UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

July 20, 1979

Marshall E. Miller, Chairman
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

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Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

In the Matter of
Duke Power Company
(Amendment to Materials License SNM-1773 for Oconee
Nuclear Station Spent Fuel Transportation and Storage at
McGuire Nuclear Station)
Docket No. 70-2623

Gentlemen:

In accordance with the Licensing Board's ruling (Tr. 2881) with respect to filing of additional testimony in the above-captioned proceeding, enclosed as additional direct or rebuttal testimony is the testimony of:

Dr. Darrel A. Nash

Mr. Clayton L. Pittiglio, and Professional Qualifications

Dr. John Nehemias

Dr. Michael A. Parsont

Sincerely,

Edward G. Ketchen
Edward G. Ketchen
Counsel for NRC Staff

Enclosures as stated

cc (w/ encl.):
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Atomic Safety and Licensing Board Panel
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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of DUKE POWER COMPANY (Amendment to Materials License SNM-1773 for Oconee Nuclear Station Spent Fuel Transportation and Storage at McGuire Nuclear Station)	))))))))	Docket No. 70-2623

TESTIMONY OF CLAYTON L. PITTIGLIO, JR.

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Question (1)

During the course of the hearing different cost estimates have been given for the construction of an Independent Spent Fuel Storage Installation (ISFSI). These estimates have ranged from a low of $10,000/assembly to a high of $34,500/assembly. Could you explain why there is a disparity in the numbers?

RESPONSE

The variations in cost are as a result of a difference in scope of the estimates, and not inconsistencies in the construction costs of the structure and equipment. For example, in the applicant's Exhibit # 7 (April 23, 1979 letter to the Staff), Duke Power Company's cost estimate for an ISFSI is $51,750,000 (escalated to 1978 dollars at an escallation rate of 8%/year) for a 1500 assembly storage facility. This cost is broken down as follows:

Structure	$ 5,964,000
Equipment	$17,106,000
Subtotal	$22,070,000
Engineering Labor and Overhead	$14,384,000
Contingencies & Interest	$14,235,000
	$51,689,000

Duke's cost estimate includes engineering, labor and overhead as well as contingencies and interest. Natural Resources Defense Council (NRDC), Exhibit # 10, (letter to Duke Power from Stone and Webster Engineering Corporation dated September 6, 1978), estimated $29,000,000 to $34,000,000 as the cost of the structure and equipment for a facility capable of storing 2300 PWR assemblies. This cost does not include engineering, labor, overhead nor contingencies and interest.

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Comparing these two facilities, the total cost for structure and equipment of the Duke Facility is \$23,070,000 or \$15,380 per assembly, and the Stone Webster Facility ranges from \$29,000,000 to \$34,000,000 or \$12,600 to \$14,800 per assembly.

As shown by these costs, the estimates represent consistent cost figures. Additionally, the Environmental Impact Appraisal presents a cost figure as a result of independent studies done at an earlier date of \$10,000 per assembly. This figure escalated to 1978 costs at 8% per year results is a cost of \$12,600 per assembly. The DOE cost estimate, when put into proper perspective, results in similar expenditures. Therefore, it can be concluded that the Duke Power Company estimate is very much in line with the other estimates which have been provided.

Question (2)

Are there any other differences between Duke's proposed facility and the Stone and Webster design?

RESPONSE

Yes, the Duke Facility is a totally independent facility, while the Stone and Webster design is not a completely independent facility. The Stone and Webster design relies on an interface with the parent facility. The following systems are not included in the cost estimate: solid radwaste; liquid radwaste; fire protection; make-up water; electrical; communications and security. If the Stone and Webster design was a totally independent facility, cost would increase.

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Question (3)

Would it be advantageous for Duke Power Company to physically expand the Oconee 3 Pool as suggested by Carolina Environmental Study Group (CESG)?

RESPONSE

The physical layout of the existing structure prohibits expansion of the pool in the manner posed by CESG. There is available space however, to proceed at a right angle to the existing pool.

The Oconee 3 Pool was not originally constructed with the capability for a later expansion. The pool does not have an expansion gate or canal which could be used for the transfer of assemblies to the new pool. Therefore, the movement of assemblies would have to be accomplished by the use of a cask as presently done between the Oconee 1 and 2 Pool and the Oconee 3 Pool.

The existing support systems needed to operate the Oconee 3 Pool have not been sized large enough to accomodate the increased capacity of spent fuel. That is the logic behind the need for a building to accommodate the new auxiliary systems, and their associated cost. The construction of such a pool would still require the majority of expense that would be required for a separate pool on the Oconee site. The only gain of such an undertaking would be the distance traveled by each spent fuel cask. However, a major drawback from this type of expansion would be the limited size of the pool, 650 assemblies, as testified to by S. Hager of Duke Power on Friday, June 22, 1979. (Tr. 1105 and 1181).

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In light of the limited size and lack of substantial cost saving, there is no advantage for Duke Power to pursue an additional pool adjacent to the present Oconee 3 Pool.

Question (4a)

The remaining costs associated with Duke Power Company's estimate of $34,500 per assembly, for the construction of an ISFSI, are attributed to engineering, labor and overhead, contingencies and interest. Would these costs be added to those cited by Stone and Webster?

RESPONSE

The Stone & Webster costs, as well as costs estimated by the other studies, were only for structure and equipment and did not include engineering, labor, overhead, contingencies or interest. These costs must be included to determine the capital cost of I.S.F.S.I.

Question (4b)

Based on your experience, do you have an opinion as to whether those costs cited by Duke Power Company are reasonable?

RESPONSE

Yes

Question (4c)

What is your opinion?

RESPONSE

Duke has the capability of being their own architect/engineer and constructor for this facility. Their charges for engineering, labor and overhead, contingencies, and interest are based on past experience from the construction of their own nuclear facilities. The Duke's estimate for contingency is 25%. This is not an unreasonable contingency for a new facility of this type.

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STATEMENT OF PROFESSIONAL QUALIFICATIONS OF
CLAYTON L. PITTIGLIO, JR.

Education

B.S. Civil Engineering University of Maryland 1969

Professional Engineering License
State of Maryland P.E. 9249
District of Columbia P.E. 6962

George Washington University - Master's of Engineering Administration Program, Current Registration - 2 courses for completion

Summary

My formal education has encompassed all phases of engineering and engineering management. The technical and management programs placed special emphasis on all phases of the nuclear and coal industry.

Experience

I have been employed by the U.S. Nuclear Regulatory Commission in Bethesda, Maryland as a Cost-Benefit Analyst since August 1978. During my employment, I have participated in review and evaluation of environmental impacts and economics of purposed nuclear generating facilities with respect to cost-benefit analysis. I have provided specialized input to NRC environmental impact statements pursuant to Appendix D, 10 CFR Part 51. I have evaluated construction cost estimates for modifications to new and existing facilities resulting from regulatory requirements along with supplying cost estimates for systems to mitigate adverse environmental impacts of nuclear generating facilities. I have worked in economic and environmental comparisons of alternate generating systems.

May 1970-August 1978

Prior to my experience with the U.S. Nuclear Regulatory Commission, I was employed by Bechtel Power Corporation for 8-1/2 years. During my employment with Bechtel, I worked on many different phases of design, construction cost estimating, bid evaluation, and construction of nuclear and coal generating facilities.

Generally, while with Bechtel Power Corporation, I was responsible for analysis, design, construction detail, and sequencing for the spent fuel building foundation for the SNUPPS - Standardized Nuclear Power Plant. My responsibilities on the SNUPPS project included review of the existing design, interface design for construction problems, including determination of appropriate material quantities for concrete and steel. I also coordinated with the designer of the exterior walls and designed the roof structure for the SNUPPS spent fuel building. Construction drawings for the SNUPPS project were issued by Bechtel Power Corporation. I signed the drawings as the responsible engineer.

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From November 1, 1977 to August 7, 1978, while at Bechtel Power Corporation as a senior engineer, I was responsible for the analysis, seismic and non-seismic, as well as the design of support systems for electrical conduits which supply power for safe shut down during accident conditions. I was responsible for supplying construction input to the job site and for checking construction drawings.

From June 1, 1977 to November 1, 1977, as a senior engineer at Bechtel Power Corporation, I engaged in engineering foundation work on a nuclear fuel building massive concrete structure. I was directly responsible for seismic and structural design, detailing, scheduling, cost analysis, and erection sequence, as well as related management and administrative duties. (See above, para. 2 -- May 1970-August 1978).

From February 1, 1976 to June 1, 1977, as a senior engineer with Bechtel Power Corporation, I was responsible for the review of the existing design of an industrial nuclear turbine generator building for construction and engineering problems. After reviewing the design, I made the necessary changes and additions as required. Along with these duties, I reviewed and approved structural steel shop drawings.

From December 1, 1975 to June 1, 1976, as a senior engineer with Bechtel Power Corporation, I was responsible for neutron shielding modification work to an existing commercial nuclear power facility, undertaken by Bechtel. This project consisted of design modifications, construction scheduling, cost analysis, and preparation of specifications, and bid evaluations.

From April 1, 1975 to December 1, 1975, as a design engineer with Bechtel Power Corporation, I was responsible for preparation of analysis of construction modifications. I worked on cost estimates and construction schedules for those modifications. I was responsible for the entire civil engineering input for a bid package for construction of a power plant modification. The particular construction contract was awarded to Bechtel based on the bid package I had prepared.

From May 1, 1970 to April 1, 1975, as an engineer with Bechtel Power Corporation, I worked on various aspects of the analysis and design of both nuclear and conventional power plants.

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of DUKE POWER COMPANY (Amendment to Materials License SNM-173 for Oconee Nuclear Station Spent Fuel Transportation and Storage at McGuire Nuclear Station)	)	Docket No. 70-2623

TESTIMONY OF DARREL A. NASH

Question: Are there economic advantages to building an ISFSI as soon as possible to avoid the effects of future inflation?

Answer: If the facility is not needed at the time it is available, it is almost never advantageous to have it sooner than needed.

Question: What do you mean by the word "needed" as used in the context of this case?

Answer: The need is for a means of storing spent fuel as it is discharged from the three Oconee units. Need is not to be confused with alternative solutions available to meet that need.

Question: Are there exceptions to your statement that it is almost never advantageous to have a facility sooner than needed?

Answer: Yes, one case is where the time of need is highly uncertain and the consequences of not having the facility when needed are great.

Question: Why is it not economically advantageous to build a facility early?

Answer: The reason for this is that cost of money (i.e., in the case of an electrical utility this consists of bonds, preferred stocks and common stocks), almost always exceeds the rate of inflation. The

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staff has found a nearly constant spread over more than 20 years between inflation and the weighted average cost of money to utilities of about 3 percentage points. Thus, investing now for the sole purpose of avoiding inflation later results in added costs.

Question: Why is the weighted cost of money to utilities important to the comparison?

Answer: In order to compare dollar costs which occur at different points in time, all costs must be adjusted (or, technically, discounted) to a common point in time because of the time value of money. A dollar is worth more now than a dollar to be received next year. The weighted cost of money is used as the discount rate. Future dollars discounted to the present time are called the present value of this sum of dollars.

Question: What is an example of the comparative costs of constructing a facility before it is needed versus constructing the same facility to be available at the time of need?

Answer: The following is an example where an ISFSI is built to become available in 4 or 5 years, assume 1983, versus delaying construction for 3 years. Using the cost of an ISFSI of $51,750,000, the comparative costs are shown below.

The cost is increased by 8% to adjust it to a 1979 dollar, (assuming 8% inflation). The 1979 level cost is $55,890,000. This is the cost of completion of a facility which is started in 1979 and completed in 1983. A facility started 3 years later and completed in 1986 would continue to inflate by 8% per year. However, to express the cost on a common time basis, the 1983 present value cost

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must be used. The present value of $55,890,000 using an 8% annual inflation and 11% discount rate for 3 years is $51,479,750. Thus, in this example, there is about an 8.5% cost increase by constructing the ISFSI earlier than needed.

The delayed facility would always have a lower present value cost, regardless of the spread between the inflation rate and discount rate, as long as the interest rate is greater.

Question: Are there any other reasons why such an ISFSI should not be built before it is needed?

Answer: Yes, one reason, especially with the continually developing options for handling spent fuel, immediate construction may tend to foreclose technological development which could reduce cost or improve public health and safety. Secondly, at some future time NRC or other regulatory bodies may conclude that protection of the public health and safety requires modifications in the design or construction of spent fuel pools. These changes likely would be lower cost and more effective if done before design and construction rather than to retrofit. Finally, national policy may change at some time and spent fuel could be reprocessed, in which case the requirements for long term storage of spent fuel would diminish.

Question: What are the cost comparisons of building an ISFSI at Oconee versus other feasible means of handling Oconee spent fuel?

Answer: Since an ISFSI will only be available in 4 years, optmistically, the comparison should be made on that timeframe when the ISFSI can receive spent fuel. This will be from 1983 to 1995. By then the 2300 assembly facility will be filled. The cost of this facility in the 1983 timeframe is $55,890,000.

A feasible alternative is to transship spent fuel first to McGuire, 300 assemblies, and then to transship to Catawba and Perkins the remaining 2000 assemblies. The alternative presented below assumes poison racks are installed at Oconee in 1991 rather than shipping to Perkins. This is done for illustrative purposes only, as it is quite uncertain which set of feasible alternatives, may ultimately be selected.

Question: What are the costs of this alternative?

Answer: First of all there is a cost of $2,500 per assembly to transship in 1978 $. Using the 8% escalation rate, by 1983 this will have risen to $3967 per assembly. The following analysis uses $4000 per assembly in 1983 dollars. Thus in 1983 the transshipment of 177 assemblies at $4000 per assembly results in a total cost of $708,000. Each year thereafter, costs of transshipment are assumed to increase at 8% per year. Cost of installing poison racks is $3650 per assembly. The following analysis assumes $4000 per assembly. By 1991, at 8% escalation for 12 years, this cost reaches $10,072.

Question: Are there other adjustments needed to obtain the cost comparison of the two alternatives?

Answer: Yes, as presented in the response to an earlier question, flows of costs over time must be expressed on a present value basis. The 1983 present value of transshipping/poison racks as described above is $5,970,428 (approximately $6 million). The 1983 present value cost of an ISFSI is over 9 times greater.

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Question: What conclusions do you draw from this analysis?

Answer: Building an ISFSI for near term storage will be a much more expensive means of providing for the need to store Oconee spent fuel. This is partly because one option is a complete new facility, and the other is simply equipment modification and transportation costs, including costs of preparing the spent fuel for transportation. Another important reason is that the ISFSI requires a large cost at the beginning of the project and results in a large amount of unused space during several years, (13 years are requires to fill the facility). The other option enables expenditures to be made much closer to the time of need, thus lowering present value costs.

There are lower cost alternatives available which allow an indefinite delay in need for an ISFSI. There is a cost penalty in building a facility early just to avoid inflation when properly expressed on a present value basis.

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of DUKE POWER COMPANY (Amendment to Materials License SNM-1173 for Oconee Nuclear Station Spent Fuel Transportation and Storage at McGuire Nuclear Station	)	Docket No. 70-2623

SUPPLEMENTAL TESTIMONY OF

MICHAEL A. PARSONT

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Q. What change do you wish to make in your testimony?

A. I should like to correct the record regarding two statements made by Dr. Leubke my responses to which do not appear in the transcript.

Q. To which of Dr. Leubke's statements do you refer and where are they located in the transcript?

A. Dr. Leubke's comments are located on page 2602 lines 23 and 24 and page 2603 lines 4 and 5.

The statements were "His heart and mind isn't in it. He doesn't believe it.", and "No, but his beliefs are different from what he does.", respectively.

Q. What was the response to Dr. Leubke's statement which does not appear in the transcript?

A. Following the statement, "No, but his beliefs are different from what he does.", I made the statement "not true, not true," which was not recorded.

Q. Would you please clarify why you made this statement?

A. I assume the use of the linear no threshold dose effect hypothesis in my calculations recognizing that there is some question about the ctual shape of the dose response curve for low doses. However, it is my belief that the linear hypothesis overestimates the number of health effects in the low dose region, and that its use is prudent for regulatory purposes. Therefore, I should like to assure Dr. Leubke that in using this hypothesis my personal views and my practices do not conflict.

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of DUKE POWER COMPANY (Amendment to Materials License SNM-1773 for Oconee Nuclear Station Spent Fuel Transportation and Storage at McGuire Nuclear Station)	))))))) :	Docket No. 70-2623

Testimony of John V. Nehemias

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Question (1)

In Staff exhibit 11.C you mentioned the value of 20 man-rems in the discussion of the occupational radiation exposure projected to result from re-racking of the Oconee spent fuel pool. In Staff Exhibit 11.A you used the value of 76 man-rems in the same context. During your prior oral testimony you were asked to compare the relative "reliability" or "accuracy" of these two values (on pages 2597-98 and pages 2715-18 of the Transcript). Is there any firm basis for concluding, in advance of the actual re-racking operation, which of these values is likely to be nearer to the total dose that actually results from completion of that operation?

Response

The figure of 20 man-rems appears on page 2 of Staff exhibit 11.C, and in the Table attached thereto, in the "Exposure" column. This value represents, to the best of my knowledge, the highest occupational radiation dose that has resulted from prior actual spent fuel pool re-rackings. It is not, and was not intended to be, a projection of the dose that might result from the Oconee re-racking.

The figure of 76 man-rems appears on page 2 of Staff exhibit 11.A, and in the Table attached thereto, in the "one-time Doses" column. This value represents the applicant's best estimate of projected doses from the Oconee re-racking, using then-current measurements of dose rates and occupancy times. If these measured dose rates were present during the actual operation, the resulting occupational dose would be expected to be approximately 76 man-rems.

However, based on some of the applicant's proposed actions to assure that occupational radiation exposures would be as low as is reasonably achievable (listed on page 2 of Staff exhibit 11.A), for example:

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vacuuming the pool floor, we could confidently expect that occupational exposures would be well below 76 man-rems. In this sense, the applicant's value of 76 man-rems, although based on actual measurements at the plant, was intentionally higher than what would be expected, and therefore conservative. As I stated on page 2717 of the Transcript, the figure of 76 man-rems is "...more accurate based on the data in hand but it is indeed conservative because we knew they were going to take further ALARA precautions".

The projection of occupational doses in advance of a planned operation is a matter of informed guesswork. It is typically not possible to determine dose rates and occupancy times within a factor of two or more, prior to the actual start of the operation, if then. Similarly, it is generally not possible to predict the effect of an ALARA action such as vacuuming the pool floor, within a factor of two or more.

Taking the above considerations into account, I would conclude that there is no basis for determining which of these values is likely to be nearer to the total dose that actually results from completion of that operation. The dose that finally results from that re-racking may well lie between the values of 20 and 76 man-rems; but could also lie below 20, as have those experienced so far, or higher than 76, as was projected initially by the applicant.

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Question (2)

Is there a qualitative difference between ALARA considerations as applied to occupational radiation exposure versus reactor effluents?

Response

Yes. The initial formal application of the ALARA concept to the regulatory process addressed control of radioactive effluents to the environment. Appendix I of 10 CFR Part 50 provides design objectives and limiting conditions for effluent releases.

The development of these provisions was based upon extensive experience with equipment designed to reduce concentrations of contaminants in effluent air and water. The state of the art is well developed. Proven techniques and equipment are available at the market place, capable of accomplishing a known degree of cleanup at a cost which can reasonably be known in advance. Thus, it is a relatively straight-forward matter to calculate costs of reducing radioactive releases and the resulting public doses that would be saved. A reasonably precise cost-benefit analysis can be obtained.

In the case of applying the ALARA concept to occupational radiation exposure, the situation is quite different. In the first place, there are not single, simple processes which will work in all instances in a predictable manner, such as filtration or ion exchange can, in reducing effluent concentrations.

Typically, there are a number of ALARA actions to be considered in addressing a proposed action, such as a fuel pool reracking; see those listed on page 2 of Staff Exhibit 11A. In general, it is not feasible to estimate precisely what the dose-reducing impact of such actions will be. There is no long history of similar experiences; and there is much less standardization of equipment and techniques.

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For example, in the reracking case, the applicant committed to vacuum the fuel pool floor prior to reracking. We could confidently expect that a dose reduction would result, but could not estimate the amount of dose that would be saved. Depending on the physical nature of the contaminants, the vacuuming might reduce the dose from that source (radioactive debris at the bottom of the pool) by, for example, as little as 10%, or by as much as 90%. Clearly, a dose estimate based on uncertainties of this magnitude is not a useful basis for detailed, quantitative cost-benefit analysis prior to an operation. In the actual case, the dose was reduced by 40%.

As a result, the ALARA process, as applied to occupation situations is principally qualitative in nature, and is concerned with assuring that all reasonable actions to reduce radiation doses are considered.

Question (3)

In your prior oral testimony, you testified on a number of occasions (e.g., on page 2536, line 24 and on page 2611, line 13 of the Transcript) that, if projected radiation doses from a number of alternative ways to accomplish an objective did not differ significantly among themselves, the choice among them would be made on the basis of factors other than radiation. Explain how that decision process might work.

Response

In this case, the applicant's projected radiation doses from the various alternatives varied from 30 to 76 man-rems, as listed in the Table attached to Staff Exhibit 11.A, in the "One-time Doses" column. These values are within a factor of 3 of one another, which is not [illegible] significant variation, given the inherent uncertainties in making such projections, as discussed in the response to Question (2) above.

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If projected radiation doses from a number of options turn out to be in the same general range of values, the decision as to which alternative is to be selected is determined by factors other than radiation dose. What this means in this case is that none of the options discussed (for example, reracking or building a new spent fuel pool) will significantly reduce doses, relative to the transshipment option. Therefore, there is no reason to pursue other factors, such as social or economic considerations, and no reason based on radiation dose considerations, to approve the transshipment application.

To illustrate the point, we will consider a comparison of two of the options, taking into account cost considerations.

According to the applicant's figures, which the staff believe are reasonable, construction of a new spent fuel pool for storage of 1500 assemblies at Oconee would cost $51,750,000. Projected occupational dose resulting from handling 1500 assemblies would be 150 man-rems (30 X 5). For comparison, the transshipment option, for 1500 assemblies would cost $3,691,000. Projected doses resulting from these 1500 transshipments would be (45.6 X 5) or 228 man-rems.

Thus, the new spent fuel pool option would save 78 man-rems (228 minus 150), at an additional cost of $48,059,000 ($51,750,000 minus $3,691,000). This dose saving would thus be accomplished at a cost of about $616,000 ($48,059,000 ÷ 78) per man-rem. A cost per man-rem this large is generally not considered reasonable.

Question (4)

In your prior oral testimony, you testified on a number of occasions (e.g., pages 2550, 2566, 2586, and 2603 of the Transcript) that given a hypothetical situation in which there were about 10 times as many fuel assemblies to be stored or transshipped, and given a comparable degree of attention to ALARA considerations, you would probably have approved the application. Explain the basis for this decision, and how that decision might relate to the review of the license amendment application.

Response

In the stated hypothetical situation, involving transshipment of about 10 times as many fuel assemblies, the relative magnitudes of the projected doses of the various alternative actions would increase proportionately. The projections do not become more accurate; they are still in the same general dose range relative to one another. Again, there would be no basis for selecting any other alternative, compared with transshipment, on the basis of health physics considerations alone, since none of the others would reduce dose significantly.

ALARA review addressed in my testimony relates to a minor action in the history of the plant. The occupational radiation exposure resulting would be a minor contribution to the total exposure caused by the plant. Regulatory Guide 8.8 describes the ALARA process. I have described the staff ALARA review, which determines that doses associated with particular actions will be ALARA.

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