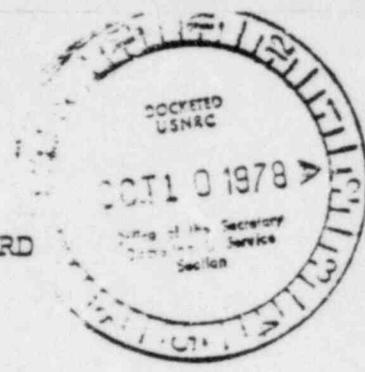


PUBLIC DOCUMENT ROOM
UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION



BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of)
)
DUKE POWER COMPANY)
)
(William B. McGuire Nuclear)
Station, Units 1 and 2))

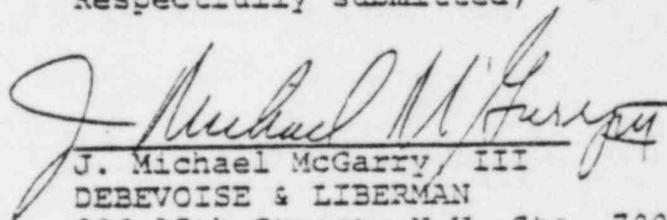
Docket Nos. 50-369
50-370

10/6/78

APPLICANT'S PROPOSED FINDINGS OF
FACT AND CONCLUSIONS OF LAW IN THE FORM
OF AN INITIAL DECISION

In accordance with 10 C.F.R. §2.754, Applicant, Duke Power Company, hereby submits Proposed Findings of Fact and Conclusions of Law in the form of an Initial Decision. These findings supersede Applicant's Proposed Findings of Fact and Conclusions of Law in the form of a Partial Initial Decision, submitted on July 19, 1977. For the convenience of the Board and Parties, Applicant would note that the instant findings differ from the July 19, 1977 findings basically only as to the inclusion of the radiological health and safety contentions and an elaboration of Table S-3.

Respectfully submitted,



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October 6, 1978

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Robert M. Lazo, Esq., Chairman
Dr. Cadet H. Hand, Jr., Member
Dr. Emmeth A. Luebke, Member

In the Matter of)
DUKE POWER COMPANY) Docket Nos. 50-369
(William B. McGuire Nuclear) 50-370
Station, Units 1 and 2))

INITIAL DECISION
(OPERATING LICENSE PROCEEDING)

I. BACKGROUND

This initial decision considers the application for facility operating licenses to the Duke Power Company (hereinafter "Applicant") to authorize the operation of the William B. McGuire Nuclear Station, Units 1 and 2 (the facility). The facility consists of two pressurized water nuclear reactors located on Applicant's site in Mecklenburg County, North Carolina. The reactors are designed to operate at core power levels up to 3411 thermal megawatts, with a net electrical output of 1180 megawatts per unit. The facility is on the shore of Lake Norman, about 1,000 yards east of the Catawba River and approximately 17 miles northwest of Charlotte, North Carolina.

On September 18, 1970, the Applicant filed an application with the Atomic Energy Commission, now the Nuclear Regulatory Commission, 1/ (hereinafter "Commission" or "NRC"), for permits to construct and operate the McGuire Station, Units 1 and 2. Construction Permits Nos. CPPR-83 and CPPR-84 were issued on February 28, 1973, following reviews by the Commission's Regulatory Staff (hereinafter "Staff") and the Advisory Committee on Reactor Safeguards, as well as public hearings before an Atomic Safety and Licensing Board in Charlotte, North Carolina, on July 27, 30, September 6-8, September 12-15, October 10-11 and October 24, and November 1-4, 1972.

On June 14, 1974, the Commission published in the Federal Register (39 Fed. Reg. 20833) a notice of the receipt of an application by the Applicant, for facility operating licenses for the McGuire facility. In response to that notice, the Carolina Environmental Study Group (hereinafter "CESG" or "Intervenor") filed a "Petition For Leave To Intervene And Request For Public Hearing" on July 15, 1974. On October 1, 1974, the instant Atomic Safety and Licensing Board (hereinafter "Board") issued an Order granting CESG leave to intervene. On June 3, 1975, the Applicant, CESG and NRC Staff entered into a stipulation relating to the the admission of contentions to be resolved at the operating license hearing.

1/ Pursuant to the Energy Reorganization Act of 1974, 42 U.S.C. §5801 et seq., the Nuclear Regulatory Commission succeeded to the licensing and regulatory functions of the Atomic Energy Commission.

We note that the Applicant did not agree that there was merit to any of the contentions, and that the Applicant entered into stipulation solely for the purpose of expediting the proceeding. The stipulation was forwarded to the Board, which approved it on December 31, 1975.

Following reviews by the Staff and the Advisory Committee on Reactor Safeguards, public hearings were conducted in this matter on March 28-31 and April 1, 19-22, 1977, to consider the Stipulated Contentions (Nos. 1, 2, and 6) relating to environmental issues, viz. need for power, cost-benefit analysis of alternative modes of generation, and solar power, and on August 22-24, 30-31, 1978 to consider the Stipulated Contentions (Nos. 3 & 5) relating to radiological health and safety issues, viz. seismic design and financial qualifications.^{1/} The parties presenting evidence at the hearings were Applicant, the Staff and the Intervenor.

The Board is guided in this operating license proceeding by Appendix A, Section VIII of 10 CFR Part 2, which in subsection (b) provides that the Board will make findings of matters in controversy among the parties. So postured, the Board focuses its attention on the contested issues of this case.^{2/}

^{1/} The Board, by its Order of April 21, 1976 ruled that Intervenor's failure to advise whether it would pursue Stipulated Contention 4, "resulted in the withdrawal" of such contention.

^{2/} Additional matters, set forth in Part III infra were also considered at the evidentiary hearings.

II. CONTESTED ISSUES

Stipulated contention 1(a) reads:

"Operation of the McGuire Plant is not required in order to meet demands for power which can reasonably be anticipated for the remainder of this decade. The Applicant's forecasts alleging the necessity for the McGuire Plant are deficient in that, among other things, they do not significantly consider the following operative factors in the Applicant's service area: (a) the historical trend which shows significantly greater decline in peak demand growth rate since Circa 1968 and especially within the past two years, than the Applicant recognizes."

Intervenor alleges that Applicant's forecast of need for power is deficient in that it fails to adequately consider what Intervenor views to be a greater decline in the peak demand growth rate than is recognized. Applicant's testimony shows that the temperature corrected annual peak demands for 1968 to 1976 have increased at an annual rate of in excess of 7.0% with the exception of the years 1974 and 1975.^{1/} (Testimony of D. H. Sterrett at 6, following Transcript (hereinafter "Tr.") 997, wherein the following table appears:

<u>YEAR</u>	<u>Annual Peak - MW</u>		<u>Increase Over Previous Year</u>	
	<u>AS RECORDED</u>	<u>CORRECTED</u>	<u>MW</u>	<u>PERCENT</u>
1968	5364.2	5432	597	12.3
1969	6031.5	5921	489	9.0
1970	6398.5	6423	502	8.5
1971	6723.1	6916	493	7.7
1972	7449.5	7580	664	9.6
1973	8235.6	8352	772	10.2
1974	8057.6	8291	(61)	(0.7)
1975	8600.6	8528	237	2.9
1976	9487.2	9122	594	7.0

^{1/}Intervenor's Exhibit 34 (See Tr. 1979) reveals that the 1977 peak, which occurred on February 7, 1978, was 9690 MW as recorded and 9557 MW corrected for temperature. As can be seen, this is an increase of 435 MW and a 4.8 percent increase over the previous year.

Both the Applicant and the Staff are in agreement that the dampening of electrical power demand during 1974 and 1975 was primarily the result of the Arab oil embargo of 1973 and the downturn which was experienced by the U. S. economy in 1974 as exemplified by the 1.7% decrease in gross national product in real dollars during the year (Testimony of D. H. Sterrett at 2, 6-7, following Tr. 997; Testimony of G. Thomas Sav at 2, 16, following Tr. 1117). Indeed, Intervenor's witness concedes that slow growth in demand may represent "plateauing" rather than a long-term trend (Tr. 1442). Likewise, 1975 was also a slow economic year from a growth standpoint (Testimony of G. Thomas Sav at 2-3, following Tr. 1117; Staff Exhibit 1, Final Environmental Statement (hereinafter "FES") at §9.1; and Applicant's Testimony of D. H. Sterrett at 6, following Tr. 997). Intervenor does not dispute the fact that the economy was in a recession during the period in question (Tr. 1442).

Applicant's testimony reflects the following forecasts of peak load:^{1/}

^{1/}For a discussion of the general methodology utilized by Applicant in forecasting peak load, see the Licensing Board's decision in Applicant's Catawba Nuclear Station, 7 AEC 659, 673-674 (1974). See also Tr. 1052. It should be noted that rather than attempting to find a simple arithmetical pattern in its historical demands, Applicant's forecast reflects a continuous process of revision to reflect changes in trends based on specific facts (Testimony of D. H. Sterrett, at 5, following Tr. 997). For instance, as early as 1949, Applicant recognized a decay factor in its load growth, and has adjusted that factor over the years based on its engineering judgement (Tr. 1065-1066).

<u>Peak Period</u>	<u>Forecast Peak Load</u>	<u>Unit Additions</u>	<u>Date of Commercial Operation</u>	<u>System Capability</u>	<u>Percent Reserve</u>
1977 Summer	9,523			12,456	30.8
Winter	9,510			12,456	31.0
1978 Summer	10,163			12,456	22.6
Winter	10,235	McGuire 1	1-1-79	12,456	21.7
1979 Summer	10,820			13,636	26.0
Winter	11,053	McGuire 2	1-1-80	13,636	23.4
1980 Summer	11,645			14,795	27.0
Winter	11,884			14,795	24.5
1981 Summer	12,337	Catawba 1	7-1-81	14,795	19.9
Winter	12,685			15,948	25.7
1982 Summer	13,059			15,948	22.1
Winter	13,506	Catawba 2	1-1-83	15,879	17.6
1983 Summer	13,810			17,032	23.3
Winter	14,352	Cherokee 1	1-1-84	16,804	17.1
1984 Summer	14,589			18,084	24.0
Winter	15,220	Perkins 1	1-1-85	17,823	17.1
1985 Summer	15,400			19,103	24.0
Winter	16,112			19,010	18.0
1986 Summer	16,243	Cherokee 2	7-1-86	19,010	17.0
Winter	17,019			20,290	19.2
1987 Summer	17,122	Perkins 2	7-1-87	20,290	18.5
Winter	17,943			21,570	20.2
1988 Summer	18,037			21,570	19.6
Winter	18,883	Cherokee 3	1-1-89	21,570	14.2
1989 Summer	18,974			22,850	20.4
Winter	19,825	Perkins 3	1-1-90	22,850	15.3
1990 Summer	19,943			24,130	21.0

(Testimony of D. H. Sterrett, Attachment 1, following Tr. 997.)^{1/}

^{1/}The Board is aware of Applicant's most recent peak load forecast of January 9, 1978. See Applicant's January 9, 1978 letter to the Board and parties. The Board notes that this forecast does not reflect a significant departure from the evidence already in the record.

The Staff's analysis of need for the McGuire facility confirms that there is a high likelihood that the facility will be needed by the 1979-1981 timeframe^{1/} (Testimony of G. Thomas Sav, at 16, following Tr. 1117). The Staff's forecast of peak load and reserve margin analysis is set forth as follows:^{2/}

1/ We note that the Applicant issued a press release on July 19, 1977, in which it announced that the commercial operation dates for McGuire Units 1 and 2 have slipped six months (to mid-1979) and one year (to early 1981) respectively. The January 9, 1978 forecast and accompanying press release does not change these dates. These new operation dates fall within the 1979-81 timeframe for operation of the McGuire Units which was analyzed by the Staff and Applicant in their need for power analyses. Accordingly, these analyses remain valid for McGuire. In this regard, see the Appeal Board's language in Niagara Mohawk Power Corp. (Nine Mile Point Nuclear Station, Unit 2), ALAB-264, 1 NRC 347, 365-66 (1975) to the effect that:

"[W]e do not consider the difference in predicted year of need - 1979 vs. 1981 - a statistically meaningful distinction. If there was one thing agreed upon in the proceeding below, it is that inherent in any forecast of future electric power demands is a substantial margin of uncertainty."

See also Duke Power Co. (Catawba Nuclear Station, Units 1 and 2), ALAB-355, 4 NRC 397, 407, 410-11 (1976); Public Service Co. of Indiana, Inc. (Marble Hill Nuclear Generating Station, Units 1 and 2), ALAB-459, 7 NRC 179, 185 (February 16, 1978) and Kansas Gas & Electric Company, et al. (Wolf Creek Generating Station, Unit No. 1) ALAB-462, 7 NRC 320, 326-333 (March 9, 1978).

2/ An explanation of the Staff's methodology of its forecasts and analyses of need for power are set forth in the testimony of G. Thomas Sav, at 10-16, following Tr. 1117.

	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>
Forecast Peak Load, MWe ^{1/}					
at 7.5%	9,733	10,463	11,247	12,091	12,998
at 6.5%	9,552	10,173	10,835	11,539	12,289
at 5.5%	9,374	9,889	10,433	11,007	11,612
Reserve Margin with McGuire, %					
at 7.5%	28.0	19.0	21.2	22.4	13.8
at 6.5%	30.4	22.4	25.9	28.2	20.4
at 5.5%	32.9	26.0	30.7	34.4	27.4
Reserve Margin Without McGuire, %					
at 7.5%	28.0	19.0	10.7	2.8	-4.3
at 6.5%	30.4	22.4	15.0	7.8	1.2
at 5.5%	32.9	26.0	19.4	13.0	7.1

(Testimony of G. Thomas Sav, Table 6 following Tr. 1117.)

In addition, the testimony reflects that the North Carolina Utilities Commission (hereinafter "NCUC") developed its own independent projections of peak load (Tr. 1391-92; See Testimony of G. Thomas Sav, at 9 and 16, following Tr. 1117). These projections reflect a peak demand of 16,756 MW in 1986 and 21,629 MW in 1990 (See pp. II-5 and II-6 of the NCUC Report of 1977 referenced at Tr. 1394). We note that the NCUC projections were the product of a thorough study of need for power within the State of North Carolina which was

^{1/} As can be seen, Applicant's 1977 temperature corrected peak load of 9557 MW (See fn. 1 at 4, supra) compares most favorably with Staff 6.5% growth rate scenario.

directed by State law (Tr. 1420).^{1/} This state evaluation was the subject of extensive public hearings in which Intervenor was an active participant (Tr. 1391, 1395-96).

In October 1975, Intervenor predicted a peak for 1986 of 8,580 MW (Intervenor's Exhibit 3, Fig. I; Testimony of Jesse L. Riley, at 13, following Tr. 1265). Using the IONCOE methodology, Intervenor now projects a peak of 11,500 MW by 1986 (Intervenor's Exhibit 3, Fig. I, pp. 13-14).

To calculate a peak forecast for a given year, Intervenor multiplied maximum demand per residential customer by the product of the number of residential customers and a value representing the ratio of discretionary income in the forecast year to discretionary income in the preceding year (referred to as DIR) (Intervenor's Exhibit 3 at p. 6). Intervenor terms this operation the IONCOE method.^{2/} The IONCOE calculations were criticized for calculating peak demand per residential customer by dividing the total peak demand on Applicant's system, including industrial and commercial loads (which account for about 60% of Duke's retail sales) by the number of

^{1/} The Board is cognizant of the Appeal Board's recent review of these NCUC projections. See Carolina Power & Light Company (Shearon Harris Nuclear Power Plant, Units 1, 2, 3 & 4) ALAB-390 NRC (Slip Op., August 23, 1978). Therein at slip op. 12, the Appeal Board stated that "the NCUC total demand forecast is entitled to be given great weight".

^{2/} IONCOE is an acronym for the Integral of the Ordinate of the Normal Curve of Error (Testimony of Jesse L. Riley, Exhibit 3 at 3). Selected historical load data has been fitted by Intervenor to a Gaussian Distribution Curve (normal curve of error) and trends projected along that curve. Hence, the name.

residential meters only (Tr. 1397, 1417-1419). Applicant testified that the peak per residential meter is not a meaningful figure since it fails to take into account consumption by wholesale customers or apartment dwellers (Tr. 1614-1615). For instance, Applicant's acquisition of the facilities of the University of North Carolina at Chapel Hill in 1977 and of the Greenwood County Electric System in 1966, adding roughly 35,000 residential meters to Applicant's system, would reduce Intervenor's forecast (Tr. 1615-16). Intervenor's calculation of discretionary income was also attacked for excluding housing as an essential cost (Tr. 1428-29). Intervenor concedes that housing is an essential cost (Tr. 1428-1429). IONCOE has not been previously exposed except to the North Carolina Utilities Commission, which did not adopt it (Tr. 1396).

The Board finds that the IONCOE method is not valid since the method includes only one component (residential meters) of Applicant's load. Industrial demands for electricity could vary with any number of factors other than discretionary income of individuals, i.e., with demands for industrial products by consumers outside Applicant's service area or an increase in industrial output of goods and services because of North Carolina's efforts to attract new industry (Tr. 1092; Testimony of G. Thomas Sav, Table 5, following Tr. 1117). Further, Intervenor's DIR projections are estimates for the nation and not North Carolina (Tr. 1444), and residential loads may reflect, in addition to the amount of discretionary income,

the consumer's decision to spend more or less of it on electricity, such as his choice whether to purchase space conditioning or new appliances.

In short, the IONCOE forecast is based on a "fit" with actual data over an arbitrary period of time and not a showing that the forecast takes all relevant facts into account (Tr. 1577). As discussed with respect to contention 1(d) infra, there is no basis to assume that demands per customer are approaching saturation. In addition to the above, an examination of the projected growth rates of peak load demand reflects that Intervenor's forecast is unrealistic.

Two relevant studies, which project the electrical power demand over the next ten years, indicate that on the basis of the growth rate of peak demand there will be a need for the power to be generated by the McGuire Nuclear Station. These studies are the previously referenced North Carolina Utilities Commission report and one conducted by the Federal Energy Administration (Testimony of G. Thomas Sav, at 4-5, 9, following Tr. 1117).

The Federal Energy Administration (hereinafter "FEA") based its national forecast upon three scenarios; a reference case, a conservation scenario, and electrification scenario. In each instance, the growth in peak load demand through 1985 is expected to be at least 3.9% per annum with

possible growth of up to 6.9% per annum, depending upon the growth scenario being analyzed (Testimony of G. Thomas Sav, at 5, following Tr. 1117). Moreover, the FEA projects that in the Southern Atlantic states (the area served by the Applicant), electrical power demand will grow at a faster rate than the national average by approximately 5.2 to 10.2% (Testimony of G. Thomas Sav, at 5, following Tr. 1117).

The North Carolina Utilities Commission's forecast of electrical power requirements for the Applicant's service area through 1986 shows an average annual total sales growth of 6.94% with an annual average peak load growth in the same period of 6.90% (Testimony of G. Thomas Sav, at 8, following Tr. 1117). In addition, the NCUC projected that the peak load growth rate will increase 6.59% per annum during the period 1986-1990 (Tr. 1391-92). We note that during the extensive public hearings held in that matter, Intervenor's witness testified and presented his methodology which reflected a 2-3% growth rate through 1986 (Tr. 1610-11).

Applicant's forecast for peak load growth from 1977 to 1981 corresponds to the above-referenced studies. Specifically, it shows an average compound growth of 6.69% in peak power demand taking into account a decaying growth rate (Tr. 1065-66).^{1/} In addition, this projection considered the effect of load management programs being implemented by the Applicant (Testimony of D. E. Sterrett, at 3, following Tr. 997).

^{1/} The Board is aware of Applicant's most recent peak load forecasts. See fn. 1 at 6, supra.

The Staff is in agreement with the Applicant's forecast and the previously cited studies in that it projected the peak load growth during this period through 1987 to be approximately a 6.5% annual growth rate, ranging from a low of 5.5% to a high of 7.5% (Testimony of G. Thomas Sav, at 12, following Tr. 1117).

Intervenor's forecasts of peak load demand project a rate of increase which is much smaller than those contained in the aforementioned forecasts. Utilizing its IONCOE methodology and based on a DIR range of .99 to 1.02, Intervenor projects essentially zero growth in per-customer consumption after 1980, attempting to support this conclusion by painting a bleak economic future for Applicant's service area (Intervenor's Exhibit 3, at 6, fig. III).

Based upon the historical pattern of growth in electrical power consumption in the Applicant's service area, Applicant and Staff projections, and other forecasts by the FEA and the NCUC, the Board finds that it is reasonable to forecast that the peak power electrical consumption will increase in the area served by the Applicant so as to warrant the operation of McGuire. The Board does not find support for, and rejects, Intervenor's contention that peak demands in 1974 and 1975 indicate that the overall historical trend of growing electrical demand in Applicant's service area has been reversed. In sum, the Board believes it would be folly to plan Applicant's generation capacity based on essentially

a no growth peak demand per customer scenario, a scenario based upon the extent to which a random mathematical curve may fit actual historical data which is distorted by the effect of the OPEC embargo and of recession. Rather, the Board finds that Applicant and Staff projections of peak load to be reasonable.

Stipulated contention 1(b) reads:

"Operation of the McGuire Plant is not required in order to meet demands for power which can reasonably be anticipated for the remainder of this decade. The Applicant's forecasts, alleging the necessity for the McGuire Plant are deficient in that, among other things, they do not significantly consider the following operative factors in the Applicant service area: (b) the significant effect recent sharp increases in the cost of electricity have had, and will continue to have on dampening demands."

Intervenor alleges that increased cost of electricity will result in a significant reduction in the demand for electricity (Testimony of Jesse L. Riley, at 2, following Tr. 1265). However, Applicant testified that contrary to the allegation, the significant impact on recent demand and energy sales appears to have come from the severe reduction in industrial output caused by the recession following the oil embargo (Testimony of D. H. Sterrett, at 7, following Tr. 997). In support of this position, the Applicant provided a tabulation of the annual percentage increase in total regular sales of electric energy from 1970 through 1976 on its system as follows:

<u>1971/1970</u>	<u>1972/1971</u>	<u>1973/1972</u>	<u>1974/1973</u>	<u>1975/1974</u>	<u>1976/1975</u>
8.6	3.2	3.8	-2.3	0.4	7.5

(Testimony of D. H. Sterrett at 7, following 997). Applicant also demonstrated that during the high cost recession period residential sales increased rather than decreased (Tr. 1069).

With respect to the possible effect of price elasticity on sales, Applicant stated that a quantitative value for the amount of price elasticity is not presently available for its system. (Testimony of D. H. Sterrett, at 7, following Tr. 997, Tr. 1072). Nevertheless, a proposed schedule of peak load rates had been filed with the North Carolina Utilities Commission, for application on an experimental basis from which the amount of price elasticity which may exist can be determined, and such peak reduction effects have been considered in the forecast (Testimony of D. H. Sterrett, at 8, following Tr. 997). However, it will be several years before any definitive value for elasticity can be determined (Testimony of D. H. Sterrett, at 7, following Tr. 997). In response to inquiries on the acceptability of the testimony of Intervenor's witness regarding price elasticity, Applicant stated that such testimony was of little value in that it was based on a period of declining rates (Tr. 1072).

The Staff stated that each of the demand forecasts it relied upon, as well as its independent need for power analysis, incorporated the probable effect that increased prices will have on the demand for electricity (Testimony of G. Thomas Sav, at 17, following Tr. 1117). Specifically, the forecasts by the FEA and the North Carolina Utilities Commission, as well as Oak Ridge National Laboratories, explicitly considered electricity prices in their consideration

of demand (Testimony of G. Thomas Sav, at 17, following Tr. 1117). The Staff was of the view that Applicant's forecast likewise considered the effect of increased prices on demand for electricity due to the historical nature of the data being analyzed (Testimony of G. Thomas Sav, at 17, following Tr. 1117). In sum, the Staff maintained that whether or not demand for electricity is price elastic to some extent, this elasticity is not significant in terms of negating the need for the plant (Testimony of G. Thomas Sav, at 17, following Tr. 1117).

In support of this contention Intervenor relied upon its modified IONCOE approach and its consideration of pricing impacts (See generally Intervenor's Exhibit 3). The lack of merit of this approach is discussed in Section 1(a), supra. In summary, the principal defect in Intervenor's approach is that it attempts to show that an IONCOE curve is a fair projection of future demands for electricity on Applicant's system although it is based on an arbitrary and limited data base. Intervenor projects an s-shaped curve which will reach its apex by 1980 based on demands occurring in a period of recession to show an imminent no-growth situation in demand per residential customer only (Intervenor's Exhibit 3, fig. III).

Intervenor additionally premises this contention upon a growth in the sales base rate of less than 4% which, it argued, will necessitate further electric rate increases with the resultant incentive to decrease demand (Intervenor's Exhibit 25, at 2). The lack of merit of this low projection of sales is likewise discussed in Section 1(a), supra.

The Board finds, as stated previously, that the significant causes for the downturn in growth of electrical power demand in 1974 and 1975 were the Arab oil embargo and economic conditions existing during the subsequent recession. The Board rejects Intervenor's contention that increases in the price of electricity were a significant factor in those downturns, or that such price increases will significantly dampen future demand. Whatever impact increases in the price of electricity have on electrical demand in Applicant's service area has been considered in the studies by the FEA, Oak Ridge National Laboratories and the North Carolina Utilities Commission, as well as the Staff's independent analysis. Applicant's projections are consistent with these studies and analyses. In sum, the Board finds that the impact the price of electricity may have on demand in the context of Applicant's future projections of need has been adequately considered.

Stipulated contention 1(c) reads:

"Operation of the McGuire Plant is not required in order to meet demand for power which can reasonably be anticipated for the remainder of the decade. The Applicant's forecast alleging the necessity for the McGuire Plant are deficient in that, among other things, they do not significantly consider the following operative factors in the Applicant service area: (c) the significant effect Government and private energy conservation programs instituted since the so-called 'energy crises' had and will continue to have on dampening demand."

Intervenor alleges that Applicant's forecast of future electrical demand is deficient in that it fails to account for the governmental and private energy conservation programs.

Specifically, Intervenor contends that electrical demand in the Applicant's service area in the 1980's will decline due to increasing conservation efforts by the Federal Energy Administration, industry, and residential customers (Testimony of Jesse L. Riley, at 6-7, following Tr. 1265).

The Applicant, in its forecast of electrical power requirements, has included a consideration of energy conservation measures, which reflect governmental and private conservation efforts, as well as the impact of the load management program which it has instituted to shift certain types of loads from peak periods of the days to off-peak periods (Testimony of D. H. Sterrett, at 8, following Tr. 997). This program includes the promotion of better residential and commercial building insulation, the promotion of reduced commercial lighting, the shifting of loads from on-peak to off-peak hours, limited application of rate design to on-peak use, and the study of the introduction of interruptible rates for direct load control (Testimony of G. Thomas Sav, at 22, following Tr. 1117).

The Staff testified that the FEA study discussed herein, supra, which predicted a national electrical power demand growth of 4.9% to 6.4% per annum through 1985, included a "conservation scenario". This scenario reflected what FEA described as an "aggressive" conservation policy, and included, in addition to load management program for utilities, consideration of national thermal efficiency standards for new

residential and commercial buildings, appliance efficiency improvements, tax incentives for insulation retrofit of commercial and residential buildings, elimination of gas pilot lights, increased dispersed solar energy and solid waste energy combustion (Testimony of G. Thomas Sav, at 19-20, following Tr. 1117). The FEA study concluded that although conservation efforts would tend to reduce electrical consumption, overall demand would continue to increase due to the national program designed to substitute electricity for imported oil and natural gas. That program is expected to increase electrical energy demand by 5.4% to 6.4% per annum (Testimony of G. Thomas Sav, at 22, following Tr. 1117). In addition, the NCUC study discussed herein, supra, which predicted a total sales growth of 6.94% and peak load growth of 6.59% in the Applicant's service area, included a consideration of energy conservation factors (Testimony of G. Thomas Sav, at 19, following Tr. 1117).

Based on the foregoing, the Board finds that the Applicant's forecast adequately considered the impact of governmental and private energy conservation programs.

Stipulated contention 1(d) reads:

"Operation of the McGuire Plant is not required in order to meet demands for power which can reasonably be anticipated for the remainder of this decade. The Applicant's forecast alleging the necessity for the McGuire Plant are deficient in that, among other things, they did not significantly consider the following operative factors in the Applicant's service area: (d) the increasing saturation, especially within the past two years, in per capita demand."

Intervenor testified that the level of saturation of electrical appliances and space-heating in homes in the Applicant's service area has reached high levels, and that increases in the demand for electricity in that area would be more a reflection of growth in population than an increase in per customer demand (Testimony of Jesse L. Riley, at 7-9, following Tr. 1265).

The Staff testified that although this saturation factor was considered as an element of the finding made in relation to Contention 1(a), a specific consideration of the instant contention indicates that no such saturation is expected within the near future, i.e. within 40 years (Testimony of G. Thomas Sav, at 23-25, following Tr. 1117, Tr. 1189).

A North Carolina Utilities Commission study relating to electrical appliance saturation level indicates that certain appliances such as refrigerators, televisions, water heaters and electric ranges will reach high levels of saturation by 1980. The study also indicates, however, that other appliances such as electrical space heating, air conditioning units, dishwashers, and freezers, and the like will have very low saturation levels in the Applicant's service area and will remain at relatively low saturation levels through 1995 (Testimony of G. Thomas Sav, at 24, following Tr. 1117). Indeed, both the Staff and the Applicant predict that the shift to electrical space heating as a

result of the unavailability of alternative fuel sources for space heating and new homes such as oil and natural gas will result in an increasing level of energy consumption due to the low levels of saturation of electric space heating (Testimony of G. Thomas Sav, at 24, following Tr. 1117; Testimony of D. H. Sterrett, 8-9, following Tr. 997). Moreover, the Staff included in its forecasts the impacts related to the introduction of appliances which are more efficient from an energy consumption standpoint (e.g., microwave oven) (Tr. 1196).

The Staff testified that the NCUC and FEA studies cited herein, supra, forecast that the demand for electricity will increase by 5.5% to 7.5% per annum through 1980. At the same time, the projected population increase in the Applicant's service area (1.15% in North Carolina and 0.7% in South Carolina) will be increasing at a much lower rate than electrical demand. These forecasts therefore reflect continued growth in per capita electricity demand (Testimony of G. Thomas Sav, at 23, following Tr. 1117).

The Staff forecasted that electrical peak demand will not become saturated in the Applicant's service area until at least 30 to 40 years, at a minimum (Tr. 1189). In addition, the Staff cited a Federal Power Commission publication which indicated that Intervenor's alleged saturation would not occur. (Tr. 1192).

Intervenor asserted that the demand for all-electric homes and electric appliances in general was becoming saturated. However, no supporting substantial evidence on this point was produced. (Testimony of Jesse L. Riley, at 7-9, following Tr. 1265).^{1/} Indeed, Intervenor's case in this regard consisted of references to the Tennessee Valley Authority (hereinafter "TVA") experience (Tr. 1516-1520; Testimony of Jesse L. Riley, at pp. 7-8, following Tr. 1265). However, Intervenor was unable to equate the percentage of the national average personal income in Applicant's service area with that of TVA (Tr. 1517). Furthermore, Intervenor's saturation argument with regard to TVA was based upon the IONCOE methodology (Tr. 1516), which was addressed and rejected by this Board in our discussions of Contentions 1(a) and 1(b), supra.

The Board finds that high levels of saturation which may occur for certain types of appliances, should be more than offset by the low level of saturation for other electrical products such as dishwashers, freezers, clothes dryers, and air conditioners, and by use of new electrical products. Accordingly, the Board finds that relative saturation level of electrical appliances in the Applicant's service area is a factor confirming the need for the McGuire Nuclear Station.

^{1/} At the August 24, 1978 hearing Intervenor, taking the total number of all-electric customers, alleged that the growth rate of this group was sharply declining. See Intervenor's testimony of Jesse Riley following Tr. 2238 at p. 9. The record reflects that Intervenor had inadvertently been provided an erroneous data point and that when corrected, the information reflects an increase in all-electric customers in 1977. See Tr. 2215, 2250.

Stipulated contention 1(e) reads:

"Operation of the McGuire Plant is not required in order to meet demands for power which can reasonably be anticipated for the remainder of this decade. The Applicant's forecast alleging the necessity for the McGuire Plant are deficient in that, among other things, they do not significantly consider the following operative factors in the Applicant's service area: (e) Applicant will have a reserve in capacity in excess of FPC recommendations by 1976. Peak-pricing and other rate revisions are additional means for suppressing subsequent peak demand."

Intervenor contends that the need for the McGuire facility has not manifested itself since reserves will exceed FPC recommended levels by 1976. Applicant argued that Intervenor's allegation concerning the reserve capacity surplus in 1976 is irrelevant since this aspect of the proceeding concerns only whether the McGuire facility should be operated at its expected operational dates of 1979 and 1980, and therefore does not concern reserve capacity situations in 1976^{1/} (Testimony of D. H. Sterrett, at 9, following Tr. 997).

Applicant demonstrated in the table referenced in Contention 1(a), supra, that operation of McGuire in 1979 will result in an average reserve capacity that year of 26%. Reserve capacities are anticipated to be between a low of 14.2% in the winter of 1988, and a high of 27.0% in the summer of 1980 for that period following the operational dates of the McGuire facility^{2/} (Testimony of D. H. Sterrett, Attachment 1, following Tr. 997). Applicant also testified that delay

^{1/} An explanation of Applicant's criteria for reserve capacity is set forth in the Testimony of D. H. Sterrett, at 2-3, following Tr. 997.

^{2/} See n. 1 at p. 7, supra.

of the scheduled operating dates for each of the McGuire units for one year would reduce the system reserve margins to less than the minimum reserve criteria (Testimony of D. H. Sterrett, at 3, following Tr. 997).

The Staff stated that the Applicant's projected reserve margins with McGuire on line are not unreasonable (Tr. at 1164). Indeed, the Staff took the position that a reserve margin of up to 30%, in order to allow for unforeseen contingencies, was reasonable for long-range planning purposes on Applicant's system (Testimony of G. Thomas Sav, at 12, following Tr. 1117). The Board notes that the Federal Power Commission states that reserve capacities for electric utility systems on a national scale of approximately 15% to 20% are reasonable, but has indicated that utilities which operate in the South Atlantic region should have a higher reserve margin than is applicable to the national average. We further note that the NCUC had adopted an 15% to 20% reserve margin for the summer peaking season and not less than 20% for the winter peaking season (Testimony of G. Thomas Sav, at 12, following Tr. 1117). The Board finds that the reserve capacity margin to be realized by the operation of the McGuire Units is within the bounds of reasonableness established by the Federal Power Commission guidelines.

Intervenor also alleges that inadequate consideration has been given to peak load pricing and similar rate revisions in Applicant's need for power projections. As discussed earlier, Applicant testified that it had submitted suggested

rates to the North Carolina Utilities Commission's reflecting peak load pricing systems, but that such had yet to be implemented and their impact remained a question (Testimony of D. H. Sterrett, at 9, following Tr. 997). In any event, as stated previously, the Applicant did consider peak reduction efforts in its forecast (Testimony of D. H. Sterrett, at 8, following Tr. 997).

The Staff testified that the effect of these peak load pricing systems is uncertain. Studies have shown that while there may be a reduction in peak load demand under such systems, they similarly result in an increase in base-load electrical demand. An increase in base-load demand enhances the cost-benefit effectiveness of a nuclear station since nuclear plants are the most cost-efficient base-load operating plants. Thus, the Staff concluded that implementation of the peak load policies promoted by the Intervenor would increase the need for the McGuire Station (Testimony of G. Thomas Sav, at 32, following Tr. 1117).

The Staff also testified that the FEA study discussed herein, supra, which forecasted peak load growth to be between 3.9% to 6.9% per annum, included a consideration of the effects of peakload pricing policies (Testimony of G. Thomas Sav, at 32-33, following Tr. at 1117).

The Board finds the reserve margin which will result from the operation of the McGuire Station is reasonable and that the Applicant's forecasts of future electrical demand adequately considered peak-pricing policies and other rate revision policies designed to reduce peak demand.

Stipulated contention 2(a) reads:

"The Applicant's comparison of alternative generation modes in its cost-benefit analysis is deficient or in error by reason of, among other things: (a) the use of unrealistically optimistic estimates of nuclear plant capacity factors when compared to base-load fossil plants, especially in light of Applicant's recent base-load fossil plant operating experience, and recent nation-wide nuclear operating experience."

The ER references a 76% station capacity factor (Er. §9.3.1.1). This factor was based upon Applicant's operating experience with its own nuclear station (Oconee), and upon the expectation that such capacity factor would improve given additional nuclear operating experience (Testimony of L. C. Dail, at 3-4, following Tr. 1639). The capacity factor for a station is determined by its availability, i.e., the percentage of time in which the station is not inoperable due to planned or forced outages, and the decision made by the system dispatcher concerning which units to operate (Testimony of L. C. Dail, at 2-3, following Tr. 1639). Thus, an analysis of the expected availability of a station is essential to forecasting its capacity factor.

An analysis of the availability factors of the Applicant's Oconee Nuclear Station (three units at 860 MW each) and its coal-fired Belews Creek Station (two units at 1140 MW each) shows that they are comparable, despite the fact that the Oconee Station is Applicant's first nuclear station and its availability can be expected to increase with additional operating experience. Specifically, the Applicant has operated

the Oconee units with availability factors of between 61.5% and 75.5%, excluding partial years. The corresponding capacity factors for those stations range from 52.4% to 69.3%. The Applicant's operating experience is consistent with nationwide power plant operation experience, both with fossil fuel-fired and nuclear generating units (Testimony of L. C. Dail, at 3-4, following Tr. 1639).

With respect to fuel costs, the Applicant testified that with a coal-fired station operating at a 100% capacity factor, the capacity factor of the nuclear alternative could be as low as 35% and still represent a break-even proposition (Testimony of L. C. Dail, at 5, following Tr. 1639; ER Figure 9.3.1-1). Applicant also testified that assuming a reduction in fossil-fuel costs of 25%, and a 25% increase in nuclear fuel costs, the break-even point for a nuclear station operating at the same production costs as a fossil unit with a 76% capacity factor would be 37% (Testimony of L. C. Dail, at 5, following Tr. 1639).

The Staff agrees with the Applicant's estimates that the probable performance by nuclear power plants ranges from 50% to 70% capacity factors (Testimony of Keblusek, Nash and Roberts, (hereinafter "Keblusek, et al.") at 10-11, following Tr. 752). The Staff based its cost-benefit analysis on the operation of the McGuire Station at both 53% and 65% capacity factors, both of which are conservative levels of

performance (Testimony of Keblusek, et al., at 10-11, following Tr. 752). The Staff projects that the McGuire Nuclear Station can operate at a capacity factor of 67% (Tr. 848).

The Staff testified that the annual fuel cost savings due to the operation of the McGuire Station in 1980 at a 65% capacity factor, relative to the operation of a coal-fired plant, would be approximately \$92 to \$103 million, due to the 7.7 mills/kWh saving with nuclear fuel recycle or 6.9 mills/kWh without recycle (Testimony of Keblusek, et al., at 10-11, following Tr. 752). Indeed, a comparison of both operating and maintenance expenses and fuel costs for the McGuire Station with the fuel cost only of a coal-fired plant at 20% capacity factors shows that the McGuire Station remains less costly to operate (Testimony of Keblusek, et al. at 11-12, following Tr. 752).

Intervenor asserted that based on industry-wide operating experience, the capacity factor for the McGuire Station should be forecasted at 48.6% with a forecasted capacity factor of 69.2% for a comparable fossil fuel unit (Testimony of Jesse L. Riley, at 13, following Tr. 1265).

The historical experience of the Applicant in operating the Oconee Nuclear Station reflects availability factors of between 61.5% and 73.5%, and capacity factors of between 52.4% and 69.3%. As the McGuire Station should be operable at even higher levels with the Applicant's increasing nuclear operating experience, the Board finds that the Applicant has not assumed

unrealistically high capacity factors in its cost-benefit analysis.

Stipulated contention 2(b) reads:

"The Applicant's comparison of alternative generation modes in its cost-benefit analysis is deficient or in error by reason of, among other things: (b) the use of unrealistically low nuclear fuel cost forecasts, especially in light of recent increases in percentage escalation of separate work unit cost, yellow cake costs, and future uranium costs."

Intervenor alleges that unrealistically low nuclear fuel costs have been factored into the cost-benefit analysis. The Applicant forecasted the price of nuclear fuel by (1) taking its present, firm nuclear fuel contract prices (plus escalation which is added under an index adjustment clause) and (2) substituting the projected current market prices for those years, if any, in which it does not presently have a firm contract or in which the contract calls for market prices. This forecasting method was used for U_3O_8 , conversion fabrication and spent fuel costs. The price of enrichment was forecasted by taking the present contract price and escalating it \$4 per separate work unit per annum with a step increase in 1980, which was based upon an assumption of commercial pricing beginning that year. Costs were computed on an annual basis and then levelized (Testimony of J. L. Elliott, at 1-4, following Tr. 563). An independent consultant familiar with industry practices concerning forecasting future nuclear fuel prices testified that the Applicant's method of cost pro-

jection is consistent with the generally accepted nuclear industry practices (Testimony of Seymour Jaye, at 1, following Tr. 560).

The Staff testified that it had based its forecast upon the 1975 price of each element of fuel cost (i.e., U_3O_8 , enrichment), adjusted those prices upward for both U_3O_8 costs (to reflect decreasing mine productivity) and enrichment costs (to reflect commercial cost basis expected in 1980), and then escalated these prices 5% per annum to 1980 (Testimony of Keblusek, et al., at 13-17, following Tr. 752).

Intervenor testified that the rapid escalation of uranium prices experienced since 1971, the decreasing supply of domestic uranium, and projected increase in enrichment services indicate a much higher rate of nuclear fuel cost escalation than forecasted by Applicant and Staff (Testimony of Jesse L. Riley, at 14-15, Tr. 1382).

There are no foreseeable shortages of supply of any element of the fuel supply system which would adversely affect either the Staff's or the Applicant's forecasts. It is reasonable to conclude that there will exist competitive resources of U_3O_8 throughout the useful life of the McGuire Station, and that there will be no problems related to the supply of conversion services, which involves a relatively simple chemical process. Further, it is reasonable to conclude that enrichment will continue to be provided under contract with the Energy Research and Development Administration based upon stand-

ard pricing policies. Spent fuel services are currently under review by the Government, and outstanding issues should be resolved accordingly. (Testimony of J. L. Elliott, at 2-3, following Tr. 563). Finally, fabrication services appear to present no problems.

Intervenor indicated that if nuclear fuel reprocessing were not to take place in the future, this would adversely affect nuclear fuel prices and influence whether the McGuire Station would be cost-beneficial. The Staff forecasted 1980 nuclear fuel costs to be 5.4 mills/kWh assuming no fuel recycle as compared to 4.6 mills/kWh with fuel recycle (Testimony of Keblusek, et al., at 16, following Tr. 752). The Applicant's testimony reflected a similar increase, indicated that such increase had been examined from a cost-benefit viewpoint, and showed that such increase did not affect the cost-benefit effectiveness of the plant (Tr. 1640).

Based upon our comparison of the operating cost of the McGuire Station (considering 4.6 mills/kWh with fuel recycle and 5.4 mills/kWh without fuel recycle) with a total cost of constructing and operating a comparable coal-fired station (considering 15.8 mills/kWh), the Board finds that the operation of the McGuire Station is the most cost-beneficial method of electrical power generation available^{1/} (Testimony of

^{1/}In an operating license proceeding where, as here, the costs of constructing the nuclear facility have in large measure been expended, it is appropriate in considering the relative economics of the fossil-fueled alternative generating facility to compare the costs of constructing and operating the fossil plant with the costs only of operating the nearly-completed nuclear plant. See discussion regarding Contention 2(e), infra. See also Consumers Power Company (Midland Plant, Units 1 & 2) ALAB-458, 7 NRC 155, 172 (1978).

Keblusek, et al., at 22, following Tr. 752). In view of the foregoing, the Board finds that the nuclear fuel cost projections of Staff and Applicant are not unreasonably low, and that even assuming a large increase in nuclear fuel cost accompanied by a negligible increase in coal prices, the McGuire Station is still cost-beneficial to operate (Testimony of Keblusek, et al., at 17, following Tr. 752).

Stipulated contention 2(c) reads:

"The Applicant's comparison of alternative generation modes in its cost-benefit analysis is deficient or in error by reason of, among other things: (c) the use of unrealistically high coal cost forecast, especially in light of the recent downturn in those costs."

Intervenor asserts that since coal is "abundantly available", and since coal prices have decreased recently, the Applicant's fuel cost forecast for a coal-fired station unit is unreasonably high (Testimony of Jesse L. Riley, at 15-16, following Tr. 1382).

The coal price forecasts upon which the Staff relied in calculating the benefit from operation of the McGuire Station were derived by taking an average of the actual spot and contract coal prices for delivered coal in North Carolina in 1976 and then escalating that average at 5% per annum to 1980. The Staff testified that the 5% escalation factor was designed to account for general inflationary pressures. Indeed the Staff projects up to 11% escalation of coal prices if the anticipated inflation is factored into the projection (Testimony of Keblusek, et al., at 18, following Tr. 752).

Applicant testified that although spot coal prices reached \$40.00 per ton in 1973-1974 and then dropped, coal prices are now again increasing. In addition, Applicant cited several factors which would increase the price of coal at even a greater rate: increased demand for low sulfur coals; decreasing productivity of coal mines as thinner, deeper and less productive seams are mined; expected increases in coal transportation costs; potential labor problems; and the effects of the proposed strip mining legislation (Tr. 612-17; Testimony of Keblusek, et al., at 18-19, following Tr. 752; Testimony of W. T. Robertson, at 1-4, following Tr. 559).

Even assuming arguendo that the projected coal price increases were unreasonably high, the Staff concluded that the operation of the McGuire Station is cost-beneficial even if coal prices increase at only 2% per annum with nuclear fuel prices increasing at 8% per annum (Testimony of Keblusek, et al., at 17, following Tr. 752).

Accordingly, the Board finds that the forecast of coal prices to be paid in 1980 is reasonable, realistic, and a conservative estimate.

Stipulated contention 2(d) reads:

*The Applicant's comparison of alternative generation modes in its cost-benefit analysis is deficient or in error by reason of, among other things:
(d) the lack of significant consideration of advantages of smaller units, including,

among other things, the potential for lower required reserve margins, and their higher capacity factor."

Intervenor contends that by operating smaller generating units in lieu of the McGuire Station, the Applicant could avoid maintaining an excessive reserve margin. In addition, Intervenor contends that smaller units would have lower operating costs due to their higher capacity factors and what Intervenor perceives to be diseconomies of scale which apply to stations with capacities of in excess of 1000 MW (Testimony of Jesse L. Riley, at 17-18, following Tr. 1382).

Applicant testified that the operation of several smaller units in lieu of the McGuire Station would not substantially reduce the reserve margin due to its present operation of the 2280 MW Belews Creek Station. The Belews Creek facility is the largest unit in the Applicant's system, one criterion for calculating reserve margin. Thus the existence of a station with a capacity comparable to the McGuire Station (1140 MW per unit v. 1180 MW per unit) precludes a substantial reduction of required reserve margins by not operating McGuire (Testimony of I. C. Dail, at 8, following Tr. 1639). The Board concurs.

In addressing Intervenor's assertion concerning capacity factors, the Applicant focused upon the availability of those units. Applicant testified that the availability of

the Oconee Nuclear Station and Belews Creek Station is comparable to the availability of its smaller generating units in the 265MW-575MW range (Testimony of L. C. Dail, at 8-9, following Tr. 1639).

Staff testified that a cost comparison between the McGuire Station and several smaller 300 MW coal-fired generating plants with comparable capacity shows that the McGuire Station will be less costly to operate. Specifically, using the "sunken cost" analysis discussed herein, infra, it is forecasted that the McGuire Station will generate an equivalent amount of electricity with a cost savings over the coal-fired stations of approximately 10 mills/kWh (Testimony of Reblusek, et al., at pp. 21-22, following Tr. 752).

The Board finds that the operation of several smaller units in lieu of the McGuire Station will neither result in a significantly lower required reserve margin for the Applicant nor permit operation at significantly higher capacity factors. Notwithstanding either of the above, the generation of an equivalent amount of power by the McGuire Station is significantly less expensive than at the smaller units.

Stipulated contention 2(e) reads:

"The Applicant's comparison of alternative generation modes in its cost-benefit analysis is deficient or in error by reason of, among other things: (e) the lack of significant consideration of the past and future escalation of construction costs of McGuire over estimates."

Intervenor takes issue with the amount of consideration given past and future escalation of the construction costs of McGuire. Although construction costs have escalated in the past, the Staff views them as "sunken costs",^{1/} and does not include them in the cost-benefit analyses in the operating license stage (Testimony of Keblusek, et al., at 24, following Tr. 752). The cost-benefit analysis presented in the FES does not rely upon an analysis of construction cost and only considers those costs and benefits associated with the operation of the McGuire Station. This analysis is appropriate, from an economic perspective, once a facility has been substantially constructed as is the case with the McGuire Station (Testimony of Keblusek, et al., following Tr. 752). As of April 1, 1976, the construction of the Units 1 and 2 were 69% and 52% complete respectively (FES §4.1). Of course, as construction continued from that date to the present, the units are substantially more complete than indicated in the FES. See Tr. 2584 wherein Applicant stated that McGuire was 85-90% complete as of August, 1978.

However, conservatively assuming that past escalations in construction costs were relevant to the present cost-benefit analysis, the Applicant periodically reassessed the practicability of the construction and operation of a nuclear station and determined that it was the more cost-beneficial mode of generating electrical power. Specifically,

^{1/} "Sunken costs" are those funds which have been expended constructing the facility (Testimony of Keblusek, et al., at 1-2, following Tr. 752).

the Applicant compared nuclear power with coal-fired generation, the least expensive fossil-fuel generation mode, on five occasions since 1967 (Testimony of L. C. Dail, at 9-10, following Tr. 1639). During that period, the costs of constructing the McGuire Station were escalating due to changes in regulatory requirements, delays in scheduled material and equipment deliveries, and the economy. Each reassessment confirmed that the construction and operation of this nuclear station were less expensive than for a comparable coal-fired plant (Testimony of L. C. Dail, at 10-11, following Tr. 1639).

The Board finds that Staff's "sunken cost" approach to the cost-benefit analysis is appropriate.^{1/} The Board further finds that, even assuming that construction costs were to be included in the cost-benefit analysis, the McGuire Station is still the least expensive method of generating electricity in the Applicant's service area.

Stipulated contention 2(f) reads:

"The Applicant's comparison of alternative generation modes in its cost-benefit analysis is deficient or in error by reason of, among other things: (f) the cost-benefit analysis fails to consider the long period in which rates must increase before the proportion of nuclear generation is sufficient to effect assumed reductions in electrical rates."

Intervenor alleges that the advantage of nuclear generation, as seen in rate reductions, will require a long

^{1/} See Consumers Power Company (Midland Plant, Units 1 & 2) ALAB-458, 7 NRC 155, 172 (1978).

period of time to manifest itself, and that the cost-benefit analysis fails to recognize this point. Neither Applicant nor Staff assumed in its cost-benefit analysis that the operation of the McGuire Station would result in a reduction of rates or of the unit cost of Applicant's total electrical power generation (Testimony of Keblusek, et al., at 25, following Tr. 752; Testimony of L. C. Dail, at 11, following Tr. 1639). Nor did Intervenor assert that any type of new generation could be added without increasing that cost.

However, the Staff and Applicant testified that there will be a lower production cost associated with the generation of electrical power by the McGuire Nuclear Station as opposed to the generation of an equivalent amount of additional electrical power by any alternative mode (Testimony of Keblusek, et al., at 25, following Tr. 752; Testimony of L. C. Dail, at 11, following Tr. 1639). The cost savings of generating the electrical power from the McGuire Station, as opposed to the comparable generation from a coal-fired station, would result in savings of between \$92.5 million and \$103.5 million per annum in 1980 and between \$150.1 million and \$167.5 million per annum in 1990 (Testimony of Keblusek, et al., at 8, following Tr. 752). Even assuming that the cost of nuclear fuel escalates at 3% per year, and that coal prices escalate at only 2% per annum, the initial savings from the operation of the McGuire facilities

ranges from \$65.7 million in 1980 to \$5.4 million in 1990 (Testimony of Keblusek, et al., at 9, following Tr. 752).

The Board finds that Intervenor's consideration of adding nuclear generation on the Applicant's rates is not a meaningful analysis. The Board recognizes that the Staff's and Applicant's approach of considering relative costs of nuclear v. fossil fuel (as opposed to rates) as a valid approach to considering alternative modes of generation of electrical power.

Stipulated contention 2(g) reads:

"The Applicant's comparison of alternative generation modes in its cost-benefit analysis is deficient or in error by reason of, among other things: (g) the recognized long-term tendency for prices of equivalent energy sources to equalize, thereby depriving nuclear energy generation by Duke Power Company of any long-term economic advantage."

Intervenor alleges that the long-term tendency for prices of equivalent energy sources to equalize will deprive nuclear energy generation of any long-term economic advantage. The Applicant testified that the cost-benefit analysis of long-term costs comparing the cost of generation of nuclear generation and coal-fired generation, as set out in their first cost-benefit submittal to the Commission in November, 1971, and in each successive evaluation demonstrates that the suggested equalization of the total cost of generation does not occur. Indeed, the capitalized

advantage of nuclear power, as compared with coal-fired generation, has increased from 1967 to 1977 by a great margin (Testimony of L. C. Dail, at 10-12, following Tr. 1639).

The Staff testified that even assuming that there may be a tendency for the cost of non-interchangeable energy resources to equalize, it would only apply to the total economic costs of the electric generation (Testimony of Keblusek, et al., at 26, following Tr. 752). Since only the operating costs of generation are considered at the operating license stage, this assumed equalization of total cost of generation would not alter the cost-benefit analysis for the McGuire Station. The McGuire Station's capital costs are already sunken and thus not properly considered. As the fuel costs of nuclear generation are significantly lower than those associated with coal-fired generation, the appropriate analysis at this stage--even assuming such equalization--clearly demonstrates that the McGuire Station remains a cost-beneficial mode of generation as compared with all alternatives (Testimony of Keblusek, et al., at 26, following Tr. 752).

The Board finds that the evidence demonstrates that the costs of equivalent sources of energy do not tend to equalize based on Applicant's experience. However, even assuming there were such a tendency, utilizing the Staff's sunken cost approach, which the Board has adopted, the costs of nuclear fuel are significantly lower than those associated with coal-fired generation, and McGuire is cost-effective.

Stipulated contention 2(h) reads:

"The Applicant's comparison of alternative generation modes in its cost-benefit analysis is deficient or in error by reason of, among other things: (h) reconsideration of the "no plant" alternative should be made in view of changed economic conditions since the issuance of the McGuire construction permit."

Intervenor asserts that since there is no need for the power to be generated by the McGuire Station, that a "no plant" alternative is the most reasonable alternative from a cost-benefit standpoint to the construction of the station (Testimony of Jesse L. Riley, at 20-22, following Tr. 1265).

Applicant maintains that the "no plant" alternative is not a valid one, from a cost-benefit standpoint or otherwise, since there is a demonstrated need for the facility (See discussion of need for power in Contentions 1(a) and 1(b), supra). Recognizing this need, Applicant testified that this capacity could not be acquired as purchased power because there is no excess capacity in neighboring power companies which could be procured on a reliable cost-effective basis (Tr. 1026, 1102). Specifically, the total reserve capacity of the Virginia-Carolina ("VACAR") Subregion of the Southeastern Electric Reliability Council during the summer of 1979 will be 16.5%, and then only if all scheduled units are on line (ER 9.1.1(a)). The purchase of replacement power from VACAR in lieu of operating the McGuire Station, would reduce that

reserve margin to 9.6% (ER 9.1.1(a)). This reserve margin is well below the FPC's minimum reserve margins of 15-20% and thus the source of this purchase power could not be considered reliable in the event of extreme weather or unexpected outages (ER 9.1.1(a)). The Board notes that VACAR is a part of a reliability council, and is not a power pool in which Applicant participated (Tr. 1102, 1111, 1112).

Even assuming that the capacity to be generated by the McGuire Station could be purchased from adjoining electrical generating companies on a reliable basis, the "no plant" alternative requires a comparison of the cost of generation of the McGuire Station with the cost of the purchased replacement power. Under this analysis, purchased power is not a viable alternative for two reasons. First, Applicant's system has historically been able, and continues, to install generating capacity in its own system at a lower cost than any other system in the Southeast (Testimony of L. C. Dail, at 12, following Tr. 1639). Accordingly, the purchase of power from neighboring utilities would be more expensive than the generation of power in Applicant's system. Secondly, in addition to the increased costs of purchased power, additional costs due to transmission loss and expense would increase the cost of the already more expensive purchased power (Testimony of L. C. Dail, at 12, following Tr. 1639). Accordingly, the "no plant" alternative is not a viable

cost-beneficial alternative to the operation of the McGuire Station (Testimony of L. C. Dail, at 12, following Tr. 1639).

The Board reiterates its finding of a need for the McGuire Station to meet the future power demands in the service area. This finding, together with the fact that there is no power which can be purchased from neighboring utilities on a reliable and less costly basis, renders meritless Intervenor's "no plant" alternative.

Stipulated contention 3 reads:

"Operation of the McGuire plant will threaten the health and safety of CESC members in that the plant's design is inadequate to assure protection against earthquakes of such intensity as can be expected to affect the site as indicated by the anomalous changes in land elevation and groundwater behavior in eastern North Carolina. This indicates a much greater probability of a major earthquake of much greater intensity in that area of eastern North Carolina which would result in a much greater acceleration at the McGuire site than was considered during the construction permit proceeding."

Intervenor alleges that anomalous changes in land elevation and groundwater in the Wilmington-Southport area of eastern North Carolina, wherein Carolina Power & Light Company's Brunswick Steam Electric Plant is located, will result in greater accelerations at the McGuire site than previously considered.

The only evidence Intervenor presented to support this contention was that of Dr. Carlos Bell. The Board ruled that "Professor Bell's proposed testimony is not admissible in this proceeding." (Tr. 2308)

Applicant presented the testimony of S. B. Hager (See Testimony of S. B. Hager following Tr. 2025). Such testimony was subsequently adopted by Applicant witnesses Sams and Sowers (See Tr. 1956, 1984). Applicant stated its awareness of the concern raised by Stewart, Dunn and Heron in a 1975 report to the NRC relating to alleged anomalous changes in land elevation and groundwater behavior in the eastern North Carolina area. Applicant asserted that the most severe earthquake known on the east coast of the United States occurred in Charleston, S. C. (1886). Continuing, Applicant stated that if an earthquake comparable to the Charleston event is postulated to occur in the Wilmington area of eastern North Carolina, about 175 miles from the McGuire site, the effects on the plant site can be calculated using attenuation data developed by Professor Otto W. Nuttli in "State of the Art for Assessing Earthquake Hazard in the United States, Report 1, Design Earthquakes for the Central United States". Using Nuttli's data, Applicant determined that the McGuire Nuclear Station's design rock accelerations exceed the calculated rock accelerations that would be caused by an earthquake similar in intensity to the Charleston event occurring in the assumed location. For an earthquake of intensity IX, MM occurring at the assumed location, the maximum rock accelerations at the McGuire site were calculated by Applicant to be 0.012g. Since the McGuire design accelerations exceed the calculated maximum acceleration for the postulated earthquake, Applicant maintains

that the site seismic design criteria are adequate to assure protection against such an event (Applicant's Testimony of S. B. Hager, at 3, following Tr. 2025; See also Tr. 1968-72, 1987-2031).

The Staff conducted a comprehensive geological and seismological review of the McGuire site and concluded that the earthquake design basis of 0.15g and 0.08g for the Safe Shutdown Earthquake (SSE) and the Operating Basis Earthquake (OBE) respectively were adequately conservative (Staff Testimony of R. McMullen and T. Bennett at 1-2, following Tr. 2035).

Like Applicant, Staff was familiar with reports of anomalous conditions in eastern North Carolina. The Staff reviewed all of the available data regarding the anomalies in the Southport area and concluded that these data do not support the assumption that a major earthquake can be expected in that area. The Staff went on to note that the McGuire site is approximately 200 miles from the area of the postulated anomalies, and even in the unlikely event that an earthquake occurred in the vicinity of these anomalies, the ground motion at the McGuire site would be greatly reduced due to attenuation. Simply put, Staff was of the view that a major earthquake assumed to occur 200 miles from the McGuire site would not produce acceleration levels as great as those for which the facility is designed (Staff Testimony of R. McMullen and T. Bennett at 3-4, as well as the attachment appended thereto,

following Tr. 2035; see Staff Exhibit B, Safety Evaluation Report at 2-23, admitted at Tr. 1975; See also Tr. 2037-2088).

The Board finds that Intervenor's failure to present affirmative evidence on this seismic issue renders it an uncontested matter and thus beyond the scope of the operating license proceeding. However, inasmuch as Applicant and Staff have presented evidence in this regard and such has been the subject of cross-examination, the Board has reviewed the matter and concludes that the alleged anomalous changes in eastern North Carolina do not serve as an adequate basis for postulating the occurrence of a major earthquake in that area. Further, the evidence clearly shows that even if such an earthquake were to occur in eastern North Carolina, it would not impair the integrity of the seismic design of the McGuire facility. So postured, the Board finds that the SSE and OBE values of 0.15g and 0.08g utilized in the seismic design of McGuire are adequately conservative.

Stipulated contention 5 reads:

"The Applicant is not financially qualified to operate and decommission the McGuire plant in that, among other things: Rate increases are not likely to be granted because they will be required by the Applicant's financial and business practices, which, in general, violate North Carolina state requirements to provide electricity at the lowest price possible, as exemplified by, among other things, the following violations of specific state requirements:

(a) That a utility not overbuild generating capacity. Applicant, on the contrary, has a massive expansion program unsupported by evidence that future demand will require it; and

(b) A utility is not to be overcharged by a wholly-owned subsidiary, which the Applicant has violated by purchasing overpriced coal from its coal mining operations.

The North Carolina Utilities Commission is not likely to permit the McGuire plant, and several other of Applicant's plants scheduled for completion after McGuire, into the Applicant's rate base, because to do so would violate state requirements prohibiting unneeded or prematurely constructed facilities as part of the rate base; and

In the event that the North Carolina Utilities Commission grants the Applicant rate increases and/or includes McGuire and other plants in the rate base regardless of the factors outlined above, the rates required by the Applicant will be so high (due to the financial and business practices outlined above, among other things) that demand and sales will be so severely affected that not even additional rate increases will be adequate to maintain the Applicant's solvency."

Intervenor questions whether during the 30 to 40 year life of the plant, revenues which are based on rates and sales, will be adequate for Applicant to operate and decommission the McGuire plant safely (Testimony of Jesse Riley at 1, following Tr. 2238). In support of this position, Intervenor presented the testimony of Mr. Jesse Riley. Mr. Riley stated that he had no formal training in finance, that he had no degree in accounting, finance or financial management (Tr. 2202). Further, Mr. Riley acknowledged his lack of practical experience in the financial discipline, stating that he had never participated in a utility or corporate financing, or performed an audit for a utility or other corporation (Tr. 2203-03). Finally, Mr. Riley stated that he was not a member of any financial organization (Tr. 2203).

With respect to the allegation of unfavorable rate treatment due to violation of North Carolina law, Intervenor stated that it was unaware of any court of competent jurisdiction in

North Carolina or any agency or other regulatory body that has found Applicant's financial and business practices to be in violation of North Carolina requirements as to the provision of electricity (Tr. 2251). Mr. Riley alluded to the fact that The Public Service Commission of South Carolina was investigating Applicant's practices with respect to coal purchases (Tr. 2255-56). However, Mr. Riley was unaware that The Public Service Commission of South Carolina had recently acted (Tr. 2543) and found Applicant's coal purchase practices not to be "unreasonable or detrimental to the public interest" (Tr. 2544).

The remaining aspects of Intervenor's contention deal with need for power matters, which have been previously discussed (See Contention 1, supra).

Applicant provided extensive financial information pursuant to 10 CFR §50.33(f) and Appendix C to Part 50 (See Applicant's Exhibit 3, License Application). In addition, Applicant presented the testimony of Richard C. Ranson, Treasurer of the Company with over 14 years of experience in accounting, finance and financial planning. Mr. Ranson is a licensed Certified Public Accountant as well as a member of numerous financial organizations (Applicant's testimony of Richard C. Ranson, at 1-2, following Tr. 2510).

Applicant stated that while significant funds must be raised through the sale of securities and from internal cash sources for the construction of a generating station, once

that facility becomes a part of electric rate base, further financings related to that station are virtually unnecessary. Continuing, Applicant testified that operating and maintenance costs, including depreciation and capital costs, are properly recovered through rates charged electric customers. Applicant advised that the Company will apply for such treatment of both units of the McGuire Nuclear Station in all three of its regulatory jurisdictions, which jurisdictions require that such rates allow a fair rate of return. In this regard, Applicant noted that the responsible agencies, the North Carolina Utilities Commission (NCUC), the Public Service Commission of South Carolina (PSC) and the Federal Energy Regulatory Commission (FERC), have indicated their concurrence with the Company's plans to build and operate a system of base load, nuclear generating stations. Further, Applicant pointed out that the McGuire Nuclear Station required and received a certificate of convenience and necessity from the NCUC (Applicant's testimony of Richard C. Ranson, at 3-4, following Tr. 2510).

Applicant presented information on all rate increases requested or implemented since 1973 (Applicant's Testimony of Richard C. Ranson, Attachment A, following Tr. 2510).

Applicant stated that its welfare depends upon the satisfaction of the customer; that the Company, therefore, has sought to provide reliable service at the lowest possible cost. Applicant testified that Duke's rates have historically

been among the lowest in the nation and today remain 25 percent below the rates charged by the average investor-owned utility and 15 percent below those charged on average by all electric utilities (Applicant's Testimony of Richard C. Ranson, at 5-6, following Tr. 2510; See also Tr. 2640-43).

With regard to the Company's financial strength, Applicant stated that today it is generally good, but the Company feels an even stronger financial profile is desirable. Applicant testified that the credit of the Company has improved significantly since 1974, as is evidenced by the improvements in ratings of its securities made by both Standard & Poor's Corporation and Moody's Investors Service. In June 1976, Standard & Poor's raised its rating of the Company's commercial paper from A-2 to A-1, the highest category for such securities, and in October of that year it up-graded the preferred stock to A from BBB and the preference stock to BBB from BB. In August 1977 Moody's uprated the preferred and preference stocks to A and Baa, respectively. Applicant stated that it continues to seek up-rating of its first mortgage bonds to Aa/AA from A/A. These rating improvements translate into greater flexibility, lower financing costs and, ultimately, relatively lower rates. Applicant noted that the rating agencies have expressed approval of the financial goals sought by Duke Power Company (Applicant's Testimony of Richard C. Ranson, at 6, following Tr. 2510).

Applicant explained that the reason Duke went from an excellent financial position through 1967-68 to a poor one in 1974-75 was that it, like other utilities and utilities commissions, had difficulty adjusting to a new environment in which the utilities went from a declining cost business which had prevailed for 40-50 years to one of suddenly very large cost increases (Tr. 2596-98). The witness testified that he knew of no case where an electric utility company has gone into bankruptcy and could not meet its financial obligations to operate its power plants (Tr. 2639-40).

In discussing Duke today, Applicant stated at Tr. 2598-99 that:

"I think that the company, meaning Duke as well as other utilities, had to adjust to a totally different environment in which we were working. And that this took a matter of time for adjustment.

I believe that today a number of things have changed.

Number one, I think that Duke is in a stronger financial position and has recovered significantly from where it was in 1974.

Number two, I think that Duke has built its staff, particularly in the financial area, to more adequately deal with the ravages of inflation and the need for adjusting its prices commensurate with increase in its cost.

Number three, I believe that the utilities commissions have also increased their forces so as to deal more expeditiously with applications for rate increases.

And, number four, we are today protected by fuel adjustment clauses in all three of the jurisdic-

tions in which we serve, the FERC, the North Carolina Commission and the South Carolina Commission. We have fuel adjustment clauses which are operative, and which have on several occasions, been affirmed by those commissions."

In sum, Applicant stated that it did not envision a repetition of the early 1970's insofar as the financial strength of the Company was concerned (Tr. 2599; Applicant's Testimony of Richard C. Ranson, at 6, following Tr. 2510).

Applicant explained that the Company has also improved its liquidity by increasing its available lines of credit to \$280 million. Applicant noted that the Company's policy is generally to maintain short-term debt levels below \$175 million; at least once during each of the last three years Duke Power has eliminated all of its short-term debt (Applicant's Testimony of Richard C. Ranson, at 6-7, following Tr. 2510).

Applicant also addressed the matter of the cost of decommissioning raised by Intervenor. Applicant's witness acknowledged his familiarity with the Battelle study concerning decommissioning (Tr. 2560). With regard to Applicant's position concerning the decommissioning methods set forth in that study, Mr. Ranson took the following position at Tr. 2562:

"To date Duke Power Company is estimating the decommissioning costs through depreciation, and it is implicit that decommissioning costs and whatever positive or negative salvage value that will relate to the plant, any particular plant, will be handled through the depreciation system.

From the standpoint of cash flow I would say it would be Duke's preference to put up the cash at

the time that you had a requirement for actual expenditures on decommissioning, and that in the Company's judgment this would result in the lowest cost of such funds, and, therefore, the lowest cost to the Company's customers."

(See also Tr. 2616 and Applicant's Testimony of Richard C. Ranson at 7-8, following Tr. 2510.) Applicant went on to state that it was Duke's position that it would be most appropriate for the customers enjoying a plant service to bear the cost related to that plant (Tr. 2615).

Applicant presented testimony regarding Intervenor's allegation of violation of North Carolina Law. Applicant stated that, to its knowledge, Duke had not violated state law (Tr. 2541; See also Applicant's Testimony of Richard C. Ranson, at 4-5, following Tr. 2510). Mr. Ranson went on to address the allegation of improper coal charges by a subsidiary of Duke, demonstrating that there was no basis to this allegation (Applicant's testimony of Richard C. Ranson, at 8-10, following Tr. 2510). Specifically, Applicant brought to the Board and parties' attention The Public Service of South Carolina Commission recent Order on the subject of Duke's coal purchases. As was noted above, this Order was the culmination of a proceeding which served as the basis for Intervenor's allegation of violation of state law. As also previously set forth, the Public Service Commission found that Duke's coal purchase practices from its subsidiaries were not unreasonable or detrimental to the public interest (Tr. 2543-44).

Finally, Applicant addressed the matter of the impact of decreasing sales and adverse rate treatment on the financial ability to operate McGuire. Applicant stated that if sales fall below the anticipated level, there will be lower earnings and several options would be available to Applicant. One would be to apply to the appropriate regulatory agencies for a rate increase; another option could be deferral of construction; or lastly, the company could ride things out for a period of time (Tr. 2578-79). As an example of the measures it could take, Applicant pointed out that during the recessionary period of 1974-75, Duke cut back on operating expenditures, such as closing down its training center for 18 months (Tr. 2621). Applicant stressed, however, that such cut-back decisions were made on the basis that the activities were not critical to the near-term operations of the Company. With specific reference to the training center, Applicant emphasized that no training was altered that related to any regulatory requirement regarding licensing or impaired Duke's ability to operate its plants in a safe manner (Tr. 2625-26). Applicant stated that if favorable rate relief was not received, it would reduce its construction program. Mr. Ranson stressed that Applicant would complete McGuire since it was so near completion and that it was not practical either to the Company's customers or its stockholders to cancel it (Tr. 2584-84).

The Staff presented the testimony of Louis Gittleman, a financial analyst educated in finance and accounting and possessing an extensive background in utility industry financial matters (See Staff Testimony of Louis Gittleman following Tr. 2096). In addition, the Staff submitted its financial review contained in its SER Supplement 1 (See Staff Exhibit C at 20.0).

At the outset the Staff explained at Tr. 2116 that:

"The analysis for the construction permit is entirely different than the analysis that is performed during the operating permit stage, in that during a construction permit we analyze a utility's ability to secure financing, to generate sufficient cash to finance the construction of the plant.

During the operating stage, we are concerned primarily not only with the fact that it can generate sufficient funds to pay for the operation of the plant as opposed to the cost of construction of the plant, so there is entirely a different set of criteria."

The Staff considered both Applicant's current financial status and projected cost of operating the plant including decommissioning. It then forecasted future financial events. Staff witness stated that the total dollar cost was divided into the kilowatt hours expected to be produced by the plant, yielding a cost per kilowatt hour of operating the plant. The Staff then compared this cost per kilowatt hour with present revenues per kilowatt hour, which is most conservative because it does not presume rate increases (Tr. 2110-12). Mr. Gittleman stated that consistent with the regulations (10 CFR Part 50,

Appendix C.I.B.) the Staff's analysis did not consider the period beyond five years (Tr. 2146A). Based upon the above approach, the Staff compared 1977 revenues to 1982-83 dollar amounts (Tr. 2111-12). The Staff concluded that there was reasonable assurance that Duke Power Company could obtain the funds necessary to cover the estimated costs of operating the McGuire Nuclear Station and, if necessary, permanently shutting the facility down and maintaining it in a safe condition (Staff Testimony of Louis Gittleman, at 1, following Tr. 2096).

The Staff went on to provide information concerning Duke's recent rate request experience. Mr. Gittleman found that over \$300 million in additional revenues have been granted by the regulatory authorities over the past five years. Referring to Table 11 in the SER Supplement (Staff Exhibit C, admitted at Tr. 1975), the Staff noted that total revenues have risen almost \$700 million since 1973. The Staff attributed the difference to increased customers, increased usage per customer, and the fuel adjustment clause. The Staff observed that Applicant has procedures in all three of its regulatory jurisdictions to adjust rates for fluctuations in fuel expense. These procedures are subject to 60 to 90-day lags from the date fuel expense charges are incurred until they are reflected in bills to customers. The Staff found that electric revenues for 1977 increased 14%, reflecting a 7% increase in

KWH sales and the collection of higher revenues through fuel cost adjustment procedures. Electric revenues for 1976 increased 19%, reflecting the full impact of rate increases implemented in mid-1975, an 8% increase in KWH sales, and the continuation of revenue collections under fuel cost adjustment procedures. The Staff noted that these increases in KWH sales followed three years of relatively flat sales growth due, at least in part, to an economic recession and occurred despite a steadily rising price per KWH (See Tr. 2137-39). Mr. Gittleman stated that today's conditions are a vast improvement with projected continuing improvement (Tr. 2154; Staff Testimony of Louis Gittleman, at 2-3, following Tr. 2096.)

Based upon the above, the Staff concluded that it appears much more likely than not that rate increases will be granted in future years to offset legitimately rising operating expenses. The Staff asserted that this seems especially true in view of the fact that it was unaware of any case where Duke Power Company has been found guilty of violating any state's requirements. Furthermore, since sales growth has rebounded in recent years in the face of rising rates, the Staff maintained that there seems to be little basis for contending that additional rate increases will so severely affect demand and sales that "not even additional rate increases will be adequate to maintain the Applicant's solvency." Mr. Gittleman stated that it may very well be that rising rates will encourage conservation efforts and thus slow demand growth,

but that is quite different from contending that rising rates will lead to bankruptcy (Staff Testimony of Louis Gittleman, at 3-4, following Tr. 2096).

With respect to Applicant's status in the financial community, the Staff noted that one of the largest investment counseling firms had just issued its recent recommendations and listed Duke as the number two company under the category of highest growth rate (Tr. 2153-54).

The Staff addressed the matter of the cost of decommissioning. Mr. Gittleman demonstrated his familiarity with the Battelle Study on this subject (Tr. 2112-18). He stated that an acceptable means of funding decommissioning during the lifetime of the facility is the recognition of negative salvage value and utilization of depreciation rates to provide cash flow over the life of the plant (Tr. 2120). Mr. Gittleman was cognizant of the decommissioning costs projected by the Battelle Study (Tr. 2121-22) and was of the view that Applicant would be in a position to finance such costs (Staff testimony of Louis Gittleman, at 4, following Tr. 2096; Tr. 2148-49).

In conclusion, the Staff stated that there is reasonable assurance of the Applicant obtaining the necessary funds to cover the estimated costs of the activities contemplated under the license. Accordingly, the Staff found that Duke Power is financially qualified to operate and, if necessary, shut down and safely maintain the McGuire Nuclear Station, Units 1 and 2 (Staff Testimony of Louis Gittleman, at 4, following Tr. 2096).

On the basis of the above, the Board finds that Applicant has reasonable assurance of obtaining the necessary funds to cover estimated operating costs, including the estimated costs of permanently shutting the facility down and maintaining it in a safe condition.

Stipulated contention 6 reads:

"The consideration of alternatives to nuclear power generation is inadequate in that no detailed and specific case was developed for solar power at the time of the construction permit proceeding. Subsequent events have made such consideration essential. The Atomic Energy Commission has been supplanted by the Nuclear Regulatory Commission and the Energy Research and Development Administration. The ERDA is giving active and significant support to the development of solar energy utilization which can be expected to reach fruition before the need for McGuire develops, witness the ERDA sponsored solar energy conference in Washington, D. C., week of May 26, 1975, and its explicit programs for phases of solar energy development."

Intervenor suggests that solar power is a viable alternative to the McGuire Station and that improper consideration has been given to this alternative.

The use of solar energy in Applicant's service area is constrained by the natural variability of sunshine and potential reception of that energy at various times during the year. The Applicant's witness, who is a recognized authority in the field of solar power technology and application, testified that the daily total solar energy reception in the Applicant's service area on a clear June day would be 2,800 BTU's per square foot on a horizontal surface, and only 550 BTU's per square foot on an average December day (Testimony of Hoyt C. Hottel, at 3,

following Tr. 273). Although a collector for space-heating would be tilted to favor the winter sun, there would be less than complete compensation for the above difference between summer and winter (Testimony of Hoyt C. Hottel, at 5, following Tr. 273). As the energy system in a solar house would be designed to provide space-heat and hot water in the winter (when BTU reception is the lowest) and for hot water only in the summer (when BTU reception is the greatest), the collector system would be vastly over-designed for summer use if it were to meet winter requirements (Testimony of Hoyt C. Hottel, at 6, following Tr. 273). As the capital costs associated with over-designing the system would be prohibitive given present collector cost, the optimum design for solar space heating in the Applicant's service area is to have the solar power system provide 35-75% of the space-heating energy with an auxiliary system to supplement the partial solar system to full capacity in winter (Testimony of Hoyt C. Hottel, at 6, following Tr. 273).

The Applicant's witness testified that a space-heating solar power system of better than average expected thermal performance must have an installed collector and associated equipment cost of less than \$14 per square foot before its use is cost efficient as compared with electric resistance heating. With other available methods of heat, the solar system would need to cost markedly less (Testimony of Hoyt C. Hottel, at 9-11, following Tr. 273).

Despite the intervenor's witness' testimony to the contrary, the Board finds that the cost of an installed space-heat solar system is well in excess of \$15 to \$19 per square foot. Intervenor's witness provided no substantial supporting evidence to establish that the collector price is presently in the \$15 per square foot range, and we note that the witness conceded that an experimental solar house which was recently being constructed in North Carolina was not completed due to the "economics" of the system (Tr. 447). 1/

1/ The following dialogue contained in the deposition of Intervenor's witness Thomas Ainscough (at p. 43) which was received into evidence as Intervenor's Exhibit 1, is of interest

Q. True enough. Do you see solar as basically directed to being an answer to this peak problem?

A. No.

Q. The reason that I asked the question, you mentioned hot water heating and you mentioned air conditioning which many people reference as contributing to the peaks. I asked you, do you foresee solar as a means of reducing this peak?

A. I think solar could reduce that peak. Yes, I do. That might be the opposite of what a lot of power companies think that solar could aggravate their peaks. To a certain extent they could but I think that can be worked out. I do not think that solar is the entire answer; nor do I think that nuclear is the entire answer; nor do I think any one source of energy.

I think all of them we need desperately, need all of them.

As the components of the solar energy collectors are ordinary building products such as glass, insulation, metal sheet, valves and pumps, the price of the components of the collector can not be expected to be substantially reduced in the foreseeable future. Moreover, experiments with low cost factory fabricating techniques have failed to reduce substantially the cost of constructing the collectors. As such, the Board finds that the use of solar energy for space-heating purposes in the Applicant's service area is not presently competitive with nuclear power generation, and shows no prospect of becoming so in the foreseeable future (Testimony of Hoyt C. Hottel, at 12-13, following Tr. 273).

Solar power for hot water purposes has been used in the past in Florida and can be expected to be used in the future although the extent of that use is uncertain (Testimony of Hoyt C. Hottel, at 3, following Tr. 273). The decline in the use of solar power for hot water purposes in Florida after World War II indicates this energy source will not make any significant contribution to the energy picture in the Duke Power Company service area during the useful life of the McGuire Station (Testimony of Hoyt C. Hottel, at 14, following Tr. 273).

Applicant's witness testified, and the Staff concurs, that industry uses of solar power are still in the developmental

stage and far from economically sound. The same limitations apply to absorption air conditioning. This is due to the fact these systems require a much higher temperature level than space or hot water heating and the use of flat plate collectors for that purpose is not cost effective. Therefore, the use of solar power for industrial and air conditioning purposes cannot be expected to compete with nuclear power generation as an alternative energy source within the next decade (Testimony of Hoyt C. Hottel, at 15-16, following Tr. 273; Testimony of Augustus C. Johnson, at 11, following Tr. 260).

The Applicant's witness testified that among the alternatives of land-based thermally generated electric power, only one type--the tower power plant--merits consideration as a feasible alternative (Testimony of Hoyt C. Hottel, at 16, following Tr. 273). This is due to the fact that with parabolic reflectors of 20 feet diameter spread over 3,500 acres, steam would be raised at 187,000 points for a 1,000 megawatt non-tower type solar plant located in the Southwest Sunbowl. The thermal loss and pressure drop from such a system would be excessive, and thus only the central tower system is a feasible alternative. Intervenor did not produce any substantial supporting evidence to the contrary (Testimony of Hoyt C. Hottel, at 16-17, following Tr. 273).

Applicant's witness testified that the tower power plant appears to become advantageous, when compared with conventional fuel power plants, only when the fuel cost of the conventional

system rises to more than four times the fixed charge on capital (Testimony of Hoyt C. Hottel, at 18, following Tr. 273). At present, the Applicant's fuel costs are only 2.5 times the fixed charge on capital, and it does not appear feasible that they will increase to the threshold level within the foreseeable future. Thus, the tower power plant is not a feasible alternative to the conventional system of electric power generation (Testimony of Hoyt C. Hottel, at 18, following Tr. 273). A much greater constraint is that no such plant has ever been built or tested, and thus its cost may escalate beyond that estimated in the testimony (Testimony of Hoyt C. Hottel, at 19, following Tr. 273). If such escalation occurs, any potential advantage of such a system might diminish to zero.

The Applicant's witness testified that the cost of electric power generation by photovoltaic cells is approximately \$20 per watt of peak power, based upon an efficiency of 13% to 14%. This cost equates to a cost of generation of \$250 per square foot, a cost which must be reduced over 50 times before such units can impact the national energy scene or provide a viable alternative to nuclear generation (Testimony of Hoyt C. Hottel, at 2, following Tr. 273).

Based upon the foregoing, the Board finds that solar power is not presently a viable alternative to electrical power generation at the McGuire Nuclear facility. The Board further finds that there is no significant chance of solar power becoming a viable alternative within the useful life

of that station since the costs associated with its application are not competitive with alternate modes of generation, and since there is no prospect of reducing those costs to competitive levels within the next decade (Testimony of Hoyt C. Hottel, at 1-2, following Tr. 273).

II. ADDITIONAL MATTERS

A. Health Effects

On January 25, 1977 the Appeal Board stated in its Hartsville decision^{1/} that in consideration of alternative sources of energy, focus should be placed upon environmental factors. The Appeal Board made specific reference to "an estimate of the incremental incidence of various diseases and genetic effects which would be caused by the operation of each type of plant." (See Hartsville, supra, fn. 52, at 102-104.)

In conformance with the Appeal Board's decision, both Applicant and Staff presented testimony regarding health effects associated with nuclear and coal-fired generation (Testimony of Lionel Lewis following Tr. 1713, and Testimony of R. L. Gotchy, following Tr. 1687). Applicant's testimony was directed to the health effect impact to the population within 50 miles of the plant, and showed that health effects attributable to nuclear generation were at least 360 times less than health effects associated with operation of comparable coal

^{1/} Matter of Tennessee Valley Authority (Hartsville Nuclear Plant, Units 1A, 2A, 1B and 2B) ALAB-367, 5 NRC 92, (January 25, 1977).

units. With respect to comparisons of health effects associated with the entire fuel cycles, Applicant stated that the health effects of the coal fuel cycle, including occupational effects and effects among the general public as well, are at least 30 times, and probably 100 times or more greater than of the equivalent nuclear fuel cycle (Testimony of Lionel Lewis, at 8, following Tr. 1713).

The Staff stated that the coal fuel cycle alternative may be more harmful to man by factors of 4 to 250 depending on the effect being considered, for an all nuclear economy, or factors of 3 to 22 with the assumption that all of the electricity used by the uranium fuel cycles comes from coal powered plants (Testimony of R. L. Gotchy, at 11, following Tr. 1687).

On April 11, 1978 the Commission stated that:

"[i]n proceedings pending before Licensing Boards, the Commission hereby directs the Licensing Boards to reopen the record on NEPA issues for the limited purpose of receiving new evidence on radon releases and on health effects resulting from radon releases. [43 Fed. Reg. 15616 (April 14, 1978)]"

Further discussion of health effects is found in the treatment of Table S-3, infra.

The Board finds, based on the above findings and those concerned with Table S-3, infra, that the matter of health effects associated with coal and nuclear generation alternatives has been adequately considered, and that such consideration confirms that the cost-benefit balance favors the

nuclear alternative. Indeed, based upon the information provided, the cost-benefit analysis originally performed is further enhanced by a comparison of the health effects of coal and nuclear.

B. Table S-3

On March 7, 1977, the Commission promulgated its final interim rule with regard to environmental impact values for the uranium fuel cycle (42 Fed. Reg. 13803, March 14, 1977). In accord therewith and pursuant to prior developments in this regard, the Staff presented testimony to the effect that such new figures contained in the revised Table S-3 of 10 CFR §51.20 are so insignificant so as not to tip the cost-benefit balance previously struck on the basis, in part, of original Table S-3 (Testimony of Oliver D. T. Lynch, at 7-8, following Tr. 1779).

Subsequent to the above testimony, the Commission amended Table S-3, which table served as a basis for the prior testimony of Applicant and Staff (See 43 Fed. Reg. 15613 (April 14, 1978)). Specifically, on April 11, 1978, the Commission stated that:

"the current Table S-3 value for Radon-222 is incorrect and does not include:

- ° estimates of radon released from mining operations.
- ° estimates of releases of radon from interim tailings piles after the mill has shut down and during the ensuing period while the tailings pond is evaporating and before stabilization programs are completed.

estimates of releases of radon from sta-
bilized mill tailings piles. [43 Fed.
Reg. 15614 (April 14, 1976)]

. . . .

"Since the original Table S-3 was promulgated, new estimates of releases have been devised that require upward revision of the value for radon in Table S-3. Therefore, the Commission is amending Table S-3 to eliminate the value for radon releases. This issue may henceforth be litigated in individual licensing proceedings since it is not now covered by the rule. [43 Fed. Reg. 15614-15 (April 14, 1978)]"

On July 20, 1978 this Board reopened the record on the issue of Radon-222 emissions related to the uranium fuel cycle. The Board, pursuant to the suggestion of Applicant and Staff, and with some scheduling modifications, adopted the procedures which have been adopted by the Appeal Board pertaining to the seventeen cases pending before it on the radon matter. See Philadelphia Electric Company, et al. (Peach Bottom Atomic Power Station, Units 2 & 3), ALAB-480, Slip op., 15-20 (May 31, 1978). Therein the Appeal Board ruled that Perkins was to be the lead case and that the Perkins transcripts of the May 16 & 17, 1978 hearings and the June 8, 1978 deposition were to be received in evidence in each of the seventeen cases. See Duke Power Company, (Perkins Nuclear Station, Units 1, 2 & 3), Docket Nos. STN. 50-488, -489, and -490. The Board adopted a procedure so as to provide full opportunity to the parties to supplement, contradict, or object to the record in Perkins. Intervenor requested an opportunity to supplement the Perkins record in several regards: First, that it be permitted to provide testimony regarding the ethics associated with increases in

incremental radiation (Tr. 1888, 2171); secondly, that it be permitted to present witnesses on coal mining safety (Tr. 1889); third, that Dr. Chauncey Kepford, the same individual who participated in Perkins, be permitted to comment on his statement about resource consumption inasmuch as it was allegedly not considered by the Perkins Board (Tr. 1889); and fourth, that it be permitted to cross-examine Staff's Perkins witness, Dr. Reginald Gotchy, with regard to the nuclear fuel cycle health effects versus coal health effects and the basis for Dr. Gotchy's 1,000 year cutoff for the consideration of Radon-222 emission consequences (Tr. 1890). The Board, after hearing extensive argument, denied Intervenor's request, except as to permit it to cross-examine Dr. Gotchy (Tr. 2196-97). The Board, thereafter, took official notice of the Perkins record and made it a part of this record (Tr. 2198).

An examination of the Perkins record reveals the following:

Pursuant to the Perkins Board's Order implementing the Commission's action regarding Table S-3, Perkins Intervenor^{1/}s presented the testimony of Dr. Chauncey Kepford. (Intervenor's Testimony of Chauncey Kepford following Perkins Tr.

^{1/} During the course of the deposition, Intervenor^s introduced supplemental testimony of Dr. Kepford as well as numerous exhibits. The Perkins Board Order of June 29, 1978 received into evidence the supplemental testimony and ruled on other matters.

(hereinafter Tr.P.) 2715). ^{1/} Under cross-examination on his professional qualifications, Dr. Kepford did not claim that his educational or employment background provided him with any expertise in the area in which he was prepared to testify (Tr.P. 2683-90). He stated that he had not received formal training in the areas of his testimony (Tr.P. 2678); that he was not a health physicist, nor one skilled in the medical profession (Tr.P. 2677, 2681-82); he indicated that he had no experience with operating or designing a power plant (Tr.P. 2697); he testified that he had no actual field experience with respect to the mining and milling of uranium or with coal ash piles (Tr.P. 2697-98); he acknowledged that he had not prepared an independent assessment of the amount of Radon-222 emanating from uranium mill tailing piles or coal ash piles (Tr.P. 2741-42) nor had he prepared an independent assessment of the health effects associated therewith (Tr.P. 2677). In sum, Dr. Kepford simply relied upon the expertise of others and used their calculations and data (Tr.P. 2677). When questioned as to his ability to assess the accuracy of the data relied upon, Dr. Kepford could only state that he had attempted to educate himself in this matter by reading the literature (Tr.P. 2681-82) commencing less than three years ago (Tr.P. 2706). Dr. Kepford made much of the fact

^{1/} The original transcript of the June 8, 1978 deposition neglected to incorporate Dr. Kepford's testimony. Pursuant to the Perkins Board Order of June 29, 1978, the transcript of the deposition was corrected to include, inter alia, the testimony of Dr. Kepford following Tr.P. 2715.

his analyses were free from institutional bias (Tr.P. 2682); however, he acknowledged that he had a long-standing bias against nuclear power (Tr.P. 2693, 2709-10).

With respect to the substance of his testimony, Dr. Kepford testified that, in taking data of others and performing simple mathematical calculations, he projected the alleged long-term impacts of Radon-222 from the uranium fuel cycle over billions of years^{1/} (Tr.P. 2677-80, 2739-41). Dr. Kepford also discussed the long-term health effects associated with Radon-222 from a Perkins coal generation facility. In comparing the health effects associated with each fuel cycle, Dr. Kepford concluded that the long-term deaths caused by the nuclear version of Perkins would exceed the deaths from a coal alternative (Intervenors' Testimony of Chauncey Kepford, following Tr.P. 2715).

Cross-examination focused upon that part of Dr. Kepford's testimony which reflected a Radon-222 release rate of 1000 curies/year/AFR^{2/} from abandoned open pit mines (Intervenors' testimony of Chauncey Kepford at 2, following Tr.P. 2715). Dr. Kepford admitted that at present only one half of all U.S. uranium comes from open pit mines (Tr.P. 2752). Continuing, he stated that it was possible that Applicant could get all or none of its fuel requirements from open pit mines and thus,

^{1/} Dr. Kepford's calculations equate with a three unit nuclear facility of 3840 MW.

^{2/} AFR refers to the Annual Fuel Requirement.

the value could range from 0 to 100 curies (Tr.P. 2752). Dr. Kepford was unable to state whether future mining operations will be predominated by open-pit or underground mines (Tr.P. 2754). Further, he acknowledged that the open-pit figure did not consider ameliorative measures, such as the flooding of the pits, nor did it consider back-filling and other restorative requirements (Tr.P. 2755).

Dr. Kepford's testimony made several geographic adjustments for the coal alternative. First, the testimony assumed a "one-day residence time over land, meaning that 83% of the radon released in the vicinity of Perkins blows out to sea prior to decay"^{1/} (Intervenor's testimony of Dr. Chauncey Kepford at 4, following Tr.P. 2715). When interrogated about this residence-time statement, Dr. Kepford admitted he was not familiar with Perkins wind data (Tr.P. 2757); rather, he stated that such figure was arbitrarily selected (Tr.P. 2756, 2764). When presented with the Perkins data, which reflected that the predominant winds at the Perkins site blow from the southwest and south-southwest sectors, as opposed from west to east (Tr.P. 2758-61), he acknowledged that there would be about a one-half life decay during the transport of Radon-222 from the ash pile at the Perkins site to the ocean (Tr.P. 2765). Second, the testimony assumed "that the released Radon-222 can cause health effects among 5% of the U.S. population" (Intervenors' Testimony of Chauncey Kepford at 5,

^{1/} This Board takes official notice of the fact that the McGuire Nuclear Station is located 40 miles southwest of the Perkins Nuclear Station.

following Tr.P. 2715). However, when asked to perform a comparative calculation based upon a recognized staff equation (Tr.P. 2768, 2744), Intervenor arrived at a population integrated exposure for the Perkins site three times greater than that which would be expected from a similar release at a western United States site assuming predominant wind patterns at the Perkins site (Tr.P. 2776). Dr. Kepford attempted to downplay this result by asserting that wind from the west, unlike that at the Perkins site, blows essentially 100% of the time from west to east (Tr.P. 2779-82). However, Intervenor's basis for this position reflected that winds in the western U.S. come predominately from eight directions rather a constant west-east flow (Tr.P. 2799-82).

Lastly, Dr. Kepford's testimony reflects that "before 1000 years goes by, Perkins 1, 2 and 3, as nuclear power plants, would cause more deaths from Radon-222 alone than a comparable sized coal fire plant would kill from all causes" (Intervenors' Testimony of Chauncey Kepford at 5, following Tr.P. 2715). Dr. Kepford testified that the Staff's geometric mean number of deaths attributable to the coal fuel cycle was 42 per year, or 1260 for an assumed 30-year plant life, which scaled for Perkins would be 4600 (Tr.P. 2784-85). Further, he acknowledged that the corresponding value for a Perkins nuclear facility would be 1/14th or 1/42nd of 4600 depending upon the assumptions one would make (Tr.P. 2785-86). On this basis, Dr. Kepford recognized that there would be at least

4270 more deaths from coal in the first thirty years of operation than from a similar sized nuclear facility, which, considering only the radon emanation from the uranium fuel cycle, places the cross-over period well past the 1000 years referenced in his testimony and closer to 10,000 years (Tr.P. 2785-86). In this regard, contrary to his statement, Dr. Kepford conceded his comparison of the nuclear and fossil options, as set forth in the tables accompanying his testimony, totally failed to consider the short-term effects that are associated with the coal fuel cycle (Tr.P. 2743-47). In addition, he admitted that he likewise failed to consider the long-term health effects associated with the coal fuel cycle. He stated he was not convinced that such existed (Tr.P. 2746). Yet, he admitted that toxic elements would be present in the ash pile and that such would leach out (Tr.P. 2747). As an example, Dr. Kepford made reference to cadmium, which he acknowledged would have an infinite half life (Tr.P. 2748).

As to the establishment of a proper evaluative period, Dr. Kepford acknowledged that man has advanced technologically, scientifically and physically in the past 1000 years (Tr.P. 2751). He further stated that there will be technological, scientific advancements in the next 1000 years, but he was uncertain about their permanence (Tr.P. 2751).

Applicant submitted supplemental evidence of its prior witness in this matter, Lionel Lewis, a trained and experienced health physicist (Applicant's Testimony of Lionel Lewis following Tr.P. 2266). Mr. Lewis found the Staff's numerical

estimates of health effects associated with the radon releases projected as a result of mining and milling activities (See discussion, infra) to be reasonably conservative (Applicant's Testimony of Lionel Lewis at 2, following Tr.P. 2266; see also Tr.P. 2326). Mr. Lewis calculated the increased health effects associated with the new Staff values and concluded that the comparison of the health effects between the nuclear and coal fuel cycle contained in his earlier testimony would not change significantly as a result of the increased value of radon from uranium mining and mill tailings piles (Applicant's Testimony of Lionel Lewis at 3, 6-7, following Tr.P. 2266). As a final point, Mr. Lewis indicated his agreement with the Staff position that regardless of the period of time considered, the projected emissions from mining and milling of uranium and the associated tailings will always constitute an extremely minute fraction of the sources and doses attributable to naturally emanated radon, and, hence, have a negligible effect on the health of the public at large (Applicant's Testimony of Lionel Lewis at 2, following Tr.P. 2266).

Applicant also presented the testimony of Dr. Leonard D. Hamilton, a physician with extensive experience in health effects and their assessment (See Statement of Professional Qualifications of Leonard D. Hamilton following Tr.P. 2256). Dr. Hamilton found that the Staff's projections in this regard (See discussion, infra) were reasonably conservative (Applicant's Testimony of Leonard D. Hamilton at 1, following Tr.P. 2266; see also Tr.P. 2270). In addition, Dr. Hamilton

found that the additional Radon-222 from the mining and milling of the uranium fuel cycle per RRY (i.e., an annual tissue dose to the bronchial epithelium of 2.5×10^{-4} millirem (Tr.P. 2274-78)) makes a negligible contribution to the annual natural background dose (i.e., the average annual natural background dose to the bronchial epithelium is 1650 millirem per year (Tr.P. 2276)). This negligible contribution is well within the range of naturally occurring variations (i.e., 210 to 23,250 millirem per year to the bronchial epithelium (Tr.P. 2276)), and therefore, has a negligible impact on the health effects associated therewith. (Applicant's testimony of Leonard D. Hamilton at 2-3, following Tr.P. 2266.)

Dr. Hamilton was questioned on the applicability of the linear hypothesis. He stated that he was unaware of any credible study which showed that low doses are more harmful per unit dose than high doses in man (Tr.P. 2272). He stated that the linear hypothesis was a conservative assumption in view of the repair of radiation injuries that had been observed (Tr.P. 2270). Dr. Hamilton acknowledged that it is reasonable to assume linearity with respect to high LET^{1/} doses (Tr.P. 2294, 2325), but hastened to add that repair, albeit diminished compared to low LET, had been detected even after high LET radiation (Tr.P. 2294, 2324). Dr. Hamilton concluded

^{1/} LET refers to linear energy transfer (Tr.P. 2299).

that, in his view, it was unrealistic and misleading to take the additional negligible dose one would receive from the Radon-222 associated with uranium fuel cycle and, using the linear hypothesis, apply such a tiny dose to millions of people over billions of years (Tr.P. 2289-90, 2322-24, 2332-33).

Nevertheless, in order to calculate the risk from Radon-222, Dr. Hamilton went on to state that an application of the linear hypothesis would yield an upper limit of the probability of such risk (Tr.P. 2654). Specifically, on this basis Dr. Hamilton calculated from the dose to the bronchial epithelium for each individual from Radon-222 from one year's mining and milling activity for a referenced reactor to be 2.5×10^{-4} millirem per year (Tr.P. 2274-78, 2654). Dr. Hamilton then multiplied this annual dose by 50 (i.e., the reasonable maximum number of years from birth that would allow for the subsequent development of lung cancer during one's lifetime) to calculate the dose an individual would accumulate over fifty years as 125×10^{-4} millirem and then, using current risk estimates for lung cancer induction, calculated the risk for each individual developing lung cancer during his lifetime to be 2.7×10^{-10} (Tr.P. 2654-56). He stated that the chance of the same individual developing lung cancer from natural background radiation during his lifetime would be 1.5×10^7 times greater (Tr.P. 2656). When compared to the variation natural background of 210 to 23,250 millirem per year, Dr. Hamilton

submitted that it was clearly obvious that this risk was insignificant^{1/} (Tr.P. 2277-78; See also Tr.P. 2322-23).

Dr. Hamilton expressed the view that he had more confidence in the extrapolation of health effects arising from the coal fuel cycle than with nuclear due to the mass of clinical epidemiological evidence associated with pollution from the former at levels close to current ambient concentrations in urban atmosphere and the paucity of such evidence with respect to radiation damage to low doses and low dose rates. The net result is that nuclear figures are more conservative than coal figures (Tr.P. 2319-20).

The Perkins Board also expressed an interest in the reliability of the risk estimates used by the Staff in light of the Environmental Protection Agency's (EPA) somewhat different values (Tr.P. 2411). Dr. Hamilton confirmed the acceptability of the Staff risk estimate of 22.2 lung cancers per 10^6 man-rem; he noted that such was also used by the United Nation's Scientific Committee on Effects of Atomic Radiation in its 1977 Report (Tr.P. 2653). With respect to the EPA value, Dr. Hamilton stated that it was very similar to the Staff's, within a factor of 1.4 (Tr.P. 2653).

Dr. Hamilton made reference to the constant scanning of literature by national and international bodies which acted

^{1/} During cross-examination it was determined that there could be an additional maximum 100 curies per year per AFR exposure associated with open pit mines. Dr. Hamilton stated that such value would not significantly affect his testimony (Tr.P. 2652).

to keep the radiation protection standards up to date. He stated that there was no other environmental hazard that has been kept under such close and ongoing scrutiny (Tr.P. 2297-98). He also discussed the efforts in cancer research and the near-term prospects for a cure, stating that there is not a single disease that is getting more attention than cancer in this country today (Tr.P. 2311-13).

Finally, Applicant presented the testimony of Dr. Morton I. Goldman, an experienced environmental and nuclear expert, who likewise concluded that the Staff's testimony on the radon issue was reasonably conservative (Applicant's Testimony of Morton I. Goldman at 1, following Tr.P. 2266; See also Tr.P. 2280-1). Dr. Goldman provided a comparison of the effects of uranium milling residuals with the residuals of an alternative coal plant, in particular with the radon produced by the uranium present in coal and coal ash (Applicant's Testimony of Morton I. Goldman at 2, following Tr.P. 2266). Dr. Goldman concluded that the Radon-222 emanation associated therewith is likely to be within the same range as that considered for the nuclear alternative by the Staff; i.e., between 1 and 100 Ci/yr/AFR (Applicant's Testimony of Morton I. Goldman at 5-6, following Tr.P. 2266; See also Tr.P. 2336). In addition, Dr. Goldman noted that whatever the radon release associated with coal, it is likely to occur in much closer proximity to the general public than would that released from mill tailings (Applicant's Testimony of Morton I. Goldman,

at 6, following Tr.P. 2266). Dr. Goldman stated that if one considers only the radon as a source of future health effects and accepts the Staff estimates of health effects, comparisons can be made of the total of contemporary deaths and the future cancer deaths from Radon-222 alone. Such comparisons show that only after thousands to tens of thousands of years would the "total life cycle costs" of the nuclear alternative hypothetically reach and cross those of coal. (Applicant's testimony of Morton I. Goldman at 7, following Tr.P. 2266; See also Tr.P. 2303-04). Dr. Goldman hastened to point out that this analysis considered only those residuals associated with the burning of coal; further, it was restricted to the solid uranium-containing residuals only, and did not consider the legacy of CO₂ emissions and the potential future "greenhouse" effects (Applicant's testimony of Morton I. Goldman at 2, following Tr.P. 2266). In addition, such a comparison was based on the assumption that other residuals from coal-burning would have no health effects whatsoever (Applicant's testimony of Morton I. Goldman at 2, following Tr.P. 2266). However, Dr. Goldman noted that coal contains trace materials other than uranium, many of which are toxic and/or carcinogenic. He stated that the burning of an annual coal requirement results in the release to the resultant ash pile of ton quantities of arsenic, mercury, cadmium, chromium, etc., which have an infinite "half-life" and which will leach out over many thousands of years in the future (Applicant's testimony of

Morton I. Goldman at 7-8, following Tr.P. 2266; See also Tr. P. 2640-41). Dr. Goldman went on to stress that the Radon-222 emanations from either cycle would be an insignificant increment to the natural radon emanations in the United States (Tr.P. 2306). This is particularly emphasized by further consideration of the wide range of Radon-222 (and daughter) concentrations to which the public is exposed by virtue of their choice of housing and the degree of energy conservation practiced, and the future dose implications of the mining and use of phosphate rock for fertilizer and other products (Applicant's testimony of Morton I. Goldman at 8-12, following Tr. P.2266; See also Tr.P. 2304, 2339-45, 2637-39). In sum, Dr. Goldman stated that he would agree with the Staff analyses of continuing Radon-222 emanations from mill tailings which concluded that these are minute contributions to the population dose from natural background radon, independent of the degree or nature of stabilization applied to these tailings (Applicant's Testimony of Morton I. Goldman at 12, following Tr.P. 2266; See also Tr.P. 2307).

The Perkins Board raised questions as to the exposure associated with open pit mines and whether such should be factored into the analysis. Dr. Goldman stated that a maximum of approximately 100-200 curies of Radon-222 per AFR would emanate from an open pit mine annually (Tr.P. 2640). Dr. Goldman went on to provide information regarding the reclamation of open pit mines, stating that presently three of the

five states in which significant uranium mining takes place, have reclamation requirements applicable to such mines (Tr. P. 2639).

The Staff presented the testimony of Messers. Lowenberg,^{1/} Rothfleisch, Magno, Gotchy and Wilde who combined, are intimately well versed in the uranium fuel cycle, particularly the mining and milling of uranium, and the health effects associated therewith, as well as the health effects associated with the coal fuel cycle. Mr. Rothfleisch and Mr. Lowenberg described the method by which the value of 74.5 curies per annual fuel requirement, as set forth in Table S-3 prior to the Commission's April 11, 1978 action, was derived. They explained that the value of 74.5 curies/AFR set forth in Table S-3 reflected only releases from mill tailings during active mill operation and did not include releases from either the mining of uranium or from stabilized tailings piles after the period of active mill operation. They presented detailed reasons why such was not included in Table S-3 (Tr.P. 2503; Staff Testimony of Jack E. Rothfleisch following Tr.P. 2369; See also the Staff Testimony of Homer Lowenberg, following Tr.P. 2369, under whose supervision the original value for Radon-222 was calculated).

^{1/} Mr. Lowenberg was unable to appear at the scheduled hearings held in this regard. However, his testimony was adopted by Kathleen Black (Tr.P. 2365-66).

Staff witness R. M. Wilde provided estimates of the radon released as a result of the mining of uranium as part of the uranium fuel cycle, which estimates had not been included in the now withdrawn Commission Table S-3 value of 74.5 curies. Mr. Wilde found the radon release from mining per annual fuel requirement to be 4060 curies (Staff Testimony of R. M. Wilde following Tr.P. 2369; See also Tr.P. 2540).

During cross-examination attention was directed to open-pit mines and the radon emanations associated therewith. Mr. Wilde stated that presently 50% of uranium comes from open-pit mines (Tr.P. 2373, 2543). Mr. Wilde was of the opinion that the value associated with the operation of an open-pit mine would be similar to the value associated with active underground mining (Tr.P. 2544). After abandonment, it was acknowledged that such mines could be a source of radon above background (Tr.P. 2466) but Mr. Wilde was of the opinion that the value was insignificant (Tr.P. 2466). Mr. Wilde based this statement upon the fact that the major source of radon, the uranium ore, would be removed for milling purposes (Tr.P. 2551). Reference was made to the fact that most open-pit mines are below the water table and thus will be partially filled, thereby reducing the emanation rate (Tr.P. 2556). Mr. Wilde also alluded to reclamation laws in the various states and the consequent attenuation of radon release (Tr. P. 2556). Finally, he stated that the number of open-pit mines was decreasing, due to the fact that most of the readily

accessible uranium had been mined (Tr.P. 2551-52). The Board pursued the matter and at its request, Mr. Wilde determined that an unreclaimed open-pit mine could contribute up to 100 curies/year/AFR after abandonment (Tr.P. 2610-12).

The Perkins Board also inquired as to the efforts the Staff would make to insure the stabilization of the tailings pile. Staff witness, Hubert J. Miller, informed the Board of the Staff's Branch Technical Position which requires an applicant to commit to a plan of reclamation (Tr.P. 2394; the Branch Technical Position is set forth at Tr.P. 2399-2400 and reflects that emissions cannot exceed double the natural background). The fundamental thesis of the Branch Technical Position is that the tailings be reclaimed in such a manner that no ongoing active care would be required to stabilize piles (Tr.P. 2395). Mr. Miller stated that the Branch Technical Position applied to existing and new applicants (Tr.P. 2401, 2452) and that there would be no subsequent removal of tailings without prior Staff approval (Tr.P. 2455). By way of example, Mr. Miller stated that the two most recent applicants have committed to dispose of tailings below grade (Tr.P. 2396).

In response to further Perkins Board questions in this area, the Staff presented G. Wayne Kerr, who testified that the Branch Technical Position had been committed to by all agreement states (Tr.P. 2479).

Staff witness Paul J. Magno presented estimates of the release rates of Radon-222 from uranium milling operations,

the majority of which were not included in the outdated Commission Table S-3 radon value. Such are set forth below:

Radon-222 Releases from Milling Operations

<u>Source of Release</u>	<u>Curies per AFR</u>
Milling of Ore	30
Tailings During Active Milling	750
Tailings During Inactive Period	<u>350</u>
Subtotal	1130
Tailings Following Stabilization	1 - 10 (curies per year per AFR)

(Staff Testimony of Paul J. Magno at 2, following Tr.P. 2369.)

Mr. Magno noted that the radon source from mining and milling represented essentially all of the radon that would be released in the uranium fuel cycle (Tr.P. 2386).

Mr. Magno made reference to the Branch Technical Position and stated that to reduce the radon release rate to the level specified in the Staff's performance objectives would require between 6 and 20 feet of cover material over the tailings. The Staff believes that such a stabilized pile will maintain its integrity over at least several hundreds of years and that any degradation, if it takes place, will be small and not catastrophic (Staff Testimony of Paul J. Magno at 8-9, following Tr.P. 2369). Further, in order to provide perspective, Mr. Magno estimated the release rate of Radon-222 which would occur from a tailings area if all of its

cover material were removed as a result of erosion processes over some long period of time such as a thousand years. This complete erosion of cover material (all other factors remaining the same) would result in a release rate of about 110 curies per year per AFR. This is a factor of about 10 - 100 greater than the estimates presented for the covered tailings area (Staff Testimony of Paul J. Magno at 10, following Tr.P. 2369).

Staff witness, Dr. R. L. Gotchy, estimated projected population doses attributable to Radon-222 releases associated with the uranium fuel cycle to support the operation of one RRY, ^{1/} considering the 4,100 curies/RRY from mining, the 1,100 curies/RRY from mill operations at an active pile and subsequent drying of the pile prior to stabilization, and the 1 - 110 curies/year/RRY from the stabilized pile (Staff Testimony of R. L. Gotchy at 2, following Tr.P. 2369). The results for a mining and milling operation are summarized below:

Table 2. Estimates of Radon-222 Population Doses and Dose Rates from Mining and Milling Operations

<u>Estimate of Rn-222 Releases</u>	<u>Environmental Dose Commitments (Man-rem)</u>		
	<u>Total Body</u>	<u>Lung</u>	<u>Bone</u>
74.5 Ci/RRY	1.9	42	51
Mining (4,100 Ci/RRY)	110	2,300	2,800
Most Recent Milling Estimate (110 Ci/RRY)	<u>29</u>	<u>620</u>	<u>750</u>
Current Mining & Milling <u>Subtotals:</u>	140	2,900	3,600
1 Ci/RRY	0.025	0.56	0.68

1/ RRY refers to reference reactor year

(Staff testimony of R. L. Gotchy at 3, following Tr.P. 2369.)
 From this table, the Staff's current best estimate of mining and milling doses (prior to stabilization) would be about 140 man-rem (total body), 2,900 man-lung-rem, and 3,600 man-bone-rem per RRY.

Consistent with Mr. Magno's testimony, Dr. Gotchy stated that, using the time varying release rates assumed above, the cumulative release and associated population dose commitments could be calculated from stabilized tailings piles as follows:

Table 3. Estimate of Radon-222 Population Doses from Stabilized Piles Per RRY

<u>Time(yrs)</u>	<u>Curies Released</u>	<u>Environmental Dose Commitments (Man-Rem)</u>		
		<u>Total Body</u>	<u>Lung</u>	<u>Bone</u>
1	1	0.026	0.56	0.68
10	10	0.26	5.6	6.8
50	50	1.3	28	34
100	100	2.6	56	68
500	4,090	110	2,300	2,800
1,000	53,800	1,400	30,000	37,000

(Staff Testimony of R. L. Gotchy at 5, following Tr.P. 2369.)
 Dr. Gotchy noted that the Staff probably overestimated the bone dose and lung dose in that it assumed that all the inhaled material was soluble (Tr.P. 2444); that he utilized the conservative bronchial epithelium dose parameter rather than the smeared lung dose (Tr.P. 2570-1); and that he used conservative population estimates (Tr.P. 2576). Dr. Gotchy then went on to calculate potential health effects. In this regard, noting some important factors affecting health effects estimates such as life expectancies, age distributions,

impacts of man-made and natural events and impact of technological changes, he stated that the question of estimating health effects over long periods of time into the future is subject to very large uncertainties (Tr.P. 2420, 2439, 2589; Tr. 2383, 2442). He stated that risk estimates of health effects are based on past and present demographic and environmental statistics which are likely to change within the next few centuries (Tr.P. 2420, 2439, 2589). Continuing, he stated that if one ignores these uncertainties, and assumes that the risk of health effects per curie of Radon-222 released to the atmosphere remains as it is today, it is possible to calculate potential health effects into the future. He stressed, however, that such an exercise is philosophical in nature and may have no real meaning (Staff Testimony of R. L. Gotchy at 7, following Tr.P. 2369). In performing this calculation, Dr. Gotchy estimated the potential health effects for a 100 to 1000 year period per reactor year to be:

	<u>Cancers</u>	<u>Genetic Effects</u>
Mining:	0.085	0.028
Active Milling & Drying:	0.023	0.0075
Stabilized Tailings Pile:	<u>0.0020-1.1</u>	<u>0.00067-0.36</u>
Totals:	0.11-1.2	0.36-0.40

(Staff Testimony of R. L. Gotchy at 19, following Tr.P. 2369.)

Dr. Gotchy found that regardless of the period selected, Dr. Jordan was correct when he concluded that "the number is insignificant compared to those due to radon contamination

in natural background," and that the authors of WASH-1248 were correct in their belief that "population doses from this source cannot be distinguished from background" (Staff Testimony of R. L. Gotchy at 16, following Tr.P. 2369; See also Tr. P. 2446).

Intervenor cross-examined Dr. Gotchy extensively on his assumptions (Tr. 2370-2493). The Perkins Board, as well as Intervenor in the instant proceeding, inquired as to the basis for the Staff's selection of the time frame within which Radon-222 is to be evaluated. Dr. Gotchy stated that he had bound the assessment of the radon impact within a period of 100 to 1000 years; that he could not carry the calculation out beyond 1000 years due to the fact that the uncertainty bounds are orders of magnitude (Tr. P. 2435, 2440-42; Tr. 2442). Dr. Gotchy also stated that EPA had selected a thousand years (Tr. P. 2440). Further, he indicated that there was broad Staff opinion that the proper time frame for calculating radon releases falls between 100 and 1000 years (Tr. P. 2582; Tr. 2454-55). The Staff presented John Lerohl, who testified that Dr. Gotchy was not alone in his selection of a proper time frame within which to perform a proper and realistic assessment of the impact of Radon-222; rather, his is the prevailing opinion (Tr.P. 2617). While on the stand, Dr. Lerohl responded to the Board question with respect to the status of Table S-3. Dr. Lerohl stated that the Staff began taking a look at Table S-3 in July 1977 and that its review to date did not reflect any major deficiencies (Tr.P. 2535).

Dr. Gotchy also updated the coal-nuclear comparison contained in his original testimony. The old figure for the nuclear alternative was 0.5 deaths per 0.8 gigawatt year and the new figure is 1 death per 0.8 gigawatt year (Tr.P. 2593). He stated that at 100,000 years, the deaths from the coal and nuclear alternatives would be at least comparable (Tr.P. 2593). In this regard, Dr. Gotchy stated that the uncertainties in the coal calculations were less than in the nuclear calculations (Tr.P. 2594). Further, he stated that he did not consider the long-term impacts of the coal-fuel cycle, much less the potentially irreversible damaging climatic "greenhouse effect" (Tr.P. 2594). Yet, Dr. Gotchy stated he was "sure" that there will be long-term effects from the coal fuel cycle, i.e., continuing acid mine drainage which mobilizes toxic trace elements (Tr.P. 2594) and that such were probably underestimated for the long-term (Tr. 2435, 2483).

The Perkins Board questioned Dr. Gotchy on the difference between his testimony and the position espoused by Dr. Pohl in this regard (Tr.P. 2591). Dr. Gotchy explained that Dr. Pohl used world-wide data and different assumptions (Tr. P. 2591). Dr. Gotchy noted, however, that their respective calculations were within a factor of two (Tr.P. 2591). Dr. Gotchy stated that the main difference with his testimony and Dr. Pohl's position was the latter's extrapolation to very long periods of time (Tr.P. 2592).

This Board finds that the environmental impacts of Radon-222 have been explored by the parties in both Perkins and herein. It is now left to the Board to weigh the evidence and decide the issue. In this regard, the Board is cognizant of its responsibility under the National Environmental Policy Act (NEPA). 42 USC 4231 et. seq.

"NEPA simply does not specify the quantum of information that must be in the hands of the decisionmaker before that decisionmaker may decide to proceed with a given project. Rather,

NEPA was intended to ensure that decisions about federal actions would be made only after responsible decisionmakers had fully adverted to the environmental consequences of the actions, and had decided that the public benefits flowing from the actions outweighed their environmental costs. [footnote omitted]"

State of Alaska, et al., v. Andrus, Fed. 2nd. _____
(D.C. Cir. Slip Op. February 24, 1978 at 18).

The Board finds the Staff values for Radon-222 emanations from the uranium fuel cycle to be reasonably conservative. As to the alleged environmental consequences, such range from the Perkins Intervenors' and the instant Intervenor's position of the accumulated health effects of billions of years to the Staff and Applicant's position that the annual release is insignificant when compared to natural background. The Board acknowledges that under the assumptions advanced by the Perkins Intervenors and the instant Intervenor, the health effects impacts of Radon-222 may be mathematically calculated for any number of billions of years. (The Board noted that Perkins Intervenors' and the instant Intervenor's assumptions

are based on documents which are conservative in their analyses.) The Board is of the view that such a mathematical exercise of projecting health effects attributable to an annual miniscule population dose for an infinite period of time has limited validity; that the extension of such assessments over so extreme a time frame is too remote and so speculative as to make them meaningless. The Board is aware that some element of speculation is implicit in NEPA. Scientists' Institute for Public Information, Inc. v. AEC, 481 Fed. 2nd 1079, 1092 (D.C. Cir. 1973). However, the Board cannot disregard future contingencies which may well render, and in all likelihood will render, projections struck today meaningless at some future time. In this regard, the Board makes reference to life expectancies, age distribution populations, impacts of man-made and natural events and impacts of technological changes such as prevention and cures for cancer. Simply put, this Board is of the view that NEPA does not require an assessment of highly speculative impacts billions of years into the future;^{1/} rather, the Commission's information-gathering obligations are subjected to a rule of reason. Natural Resources Defense Council, Inc. v. Morton, 458 Fed. 2nd 827, 337 (D.C. Cir. 1972).

^{1/} See State of Alaska, et al., v. Andrus, supra, at Slip Op. 16, wherein it is acknowledged that agency action can proceed, despite being faced with uncertainty; that

"Agencies need not 'wait forever to fathom the unfathomable, or arrive at definitive answers on questions far beyond the existing state of scientific or technological ability.'"

The Board is also of the view that, while a comparison with the annual natural background is extremely helpful, especially the prospective it provides with regard to the fact that the radon arising from the uranium fuel cycle is within the naturally occurring variations in such emanations, one must go beyond that time frame. So postured, the Board has assessed this matter in terms of the health effects impact to the U.S. population during the lifetime of each individual over the decay life of Radon-222 (i.e., a continuing 70-year period). In this regard, the testimony is clear that the Radon-222 impacts from the uranium fuel cycle per RRY are so infinitesimally small as to render the health effects insignificant. Specifically, the risk to the individual developing lung cancer during his lifetime from such emanation would be 2.7×10^{-10} --the risk of developing lung cancer from natural background radiation is 1.5×10^7 times greater than developing lung cancer from the Radon-222 emanation from the uranium fuel cycle.

The Board notes that based on the Perkins record and the instant record, it has been inclined to extend more weight to the presentation of Applicant and Staff than that of Intervenors.

In addition to the above, the Board finds that the health effects associated with the coal fuel cycle, insofar as radon is involved, are comparable to those of the uranium fuel cycle and thus, based upon the other benefits accruing

to the nuclear option as set forth herein, the cost-benefit analysis favors the operation of McGuire as described.^{1/}

C. Appendix I

The Final Environmental Statement (FES) for the McGuire Nuclear Station was issued in April 1976. The FES indicated that the Staff was in the process of reassessing the parameters and mathematical models with respect of Appendix I of 10 CFR Part 50 and that a detailed assessment to determine conformance with Appendix I would be completed in connection with the environmental hearing before the Board. The Staff presented testimony which detailed the results of that assessment (Testimony of J. S. Boegli et al., following Tr. 444). Specifically, the assessment was performed to determine whether the McGuire facility complied with Sections II.A, II.B, II.C and II.D of Appendix I.

Based on its detailed evaluation, the Staff concluded that the radioactive waste management systems proposed for McGuire are capable of maintaining releases of radioactive material in liquid and gaseous effluents during normal operation, including anticipated operational occurrences, such that the doses will not exceed the numerical design objectives specified in Section II.A, II.B, and II.C of Appendix I (Testimony of J. S. Boegli et al., at 6, following Tr. 444).

^{1/} The Board notes the short-term and long-term health effects associated with the coal fuel cycle.

The evaluation also showed that the Applicant's proposed design of the liquid and gaseous waste treatment systems for the McGuire facility satisfies the guides on design objectives set forth in the Annex to Appendix I (Docket RM-50-2) specified in the option provided by the Commission's September 4, 1975 amendment to Appendix I and, therefore, need not comply with the requirements of Section II.D of Appendix I (Testimony of J. S. Boegli et al., at 6, following Tr. 444).

The Staff concluded that when the McGuire facility becomes operational, the liquid and gaseous radwaste treatment systems will reduce radioactive materials in effluents to "as low as is reasonably achievable" levels in accordance with 10 CFR Part 50.34a and, therefore, are acceptable (Testimony of J. S. Boegli et al., at 7, following Tr. 444).

The Board finds, based on the Staff's evaluation, that the proposed liquid and gaseous radwaste management system for the McGuire Nuclear Station meet the criteria set forth in Appendix I, and are therefore acceptable.

III. CONCLUSION

The Board has reviewed the entire record of this proceeding, including the proposed findings of fact and conclusions of law submitted by the parties. All of the proposed findings and conclusions submitted which are not incorporated directly or inferentially in this Initial Decision are herewith rejected as being either unsupported by the weight of

credible evidence or as being unnecessary to the rendering of this Initial Decision.

In an operating license proceeding the Board is called upon to decide only the issues in controversy among the parties (10 CFR §2.760a and Appendix A to 10 CFR Part 2, §VIII). In this case, the contentions and evidence have placed in issue the general subjects of need for power, alternate modes of generation, seismic design, financial qualifications and solar power.

Although the Board's resolution of environmental matters is not materially different from that by the Staff in the Final Environmental Statement (Staff Exhibit A) the Board is mindful both of the provision in 10 CFR Part 51 (Section 51.32(b) (3), which states in effect that the FES is deemed modified by this Board's decision), and is mindful also of the Commission's own direction with respect to the proper handling of such matters as the uranium fuel cycle issue (revolving around Table S-3).

The burden of that direction is that when there is some possibility that the overall cost-benefit balance may have been affected by the Board's assessment of an impact somewhat differently from the FES, the Board should consider whether the change is so significant as to tip the overall cost-benefit balance. Accordingly, this Board has struck its own independent cost-benefit balance, taking into account its own assessment of the factors indicated above and those set

forth in the margin.^{1/} This, in turn, has required the Board to consider the margin favoring licensing action in the FES cost-benefit balance by the Staff and the adequacy of the Staff review. In that regard the Board has satisfied itself that the FES is an adequate and comprehensive assessment of the factors to be considered under NEPA. We find that the totality of the changes are not so significant as to tip the cost-benefit balance against the action otherwise indicated, i.e., issuance of operating licenses.

Accordingly, in accordance with the Atomic Energy Act and the Commission's Regulations, and on the basis of the entire record in this proceeding and the foregoing discussion and findings, the Board concludes as follows:

- (1) The Environmental review conducted by the Commission's Regulatory Staff pursuant to Section 102(2)(A), (C) and (E) of NEPA and 10 CFR Part 51 is adequate;
- (2) The requirements of Section 102(2)(A), (C) and (E) of NEPA and 10 CFR Part 51 have been compiled within this proceeding;
- (3) Having considered and decided all matters in controversy among the parties, and having in-

^{1/} The Board has also considered whether it would make any difference to the cost-benefit balance of the final assessment under 10 CFR Part 50, Appendix I, the health effects of coal vs. nuclear, and the Commission's interim rule regarding the effects of the uranium fuel cycle.

dependently considered the final balance among conflicting factors contained in the record of the proceeding with a view to determining the appropriate action to be taken, the Board has determined that full-term, full-power operating licenses for Units 1 and 2 should be issued. The Board has determined that the license conditions proposed in the Staff FES should be applicable to the operating licenses as follows: Before engaging in additional construction or operational activities which may result in a significant adverse environmental impact not evaluated or significantly greater than that evaluated in the FES, the Applicant shall provide written notification to the Office of Nuclear Reactor Regulation. The Board has also determined that environmental technical specifications should be established along the lines proposed by the Staff in item 7B(1) through (8) of the Summary and Conclusions at p. iii of the Final Environmental Statement.

With regard to the safety issues, the Board concludes that the application for operating licenses and the record of the proceeding contain sufficient information, and that the review of the application by the Staff has been adequate to support the following finding:

The Board finds that in accordance with the provisions of 10 CFR §50.91 and 10 CFR §50.57:

- (1) There is reasonable assurance that construction of the facility will be substantially completed, on a timely basis, in conformity with the construction permit and the application as amended, the provisions of the Act, and the rules and regulations of the Commission;
- (2) There is reasonable assurance that the facility will operate in conformity with the application as amended, the provisions of the Act, and the rules and regulations of the Commission;
- (3) There is reasonable assurance (i) that the activities authorized by the operating licenses can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
- (4) The Applicant is technically and financially qualified to engage in the activities to be authorized by the operating licenses in accordance with the Commission's regulations;
- (5) The applicable provisions of 10 CFR Part 140 have been satisfied; and
- (6) The issuance of the licenses will not be inimical to the common defense and security or to the health and safety of the public.

Having considered and decided all matters in controversy among the parties related to operation, the Director of Nuclear Reactor Regulations should be authorized to make such additional findings on uncontested issues as may be necessary to issuance of full-term operating licenses for McGuire Nuclear Station, Units 1 & 2, subject to the conditions referenced above.

IV. ORDER

Based upon the Board's findings and conclusions, and pursuant to the Atomic Energy Act of 1954, as amended, and the Commission's regulations, IT IS ORDERED that the Director of Nuclear Reactor Regulation is authorized to issue operating licenses to the McGuire Units 1 & 2, consistent with the Notice of Receipt of Application for Facility Operating Licenses; Notice of Availability of Applicant's Environmental Report; and Notice of Consideration of Issuance of Facility Operating Licenses and Notice of Opportunity for Hearing (39 Fed. Reg. 20833, June 14, 1974).

In accordance with Sections 2.754, 2.760, 2.762 and 2.764(a) of the Commission's Rules of Practice 10 CFR Part 2, that this Initial Decision shall be effective immediately and shall constitute the final action of the Commission forty-five (45) days after the date of issuance hereof, subject to any review pursuant to the Rules of Practice. Exceptions to this Initial Decision may be filed by any party within ten (10) days

after service of this Initial Decision. A brief in support of the exceptions shall be filed within thirty (30) days thereafter, forty (40) days in the case of the Regulatory Staff. Within thirty (30) days after service of the brief of appellant (forty [40] days in the case of the Regulatory Staff), any other party may file a brief in support of, or in opposition to, the exception.

THE ATOMIC SAFETY AND
LICENSING BOARD

Dr. Cadet H. Hand, Jr., Member
Dr. Emmeth H. Luebke, Member
Robert M. Lazo, Esq., Chairman

Dated at Bethesda, Maryland

this _____ day of _____, 1978.