the Summer site is to be given prior to operation of the Summer facility above 5% of full power;

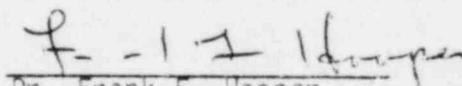
10. That the NRC Staff will satisfy itself that appropriate surveillance measures and remedial action plans are being implemented with respect to the steam generator tube failure problem prior to operation of the Summer facility at full power.

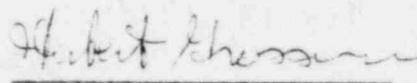
IT IS FURTHER ORDERED, in accordance with 10 C.F.R. §§ 2.760, 2.762, 2.764, 2.785, and 2.786, that this Initial Decision shall become effective and shall constitute, with respect to the matters covered herein, the final decision of the Commission 30 days after the date of issuance hereof, subject to any review pursuant to the above cited Rules of Practice. Exceptions to this decision may be filed within ten (10) days after service of this Initial Decision. A

brief in support such exceptions may be filed within thirty (30) days thereafter, forty (40) days in the case of the Staff. Within thirty (30) days after service of the brief of appellant, forty (40) days in the case of the Staff, any other party may file a brief in support of, or in opposition to, such exceptions.

THE ATOMIC SAFETY AND
LICENSING BOARD


Gustave A. Linenberger
ADMINISTRATIVE JUDGE


Dr. Frank F. Hooper
ADMINISTRATIVE JUDGE


Herbert Grossman
ADMINISTRATIVE JUDGE

Dated at Bethesda, Maryland
this 4th day of August, 1982

IX. EXHIBIT APPENDIX

Applicants' Exhibits

<u>Number</u>	<u>Identified</u>	<u>Received</u>	<u>Description</u>
1	740	743	Report - "Supplemental Seismologic Investigation" - Virgil C. Summer Nuclear Station Unit 1, Docket No. 50/395, December, 1980.
2	744	746	Letter - Nichols to Denton, dated March 4, 1981 - Revised Appendix X - Supplemental Seismologic Investigation.
3	744	746	Letter - Nichols to Denton, dated April 15, 1981 - FSAR Change - Effect of Reservoir Induced Seismicity.
4	747	751	Letter - Nichols to Denton, dated May 27, 1981 - Added Appendix XI - Supplemental Seismologic Investigation.
5	1233	1234	Final Safety Analysis Report, as amended.
6	1402	1424	Notice to Employees (Energy Reorganization Act of 1974).
7	1404	1424	Booklet - Daniel Construction Company/SCE&G - Welding Parameters and Information for Welders (VCS).
8	1405	1424	Booklet - Daniel International Employee Handbook (VCS).
9(a)	1406	1424	Example of Socket Weld, Photograph of single cross-sectional cut.
9(b)	1406	1424	Example of Socket Weld, Photograph of three pipe sections standing on end.
9(c)	1406	1424	Example of Socket Weld, Photograph of three pipe sections lying horizontally.
10(a)	1420	1424	Corrective Action Request 047.
10(b)	1420	1424	Corrective Action Request 049.
10(c)	1420	1424	Corrective Action Request 050.
11	3117	3118	Newberry County, Plan for Emergency Operations of County Government.

<u>Number</u>	<u>Identified</u>	<u>Received</u>	<u>Description</u>
12	3117	3118	Richland County - City of Columbia Emergency Plan.
13	3117	3118	Lexington County Emergency Operations Plan.
14	3117	3118	Fairfield County Emergency Operations Plan.
15(a)	3116	3116	S. C. Operational Radiological Emergency Response Plan for V. C. Summer site.
15(b)	3116	3116	State of South Carolina, Technical Radiological Emergency Response Plan.
16	2547	2551	South Carolina Electric & Gas Company Annual Report - 1980.
17	2547	2551	Letter - Nichols to Denton, dated December 31, 1981 - Financial Qualifications.
18	2554	2554	South Carolina Public Service Authority Annual Report - 1980.
19	2637	2637	Attachment to the Testimony of Oscar Wooten.
20	2872	2872	Joint Ownership Agreement, as amended.
21	2917	2921	Letter - Nichols to Denton, dated September 9, 1980 - Response to Management Review Concerns.
22	2917	2921	Letter - Nichols to Denton, dated January 9, 1981 - Technical and Management Comparison to Guidance for Staffing Nuclear Power Plants.
23	2918	2921	Letter - Nichols to Denton, dated March 4, 1981 - Response NRC NRR/I&E Management Audit.
24	2918	2921	Letter - Nichols to Denton, dated March 25, 1981 - SCE&G Corporate Plans for In-House Nuclear Development.
25	2918	2921	Letter - Nichols to Denton, dated May 13, 1981 - Interim Training Organization.

<u>Number</u>	<u>Identified</u>	<u>Received</u>	<u>Description</u>
26	2918	2921	Letter - Nichols to Nuclear Operations Personnel, dated May 15, 1981 - Executive Directive No. 3 - "Safety Awareness - Responsible Reporting."
27	2918	2921	Letter - Nichols to Denton, dated May 27, 1981 - Updated Management Organization.
28	2918	2921	Letter - Nichols to Nuclear Operations Personnel, dated May 14, 1981 - Executive Directive No. 2 - "Shift Technical Advisors - Clarification of Position and Utilization."
29	2918	2921	Letter - Nichols to Nuclear Operations Personnel, dated May 20, 1981 - Executive Directive No. 4 - "Shift Supervisor - Duties and Responsibilities."
30(a)	3106	3115	Virgil C. Summer Nuclear Station, Radiation Emergency Plan.
30(b)	3114	3122	Wilbur Smith Study.
31	3117	3118	Appendix 3 Annex B-7, S. C. Disaster Preparedness Plan.
32	3773	3783	Letter - Crews to the FERC, dated July 13, 1981.
33	3773	3783	Letter - Response from the FERC to Crews, dated July 14, 1981.
34	3774	3783	Letter - Timmerman to Crews, dated July 15, 1981.
35	3818	3818	License Application.
36	3818	3818	Environmental Report, as amended.
37	3842	3847	Letter - Dames & Moore to Whitaker, dated May 13, 1981 - Operational Dose Calculations.
38	4427	4440	Summary of Emergency Actions at the Virgil C. Summer Nuclear Station based on Dr. Kaku's accident scenario, by Mr. Beale.

<u>Number</u>	<u>Identified</u>	<u>Received</u>	<u>Description</u>
39	4506	4508	Corrected Version of Applicants' Exhibit 38.
40	4666	4666	Corrections to the Supplemental Testimony of Mr. T. C. Nichols following Tr. 3783, regarding the analysis of cost to drain the Fairfield Pump Storage facility, Monticello Reservoir and refill.
41	5170	5170	Seismometric Data Recorded at Mammoth Lakes, California.
42	5170	5170	Active Field Experiments.
43	5170	5170	Response to FSAR Question 361.23, Accelerograph Deployment Information and Records at Monticello Reservoir, South Carolina.
44	5170	5170	Seismic Question 361.24 Concerning Mammoth Lakes Sequence.
45	5637		Viewgraph Displaying a Schematic Representation of Amplification and/or Reduction Factors.
46	6061	6061	Memorandum - Hugh K. Boyd, Coordinator for Richland County, City of Columbia, Office of Civil Defense.
47	6061	6061	Memorandum - George R. Wise, Sr. of the Emergency Preparedness Division of the Office of the Adjutant General of the State of South Carolina, dated January 12, 1982.

Intervenor Exhibits

<u>Number</u>	<u>Identified</u>	<u>Received</u>	<u>Description</u>
1	1437	4008	NRC Report 79-35.
2	1437	4008	Deposition - Mr. Whisennant.
3	1437	4008	Deposition - Mr. Forte.
4	1972	4008	Brochure - SCE&G Public Information.

<u>Number</u>	<u>Identified</u>	<u>Received</u>	<u>Description</u>
5	2551	<u>4/</u>	Reserved - Cross-examination of Mr. Sherwin.
6	2577	2584	Testimony of Mr. O. S. Wooten before the South Carolina Public Service Commission.
7	3820	3820	Response of SCE&G to a Data Request.

Staff Exhibits

<u>Number</u>	<u>Identified</u>	<u>Received</u>	<u>Description</u>
1	1057	1057	Safety Evaluation Report, February, 1981.
1(a)	1057	1057	Supplement No. 1 to the Safety Evaluation Report, April, 1981.
1(b)	1057	1057	Supplement No. 2 to the Safety Evaluation Report, May, 1981.
2	1072	1072	Letter - Dr. Murphy to Mr. Jackson, February 6, 1981.
3	2385	2385	Final Environmental Statement, May, 1981.
4(a)	2525	2529	Affidavit - Phyllis Sobel.
4(b)	2525	2529	Affidavit - Richard McMullen.
4(c)	2525	2529	Affidavit - Andrew Murphy.
4(d)	3870	3870	Affidavit - Carl Newton; corrections to the ACRS and Subcommittee Transcripts.
5	3289	3289	Memorandum from John Dickey (FEMA) to Brian Grimes (NRC) regarding the Status of Emergency Preparedness at the Virgil C. Summer Nuclear Station.

4/ Discussion appears on Tr. page 4008, however, final action is deferred.

Board Exhibits

<u>Number</u>	<u>Identified</u>	<u>Received</u>	<u>Description</u>
1	2527	2528	ACRS Subcommittee Hearing Transcript of November 26-27, 1980.
2	2527	2528	ACRS Subcommittee Hearing Transcript of March 11, 1981.
3	2527	2528	Full Advisory Committee Hearing Transcript of March 11, 1981.
4	2527	2528	Consultants' Report.
5	2527	2528	Abstract prepared by a student of Dr. Talwani.
6	2528	<u>5/</u>	An Earthquake Primer by Bruce Bolt.

5/ Board Exhibits 1-4, received into evidence at the July 13, 1981 hearing session (Tr. 2528) were subsequently withdrawn from evidence at the January 16, 1982 hearing session (Tr. 5998). Board Exhibit 6, the Bolt book was identified (Tr. 2528), but never received in evidence (Tr. 5598).