

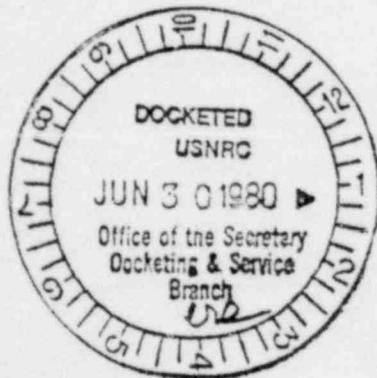
UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of)	Docket No. 50-272
)	
PUBLIC SERVICE ELECTRIC)	(Proposed Issuance of
AND GAS COMPANY, et al.,)	Amendment to Facility
)	Operating License No.
(Salem Nuclear Generating)	DPR-70)
Station, Unit 1))	

INTERVENORS-COLEMANS' PROPOSED
FINDINGS OF FACT AND CONCLUSIONS
OF LAW ON THEIR CONTENTIONS 2
AND 6, BOARD QUESTION 5 AND
AWAY-FROM-REACTOR ALTERNATIVES

Intervenors-Colemans hereby submit the attached proposed findings of fact and conclusions of law in accordance with the Board's Order of May 9, 1980 and 10 C.F.R. §2.754, §2.710.



Respectfully submitted,

STANLEY C. VAN NESS,
PUBLIC ADVOCATE

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On the Pleadings:

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Dated: June 26, 1980

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I. Proposed Findings of Fact

A. Introduction

1. Public Service Electric and Gas Company (hereinafter "Licensee"), on its own behalf and as agent for Atlantic City Electric Company, Delmarva Power and Light Company, and Philadelphia Electric Company, seeks an amendment of its Facility Operating License No. DPR-70 for Salem Nuclear Generating Station, Unit No. 1 located in Salem County, New Jersey. The proposed amendment would allow installation of new racks in the Generating Station's on-site Spent Fuel Pool (hereinafter "SFP"). This modification, or reracking, would expand the SFP's present storage capacity of 264 spent fuel assemblies to a capacity of 1170 assemblies, by increasing the density of storage.¹

2. The proposed new racks would be a modular stainless steel structure, with open-ended, box-like individual storage cells for each spent fuel assembly. Whereas the existing rack design has a center-to-center spacing between storage cells of 21 inches, the proposed racks would decrease that spacing to 10.5 inches. The four walls of each new storage cell would

¹Exhibit 6B, at 1-1

consist of an inner shroud of stainless steel, type 304, a center Boral sheet (boron carbide, B₄C, in an aluminum matrix) and an outer stainless steel shroud, again type 304. The Boral would provide for neutron absorption.²

B. Re: Colemans' Contentions 2 and 6

1. Eleanor B. and Alfred C. Coleman, Jr., were granted permission to intervene in these proceedings,³ raising the following, among other, contentions:⁴

2. The Licensee has given inadequate consideration to the occurrence of accidental criticality due to the increased density or compaction of the spent fuel assemblies. Additional consideration of criticality is required due to the following:

A. deterioration of the neutron absorption material provided by the Boral plates located between the spent fuel bundles;

B. deterioration of the rack structure leading to failure of the rack and consequent dislodging of spent fuel bundles.

6. The Licensee has given inadequate consideration to qualification and testing of Boral material in the environment of protracted association with spent nuclear fuel, in order to validate its continued properties for radioactivity control and integrity.

²Exhibit 6B, at 1-1, 2-1, 2-10, 2-13

³Order Following Special Prehearing Conference, dated May 24, 1978.

⁴Other contentions were dismissed as a result of the Licensee's motion for summary disposition (See Order, dated April 30, 1979).

2. Brooks and Perkins, Inc., manufacture poison materials and, in this case, has supplied the Boral material.⁵ The Lackenby manufacturing firm is under contract to Exxon Nuclear Company (hereinafter "Exxon") to assemble the finished racks.⁶ Exxon, in turn, will supply the racks to the Licensee, and was responsible for their design, engineering analyses and quality control during fabrication.⁷ Exxon also did the testing and criticality calculations in support of the integrity of the racking system.⁸ The Licensee has done no independent studies.⁹

3. Exxon's criticality analysis, submitted with the Licensee's application, concluded that K_{eff} ¹⁰ is lower than the .95 criteria accepted by the Nuclear Regulatory Commission (hereinafter "NRC") for spent fuel storage in high density racks. Those calculations, however, and the NRC Staff's accord with their conclusions, were predicated upon the integrity of the Boral in the proposed racks. According to the Staff, the K_{eff} of .95 in relation to the reracking of

⁵Exhibit 6B, at 2-13; Tr 545

⁶Tr 547

⁷Tr 602

⁸See Exhibit 5; Exhibit 6B, at 2-1

⁹Tr 581

¹⁰ K_{eff} or K effective is the measure of the approach toward criticality. For criticality to occur, K_{eff} must equal 1.0. (Exhibit 6B, fn at 2-1)

the Salem SFP is a function of how much Boron is in the racks.¹¹ In short, as a Staff witness pointed out, "[t]here has to be a minimum amount of boron in those racks to maintain the effective below .95."¹² Given the increased density of the new storage array, that minimally required areal density of boron between fuel assemblies is the 2.41×10^{21} boron-10 atoms per square centimeter created by the two Boral sheets.¹³ Thus, irrespective of any boron in the pool water,¹⁴ from a criticality standpoint it is imperative that there be no impeachment of the Boral material during the intended useful life of the modified SFP.

4. Yet, Boral, like all poison materials is subject to degradation depending upon its environment.¹⁵ The relevant

¹¹Exhibit 6B, at 2-1, 2-2

¹²Tr 658

¹³Id.; Exhibit 6B, at 2-1, 2-2

¹⁴The Salem SFP water is borated with boric acid to a concentration of approximately 2000 ppm in order to be compatible with, and not dilute the reactor cooling water which it contacts during refueling. (Tr 445) At the hearings, Exxon suggested that because of the boron in the SFP water, all Boral might be lost without criticality occurring. (Tr 557) However, no calculations, or other verifications appear in the record in support of this anomalous position, which does not logically flow from the NRC Staff analysis cited above. Indeed, Exxon admitted that it did not account for affect on criticality resulting from the presence of boron in the SFP water in the calculations submitted by the Licensee for NRC review. (tr 550) Moreover, and in stark contradiction, the same Exxon witness admitted at one point that if all or part of the Boral is lost, this "certainly would have a serious impact on criticality." (Tr 556)

¹⁵Tr 624

environment in this case is the borated SFP water.¹⁶ Corrosion occurs when Boral is exposed to a boric acid SFP environment. This problem, not "fully expected" in the words of Exxon,¹⁷ came to light recently at the Monticello Nuclear Generating Plant SFP. In summary, leaks developed in a number of the storage cells at Monticello, and when the Boral was exposed to the borated pool water aluminum oxidation and corrosion resulted.¹⁸

5. According to Exxon, the welding procedures used during fabrication of the racks proposed for the Salem SFP make them 'leak-tight', and overcome the Monticello problem. Upon closer examination, Exxon's precise, and less extravagant, claim is that there is a 95% leaktightness with a 95% confidence level.¹⁹ When pressed further by the Board, Exxon interpreted this to mean, leaks in up to 30 cells could be anticipated.²⁰ And, even this claim is questionable where it is based upon only one helium check of the completed cells,²¹ and obviously not on experience. In short, if the proposed reracking proceeds, corrosion will occur in up to 30, and perhaps more, of the storage cells.

¹⁶Tr 448; see fn. 14, supra.

¹⁷Tr 628; In fact, the problems were "new." (Tr 626-627)

¹⁸Exhibit 6B, at 2-13

¹⁹Tr 458, 493, 599; see also Exhibit 6B, at 2-13

²⁰Tr 770

²¹Tr 493

Moreover, the corrosion will most likely extend to all four Boral plates in the walls of each affected cell.²²

6. It is significant to realize that the use of stainless steel clad Boral in a boric acid SFP environment for an extended period of time, and in conjunction with a still relatively novel high density storage array,²³ is essentially experimental. This is obvious from the record. None of the longer term uses of Boral mentioned by the Licensee, Exxon or the NRC Staff involved borated SFP water.²⁴ Furthermore, past experience with Boral in an unborated environment has not even come close to the 40 year time-frame being addressed in this case.²⁵

7. Clearly, the impacts of an "experiment" with Boral use over an extended period and in the face of real corrosion problems, as proposed in this case, are highly speculative and shrouded with doubt. The full, longer term results of the Monticello incident are not yet in. And, the Licensee's conclusion that the occurrence of corrosion will have little or no affect on the Boral's neutron absorbing capacity for the next 40 years is based solely upon Exxon's brief one-year corrosion study, and extropolation of its necessarily limited

²²Tr 617, 618

²³Tr 1062, 1064

²⁴Exhibit 6B, at 2-2; Tr 592, 603, 680

²⁵Compare Tr 680 with Tr 417, 418, 866 through 873

findings to a 40 year period.²⁶ The magnitude of the difference between the study period and the time-frame in which the study findings are predicted to apply, alone destroys confidence in the conclusion by extropolation. Indeed, in response to questioning by the Board on a related matter, an Exxon witness admitted (during an obviously evasive dialogue with the Board) that it would not be "judicious" to rely upon Exxon's corrosion report and the mere one-year study it reflected, to conclude that there would be no problem in the long run if the Boral sheets in the storage cells were indiscriminately exposed to the boric acid pool environment.²⁷ At one point he went so far as to state:

I'm saying based on our one-year test program I cannot conclusively say that every single possible effect due to Boral performance in a boric acid environment has been identified.²⁸

At other points he noted that corrosion problems had not been completely put to rest by the one-year study and that unknown questions remained as to the 30 or 40 year performance of Boral exposed to borated pool water.²⁹

²⁶Exhibit 5; Tr 582, 680

²⁷Tr 619 through 630

²⁸Tr 630

²⁹Id.

8. The proponents of reracking invalidly insist that when corrosion occurs it should be considered only as an occasional inconvenience to be resolved by venting. This ignores the obvious limitations of Exxon's leak and corrosion tests described above. It focuses only on the immediate, discrete problem of eliminating the swelling caused by gas pressure within the storage cell walls,³⁰ and fails to recognize the legitimate concerns with the integrity of the Boral, particularly over the long term, after the leak and venting have exposed it to the boric acid environment and corrosion.³¹ This short-sightedness, and resulting failure to deal with the most critical question of continued Boral performance, is exemplified by the Licensee's position with regard to use of corrosion damaged storage cells. While cells damaged before spent fuel has been inserted purportedly will not be used thereafter, the Licensee would not say that such use was impossible, and inadvisable.³² Most significant

³⁰The oxidation of aluminum at Monticello generated hydrogen gas, and pressure from the gas build-up caused swelling in the storage cell wall. This was relieved by venting the gas. (Exhibit 6B, at 2-13)

³¹The venting procedure also has risk implications where it contemplates activity, including use of tools which might be dropped, in close proximity to stored fuel assemblies. In fact, because of the risks of periodic venting after the racks are in use, one NRC Staff witness would prefer venting all cells before installation. (Tr 719, 720)

³²Tr 684

is the Licensee's clear intention to leave in place spent fuel assemblies stored in corrosion damaged storage cells,³³ possibly for more than 30 years depending upon the economic advantages to the Licensee.³⁴ This is patently unacceptable in the face of legitimate questions as to the continued integrity of Boral once exposed to the borated pool water.

9. The Licensee's proposed surveillance and monitoring program is similarly infirm. Because of the Licensee's failure to acknowledge the potential risks of Boral use in borated SFP water, the program is fundamentally defective. Only fifty poison coupons would be deployed in the SFP, to test for corrosion effects by visual observation and weighing, a year after the racks are installed and every two years thereafter. Such a program is clearly designed as an extension of Exxon's experiments, not to detect and protect against Boral failure in individual cells.³⁵ Specific storage cells will be tested, with a dummy assembly, only at the time fuel assemblies are to be inserted, and only to see whether swelling in cell walls will prevent insertion.³⁶ Swelling will be detected in storage cells already housing spent fuel only when an attempt

³³Tr 496, 497

³⁴Tr 417, 418, 866 through 873

³⁵Tr 513, 586

³⁶Tr 580

to remove an assembly fails. In short, as admitted by the Licensee, no one will know if there is a corrosion problem in cells where fuel assemblies are located, and possibly impeachment of the Boral's capacity to absorb neutrons, until removal is attempted.³⁷ And, as noted above, it is possible under the proposed licensing amendment that this awareness will not occur for 30 to 40 years. Finally, the Licensee has no standards for, or plan of action if coupon specimens indicate that boron particles are being dislodged, nor clear procedures, indeed direction, for noticing the NRC.³⁸

C. Re: Board Question 5

1. During the course of the hearings, the Board posed the following question:

In the event of a gross loss of water from the storage pool, what would be the difference in consequences between those occasioned by the pool with expanded storage and those occasioned by the present pool?

1. The record to date is inadequate to provide a satisfactory answer to this question. The missing element, identified in the April evidentiary hearings, is a calculation which could be done fairly easily and within a time-frame which is manifestly reasonable. All of the analyses presented during the hearings on the above question involved the propagation of a

³⁷Tr 761

³⁸Tr 512-513, 516, 684

"zirconium fire" as an intermediate step toward potentially untoward consequences.³⁹ As Dr. Benjamin, an NRC Staff witness, pointed out, there are uncertainties as to the effect of the proposed SFP configuration on propagation of a zirconium fire.⁴⁰ After summarizing bases for such doubts,⁴¹ he indicated that a calculation to resolve them, one way or another, could be done by one person in a few months.⁴²

3. It would be inappropriate to finesse a finding on the issue of a zirconium fire through legalistic hair-splitting, using terms like "significant possibility" to indicate degrees of probability.⁴³ Dr. Benjamin eloquently responded to such an attempt by the Board, and indicated that the missing calculation is indeed warranted. His testimony in this regard was the following:

I believe that the possibility of this phenomenological occurrence happening is significant enough to warrant its inclusion in a consideration of what the consequences might be.

Let me restate what I just said. I think that the possibility of this occurrence of clad oxidation propagation is significant enough to warrant its consideration in determining whether there is a difference between one special [(sic) spatial] geometry

³⁹For brevity, the term "zirconium fire" is used herein, as in Mr. Pasedag's prepared testimony, to refer to a class of situations, not all of which would be fires in a technical physio-chemical sense.

⁴⁰Tr 1481 through 1491

⁴¹Tr 1485

⁴²Tr 1482-1483

⁴³See Tr 1486-1487

and another. Scientifically we were to [(sic) would] approach it this way. I would not say whether the probability of this occurring is greater than or less than 50 percent because it is not a [stochastic] process - it is a process which has an answer and we need to find the answer before we can say what it is but I would say that it would be scientifically correct to include as a conservative possibility in evaluating the difference between fuel pools the possibility that this would occur.⁴⁴

Although another Staff witness, Mr. Pasedag, felt that further study is unnecessary, his testimony was based only upon a few days of reviewing literature,⁴⁵ whereas Dr. Benjamin is an expert working in the field. In any event, the fact that they were in disagreement over the existing data can lead to only one reasonable conclusion viz., more specific data is needed.

D. Re: Away-From-Reactor Alternatives
(See Lower Alloways Creek Contention)

1. The design of the present Salem SFP rack allows for discharge of spent fuel assemblies equal to 1/3 of the core upon annual refueling, plus a full core, 193 assemblies, if necessary for core maintenance operations.⁴⁶ This limited capacity

⁴⁴Tr 1488-1489 (emphasis added)

⁴⁵Tr 1588-1589

⁴⁶Exhibit 6C, at 2; Tr 1062; The Licensee maintains that the reservation of storage capacity for a full core discharge is not a safety measure, but merely expedient if a core maintenance operation becomes necessary. (Tr 866) We do not agree that safety is not involved with regard to the reservation of such capacity. If a core maintenance operation is called for, yet there is no immediately available capacity in the SFP to house the fuel assemblies in the core, this surely has safety implications. For this reason, we fully support reserved capacity for a full core, and urge the NRC to require it.

is clearly premised upon the SFP at the reactor site being used primarily to store approximately 65 spent fuel assemblies in a less dense array for an initial and temporary decay period of about a year or less before shipment off-site. At most, if full core discharge capacity is ignored, only 264 spent fuel assemblies could be accommodated before the SFP reaches capacity in approximately 4 years.⁴⁷

2. The Licensee claims that if the existing rack configuration is maintained, at its 5th annual refueling date the Salem Generating Station would have to close down.⁴⁸ This is predicted because there has been no provision as yet for final, off-site disposition of the spent fuel. Nor, according to the NRC Staff, is it foreseeable that such capacity, or alternative away-from-reactor storage facilities, will be available in time to meet the Licensee's spent fuel needs.⁴⁹ Therefore, in contrast with the present design, the proposed reracking would permit higher density storage of spent fuel at the SFP at least until (i) about 1996 with a capacity for full core discharge; or (ii) about 1999 without capability after 1997 to store an additional full core. (1170 fuel assemblies in total)⁵⁰

3. It should be noted, however, that relevant federal

⁴⁷ Exhibit 6P, at 1-1

⁴⁸ Tr 1026, 1030

⁴⁹ Exhibit 6C, at 15-16

⁵⁰ Tr 1105

agencies are predicting interim away-from-reactor storage capacity by 1983 or 1984, and final depository could be available between 1988 and 1993.⁵¹ If these facilities proceed as forecast, there would be a considerable overlap with remaining capacity in the Salem SFP if modified. Moreover, according to the Licensee, the proposed licensing amendment would allow the higher density storage of 1170 spent fuel assemblies at the on-site Salem SFP up to the 40 year life span of its original operating license -- at the Licensee's discretion which would be exercised primarily on the basis of its own economic advantage.⁵² Apparently then, despite the availability of off-site facilities, including final depository, the Licensee would nonetheless be at liberty to decide for economic reasons alone to ship-off-site only sufficient numbers of fuel assemblies to maintain available cells for discharge of 1/3 of the core during annual refueling, and keep over 1000 assemblies at the reactor site. And, this would be irrespective of any overriding benefits of away-from-reactor facilities from an environmental and safety standpoint.

4. The factors set forth above signal what should be the very limited purpose and scope of the proposed license amendment, and NRC's consideration thereof. The reracking

⁵¹Exhibit 6C, at 15-15

⁵²Tr 517, 518, 866 through 873

proposal cannot be viewed as anything more than an alleged expedient solution to a perceived need for interim spent fuel storage space at the reactor site pending more appropriate away-from-reactor facilities. Thus, the Licensee's burden includes a showing that off-site alternatives are not feasible.⁵³ And, amendment approval, if at all, should be narrowly conditioned to meet only the need shown. It should not, as the Licensee would have it, stand for a blanket sanction of continued on-site, high-density storage for 40 years or so at the economic will of the Licensee, and irrespective of off-site alternatives should they become available and prove more appropriate protection of the public health and welfare.

II. PROPOSED CONCLUSIONS OF LAW

A. Standards

1. In order to rule affirmatively on the proposed amendment to the Licensee's operating license, the following conclusions of law must be made:

(a) that there is a need to expand the Salem SFP to meet the spent fuel needs of the Licensee which needs cannot be more appropriately met by away-from-reactor facilities;

(b) that there is reasonable assurance

⁵³Cf., Exhibit 6C, at 15-16

that the activities authorized can be conducted without endangering the health and safety of the public; and (c) that the issuance of the requested amendment will not be inimical to the health and safety of the public.

2. In addition to the above, it is incumbent upon this Board in considering the request for increased on-site storage capacity at the Salem SFP to weigh, balance and apply the five factors listed in the NRC "Notice of Intent to Prepare Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel," including factors: (2) concerning the likelihood of amendment approval constituting a commitment or resources which would tend to foreclose alternatives; and (5) with regard to the likelihood that deferral or severe restrictions on licensing would result in substantial harm to the public interest.⁵⁴

⁵⁴40 F.R. 42801, September 16, 1975; This NRC policy direction was to provide the guidelines for review of specific SFP expansion applications pending generic consideration of the industry-wide problem of spent fuel disposition in the noticed environmental impact statement. While it is true that the "Final Generic Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel" (NUREG-0575) was released in August of 1979, the policy in the Notice of Intent has not yet been modified. Therefore, contrary to the Licensee's arguments, that policy remains in effect and is applicable to this Board's review of the instant amendment application. In the Matter of Commonwealth Edison Company (Zion Station, Units 1 and 2), February 14, 1980, slip opinion, at 11.

B. Amendment Denial

1. The requested license amendment should be denied as a matter of law. Based upon the existing record, there is no reasonable assurance that the activities proposed can be conducted without endangering the health and safety of the public, or sufficient proofs that issuance of the proposed amendment will not be inimical to the health and safety of the public. This is so because:

- (a) there has been inadequate testing of the Boral material in a boric acid SFP environment and compacted storage array in order to validate its continued ability to absorb neutrons throughout the anticipated life of the modified Salem SFP and protect against criticality;
- (b) there has been inadequate consideration of the potential for criticality due to Boral corrosion and deterioration of its neutron absorbing capacity during the anticipated life of the modified Salem SFP;
- (c) the Licensee's proposed monitoring and surveillance program will provide inadequate protection against criticality due to Boral deterioration and inability to absorb neutrons in individual storage cells, particularly those which house spent fuel assemblies; and

(d) there has been inadequate consideration of the potential for propagation of a "zirconium fire" in the compacted storage array proposed for the Salem SFP and, thus, inadequate consideration of the consequences of such an incident.

2. In addition, the requested license amendment should be denied as a matter of law because:

(a) as proposed the amendment would permit a modification of the at-the-reactor Salem SFP which would result in a commitment of resources tending to foreclose the alternative of shipping spent fuel assemblies from the Salem facility to away-from-reactor facilities, interim or final depository, once such facilities become available and if they prove to be the more appropriate alternative from an environmental and safety standpoint;

(b) the Licensee has not shown, and in light of the present storage capacity at the Salem SFP cannot show, that denial of the requested amendment at this time, in order to further study the use of Boral and the matter of propagation of a zirconium fire, would result in substantial harm to the public interest.

C. Conditional Approval

1. Although we oppose such action, if this Board is inclined to rule affirmatively on the proposed license amendment, it clearly cannot pretend to reach the conclusions of law necessary to such a ruling without the following express conditions in the Order:

(a) the Licensee shall, in addition to its presently intended monitoring and surveillance program, develop for NRC approval a procedure for testing each individual storage cell periodically, particularly those cells which are housing spent fuel, to detect signs of corrosion and any deterioration of the Boral's capacity to absorb neutrons;

(b) upon detection of a leak, corrosion or Boral deterioration in a particular storage cell wall, the Licensee shall report the incident to the NRC and not thereafter use the cell for storage of spent fuel;

(c) upon detection of a leak, corrosion or Boral deterioration in a particular storage cell housing a spent fuel assembly, the Licensee shall remove the assembly according to procedures approved by the NRC;

(d) so long as other storage cells are available, the Licensee shall avoid use of cells adjacent to one where a leak, corrosion or Boral deterioration has been detected;

(e) the Licensee shall maintain throughout the life of the modified SFP, capacity for discharge of a full core, unless, upon application by the Licensee, the NRC for good cause authorizes otherwise;

(f) the NRC, shall perform the calculations necessary to determine any increased potential for propagation of a zirconium fire created by the compacted storage array and these hearings shall be reopened to pursue the matter of consequences where such calculations show an increase in potential; and

(g) this Order is expressly conditioned upon the reservation of authority in the NRC to reopen the licensing amendment whenever away-from-reactor capacity to handle spent fuel becomes available, and to order that spent fuel from the Salem Generating Station, Unit 1 be sent to such a facility or facilities upon evidence that the away-from-reactor alternative is more appropriate than continued, longer term high-density storage at the Salem SFP from an environmental and safety standpoint.