U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

REGION III

Report No. 50-358/79-31

Docket No. 50-358 License No. CPPR-88

Licensee: Cincinnati Gas and Electric
Company
139 East 4th Street
Cincinnati, OH 45201

Facility Name: Wm. H. Zimmer Nuclear Power Plant

Investigation At: Sargent & Lundy, Chicago, IL
Cincinnati Gas and Electric Company Headquarters,
Cincinnati, Ohio

Investigation Conducted: October 19, 1979

Investigator: J. E. Foster 12/4/79

Reviewed By: C. E. Norelius 12/5/79
Assistant to the Director

Investigation Summary

Investigation on October 19, 1979 (Report No. 50-358/79-31)
Areas investigated: Special, announced investigation into documentation related to studies referenced in the Zimmer Nuclear Power Station Environmental Report related to construction; review of Sargent & Lundy studies, review of environmental report submittals, interviews with CG&E management personnel. This investigation involved 11 inspector-hours onsite by an NRC investigator, and additional hours of in-office review.
Results: No items of noncompliance were identified during the investigation.

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REASON FOR INVESTIGATION

During March of 1979, an anonymous individual (Individual "A") contacted Mr. C. Barth, of the Nuclear Regulatory Commission's Office of the Executive Legal Director. Mr. Barth is representing the NRC staff in the current operating License hearings for the Zimmer Nuclear Plant. During this telephone contact with Mr. Barth, Individual "A" advised that during a review of the Zimmer Environmental Report related to construction he became aware that some of the economic information regarding the Zimmer Plant's comparative economics had been misrepresented in the report. He subsequently provided Mr. Barth with a letter indicating his concerns in detail (see Exhibit II), and stated that an early Sargent & Lundy study concerning the alternatives of selecting a coal or nuclear fired unit for the Zimmer site had been misrepresented in Supplement Two and in the main body of the Environmental Report related to construction. On the basis of this information an NRC investigation into this matter was initiated.

SUMMARY OF FACTS

When received, the allegation regarding falsified information was referred to the NRC Office of Nuclear Reactor Regulation (NRR) which was questioned as to the significance of the referenced information in the NRC licensing process for the Zimmer plant. The NRR staff replied, following a review of the documentation supplied, that the economic information supplied had no significant part in the licensing for the Zimmer plant, and that they had performed their own independent review of the economics of the facility.

Individual "A", contacted Region III by telephone on several occasions. He indicated that he had seen the S&L study and compared it to information in Supplement Two to the ER. He stated that the S&L study had concluded that the economics of the coal power plant were superior to that of a nuclear power plant in all cases except when the nuclear fuel was leased. He stated that the study did not find that nuclear was the economic choice, but it was indicated that S&L believed that it would be the economic choice in the future.

Individual "A" indicated that the nuclear fuel leasing study was a hypothetical study and totally invalid. He stated that this was clearly noted in the S&L report. As such, he stated that use of figures based on the leasing study constituted misrepresentation.

Individual "A" also stated that the S&L report was stamped "Confidental" and contained the wording that "disclosure of this report would be detrimental to the interest of Cincinnati Gas & Electric."

A copy of the Sargent & Lundy (S&L) study refered to by Individual "A" "Economic Evaluation of Alternatives" (SL-2561) was obtained from S&L through Cincinnati Gas and Electric (CG&E) and reviewed by Region III

1766 043

personnel. Copies of the draft Environmental Report - Construction Stage (ER), amendments to that report and a copy of the final Environmental Report related to construction were reviewed and compared to information in the S&L study referenced by the alleger. Related S&L studies were also reviewed, and a visit was made to the CG&E offices to discuss the submitted information. In addition, the economic comparison section of the Environmental Report related to operation of the William Zimmer Plant was reviewed.

As it had been determined that the economic information contained in the draft ER and Supplement Two to that report had no significance in the Zimmer plant licensing, the remaining question was whether the information submitted to the Atomic Energy Commission, now the NRC, was correct. Individual "A's" statement was that the company had misrepresented the S&L study by inclusion of the number 7.66 Mills/KWH (derived from a fuel leasing study) in Table 9.3-1 of Supplement Two to the environmental report.

Comparison of information in the S&L studies and information submitted indicated that the draft environmental report appears to correctly reflect the information contained in the various S&L studies as interpreted by CG&E. The indication was that a nuclear power plant was the economic choice over a fossil powered plant for the Zimmer location in Moscow, Ohio.

Supplement Two to the ER correctly reflects the findings in SL-2561, and indicates that the referenced number (7.66 mills/kilowatt hour) is based on a leasing study. From a review of Supplement Two, and discussion with CG&E personnel, it is apparent that the discussion in the environmental report of the S&L studies was intended to demonstrate rising costs for coal and nuclear power, with figures from the various studies included for comparison purposes. It is apparent from the chronology of studies and submittals that the early study (SL-2561) had been augmented and then replaced with updated information prior to submittal of Supplement Two.

CG&E personnel stated that they have performed in-house evaluations of the plant's economics since 1975, which continued to indicate that the nuclear plant is the economic choice over a fossil powered unit. They additionally advised that while they presently own the nuclear fuel for the Zimmer plant, leasing is still a viable option which can be exercised whenever their current analysis shows economic benefits of such an arrangement.

It was concluded that the information supplied by Cincinnati Gas and Electric on behalf of CG&E and other utilities participating in the Zimmer project was correct.

DETAILS

1. Personnel Contacted

   Cincinnati Gas and Electric

   E. Borgmann, Vice President, Engineering Services and Electric Production
   K Chitkara, Manager of Nuclear Fuels and Advanced Engineering Projects

   Sargent & Lundy Engineers

   D. Pruski, Engineer
   R. Schuetz, Environmental Engineer

   Individuals

   Individual "A"

2. Scope

   This investigation reviewed allegations that information supplied in submittals for the Environmental Report, Construction Stage, for the Zimmer Nuclear Power Plant had been misrepresented to the Atomic Energy Commission (AEC) and its successor agency, the Nuclear Regulatory Commission (NRC). The specific allegation was that the findings in S&L study SL-2561 had been misrepresented in Supplement Two to the Environmental Report.

   It should be noted that the initial decision to build the Zimmer plant is not considered as an issue in this investigation. The issue investigated was whether the licensee had either supplied false information or misrepresented information in their submittals to the AEC/NRC.

3. Background (Please see Exhibit I)

   In early 1962, the CCD Companies, Cincinnati Gas and Electric, Columbus and Southern Ohio Electric Company, and the Dayton Electric Company decided to construct certain generating units on a common ownership basis to take advantage of economies of scale.

   In 1967, the CCD group asked S&L to analyze their system and make recommendations on future actions. This study, issued on October 31, 1967, recommends additional generating capacity, and a base loaded coal or nuclear plant at the Zimmer site in Moscow, Ohio.

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In 1968, S&L performed a further study (entitled "Economic Evaluation of Alternatives") SL-2561, to determine the choice of the unit for the Zimmer site. This study recommended an intermediate sized nuclear unit as the most economical alternative commensurate with S&L's estimated load requirements. This study was issued February 17, 1969.

Report SL-2561 was updated by letter on July 2, 1969. This letter "Updated Evaluation of Alternatives" (later issued as SL-3739) gives updated cost figures, and provides a "break-even" cost for coal (coal prices above which a nuclear unit is economically superior).

A further study, entitled "Economic Re-evaluation of Alternatives," SL-2597, was done in early 1970, and issued on April 7, 1970. This study utilized further updated cost analyses and a 33 year plant life to provide an improved economic analysis of the plant.

During January 1971, the CCD group submitted the Environmental Statement - Construction Permit Stage - William H. Zimmer Nuclear Power Station, to the AEC.

In July of 1971, the "Calvert Cliffs" court case required changes to Appendix "D" of 10 CFR Code of Federal Regulations Part 50 (10 CFR 50) regarding the Atomic Energy Commission's implementation of the National Environmental Policy Act (NEPA) of 1969. These changes included the requirement of a cost - benefit analysis, and were incorporated into 10 CFR 50 in September of 1971 (later changed to 10 CFR 51).

The CCD companies prepared Supplement Two to the Environmental Statement, dated December 29, 1971, to meet these new requirements in 10 CFR 50, Appendix D.

In 1972, the AEC requested the Federal Power Commission to comment on the draft statement, the need for the Zimmer facility, facility costs and alternatives. They approved the information submitted by the applicants.

The AEC staff reviewed the information provided by the applicants, (and comments by other agencies) in some cases performing their own independent reviews, and issued the final Environmental Statement related to construction of the Zimmer plant in September of 1972.

4. Background on Cost Analysis

Cost analysis for the life of a power plant is an attempt to predict, based on current knowledge, future prices, generating needs, and regulatory climate for the plant. In such a study assumptions are made on needs for power, cost of constructing and operating the generating station, cost of additional equipment required by changes in regulations, and changing costs for the fuel supply for the unit. In an analysis which attempts to predict the levelized generating cost for a power unit over a period of many years, assumptions

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have to be made concerning long-range future events. If the assumptions made in conjunction with the study are conservative, it is expected that actual conditions will provide better results than the analysis.

In comparison of a nuclear power plant with a fossil fuel power plant, capital costs for actually constructing the station have been found to be higher than for the comparable coal fired unit because of the expensive equipment and quality requirements required for construction of the nuclear generating facility. Any ultimate economic benefit gained from construction and utilization of such a nuclear power plant is gained from the cost differential between the nuclear fuel and the comparable fossil fuel, be it either coal, gas or oil, over the life of the facility. As such, if an economic analysis of the plant is to be totally representative, it must take into consideration the entire life of the plant, as initial operating and generating costs for a nuclear power station, including the higher capital costs, will be more than the comparable coal fired unit. Over the operating life of the plant, (generally assumed to be thirty years) however, the lower costs of the nuclear fuel provides a lower levelized cost of generating electricity than the comparable coal fired plant.

For such an economic review, if a shorter time period, such as fifteen years is utilized, conservatism involved in this assumption tends toward favoring a fossil fired unit, as the economics of the nuclear unit involve lower fuel costs over the total operating life of the plant.

Such an evaluation does not consider other possible non-economic benefits of a nuclear plant, such as diversity of power supply, smaller plant site, or lack of chemical air pollutants. It also does not consider possible disadvantages such as increased thermal discharges and radioactive emissions.

A number of exhaustive studies have been performed on a comparison between the costs of nuclear power generation and comparable coal, oil or gas fired generation. Such studies are included in NUREG-0246, a series of eight reports included in the commercial electric power costs studies prepared for the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy by United Engineers and Constructors Company, and NUREG-0480, Coal and Nuclear: A Comparison of the Cost of Generating Base Load Electricity By Region, dated December, 1978.

5. <u>Contacts With Individual "A"</u>

In March of 1979, Individual "A" contacted Mr. Charles Barth, legal counsel for the NRC Office of the Executive Legal Director (NRC counsel in the Zimmer Operational License hearing). Individual "A" discussed what he considered to be misleading statements contained in the Zimmer Environmental Report - Construction Stage, and Supplement Two to that report. Following the discussion, Individual "A" by unsigned and undated letter, detailed his concerns to Mr. Barth. (See Exhibit II).

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Later, several telephone contacts were made between NRC Region III personnel and Individual "A." During these telephone conversations his concerns regarding the information in the Environmental Statement were discussed in detail.

Individual "A" stated that he had recently reviewed S&L Report SL-2561. He indicated that this report was marked "Confidental" and contained a warning that "disclosure of this report would be detrimental to the interests of Cincinnati Gas and Electric." He also stated that the summary section of the report would state that "this report does not show that nuclear power is the economic choice presently, but we believe that it will be in the future."

Individual "A" stated that only one case in 13 cases analyzed in the study indicated that a nuclear powered plant was more economical than a fossil plant, a case which involved leasing the nuclear fuel supply. He stated that the S&L report clearly indicated that this leasing case was hypothetical, cursory, and invalid. Therefore, he stated, submission of a value from this study was a deliberate misrepresentation to the AEC/NRC. He indicated that the utilities involved were aware that the Zimmer Nuclear Plant was uneconomic prior to the start of its construction but they had proceeded with its construction regardless of their economic analysis.

6. Review of Report SL-2561

A copy of S&L report SL-2561 entitled, "CCD Unit 6 Economic Evaluation of Alternatives" dated February 17, 1969, was received from Sargent & Lundy, and reviewed by RIII personnel.

The report carries on its cover a red stamp indicating "Confidential." The inside cover contains a statement stating "Confidential, this report contains information that would be detrimental to the commercial position of the bidders if divulged to unauthorized persons." During an October 19, 1979 visit to Cincinnati Gas and Electric Headquarters their copy of the report was compared to that obtained by RIII. Their copy was found to be identical with that reviewed by RIII personnel. The two warning statements were considered representative of common practice labeling of reports containing proprietary information such as equipment bids. Both CG&E and S&L indicated that they consider the report as proprietary information.

This report states that it was designed to compare the best nuclear option for the Zimmer site with the best fossil (coal) option, and determine the most economic plan for system expansion. The study evaluated 13 alternate plans, eleven nuclear and two fossil plants, assuming the need for 1,000 to 1,800 megawatts electrical (net) for the CCD system, and using a 15 year time span. The plant size recommended by this study was larger than the recommendation in the S&L study done in 1967.

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The study recommended an intermediate size nuclear plant and indicated that the larger the size of the nuclear plant, the more favorable was the comparison with a coal fired generating plant. The study states that the intermediate size plant "demonstrates the most favorable economics. This is true notwithstanding the fact that the most conservative approach possible is taken in the nuclear cost analysis. On the other hand, optimistic views have been taken of fossil plant and coal prices, as well as the need for capital equipment to account for potential sulphur and nitrious oxide control regulations."

Each of the vendor's fuel offerings were analyzed in this study on the basis of either owning or leasing nuclear fuel for two possible modes of fuel supply: fabrication of the fuel only, or a uranium supply plus fabrication of the nuclear fuel. Costs in terms of mills per kilowatt hour (mills/kwh) for the fifteen-year period were computed utilizing computer programs. In each case, leasing of the nuclear fuel indicated the least total cost.

The report contains the following comment on leased fuel:

> "The generating costs indicated in Table 4 (of the report) for the leased fuel supply mode should not be considered as the actual cost that would be incurred should a leasing contract be executed. They are provided merely as an indication of the relative savings resulting from a decrease in the inventory carrying charge rates from those applicable to fuel ownership. The details of a leasing contract have not been finalized. A more accurate appraisal of the fuel revenue requirements would necessitate consideration of such factors as the length of the fuel lease, the ownership of the fuel residuals, timing of lease payments, and the financial effects a lease might have on the credit rating of the CCD group. Legal, regulatory, tax and accounting implications of leasing should all be carefully reviewed prior to entering into a lease agreement for which there is presently no commercial precedent."

The study indicates, in Exhibit 101, that the levelized cost of generating energy for the size unit finally selected for the Zimmer plant, over a 15 year period, assuming use of cooling towers, 1975 prices, fuel fabrication and leasing of fuel, would be 7.76 mills/kwh. Exhibit 98 indicates that a 955 megawatt electrical (gross) fossil fueled unit over the same period, with 5% overpressure operation, 1% coal price escalation per year, cooling towers and sulphur dioxide removal equipment, would yield a levelized generating cost of 8.01 mills/kwh. From other figures contained in the report, the analysis for the same fossil plant without overpressure operation would apparently yield a levelized 8.13 mills/kwh.

The study indicates that its' conclusions must be considered along with possible requirements for sulphur dioxide removal equipment,

1766 049

advantages of entering the nuclear power field early, reliability of large fossil fueled units, and a realistic appraisal of coal price trends as compared to the 1% coal price escalation utilized as an assumption in the study.

No comment to indicate "this report does not show that nuclear power is the economic choice presently but we believe that it will be in the future" or similar statement was noted.

7. <u>Review of Further S&L Studies</u>

Report SL-3739, "Updated Economic Evaluation of Alternatives" (July 2, 1969) was also reviewed. This report updated information contained in report SL-2561 and provided "break-even" prices for coal where a nuclear unit would be economic choice if coal prices were above the indicated level. This study assumed CCD nuclear fuel ownership, fabrication only scope of nuclear fuel supply, 1975 estimated price levels, and no cooling towers or sulphur dioxide removal equipment for the fossil fired comparison plant. The study found that the intermediate size nuclear plant was approximately 4% more economic than a small sized nuclear plant and was the economic choice regardless of the rate of coal price increase. This study was based upon then current information, and noted the possibility of uranium price decreases based upon then anticipated increases in uranium supplies. The report notes that the figures used for nuclear fuel price estimates may be conservative, and the figures used for coal price estimates may be nonconservative.

S&L report SL-2597, an "Economic Re-evaluation of Alternatives", (dated April 7, 1970) provides a further update of the original study, based upon revised vendor rebids and cost estimates. This study also utilized a more realistic 33-year plant life, and a plant size limitation based upon revised predicted electrical load requirements from CG&E.

8. <u>Review of Draft Environmental Report</u>

The Draft Environmental Report (January 15, 1971) refers to the comparison study of fossil and nuclear power generation in sections 1.2.3, 2.3, 2.4 and 2.5 (see Exhibit III). This information accurately represents the findings of reports SL-2561, SL-3739, and SL-2597. It should be noted that large size nuclear units were excluded in the evaluation performed in report SL-2597.

9. <u>Review of Supplement Two to the Environmental Report</u>

Supplement Two to the Environmental Report related to construction of Zimmer, dated December 29, 1971 provides a cost-benefit analysis of the Zimmer plant as required by the NEPA Act of 1969. Discussions of the comparative costs of nuclear and fossil fuel generation are included

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in section 9.3 (see Exhibit IV). The information contained in Supplement Two appears to be a correct representation of the information found during review of the S&L studies. An error was noted in the comparison as the 1.47 mills/kwh referenced in paragraph 9.3.3.4 is apparently incorrect. Exhibit 94 of report SL-2561 indicates this figure should actually be either 1.42 mills/kwh (fabrication, leasing) or 1.54 mills/kwh (uranium, fabrication and leasing), for a Zimmer - sized unit.

The number 7.76 mills/kwh in Table 9.3-1 is based on a leasing study, as noted in paragraph 9.3.3.4 and is a true statement. The figure is found in Sargent & Lundy study SL-2561.

The review of Supplement Two indicates that figures from the "1968" S&L study (SL-2561) were included to demonstrate cost increases in both fossil and nuclear electrical generation rather than provide a basis for a licensing decision. This conclusion is based on the fact that the 1968 information was superseded by later studies using more current figures, updated analyses and revised assumptions.

10. Significance of Information

Following submittal of the information to the AEC/NRC, the AEC/NRC requested the Federal Power Commission to review the information supplied by the applicants. The Federal Power Commission advised by letter on June 27, 1972 that the values supplied by the applicants were within the expected range of similiar projects they had reviewed elsewhere. This letter is reproduced as Appendix B-18 to the final Environmental Statement related to construction.

Through discussion with the division of Nuclear Reactor Regulation, it was found that the economic information provided in the Environmental Report and its Supplement Two had no impact on the licensing of the Zimmer plant. (See Exhibit V). The staff advised that they had reviewed the information supplied by the applicant and performed their own independent analysis of the economics of the Zimmer plant.

11. Discussion with Cincinnati Gas and Electric Personnel

A visit was made to the CG&E offices on October 19, 1979, to review reports related to the various economic analyses of the Zimmer plant, and discuss figures provided by CG&E on behalf of the other utilities in their submittal of the Environmental Report and Supplement Two.

CG&E personnel advised that many of the people who had helped prepare the submittals were no longer with the company, and it was not possible to determine who had selected the numerical values in the various submittals.

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CG&E personnel advised that their studies had shown that nuclear power was the clear economic choice, based on their review of the studies done by S&L, but in-house discussions indicated that the size plant recommended by some of the Sargent & Lundy studies was not required by their own load requirement projections.

CG&E personnel stated that all evaluations of the Zimmer plant's economics have been performed in-house since February, 1975, and continue to indicate that the Zimmer Station is economically preferable to a fossil station of similar size.

They also indicated that while the CCD companies presently own the nuclear fuel for the unit, fuel leasing is still an option which may be exercised at any time their ongoing analysis indicates that it is a worthwhile arrangement. CG&E personnel advised that leasing is actively being considered.

12. Contact with Individual "A"

Individual "A" contacted RIII several times during and at the close of the investigation (which was delayed and extended due to other priority work). The findings of the investigation were discussed with Individual "A", and he expressed dissatisfaction with the findings of the investigation.

13. Licensing Contention

There is presently a contention in the Zimmer Operating License hearing process proposed by intervenors into the licensing hearing. This contention indicates that Cincinnati Gas and Electric does not have a sufficient economic basis to properly operate and maintain the Zimmer plant. This contention is yet to be addressed during the licensing hearings, but does not to appear to be related to the matter under investigation in this report.

Attachments:
1. Exhibit I - Chronology
2. Exhibit II - Letter from Individual "A"
3. Exhibit III - Part of Draft Environmental Report
4. Exhibit IV - Part of Supplement Two to the Environmental Report
5. Exhibit V - July 18, 1979 memo, NRR to IE

Partial Chronology of Events Related to Zimmer Environmental Statement

10/31/67	New Generating Facilities Planning Study (SL-2394)
10/68	Proposals received from reactor vendors
5/2/68	Preliminary Site Investigation and Description (S&L Study)
2/6/69	S&L Presentation to CG&E on Report SL-2561
2/17/69	Economic Evaluation of Alternatives (SL-2561)
6/11/69	Telephone Conference with S&L on plant economics
6/13/69	Telephone Conference with S&L on plant economics
7/2/69	Updated Economic Evaluation of Alternatives (SL-3739)
8/19/69	Meeting of CG&E, S&L and General Electric to discuss their proposal
8/29/69	Contract let with General Electric (not signed until 1972)
9/2/69	Plant announced
4/6/70	Application filed with AEC for the Zimmer plant
4/7/70	Economic Re-evaluation of Alternatives (SL-2597) issued
1/15/71	Environmental Report, Construction Stage
1/22/71	Environmental Report, Construction Stage, received by AEC
5/12/71	Ammendment No. 1 to Environmental Report
7/23/71	"Calvert Cliffs" court decision on NEPA
9/17/71	Revised Appendix D to 10 CFR 50 (later made part of 10 CFR 51)
11/18/71	Supplement No. 1, "Responses to Questions"
12/3/71	Amendment No. 2 to Environmental Report
12/29/71	Supplement No. 2 provides cost-benefit analysis required by new 10 CFR 50, Appendix "D"
1/31/72	Supplement No. 3 to Environmental Report
2/18/72	Amendment No. 3 to Environmental Report
4/72 - 11/72	The various parties sign the contract with GE for the Zimmer plant
5/15/72	AEC requests Federal Power Commission review
5/27/72	Federal Power Commission finds estimated costs acceptable
9/72	AEC issues Final Environmental Statement related to construction of Zimmer
10/27/72	AEC issues construction permit for Zimmer
10/76	NRC publishes Draft Environmental Statement related to Operation of Zimmer
6/77	NRC publishes Final Environmental Statement related to Operation of Zimmer
3/79	Individual "A" contacts NRC

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Dear Mr. Barth,

As per our recent telephone conversation, I am writing anonymously to inform NRC of what may be criminal conduct of the part of Cincinnati Gas & Electric (CG&E), to wit, the deliberate submittal of false information in the Zimmer Plant Environmental Report (ER), dated January 15, 1971.

In short, CG&E stated in the main ER volume that a study performed in 1968 by their consultant Sargent & Lundy (S&L) comparing the economics of nuclear vs. coal generation showed nuclear power as clearly more economical than coal power (see section 1.2.3.1 - Fossil vs. Nuclear Plant - on pg. 1.2-14 and also number (4) on pg. 1.2-15). CG&E did not include the comparitive nuclear vs coal generating costs calculated by S&L in their 1968 study in the main volume ER but only made the general statement that nuclear came out as more economical.

The truth is that coal power actually came out as more economical in the 1968 S&L study in all parametric cases where ownership of the nuclear fuel by the utilities was assumed. S&L, however, performed one economic case study assuming the nuclear fuel would be leased by the utilities and this case shows a lower total generating cost for nuclear power This is the case study which CG&E refers to in S ER (see section 9.3.3.4 - Nuclear Fuel Cycle Costs - on pg. 9.3-12 of Supplement 2) where CG&E finally gives out the numerical results of the 1968 study (1.47 mills/kwh for nuclear fuel cycle cost) and states that this cost is based on leasing the nuclear fuel. Also included in Supplement 2 to the ER, issued in late 1971, are the results of a new economic analysis by S&L showing nuclear generating costs to be 2.52 mills/kwh less, levelized over 33 years, than coal costs (see section 9.3.3.1 - Summary of Original and Recent Cost Comparisons - in Supplement 2). Table 9.3-1 in Supplement 2 to the ER summarizes the cost comparisons of nuclear vs. coal in the 1968 study and in the study of late 1971. The 1968 total generating costs are shown to be 7.76 mills/kwh for nuclear and 8.01 mills/kwh for coal. Remember that the figure of 7.76 mills/kwh for nuclear is based on the assumption that the utilities will lease the nuclear fuel since all case studies of nuclear fuel ownership came out in favor of coal.

1766 054

Exhibit II
Page 1 of 3 pages

The clinker in all of this is that the 1968 case study by S&L based on the assumption that the utilities would lease the nuclear fuel was totally invalid and this is so stated in their report to CG&E which contains the results of all their economic case study comparisons of nuclear vs coal. This report is entitled, "An Economic Evaluation of Alternatives," has the word "Confidential" stamped all over it, and contains a warning on the very first page that divulging of the contents would be harmful to the interests of CG&E.

The reason that the results of the nuclear fuel leasing case are invalid is that at the time this study was done the federal government had not yet ruled on the income tax status of nuclear fuel leases in regards to whether they would be looked upon as debt or equity expenditures. There is no federal income tax on electricity revenues collected to pay off debt capital but there is income tax on revenue collected to gain an equity position. With a corporate income tax rate of 48% the question of whether a lease is debt or equity must be answered before it can honestly be stated whether the leasing of nuclear fuel will result in total nuclear generating costs lower than the total generating costs of an equivalent coal fired unit.

The nuclear fuel leasing case study described in the 1969 S&L report, "An Economic Evaluation of Alternatives," was thus merely a <u>hypothetical</u> study done to show what the relative economics would be <u>if</u> the government eventually ruled that nuclear fuel leases could be treated as debt for income tax purposes. To our knowledge, the federal government has never made such a ruling. If it had, all nuclear fuel would obviously be leased rather than owned and we do not believe that to be the case. Also, by such a ruling the government would forfeit billions of dollars in annual utility income tax revenue.

In "An Economic Evaluation of Alternatives," S&L plainly states that their nuclear fuel leasing case study is merely hypothetical because of the unknown income tax status of nuclear fuel leases. In the "conclusions" section of this report S&L candidly states that they have not conclusively shown nuclear power to be more economical than coal power at this point in time but they <u>believe</u> it will be in the future.

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Thus what CG&E did from the initiation of the Zimmer project in 1969 until late 1971 when a new economic study was performed by S&L was to knowingly misrepresent the conclusions of the 1968 S&L study as showing that nuclear power was more economical than coal power when in fact the only case study that gave these numerical results was invalid, hypothetical, and incomplete.

We believe that CG&E executives knowingly misrepresented the economic conclusions of the 1968 S&L report because they had already gotten the ball rolling to build Zimmer, notwithstanding the uneconomics, before N.E.P.A. was passed in 1969 and interpreted by Calvert Cliffs in 1971. They obviously didn't want to suspend their incipient nuclear program until the economics could be reversed or let their customers know they had embarked on a course without regard for the economics. Instead, they kept the licensing process moving by stating in the ER main volume that their consultant's 1968 study proved nuclear more economical than coal.

In summary, CG&E executives lied when they stated in the ER main volume that the 1968 S&L study showed nuclear more economical than coal since this report itself did not draw this conclusion but rather labeled the one case study (leasing) that did support this conclusion as invalid, hypothetical, and incomplete. CG&E also acknowledges in the ER that it reviews and analizes all consultant's reports and thus must accept responsibility for knowingly misrepresenting the facts. Further, on pg. 1.2-1 (section 1.2 - Summary) of the ER main volume CG&E states that they recognize a requirement by the newly enacted National Environmental Policy Act of 1969 to ".... include... a detailed statement by the responsible official on.... (III) alternatives to the proposed action." Thus, by knowingly misrepresenting the facts regarding the economics of Zimmer vs alternatives it seems they may also be in violation of the N.E.P.A. of 1969. One only hopes that they don't treat the results of adverse safety studies in the same manner.

The truth of the contentions contained in this letter can be very easily verified by NRC by merely obtaining a copy of the 1968 S&L report to CG&E, "An Economic Evaluation of Alternatives," from either CG&E or S&L.

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applicable rules, codes, licenses and regulations, and by virtue of this compliance, as well as the Company's determined desire and obligation to produce an economical, safe and clean source of electric power, no unfavorable, repugnant or adverse environmental effects will result from the construction and operation of the Wm. H. Zimmer Nuclear Power Station.

1.2.3 Alternatives to the Proposed Action

The Cincinnati Gas & Electric Company, Columbus & Southern Ohio Electric Company and The Dayton Power and Light Company (CCD Companies) have studied and analyzed the choices available for meeting the projected load demands as discussed in Section 2.0 and Subsection 2.2.

A highly industrialized society requires a tremendous amount of electric energy. In a recent article by Fremont Felix, Planning & Development Consultant, appearing in the July 6, 1970 issue of Electrical World magazine, Mr. Felix points out that, "...... on the average, every dollar of GNP requires the simultaneous availability of 3 cents worth of electricity ...... and since as much as 70% of electric power consumption is for commercial and industrial purposes, a forced reduction in the availability of this vital form of energy will have an adverse effect on employment." The level of the standard of living of every nation in the world is directly related to the amount of economic electrical energy available. Our nation and its electric industry are the leading example of this mutual interdependency as a prime factor of dynamic growth. The effect that energy deprivation would have on our livelihood would be to reduce that livelihood to levels that are termed "poverty" by todays standards and also greatly affect out psychosocial environment by cutting back on schools and other cultural activities.

Additionally, the three CCD Companies operate as public utilities under the jurisdiction of the Ohio Public Utilities Commission. The charter granted to the utilities stipulates that the operating companies make every effort to provide electric energy to all residential, commercial and industrial customers within the specified service area.

The responsibility of the companies to meet their obligations of providing low cost abundant power can be met by several alternate actions as discussed in the following Paragraphs.

1.2.3.1 Fossil vs. Nuclear Plant

The projected need for power as detailed in Section 2.0 is addressed to the installation of a base-load plant. These large, efficient units are loaded to their peak capacity the majority of the time (base-loaded) and by taking advantage of relatively lower fuel costs and the economics of the large turbine units, are able to produce huge blocks of low cost electric power. Peaking plants are utilized during periods of high demand, short duration and are characterized by high fuel costs and low initial capital investments when compared

1766 057

with the installed costs of base-load units. Combinations of base-load and peaking capacity are integrated into the system for optimum economy and flexibility of operation.

Since the area's potential for large hydro-electric plants is nonexistent, the only practical alternative solution to a nuclear plant is the installation of a fossil fuel fired, base-loaded unit. Coal, oil and natural gas are the three fossil fuel energy sources used in the United States. This stored energy is released in the form of heat, converted into mechanical energy and transformed into electrical energy for immediate use.

The use of natural gas and oil is impractical due to the nation's limited reserves, not to mention the double and triple cost for these fuels respectively as compared to coal. Natural gas is being consumed at a rate greater than exploration is able to discover reserves to meet future demends. This clean, convenient and valuable resource should be preserved for space-heating of homes for future generations. The situation for fuel oil is similar. There are large proven reserves throughout the world and just recently the discoveries in Alaska have added greatly to this reserve. Fifty percent of all oil is used for transportation while the remainder is used for space heating, chemical processes, and by industry. It is also a valuable resource and should be preserved for those existing applications mentioned above. Coal is the most plentiful fossil fuel with projected reserves of several hundred years indicated. This evaluation of availability and relative fuel costs, indicates that a coal fired unit is the only practical alternative to the nuclear plant in this area.

An inescapable accompaniment in the burning of coal is the emmission of combustion by-products. These by-products or air pollutants are fly ash and the gaseous oxides of sulfur, carbon and nitrogen. All of these have, in varying degrees, the potential of impairing health, creating annoyance, and causing property damage.

A typical 1,000,000 kilowatt unit operating at full capacity in addition to consuming 10,000 tons of a typical coal per day will also require 110,000 tons of air daily, containing 25,000 tons of oxygen. The pollutants produced each day by the unit will include about 800 tons of fly ash, 250 tons of sulfur dioxide, 80 tons of nitrogen oxides, and 29,000 tons of carbon dioxide.

State regulatory bodies are now establishing standards based on Federal guidelines on the emission of particulates and sulfur dioxide. Standards for the control of carbon monoxide and nitrogen oxides will be established at a later date. Modern technology has made it possible to collect 99.6 percent of the particulate matter formed as the by-product of combustion, but the technology for the removal of the oxides of sulfur is in the developmental stage. The standards for sulfur dioxide concentrations in the atmosphere being enacted by the various states are so stringent that at present there is no practical way of achieving their goal except by using coal having one percent or lower sulfur content. The great bulk of the U.S. coal reserves contain more than one percent sulfur and ninety-nine percent of Ohio's coal reserves contain more than one percent sulfur.

The nuclear power station can eliminate the impact on the environment that the air pollution problems of the coal fired plant create. A nuclear unit requires no oxygen for combustion and eliminates completely the gaseous and particulate emissions of the coal fired plant.

During the operation of a nuclear power plant, small amounts of radioactive matter are released to the environs. The gaseous radioactive products are collected, filtered and held for a time to allow decay in activity, and then released under controlled conditions. The liquid radioactive waste byproducts are collected, concentrated, stored in drums, and shipped off-site to permanent burial grounds set aside for that purpose. The AEC has jurisdiction over these burial sites. Small amounts of low level liquid radioactive wastes are released to the river under controlled conditions.

As covered in Subsection 6.4, Radiation Standards, the release of any radioactive material to the environs is regulated by the permissable limits of part 20, title 10, Code of Federal Regulations. The operating design objective of those systems to be used in the Wm. H. Zimmer Nuclear Power Station releasing radioactive materials to the environment, will be one percent of the limits as set forth in 10CFR20.

Fuel shipments and handling facilities must be provided for the large coal fired plant. Large land areas for an emergency coal supply are necessary to assure reliable, continuous operation during periods when adequate fuel shipments cannot be made. The noise and dust pollutants that accompany an operation of this magnitude (average of 350 tons per hour for continuous 24 hour, 840,000 kilowatt unit) are additional factors that favor the nuclear power plant. In a nuclear power plant, sufficient energy is contained in the reactor core to produce electric energy for approximately one year before it is necessary to shut down for partial refueling. Relatively small nuclear fuel shipments are transported by railroad (spent fuel) or by truck (new fuel) at infrequent intervals.

Because of the long lead times required when large central stations are designed, fabricated and constructed, The Cincinnati Gas & Electric Company and their consultants, Sargent & Lundy, analyzed the economics of a nuclear power vs. a coal fired station. Costs were developed based on known parameters and included plant capital investment, fuel cost, operating costs and maintenance costs. The details of this comparison are given in Subsection 2.3 and indicate that although the nuclear plant had higher capital costs, the lower nuclear fuel costs gave the nuclear plant the competitive edge. Escalation of labor and materials plus the sharp rise of coal prices during the past several years would indicate that if this analysis were performed today, the nuclear plant would still maintain its economic advantage.

A fundamental law of thermodynamics dictates that, regardless of whether electricity is produced by conversion of fossil energy or nuclear energy, each system must release heat to the environment. The total rejected heat would be reduced by about thirty percent if a fossil fired unit were installed. However, since natural draft cooling towers (Subsection 8.3) will be utilized to dissipate the waste heat to the atmosphere.

In summary then, the evaluation of the alternatives of installing a nuclear power plant vs. a fossil fuel plant are as follows:

(1) From an environmental standpoint the nuclear power plant offers a clear advantage. Only minute amounts of radioactive gaseous and liquid are released to the environs and are rigidly controlled and regulated. The fossil fuel fired plant releases large volumes of gaseous combustion products which are annoying, in varying degrees which cause property damage, and which have the potential of impairing health.

(2) The advantage that fossil fuel unit enjoys as far as waste heat rejection is offset because of the planned installation of cooling towers that dissipates the heat to the atmosphere.

(3) The noise and dust associated with the fuel handling facility accompanying a large fossil fuel fired plant are not required at a nuclear station. Compact, infrequent nuclear fuel shipments are required at a nuclear plant.

(4) [illegible] analysis favors the nuclear powered unit and this saving is the form of lower energy costs. This affects man's standard of living as well as his psychosocial environment.

1.2.3.2 Purchasing the Power

An alternative to generating the needed energy to satisfy the consumers is to purchase the power from neighboring utilities and importing this electrical energy into the system via interconnecting tie lines.

This is an impractical option because the majority of the electric utility industry is being hard pressed to keep up with the electrical demand. Even if it were possible to purchase sufficient power to meet the requirements of the CCD service areas, transmission capability would have to be increased substantially, and these large overhead facilities cannot be constructed without some environmental disadvantages. Additionally, the costs involved would increase the cost of electricity to the consumer.

Existing interconnecting transmission facilities are capable of carrying 1370 MW of emergency power. One of the primary reasons for these tie lines is for the exchange of energy during periods of unscheduled generating outages.

2.3 SYSTEM GROWTH REQUIREMENTS

System growth and load predictions have historically proven to be very accurate and reliable tools that the electric utility industry has utilized to schedule their expansion programs. These system load studies are continually updated to reflect knowledge gained from comparing actual generation vs. that predicted for the corresponding period, construction activity and influx of industry in the service area, and the general economic outlook for the period under study.

Present studies show an anticipated combined peak load growth over the next 10 years of about 8.4 per cent compounded annually. This is slightly greater than the total predicted load growth of 7.8 per cent for the entire United States, and for the study period of 1970-79, results in expansion of about 2.07 times. Figure 2.3-1 indicates the '70 - '79 period showing this peak load growth and the scheduled generating capacity increases necessary to meet the peak. During those years where a deficiency of generating capacity exists, surplus commitments from the Ohio Valley Electric Corporation plus other purchased power match the requirements with the capability.

Expansion plans beyond 1976 are still in the preliminary study stage, but it can be seen that in order to meet the responsibilities of the 70's and beyond, the Wm. H. Zimmer Nuclear Power Station must be built and operated as scheduled.

1766 061

2.4 ECONOMIC EVALUATION OF ALTERNATIVES

2.4.1 Basis of Evaluation

Planning studies completed in 1967 by the three companies, with the assistance of Sargent & Lundy Engineers, resulted in the recommendation to install a unit having a capacity of approximately 800,000 kilowatts for a scheduled commercial operating date early in 1975. The unit was to be located in the Cincinnati Gas & Electric Company service area at a site owned by CG&E. Both nuclear and fossil fueled plants were to be considered.

In accordance with this planning, bid proposals were taken in 1968 on a nuclear steam supply system for a new generating unit. In order to evaluate the technical and economic feasibility of this proposed expansion Sargent & Lundy was commissioned to make a detailed evaluation of the alternatives available in designing the steam supply system for this additional generating facility. This work was conducted in cooperation with and reviewed by the applicants.

The objective of this evaluation was to identify the nuclear plant design utilizing the optimum nuclear steam supply system offered by the various bidders. The best plan was defined as that one which could be operated on a schedule consistent with existing generating units and which would result in the lowest total annual owning and operating costs over the first 15 years of operation of the generating unit.

A further objective of the evaluation was to compare the best nuclear plan to a comparable coal fired plan and to determine on the basis of economics which expansion mode would be best suited for the three companies.

The following paragraphs discuss the steps that were taken in the course of evaluation.

2.4.2 Capital Cost Estimates

Detailed plant arrangements and capital cost estimates were prepared for a total of six basic nuclear and fossil plans. These detailed costs were extrapolated in several instances to provide cost estimates for a total of thirteen alternate plans of varying electrical capacities. The capital cost estimates included direct construction costs calculated on 1968 price levels, escalation of labor and materials prices to the projected commercial operation date in 1975, estimated overtime costs required to complete construction within the construction period allotted, and indirect expenses applicable to the project. A special allowance was added to the nuclear alternatives to cover licensing expenses, nuclear training costs, and public information activities, including a Nuclear Information Center to be constructed adjacent to the nuclear generating facility.

1766 062

2.4.3 Fixed Charges on Depreciating Capital

A fixed charge rate applicable to depreciating capital was derived by the use of a computer program using economic factors applicable to the Companies. The annual fixed charge rate, for each of the first 15 years of plant service, was then applied to the total capital estimate of each plan, yielding the annual fixed and levelized owning expense over the 15 year evaluation period.

2.4.4 Nuclear Fuel Cycle Cost Analysis

This analysis was based on the bids received from the various reactor vendors offering to provide partial or total fuel cycle services. Each of the vendors' fuel offers was analyzed on the basis of either ownership by the Companies or leasing from the nuclear fuel supplier or from a third party. In combination with the ownership vs. leasing analysis, the various combinations of fabrication services and supply of fissionable materials were also analyzed to arrive at the overall fuel cycle costs for various combinations of fuel cycle services.

To evaluate the fuel cycle offerings, a computer code was used which calculated fuel costs for each month of the 15 year evaluation period, starting with the procurement of the ore concentrate and ending with the disposition of the reprocessed spent fuel. In addition to direct materials costs, processing and fabrication expenses associated with the fuel cycle, carrying charges, including return taxes and insurance were also included in the cost analysis.

2.4.5 Fossil Fuel Costs

Coal prices used in the calculation of annual fuel costs for the fossil plans were based on coal price statistics of the three companies with the application of projected price escalation extending over the 15 year evaluation period.

2.4.6 Generating Unit Loading Projections

The same operating schedule was used for both fossil and nuclear plants. The average unit loadings were projected for each year of the 15 year evaluation period. This projection resulted in an average annual capacity factor of 76.7% for all plans.

2.4.7 Unit Energy Costs

The criterion for the selection of the most economical plan was defined as the net total cost of generating electricity. Total generating costs were developed using a computer program which calculated the unit energy costs in mills per kilowatt hour, levelized over the first 15 years of plant operation. The calculated unit energy cost included the fixed owning expenses, fuel costs,

1766 063

and annual operating and maintenance expenses, including nuclear insurance where applicable, for each of the plans considered.

Two other evaluation procedures were used as a check on the above procedure; (1) Spreading the total owning and operating costs over the energy generated by a unit of specified size and (2) application of an equalizing capability charge to recognize the differences in capability between the unit sizes bid. The same economic ranking of alternatives was arrived at notwithstanding the evaluation procedure used.

Exhibit III
Page 8 of 9 pages

2.5 DISCUSSION OF ALTERNATIVES TO MEETING LOAD DEMAND

2.5.1 Summary of Plans Evaluated

A total of thirteen alternative plans were analyzed and evaluated. Eleven of these alternatives were nuclear plans including seven which utilized pressurized water reactors as offered by three different manufacturers, three which utilized boiling water reactors offered by one manufacturer, and one plan which utilized a high temperature gas cooled reactor. Two fossil plans were analyzed, both of which were coal fired inasmuch as the only economically feasible fossil fuel for a large base load generating unit located in this area appeared to be coal.

The evaluation of the fossil alternatives recognized the high probability of a requirement for the addition of sulfur oxides removal equipment.

In the evaluation of both nuclear and fossil alternatives, the installation of cooling towers was included as a means for reducing the thermal effects of the plant on the Ohio River.

2.5.2 Conclusions

The conclusions resulting from the evaluations made are as follows:

2.5.2.1 Nuclear Plan Economics

The nuclear plan utilizing a boiling water reactor as the steam supply system for an 840 MW unit was determined to be more economical than any other nuclear alternative considered in the evaluation.

2.5.2.2 Nuclear vs. Fossil Plan Economics

The evaluation indicated that over the first 15 years of generating unit service the best nuclear plan resulted in a lower levelized unit generation cost than the best fossil alternative, and was therefore the economic choice.

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9.3 STUDY OF ALTERNATIVES

9.3.1 Base-Load Versus Peaking Capacity

In October of 1967, the CCD Companies completed a series of detailed studies of new generating facilities. A report was issued which contained the results of a technical and economic evaluation of various new facilities for expansion purposes. The CCD Companies' system as it existed at that time was thoroughly reviewed; load projections for the system were studied; and various modes of expansion were developed. All practical sizes and types of generating capacity were considered, including nuclear and coal-fired base-load units, oil-fired steam peaking units, pumped hydro, diesel units, and gas turbines. Minimum reserves of 12% and 15% of projected peak load requirements were used to provide an estimate of the effect of reserves on system economics. Using these criteria and all possible combinations of units, approximately 200 expansion patterns were developed and analyzed.

The general conclusions of the study were as follows:

1. The CCD Companies' system expansion pattern should be such that minimum reserves equal 15% of the peak load requirements.

2. A relatively small amount of new capacity would need to be added in 1969 and 1970 to meet the reserve requirements. The capacity could be either from industrial gas turbines or from purchased power.

3. If gas turbine peaking capacity is added in 1969 (152 MW) and 1970 (32 MW), then the remaining expansion should be:

   a. A 270 MW peaking unit in 1973.

   b. A nuclear base-load unit at the Moscow site or a coal-fired base load unit at the Conesville site in 1974.

4. If power is purchased in 1969 (144 MW) and 1970 (188 MW), then the remaining expansion should be:

   a. A 735 MW coal-fired base-load unit at the Conesville site in 1973.

   b. A 32 MW peaking unit in 1974.

   c. A nuclear base-load unit at the Moscow site in 1975.

Based on the conclusions drawn in this 1967 report, the CCD Companies embarked on an expansion program which would satisfy their projected load demands.

The expansion program undertaken by the three companies is described in Paragraph 9.2.2.3.

1766 006

9.3.1.1 Electric Power Purchases

The alternative of purchasing power from a neighboring utility was briefly discussed in Paragraph 1.2.3.2. Since this alternative was rejected as impractical at the time the decision was made to build the Wm. H. Zimmer Nuclear Power Station, it becomes even more unrealistic now to assume that purchased power is a solution to supplying the energy demands of the consumers in the CCD service area. The electric utility industry as a whole is being hard pressed to keep up with the demand for electricity. The construction schedules of fossil fueled plants have been lengthened in some sectors of the nation due to environmental delays and have generally slipped because of a decline in worker productivity. When this is coupled with the recent delays in nuclear plant construction, in part due to licensing delays, the ability to export electricity from an area with surplus energy to a region facing a deficiency is not only reduced, but in some instances eliminated. A preliminary study recently released by the Edison Electric Institute (EEI) indicates the possible impact on power supply throughout the nation due to the new AEC regulations to implement NEPA. Based on data received from regional reliability councils, the EEI statement points out "...Delays in the operation of this needed generating capacity will cause serious electric power supply problems in the Northeast, Middle Atlantic, Southeast, Midwest, North Central, South Central, and Pacific Northwest regions of the country."

Energy transfers between regions to assist areas facing deficiencies is a common practice. An example of this type of interchange occurred during the eastern power shortage in the summer of 1970 when power was diverted from Canada, midwestern utilities and AEC enrichment facilities to alleviate a serious situation. Using the CCD system as a further example, it can be seen as system reserve margins decrease and inability to meet internal energy demands increases, reliability within the system is degraded and the ability to aid neighboring utilities, even in emergency situations, is reduced, if not eliminated.

The alternative of purchasing long-term capacity and energy merely relocates the source of generation. When viewed from the standpoint of overall environmental effects there appears to be no clear advantage to importing electric power. Thus the CCD Companies feel that the alternative of purchasing electric energy to supply their consumers needs is not practical from an environmental standpoint nor from an availability standpoint.

9.3.2 Fuel Alternatives

In order to determine how best to meet the base-load power demands of the CCD Companies, several alternate means of generating electricity are discussed in this section. Each of these sources of power is covered in the light of the present state of its technological development with respect to commercial base-load generation possibilities, the expected future availability of the fuel to be used, the overall economic competitiveness of a large commercial plant based on the given energy source, and the environmental impact of the effluents emitted by the fuel. If the investigation of a given alternate source of power gives unacceptable results in any of these areas, then that source of power will be eliminated as a feasible alternative for meeting the projected load requirements.

9.3.2.1 Geothermal Energy[1]

Geothermal plants operate by taking hot water under pressure from the earth in volcanic areas to run steam turbines. In the U. S. there are some such plants in California. There are also small and medium-sized plants in Russia, Italy, New Zealand, Japan, and other areas. The present total developed capacity in the world is a little more than 1,000,000 kW or about half of the Cincinnati system load. Rough estimates of the world's potential capacity run about 60,000,000 kW, or less than 1/5 of the present U. S. installed capacity. While one might think geothermal energy is inexhaustible, those who have studied the subject believe that the life expectancy is on the order of 50 years or so, since the reservoirs of stored energy being tapped will become depleted. The geographical area served by the CCD Companies does not include reservoirs of this stored energy. For this reason, geothermal energy is not a feasible means of meeting future power demands.

9.3.2.2 Magnetohydrodynamic (MHD) Energy[2]

Magnetohydrodynamic (MHD) power generation is the conversion of the kinetic or potential energy of a fluid into electric power by the interaction of that fluid with a magnetic field. MHD offers the prospect of increasing the energy conversion efficiency above that found in the power cycles presently used in conventional generators. The biggest difficulty in the use of MHD energy arises from the necessity that the fluid be a good electrical conductor. Thermal ionization, combustion, and nuclear processes have all been examined as means by which the gas can be made conducting. Each method poses its own special problems, however, so research is being pursued in an attempt to solve these problems. Since the era of successful commercial power generation through the use of MHD energy is not yet imminent, MHD is not yet a viable alternative for satisfying projected demands for commercial power.

1766 068

9.3.2.3 Solar Energy[(1)]

Collector cells can be used for harnessing solar energy. However, the most promising application of solar energy appears to be on a small scale as used in space-craft. It was estimated that about 19,000 acres of solar cells would be required to meet the 1971 Cincinnati peak load. In addition, spare equipment, access areas and large storage systems for meeting nighttime load requirements would be needed. For these reasons, the use of solar energy is not a feasible alternative source of power.

9.3.2.4 Fusion Energy[(3)]

Meeting the projected power demands through the use of fusion reactors is another future possibility. However, there are four major problems which remain to be solved before the practical application of fusion energy will be a reality: plasma confinement, engineering design, economic competitiveness and environmental impact. Even the most optimistic estimates place the commercial availability of licensable fusion reactorsin the late 1990's. Due to this lead time for research and development efforts, fusion energy as a viable means of meeting anticipated power demands is presently rejected.

9.3.2.5 Hydroelectric Energy[(1)]

Water power is reasonably abundant by today's energy consumption standards. Estimates put the worldwide potential at about 3 trillion kilowatts - roughly three times today's total installed electrical generating capacity in the world. Unfortunately, almost half is in Africa and South America. If usage of electricity continues to double every decade, even the seemingly abundant water power potential will soon be used, if the continents mentioned develop industrially. Also there is the problem that hydro-station reservoirs tend to fill with silt in about a century, so falling water is a relatively short range energy source at best. Since the potential for a large hydroelectric power plant in the area to be served is nonexistent, this alternative is considered to be an impractical solution to the problem of meeting the future load requirements of the three CCD Companies.

9.3.2.6 Pumped Storage

The planned unit is a base-load unit and is designed for 24 hours per day generation. Pumped storage plants can operate for only part of a day. Also, they must rely on base-load units for pumping power during off-peak hours to refill the upper reservoir. Licensing and construction lead time for pumped storage facilities is in excess of ten years. Such scheduling problems would prevent such a plant's meeting an operation date during this decade. Pumped storage, then, cannot be considered as a feasible means of generating base-load power.

There are few, if any, locations in the CCD Service area that lend themselves to an economically feasible pumped storage facility.

1766 069

9.3.2.7 Gas as a Fuel

The use of natural gas as a fuel for the proposed generating station was considered. However, natural gas is being consumed faster than exploration is able to discover reserves to meet future demands. The ratio of proven reserves of natural gas to annual production dropped from 32.5 in 1946 to 11.9 in 1970 and is expected by the American Gas Association to drop to about 9.5 by 1975.[4] Due to its limited natural supply, this valuable resource may be limited by the laws of the marketplace or the government to such applications as home heating, rather than allowed to be depleted by use as a central station steam generator fuel.

Some help for the situation may come from areas such as new discoveries in the lower 48 states, liquefied natural gas, gasified coal, increased imports from Canada, or deliveries from Alaska's North Slope. The use of underground nuclear blasts to pry loose gas trapped in rocks for commercial production is being investigated now. However, problems such as control of resultant radiation levels and general public opposition to the process itself could delay gas production from the Plowshare Program indefinitely. Liquefied natural gas (LNG) has only 1/600th the volume of natural gas, so it can be easily transported and stored in large quantities. Sources of LNG are largely in South America and Africa, however, and international contracts would be subject to added risks and costs. The technological and economic possibilities of producing pipeline quality synthetic gaseous fuels from coal are currently the subject of various long-range research efforts. Few of the domestic coal gasification processes have even achieved the pilot plant stage and none have been proven on a large commercial scale. El Paso Natural Gas Company plans to build the first domestic coal gasification plant based on the Lurgi process, which has been used on a commercial scale in West Germany.

Imports from Canada will depend largely on the international politics involved as well as on Canada's ever-increasing national needs. The gas reserves recently discovered in Alaska should be tapped as quickly as is possible. However, the construction of an adequate pipeline system for transporting this gas to its markets in the lower 48 states is being opposed.

The limited supply of natural gas, compounded by the uncertainty of the exact date of commercial availability of the other gas resources, is the basis by which gas was judged to be an impractical alternative for future base-load application.

9.3.2.8 Oil as a Fuel

Fuel oil represents another alternative fuel source, but its supply situation is similar to that of natural gas. Except for the reserves addition resulting from the Alaskan North Slope discoveries in 1970, national crude oil proven reserves have decreased steadily since 1960. The reserves-to-production ratio has dropped from 12.8 years in 1960[5] to 8.9 years in 1970[6], prior to the Alaskan discoveries. Continuing debate on the environmental advisability of constructing the necessary pipeline system for transporting this oil to market has resulted in prolonged delays in construction and, hence, increased shortages of oil in the lower 48 states. One undeveloped possible source of increased oil reserves is the Atlantic offshore shelf and coastal plain. Such exploration may be hampered, or at least slowed, by stringent environmental protection regulations.

Much of the current shortage of oil is based in national and international politics. United States of America import restrictions, the disruption of the Arabian oil supply due to the closing of the Suez Canal, the increase in the price of Mid-East oil as a result of the pact reached early this year between Persian Gulf countries and major western oil companies - all these factors are involved in the current oil supply problem. Such factors are difficult to predict and almost impossible to control, so that the future availability of oil at any reasonable price is very uncertain.

In addition, oil commonly available for use as a boiler fuel generally has a high sulfur content and requires expensive desulfurization before it can meet sulfur oxide emission regulations. In summary, the problems of supply and demand and international politics, coupled with the technological status of satisfactory pollution control techniques, render this fuel an unfeasible alternative for base-load application on the CCD Companies' system.

9.3.2.9 Combustion Turbines(7)

The cost of combustion turbines installed in the mid-70's is estimated in excess of $120/kW. These units have heat rates averaging about 14,000 Btu/kWh. With a relatively high fuel cost for light oil, the overall cost including capital, operating and maintenance for these units is much higher than for nuclear units. In general, combustion turbines are installed for peaking service because of the relatively short lead time for construction, lower initial cost and limited period of operation. The largest size of individual units available today is approximately 59 to 60 MW, whereas the capacity to be installed at the Moscow site is 840 MW. The operating and maintenance cost of combustion turbines is high due to short operating periods between overhauls. Accordingly, this type of generation is not applicable for base-load operation on the CCD Companies' system.

9.3.2.10 Combined Cycle Plant(7)

The combined cycle concept utilizes combustion turbines, waste heat boilers and conventional steam turbine generators. This concept is being estimated for mid-1970's generation at above $175/kW. The units have a heat rate of about 9,000 Btu/kWh. These units, however, use high-cost fuel (oil or natural gas) and the availability of such fuels in the future is not certain. The combined cycle concept is considered intermediate type generation. The operating

1766 071

and maintenance cost of combustion turbine units which are the major part of a combined cycle plant has been high in utility service.

Due to the fuel supply problem associated with a combined cycle plant, this alternative is considered inappropriate for meeting future base-load system power demands.

9.3.2.11 Diesel Generators[7]

Diesel generators are used in this country for small amounts of power for peaking service. Most of the units running today are smaller than 10 MW. A few are being offered in the 10-15 MW range. At least 56 of the largest units and 84 of the more common units would be required to supply the needed 840 MW power.

Diesel generators use high-cost fuel and have high maintenance costs per hour of operation. With the large number of generators which would be needed to supply 840 MW, an additional cost of substantial economic and environmental magnitude would be spent merely controlling noise levels. In general, diesel generators are best used for peaking service and for few units at a given location. For these reasons, the installation of such diesel units for base-load generation is not practical.

9.3.2.12 Coal as a Fuel

[illegible] general arguments for and against the use of coal as a fuel can be found [illegible] this Report. In addition to the point made there concerning [illegible] impact of the combustion emissions from a coal-fired plant, there is a question of the future economic availability of low-sulfur coal.

Total coal resources in the U. S. were recently estimated at about 3200 billion tons but only about half of that total is recoverable at depths of less than 3000 feet[8] and only about 220 billion tons are estimated to be mineable at or below present costs. At present rates of consumption, this amounts to over 400 years' supply. Unfortunately, however, 2/3 of the proven reserves are west of the Mississippi River, but 90% of all coal is burned east of the Mississippi. This adds transportation costs to coal production costs. In addition, the principal highly developed eastern coal fields produce coal with a sulfur content too high to allow reduction to a level permitted by sulfur emission regulations. Much of the reserves in the Rocky Mountain and northern Great Plains regions are comprised of coal with low sulfur content, but also with low heating value.

A large percentage of the U. S. coal production (35% in 1968 [9] is mined from strip mines. These operations must generally institute reclamation programs on the land which has been denuded by the mining process. The cost of such reclamation programs may either increase the price of the coal mined or force some of the strip mining operations out of business. In either case, the price and availability of coal will be unfavorably affected.

One of the biggest factors in the coal availability picture is the uncertainty and turmoil of the labor situation. The United Mine Workers have participated in strikes for better compensation in wages and benefits. Some of the demands made in the included daily wage increases which would amount to pay for the highest-ranking workers of up to $50 per day; an increase, from 40¢ to 80¢ per ton, of the "royalty" paid by the mine operators into the union's pension fund; and paid sick leave and improved welfare benefits.(10) The miners are also becoming more aware of the health hazards associated with career mining, as are evidenced by the fact that, in July of 1970, 22,400 miners or their widows were receiving monthly compensation for "black lung" incidence.(11)

These problems and others - rising exports, lack of adequate mine capacity, etc. - all point to the conclusion that base-load of the CCD Companies should not rely solely on coal as its fuel.

9.3.2.12.1 Effect of Coal Supply on Ohio River Traffic

The installation of an 800 MW coal fired alternative to the Wm. H. Zimmer Nuclear Unit 1 would pose additional logistical demands upon the Ohio River. Assuming representative coal consumption rates and loadings on the unit, it is estimated that about 2.6 million tons of coal per year would have to be transported to the station by over 1700 barges. This would increase river traffic by about 100 (20-barge) tows annually, or one almost every three days.

9.3.2.13 Nuclear Fuel

General arguments for and against using nuclear fission as the energy source for the proposed power plant are presented in Paragraph 1.2.3.1 of this environmental Report. In addition to those points mentioned, some information on the expected future availability of nuclear fuel should be presented.

In a speech before the 1971 Energy Resource Conference in Lexington, Kentucky, Robert D. Nininger, AEC Assistant Director of the Division of Raw Materials, stated that as of January 1, 1971 there existed in the United States uranium reserves of 246,000 short tons of U_3O_8 at a price of $8 or less per pound, the U_3O_8. At a price of $10 or less per pound, the U. S. reserves total 300,000 short tons of U_3O_8. Recent AEC estimates show that cumulative domestic demand for U_3O_8 through 1980 will reach 206,000 tons, and then will increase to 450,000 tons through 1985. The present rate of reserve additions, about 50,000 tons per year, will meet needs and maintain an eight-year forward reserve through 1980. Then, from 1980 through 1985, about 85,000 tons of discoveries per year will be needed. Lifting of present uranium import restrictions would open the U. S. market to foreign suppliers, where current estimates of free world reserves at $10 or less per pound amount to 630,000 tons of U_3O_8. (12)

Because of the anticipated increase in the need for electric power, breeder reactors are being developed for commercial use, and plutonium recycle technology is being advanced. The timely use of both of these concepts will eliminate a uranium supply problem which could conceivably develop. One other factor which will affect the nuclear fuel production cycle is the availability of adequate domestic enrichment capacity. Congressional funds have been authorized for a planned increase in the present enrichment capacity. Also, the AEC has invited the industry to express its interest in enrichment technology with a design for the development of a private enrichment industry in the future. On June 4, 1971, President Nixon declared that, "...the Government must carry out its responsibility to ensure that our enrichment capacity expands at a rate consistent with expected demands."(13)

The results of the economic analysis of coal versus nuclear fuel are seen in Paragraph 9.3.3. Coupled with the fuels' supply and demand situations and their individual environmental effects, the economic analysis supports the conclusion that the Wm. H. Zimmer plant should be nuclear.

9.3.2.14 References

1. Hubbert, M.K., Resources and Man: A Study and Recommendations by the Committee on Resources and Man, Chapter 8: "Energy Resources," pp. 157-242, Division of Earth Sciences of the National Academy of Science and the National Research Council (1969).

2. Womack, G.J., MHD Power Generation: Engineering Aspects, Chapman and Hall, Ltd. (1969).

3. Postma, H., "Engineering and Environmental Aspects of Fusion Power Reactors," Nuclear News, 14(4) pp.57-62 (April, 1971).

4. Mishara, D., V.P., Eastman Dillon, Union Securities & Co. Inc., "Financing for the Seventies," taken from paper presented to Electrical World Conference, New York City (October, 1971).

5. U.S. Senate Committee on Public Works, "Some Environmental Implications of National Fuels Policy," (December, 1970).

6. The Oil and Gas Journal, "North Slope Reserves Count Veils Sharp Drop in Lower Forty Eight," Vol. 69, No. 14, pp. 38-39 (April 5, 1971).

7. Environmental Report for the Midland Station, Consumers Power Co. (January, 1969).

8. Averitt, P., "Coal Resources of the United States - January 1, 1967," Geological Survey Bulletin 1275 (1969).

9. National Coal Association, Bituminous Coal Facts 1970, Page 47, Washington, D.C. (1970).

10. Time, "Coal: New Fuel for Inflation?" p78 (October 4, 1971).

11. Office of Research and Statistics of the Social Security Administration, Publication (November 6, 1970).

12. Nininger, R.D., Nuclear Resources, Remarks Before the Energy Resource Conference, Lexington, Kentucky (May 11, 1971).

13. Nixon, President R.M., Energy Message to Congress (June 4, 1971).

9.3.3 Economic Comparison of Feasible Fuels - Nuclear vs. Coal

In Paragraph 9.3.2, twelve alternatives to nuclear power were discussed in the light of their applicability as base-load additions to the CCD system. The state of technological development and the availability of fuel leads to the conclusion that the two feasible alternatives are generation with coal or with nuclear fuels. The comparative economics of these two sources of energy were studied in great detail before the decision to expand with nuclear power was made. This section will review the study as first made in 1968 and as it was re-examined in late 1971.

9.3.3.1 Summary of Original and Recent Cost Comparisons

During 1968, Sargent & Lundy Engineers (S&L) was retained by the CCD Group to evaluate the technical and economic facets of the expansion of the CCD system by the installation of either nuclear or coal units. As part of the evaluation, a comparable fossil unit was compared to a comparably sized nuclear fueled unit. Estimates of future growth patterns, referred to in Paragraph 9.3.1, having dictated the need for an 800 MWe unit in the mid 1970's, the final decision to install a nuclear unit was based primarily on this economic comparison. As shown in Table 9.3-1, nuclear was the economic choice by 0.25 mills/kWh, on a 15-year levelized cost-of-energy basis. Table 9.3-1 also shows the economic comparison as it would be estimated today based on a generating cost levelized over a 33 year period of plant operations. This shows an even greater gap between nuclear and coal generation of 2.52 mills/kWh.

9.3.3.2 Capital Costs

Capital costs for the 1968 estimated nuclear unit were based on estimated 1975 price levels including interest during construction and other indirects (top charges). The scope included a cooling tower system for condenser cooling at $11.00/kW. The cost estimated in 1968, namely $241/kW, was updated in 1971 to $355/kW to reflect, among other things, slippage in the estimated start of commercial operation date to October, 1976 and increases in construction cost escalation. The comparable coal-fired unit estimate included first-unit-at-site costs, top charges, SO_2 removal equipment, cooling tower system for condenser cooling at $7.50/kW, coal inventory at $2.20/kW and escalation to the date of commercial operation. The SO_2 removal equipment was included at a cost of $20/kW, a value considered to be reasonable in the light of the existing state of the art.

TABLE 9.3-1

LEVELIZED GENERATING COSTS IN MILLS/kWh

	Boiling Water Reactor Unit	Comparable Coal Fired Unit
Estimated in 1968	7.76	8.01
Estimated in Late 1971	11.92	14.44

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The 1968 estimate, based on a 908 MWe net coal unit, was \$223/kW; the latest estimate, based on an 800MWe net unit, \$266/kW, including \$35/kW for SO_2 removal equipment.

Fixed charge rates applied to depreciating capital were levelized over the study period. The 1968 estimate of the fixed charge rate was 16.4% of the depreciable generating plant cost; the 1971 update showed 16.6% for the nuclear plant and 16.5% for the coal-fired plant.

9.3.3.3 Coal Prices

The coal price was estimated in 1968 to be 23.4¢/10^6 Btu in 1975, with escalation estimated at about 1%/yr throughout the fifteen year study. Using this fuel price, load distribution estimates, and hear rates as a function of loading, the levelized mill/kWh expenditure for fossil fuel was calculated. Severe perturbations which have occurred recently in the coal market have necessitated a sharp increase in the predicted fossil fuel price to 42¢/10^6 Btu in 1977, with escalation thereafter estimated at 4%/yr compounded annually.

The extraordinary escalation of delivered coal price is the most important factor in the increased economic benefit of nuclear power.

9.3.3.4 Nuclear Fuel Cycle Costs

The nuclear fuel cycle costs calculated in 1968 were based on the cost parameters outlined in Table 9.3-3. Nuclear fuel cycle costs are calculated starting with the procurement of the uranium ore concentrate and ending with the disposition of the reconverted spent fuel. The direct costs are allocated to each power-producing month in proportion to the fission heat produced during the month. The inventory costs are obtained by applying the appropriate carrying charge rate to the average monthly inventory value. In 1968, the nuclear fuel costs were calculated to be 1.47 mills/kWh, assuming the leasing of fuel. Estimated as of late 1971, fuel cost has increased to 1.84 mills/kWh to reflect fuel design changes, escalation and a \$32/kg-SWU enrichment charge together with a 0.25% enrichment tails which is expected to be experienced in 1976.

9.3.3.5 Net Savings at Nuclear Over Coal

Table 9.3-2 indicates the net savings of the nuclear plant over the coal-fired alternative, based on a 33-year study period. Both coal and nuclear plant costs are total values over the estimated operating life of the plant present worthed to 1977 and include capital charges, fuel, operation, maintenance, insurance, and supply costs. Coal price increases are reflected in the total production costs for the coal-fired plant, and are projected at compounded escalation rates of 1%, 2%, 3%, and 4% per annum. Experience over the past three years has shown that coal prices have increased on the average of 15% per year. As a result of the application of stringent mine safety laws, environmental concern over strip mining activities, and recent wage negotiations in the coal mining industry, a conservative estimate of increased coal price of 4% compounded per year does not seem unreasonable to use in economic evaluations.

9.3.3.6 Effect of Operation of Nuclear Facility on Uranium Resources

The operation of the Wm. H. Zimmer Nuclear Power Station will involve the consumption of a certain amount of uranium ore, which represents a fraction

TABLE 9.3-2

NET SAVINGS - NUCLEAR OVER COAL

Coal Price Escalation Percent Per Year	Present Worth Costs for Coal Fired Plant in Dollars	Present Worth Costs for Nuclear Fuel Plants in Dollars	Net Savings - Nuclear over Coal in Dollars
1	$578,757,000	$570,698,000	$ 8,059,000
2	605,967,000	570,698,000	35,269,000
3	641,641,000	570,698,000	70,943,000
4	683,724,000	570,698,000	113,026,000

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TABLE 9.3-3

COST PARAMETERS USED IN THE 1968 NUCLEAR FUEL EVALUATION

Uranium Ore Concentrate, net to conversion	\$8.00/lb U_3O_8
Conversion from U_3O_8 to UF_6	\$1.25/lb U as UF_6
Separative Work	\$26.00/kg-Unit Separative Work
Fabrication (Initial Core)	As bid by GE
Spent Fuel Shipping	\$4.25/kg Discharged
Reprocessing	\$24.00/kg Discharged
Reconversion	\$ 5.60/kg Reprocessed
Plutonium Credit	\$ 8.00/gm Fissile Material as Nitrate

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JUL 1 8 1979

Docket No. 50-358

POOR ORIGINAL

MEMORANDUM FOR: Victor A. Stello, Director
Office of Inspection and Enforcement

FROM: Harold R. Denton, Director
Office of Nuclear Reactor Regulation

SUBJECT: ALLEGATION RE CINCINNATI GAS AND ELECTRIC COMPANY
ZIMMER POWER STATION

Your memorandum of June 4, 1979 requested that this office review the Zimmer Construction Permit files to determine the extent to which NRC's decision to grant the permit was dependent on "allegedly spurious information." We have reviewed the following documents with respect to the allegations transmitted by your memorandum:

a. Applicant's Environmental Report January 15, 1971, as amended
b. NRC Final Environmental Statement, CP Stage (FES-CP) dated September 1972.
c. NRC Final Environmental Statement, Operating License Stage, (FES-OL) dated June 1977.
d. Transcript of Environmental hearing, September 20, 1972.
e. Atomic Safety and Licensing Board Initial Decision issued October 19, 1972.

Based on the review of these documents, we confirm the staff conclusion that nuclear fuel is economically superior to coal. This conclusion was independently developed from information additional to that provided in the applicant's environmental report. We further conclude that the relative economics of coal versus uranium fuels was not a significant contributor to the staff recommendation that a construction permit be issued.

Original signed by
H. R. Denton

Harold R. Denton, Director
Office of Nuclear Reactor Regulation

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Exhibit V
Page 1 of 1