UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket Nos. 50-295
COMMONWEALTH EDISON COMPANY	)	50-304
	)	
(Zion Station, Units 1 and 2)	)	

NRC STAFF'S MOTION FOR SUMMARY DISPOSITION

Richard J. Goddard
Counsel for NRC Staff

January 31, 1979

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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The United States Nuclear Regulatory Commission Staff (Staff) moves that the State of Illinois' Contentions 6C, 7, 8, 9, 14 below be dismissed pursuant to 10 CFR §2.749 for want of a genuine material issue of fact to be adjudicated during the upcoming hearings. The Staff is of the opinion that the attached affidavits, together with other documents referenced herein,[1/] demonstrate that Intervenors have failed to produce a sufficient factual basis for these contentions and that there are no issues of fact worthy of adjudication at the hearing. Accordingly, this Atomic Safety and Licensing Board (Board) should dismiss these contentions as a matter of law.

Section I of this pleading will discuss, in general terms, the law applicable to summary disposition motions. By means of the attached affidavits

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1/ See footnote 7 *infra*.

of NRC Staff members, Section II will show, contention by contention, that there are no material issues of fact raised by certain of the Intervenors' contentions. Legal arguments and statements of material facts as to which there are no genuine issues will be listed infra by contention along with the supporting Staff affidavit(s) relating to that contention.

I. General Points of Law

The requirement that there be a factual basis for each contention in issue in a Nuclear Regulatory Commission proceeding derives from two sources: 1) the contention requirement of 10 CFR §2.714 and (2) the summary disposition provisions of 10 CFR §2.749. As will be shown below, a motion to dismiss will lie on the basis of either rule.

A. Factual Bases for Contentions Under 10 CFR Section 2.714.

The new 10 CFR §2.714(b) requires that there be a factual basis for each contention set forth by each petitioner to intervene.[2/] That section states

2/ This concept is supported by prior case law. See Duquesne Light Co. et al. (Beaver Valley Power Station, Unit No. 1), ALAB-109, 6 AEC 243 245 (April 2, 1973); Virginia Electric and Power Co. (North Anna Power Station, Units 1 and 2), ALAB-146, 6 AEC 631, 633 (September 14, 1973); Wisconsin Electric Power Co., et al. (Point Beach Nuclear Plant, Unit 2), ALAB-137, 6 AEC 491, 505 (July 17, 1973).

Adickes v. Kress & Co., 398 U.S. 144, 157 (1970); Cleveland Electric Illuminating Co. (Perry Nuclear Power Plant), ALAB-443, 6 NRC 741 (November 8, 1977).

The rules governing summary disposition are analogous to the law of summary judgment in the Federal Courts under the Federal Rules of Civil Procedure,[4/] in that the moving party must demonstrate that there is no genuine issue of fact remaining to be decided and that the uncontroverted facts entitle him to judgment as a matter of law.[5/] Affidavits setting forth the material facts about which there are no genuine issues to be heard may ccompany the motion to dispose of issues in the pleadings, and the affidavits may be supplemented or opposed by depositions, answers to interrogatories or further affidavits.[6/]

While it is not necessary to present evidence in order to defeat a motion for summary disposition since the motion itself and accompanying affidavits must discharge the movant's burden (and no defense to an insufficient showing by movant is required) it is said to be perilous for an opposing party not to proffer any countering evidentiary materials or affidavits, since

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4 / Alabama Power Company (Joseph M. Farley Plant, Units 1 and 2), ALAB-182, 7 AEC 210, 217 (March 7, 1974); Public Service Company of New Hampshire (Seabrook Station, Units 1 and 2), LBP-74-36, 7 AEC 877, 878 (May 17, 1974); Gulf States Utilities Company (River Bend Station, Units 1 and 2), LBP-75-10, 1 NRC 246, 247 (March 20, 1975).

5 / Adickes v. Kress & Co., 398 U.S. 144, 158-161 (1970).

6 / To the extent that summary disposition is appropriate to dispose of contentions alleging inadequate analysis or failure to consider potential issues, see Public Service Co. of Oklahoma, (Black Fox Station, Units 1 and 2), LBP-77-46, 6 NRC 167 (1977).

As will be shown by the attached Staff affidavits, each of the Intervenors' specified contentions lack a sufficient factual basis to be allowed to go to hearing in this proceeding.

B. Summary Disposition Under 10 CFR §2.749

In addition to the factual basis requirement of §2.714, the Commission's rules provide that a moving party is entitled to summary disposition if it can be shown that there are no material issues of fact to be adjudicated at the hearing. 10 CFR §2.749. That Section states:

> Summary Disposition on Pleadings
>
> §2.749 Authority of presiding officer to dispose of certain issues on the pleadings.
>
> (a) Any party to a proceeding may, at least forty five (45) days before the time fixed for the hearing, move, with or without supporting affidavits, for a decision by the presiding officer in that party's favor as to all or any part of the matters involved in the proceeding.

C. Burden of Proof

The Supreme Court and NRC have clearly held that it is the party seeking summary judgment, not the party opposing it, which has "the burden of showing the absence of a genuine issue as to any material fact, . . . ".

that the Intervenor must file a supplement to his petition to intervene that includes . . ." a list of the contentions which petitioner seeks to have litigated in the matter and the bases for each contention set forth with reasonable specificity." 10 CFR § 2.714.

Thus, prior to any hearing, the Atomic Safety and Licensing Board must assure itself that each contention presents a genuine issue appropriate for resolution in the proceeding. Case law provides that

> "Before commencing an evidentiary hearing, a licensing board must, of course, pass upon the sufficiency of every contention contained in an intervention petition which has previously been granted. And. . . the board is to exclude from consideration at that hearing any contention which does not present a genuine issue appropropriate for resolution in the proceeding. Stated otherwise, the hearing is not to embrace a contention which either (1) as presented, fails to satisfy the requirements of 2.714; or (2) can be summarily rejected on the merits under the provisions of Section 2.749 of the rules of practice. 3/

As an illustration of this principle, in the Beaver Valley case, the Appeal Board stated that a Licensing Board

> ". . . must be satisfied, with respect to each contention which the petitioner seeks to litigate, that a genuine issue in fact exists. Any contention which on preliminary examination does not survive the application of that standard is to be excluded from consideration at the evidentiary hearing." Duquesne Light Co., et al. (Beaver Valley Power Station, Unit No. 1), ALAB-109, 6 AEC 243, 245 (April 2, 1973) (Emphasis added).

3/ Mississippi Power and Light Co. (Grand Gulf Nuclear Station, Units 1 and 2), ALAB-130, 6 AEC 423, 424-25 (June 19, 1973).

the rule clearly states that a party opposing the summary disposition motion may not rest upon the mere allegations or denials in his answer but rather must provide by affidavit, deposition or answers to interrogatories, specific facts showing there is a genuine issue of fact in controversy. 10 CFR §2.749(b); Perry, ALAB-443, supra, at 754.

In this regard, a Licensing Board has said:

> In order to defeat a motion for summary disposition the Intervenor must establish (or the Board perceive from the record) that there does exist a genuine issue of material fact with respect to each contention so attacked. At this stage, mere allegations in the pleadings are not sufficient to establish the existence of an issue of material fact. 10 CFR §2.749(b); See Orvis v. Brickman, 95 F.Supp. 605 (USDC, D.C. 1951), aff'd. 196 F.2d 762 (D.C. Cir. 1952); see also 6 Moore §56.15/3/.
>
> To defeat summary disposition an opposing party must present facts in the proper form; conclusions of law will not suffice. The opposing party's facts must be material, substantial, not fanciful, or merely suspicious.
>
> One cannot avoid summary disposition "on the mere hope that at trial he will be able to discredit movant's evidence; he must, at the hearing, be able to point out to the court something indicating the existence of a triable issue of material fact" 6 Moore's Federal Practice 50.15/4/. One cannot "go to trial on the vague supposition that something may turn up." 6 Moore's Federal Practice 56.15/3/. See Radio City Music Hall v. U.S. 136 F.2d 715 (2nd Cir. 1943). In Orvis v. Brickman, 95 F.Supp. 605 (D.D.C. 1951), the Court, in granting the defendant's motion for summary judgment under the Federal Rules said:

Footnote 8 continued from previous page.

4. Letter with attachment from Licensee to Director of Nuclear Reactor Regulation supplying additional information on proposed Spent Fuel Pool expansion, dated November 8, 1978.

5. Deposition of Intervenor's expert witness, Marvin Resnikoff, taken on December 27, 1978.

6. Zion Station Final Safety Analysis Report.

7. United States Atomic Energy Commission, Safety Evaluation Report, Zion Nuclear Power Station, Units 1 and 2, dated October 6, 1972.

8. Letter from Alan P. Bielawski to Licensing Board members correcting "Affidavit of John P. Leider, Jr.," dated January 17, 1979.

> All the plaintiff has in this case is the hope that on cross-examination . . . the defendants . . . will contradict their respective affidavits. This is purely speculative and to permit trial on such basis would nulify the purpose of Rule 56 . . . .
>
> Gulf States Utilities Company, (River Bend Station, Units 1 and 2), LBP-75-10, 1 NRC 246, 248 (March 20, 1975) (Footnotes omitted)

Summary disposition is appropriate in administrative hearings because it makes possible the prompt disposition of a case on its merits without a formal hearing by permitting a party to pierce his opponents' pleadings by presenting material evidence in affidavit form which establishes that no factual dispute exists.[7/] The Staff submits that such a procedure for saving hearing time by culling out baseless allegations is particularly appropriate in the instant case since, as will be shown below by affidavits and the parties' own answers to discovery and depositions,[8/] there is no factual basis for any of the Intervenors' contentions discussed herein.

7/ Gellhorn and Robinson, Summary Judgment in Administrative Adjudication, 84 Harv. L. Rev. 612 (1971).

8/ The following documents are considered by the NRC Staff to be relevant to the requested ruling on this Motion:

1. Letter with attachment from Licensee to the Deputy Director, Office of Nuclear Reactor Regulation requesting License amendment, dated April 13, 1978.
2. "Lice' ing Report, Zion Nuclear Power Plant, Units 1 and 2, Spent Fuel Rack Modification" prepared by Nuclear Services Corporation.
3. Letter with attachment from Licensee to the Director of Nuclear Reactor Regulation supplying additional information on proposed Spent Fuel Pool expansion, dated October 24, 1978.

CONTENTION 6C

I. Contention 6C states:

> There has been insufficient development of all credible accident scenarios.
>
> * * *
>
> C. There is insufficient information regarding the methods by which accidental damage to stored spent fuel assemblies will be prevented during the installation of the new poisoned spent fuel storage racks.

II. Material Facts As To Which There Is No Genuine Issue To Be Heard

A. Licensee has outlined administrative procedures and controls designed to insure that, in carrying out the proposed replacement of the spent fuel storage racks, neither the old or new racks will be transported above the spent fuel assemblies in the pool.

B. The spent fuel handling procedure to be employed is the normal procedure outlined in the Zion FSAR, and is in no way affected by the proposed modification.

C. Licensee has adequately analyzed, in the Licensing Report and by affidavit, the most severe credible accidents relating to the proposed modification, which consist of the dropping of a spent fuel assembly as it is being moved. Such an accident, if it were to occur, would nevertheless result in consequences below the limits of 10 CFR Part 100.

The above statements of material fact are supported by the attached affidavit of Steve B. Hosford, by Sections 3.4.3.5 and 3.8 of the Licensing Report submitted by Licensee, and by Section 14.2 of the Zion FSAR. Additional support is found in the affidavit of John P. Leider, Jr., in support of Licensee's Motion for Summary

Disposition of this contention.

III. Argument

Contention 6C alleges inadequacy of information regarding fuel handling safeguards to prevent damage to spent fuel stored in the pool. Intervenor, however, has not alleged any specific defects in Licensee's original proposal (attached hereto). Such information contained therein, supplemented by (1) the procedure set forth in full detail in the Leider and Hosford affidavits, (2) Question and Response Nos. 17 and 19 of the October 24, 1978 letter referenced *supra* Note 7, and (3) Question and Response No. 7 of NRC's Round 3 Questions, (undated, which is attached hereto)[1/] should be deemed adequate to dispel concern over the consequences of any postulated fuel drop accident, and thus, Contention 6C should be struck.[2/]

1/ Round 3 Questions and rhe Responses thereto are now being formally transmitted, in the same form as attached hereto, and will be made available to the Licensing Board upon receipt.

2/ See *Public Service Co. of Oklahoma* (Black Fox Station, Units 1 and 2) LBP-77-46, 6 NRC 167 (1977).

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AFFIDAVIT OF STEVE B. HOSFORD

I, Steve B. Hosford, being duly sworn, do state as follows:

I am employed as an Applied Mechanics Engineer in the Engineering Branch, Division of Operating Reactors, Office of Nuclear Reactor Regulation, United States Nuclear Regulatory Commission. A statement of my professional qualifications is attached to this affidavit.

This affidavit addresses the following contention:

> 6. There has been insufficient development of all credible accident scenarios.
>
> * * * *
>
> C. There is insufficient information regarding the methods by which accidental damage to stored spent fuel assemblies will be prevented during the installation of the new poisoned spent fuel storage racks.

Contention 6C states that insufficient consideration is given in the Licensing Report to accidental damage to the stored spent fuel during installation of the new racks. Section 3.8 of the Zion spent fuel pool rack modification proposal addresses the procedure for replacing the existing racks with the new racks. Neither the old racks nor the new racks will be transported over the locations which contain stored spent fuel, thus eliminating the potential for a drop accident involving the racks. The actual procedure for replacing the racks, as described by the licensee, is summarized below.

1. The spent fuel (which at that time will total 368 assemblies) will be stored in the southern end of the pool (Figure 1).

2. The eight northernmost racks in the spent fuel pool will be removed, one by one, from the north end of the pool. These racks will be empty and will be removed one at a time, northernmost first. Where these racks are adjacent to racks which contain fuel assemblies, the empty racks will be raised slightly and translated at least the width of the rack to the north, away from the partially filled rack, before they are lifted out of the pool.

3. Eight new absorber racks will be placed in the north end of the pool. They will be emplaced northernmost first, one by one. As Figure 2 shows, four of these racks will be a 10' x 10' configuration, three will be 10' x 11', and one will be 5' x 10'.

4. Using normal fuel handling procedures, the 368 stored fuel assemblies will be transferred to the four northernmost new absorber racks.

5. The remaining nine large and three small racks will be removed, one by one, over the west side of the pool.

6. The remaining 16 new absorber racks will be installed, one by one, northernmost first, from the west side of the pool.

The fuel handling procedure to be employed is the normal procedure as described in the Zion FSAR and is not affected by this modification. The consequences of all known credible accidents were evaluated and reviewed at the operating licensing stage and reported in the FSAR, and they are unchanged by this proposed modification. The maximum credible accident was found to be a postulated fuel bundle drop and the consequences of such an accident were below the limits of 10 CFR 100. Therefore, it is my opinion that the proposed procedure for replacing the spent fuel racks at Zion is (a) adequate to prevent accidental damage to spent fuel in the pool, and (b) is adequately described in the licensee's submittal and supplemental information. It is my further opinion that the proposed modification does not give rise to any previously unreviewed credible accident scenarios.

PROFESSIONAL QUALIFICATIONS

OF

STEVE B. HOSFORD

I am an applied Mechanics Engineer in the Engineering Branch, Division of Operating Reactors, Office of Nuclear Reactor Regulation, United States Nuclear Regulatory Commission. My duties and responsibilities include the review and evaluation of structural, mechanical and material aspects related to safety issues involving nuclear reactor facilities licensed for operation. I am also the Task Manager of a Category A generic investigation, "Asymmetric Blowdown Loads on Reactor Primary Coolant Systems (A-2).

I have an associate degree in engineering from Montgomery College (1972) and both a B. S. degree (1974) and a M. S. degree (1978) in mechanical engineering from the University of Maryland.

Prior to my present appointment, I was associated with Bechtel Power Corporation as a stress engineer in the piping stress analysis group. My duties and responsibilities included the location of supports and the stress analysis on both nuclear and non-nuclear piping systems and components. The stress analysis considerations included dynamic transient events such as earthquakes. I was responsible for the review and approval of piping and component support and anchor designs. I also developed two field procedure guides, on cold springing piping limits and maximum pressure for Hydro testing of piping systems, for use in the construction and start-up of nuclear plants.

Professional Societies

American Society of Mechanical Engineers

Publications

"Methodology for Combining Dynamic Responses," NUREG-0484, S. Hosford, R. Cudlin, K. Wichman, R. Mattu.

I have prepared the foregoing affidavit and swear that it is true and correct to the best of my knowledge.

Steve B. Hosford

Subscribed and sworn to before me this 22 day of January, 1979.

Notary Public

My Commission expires: July 1, 1982

Affidavit of John P. Leider, Jr.*

(Enclosure to Licensee's Motion)

* As corrected by letter from Alan P. Bielawski to Licensing Board, dated January 19, 1979.

ZION FSAR § 14.2

(Enclosure to Licensee's Motion)

3.4.3.5 Fuel Bundle Drop Analysis - The objective of this analysis was to ensure that, in the accidental event of dropping a fuel bundle on the proposed rack at any location, the deformed configuration of the rack would still maintain the criticality coefficient k_{eff} <0.95. This criticality criteria was translated to the following equivalent structural criteria: The resulting deformation state shall be such that the structure which maintains the fuel spacing in the active fuel region remains within elastic limit.

An elasto-plastic analysis of the rack was performed to determine the maximum length of the rack that might be stressed beyond elastic (yield) limit in the event of a postulated 24 inch drop of a fuel bundle at the most critical location on the rack. The inverse of the ratio of this length to the length of the rack above the active fuel constituted the factor of safety against having k_{eff} > 0.95.

3.8 Fuel Rack Installation

The high density poisoned spent fuel storage racks will be installed in the water filled spent fuel pool as the existing racks are removed. Each rack will be located on the existing embedments and leveling plates with the exception of the racks in the south end of the pool. Clearance holes are provided in the rack feet to fit around the dowel and stud bolts on the leveling plates.

The rack replacement procedure requires that racks which are being removed or replaced will not be carried over fuel storage positions where fuel is stored. The general sequence is as follows:

1. Store spent fuel in the racks at the south end of the pool.

2. Remove ten (10) large and two (2) small racks from the north end of the fuel storage pool.

3. Place eight (8) new racks in the empty position at the north end of the fuel storage pool.

4. Transfer stored fuel to the new racks at the north end of the pool.

5. Remove remaining six (6) large racks and two (2) small racks.

6. Insta . the remaining sixteen (16) new racks.

(Round 2 Responses; Letter of October 24, 1978)

QUESTION NUMBER 17:

Provide a list of typical loads representing the range and type of loads that you would intend to carry near or over the spent fuel pool. Provide the weight and dimensions of each load. Discuss the load transfer path, including whether the load must be carried over the pool, the maximum height at which it could be carried and the expected height during transfer. Provide a description of any written procedures instructing crane operators about loads to be carried near the pool. Provide the number of spent fuel assemblies that could be damaged by dropping and/or tipping each typical load carried over the pool

RESPONSE:

The fuel building crane is rated at 125 tons, and it is equipped with interlocks which prevent it from going over the spent fuel pool area. The interlocks can be defeated only with keys held by the fuel handling foreman and the shift engineer. The transfer path is from the area to the east of the pool, along the north wall, and over to the western area of the spent fuel pool (new fuel vault and unloading area).

The most typical loads moved near the pool and their approximate weights and dimensions appear below:

Load	Weight	Dimensions
Single Fuel Assembly	1600 lb	8" X 8" X 13'
Westinghouse Fuel Container (full)	6700 lb	3' X 3' X 14'
Movable Shielding Blocks	20 tons	6' X 6' X 15'
Waste Drums	500 lb	2' X 2' X 4'

QUESTION NUMBER 19:

Propose a Technical Specification which prohibits carrying loads greater than the weight of a fuel assembly over spent fuel in the storage pool; or justify why such a specification is not needed to limit the potential consequences of accidents involving dropping heavy loads, other than casks, onto spent fuel to consequences already evaluated for the design basis fuel handling accident.

RESPONSE:

Heavy loads and cask drop analyses have been submitted to the NRC Staff via the following letters:

G.J. Pliml to Mr. Robert A. Purple, Chief Operating Reactors - Branch 1, dated April 8, 1976.

R.L. Bolger to Mr. Albert Schwencer, Chief Operating Reactors - Branch 1, dated September 14, 1976.

D.E. O'Brien to Mr. Albert Schwencer, dated August 9, 1977.

D.E. O'Brien to Mr. Albert Schwencer, dated March 3, 1978.

W.F. Naughton to Director of Nuclear Reactor Regulation dated July 13, 1978.

The last of these letters was in response to an NRC Staff request for additional information on control of heavy loads near spent fuel. In this response, Commonwealth Edison indicated that no heavy loads are required to be moved over the fuel pool, with the exception of the spent fuel cask. Heavy load and cask drop accidents have been analyzed per the first four references above. In addition, administrative control precludes the movement of heavy loads over the spent fuel pool during refueling; therefore, no procedures exist for moving heavy loads. Any required movements of heavy loads will be evaluated on a case by case basis and a special procedure for the move will then be written and be subject to the onsite review process.

SPENT FUEL POOL CAPACITY EXPANSION

ZION NUCLEAR POWER PLANT, UNITS 1 AND 2

DOCKET NOS. 50-295 AND 50-304

ROUND 3 QUESTIONS

QUESTION NUMBER 7:

The fuel bundle drop analysis considered a drop at the most "critical" location on the rack, provide a description of this location and drawings to illustrate the postulated configuration of the fuel bundle at impact. Discuss the procedure for limiting the height of the fuel bundles above the racks to 24 inches. Discuss the consequences of a fuel bundle dropping straight through the tube and impacting the bottom of the rack.

RESPONSE:

The top corners of the racks were found to be the most critical locations for evaluating the consequence of dropping a fuel bundle. When the fuel bundle drops on the rack, the cross-sectional area of the cell walls absorbing the impact energy increases as the load is transmitted downward. Since this gradually-increasing cross-sectional area is minimum when the fuel bundle drops on a corner, the latter constituted the most critical location.

For evaluating the consequences of fuel bundle drop, the bundle configuration was assumed to be vertical at impact

(Figure 7.1). An inclined drop was judged to be less critical from the following considerations:

(a) The impact area will be larger,

(b) The impact will be "softer" because of the flexibility of the fuel bundle itself.

The length of the fuel handling tools and interlocks on the fuel pool bridge hoist limits the distance between the top of the rack and fuel assembly to less than 24". Fuel assemblies thus cannot be raised above the 24" limit.

Consequences of the fuel bundle dropping straight through the tube and impacting the bottom of the rack had not been investigated. From engineering judgment, the following consequences are envisioned:

The fuel bundle will drop approximately 164 inches from the top of the rack to the rack base plate. If the fluid drag on the bundle is neglected, the impact energy will be approximately 254,000 in-lbs. With this energy local damage to the rack base plate and the fuel assembly itself will occur. The rack base plate within the cell containing the bundle will deform and the adjacent vertical structural panels may undergo inelastic deformation near the bottom, but the overall structural integrity of the rack is not likely to be impaired. The fuel bundle itself will undergo considerable damage.

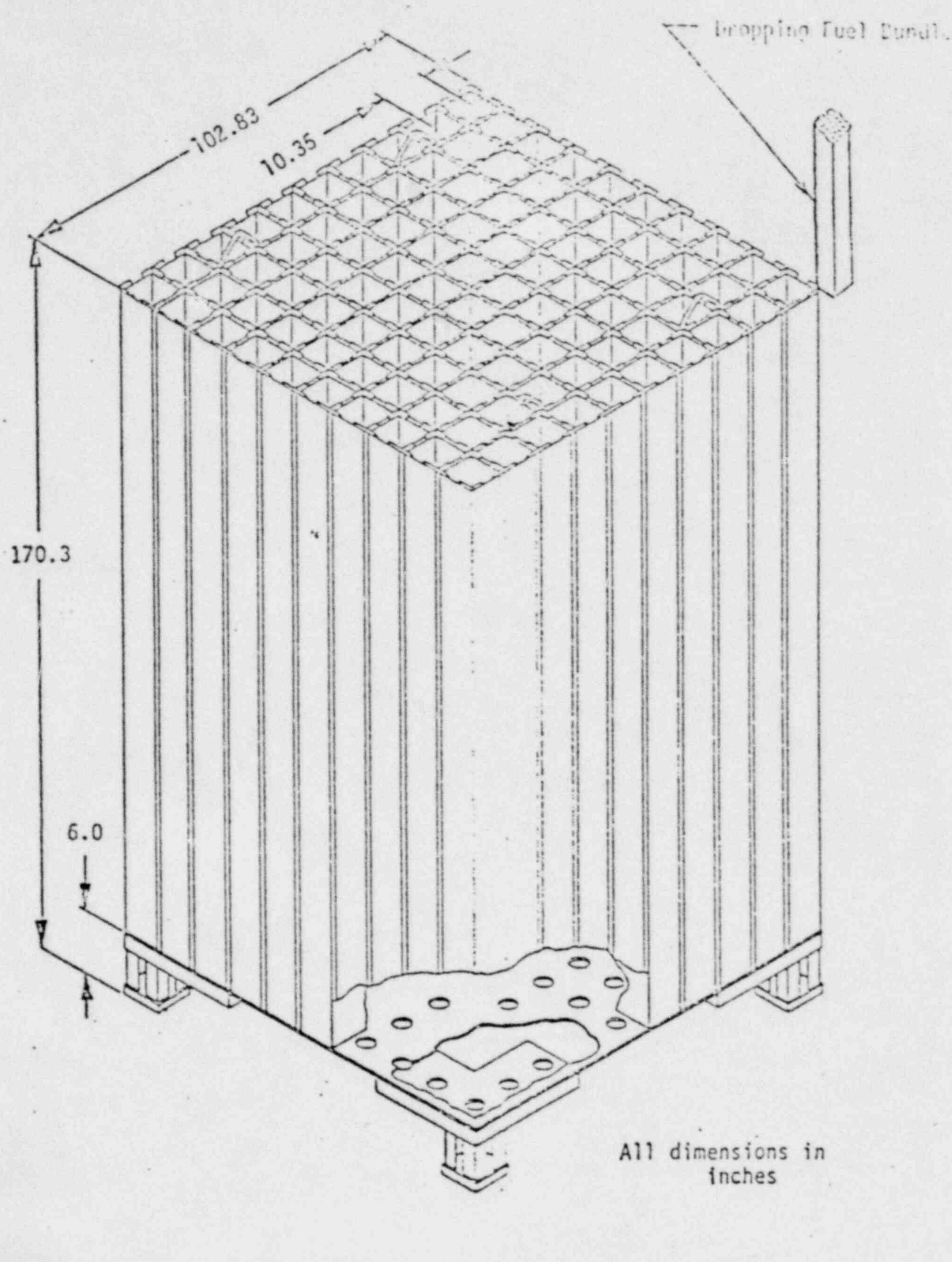

FIGURE 7.1 SPENT FUEL RACK SHOWING CRITICAL LOCATION OF POSTULATED FUEL BUNDLE DROP

CONTENTION 7

I. Contention 7 states:

> The Applicant's discussion of spent fuel boiling is inadequate in that (1) there is no consideration given to the possibility that the pool might boil, and (2) there is no discussion of possible damage to fuel cladding or of the consequent release of radionuclides under such conditions; therefore there is no assurance that public health and safety will not be endangered.
>
> In addition, the heat removal capacity of the Spent Fuel Pool Cooling Systems has not been shown to be adequate to support the expanded pool capacity.

II. Material Facts As To Which There Is No Genuine Issue To Be Heard

A. The Licensee's analysis of spent fuel pool boiling is adequately set out in the Licensing Report.

B. Failure of either of two redundant coolant trains in the Zion SFP would not prevent adequate cooling of the pool under all normal or credible abnormal situations which might exist.

C. Failure of both cooling trains would not result in a significant release of radionuclides, as adequate sources of makeup water exist to resupply the pool's coolant water.

D. Boiling of the pool water would not result in damage to fuel stored in the pool, even if such fuel were defected prior to removal from the reactor vessel.

These material facts are supported by the attached affidavit of Richard M. Lobel, Edward Lantz, and Jack N. Donohew, Jr., by Sections 3.2 and 3.6 of the Licensing Report, by the Affidavit of Tom R. Tramm (attached to Licensee's Motion for Summary Disposition), and by Sections 9.3 and 9.5

of the Zion FSAR. Additional support may be found in the deposition of Dr. Marvin Resnikoff, expert witness for Intervenor, which has been furnished to the Board.

III. Argument

Contention 7 alleges inadequacy of information regarding the possibility of spent fuel pool boiling or the effect of such boiling on the stored assemblies, and a failure to demonstrate adequacy of the Spent Fuel Pool Cooling Systems to support the expanded pool capacity.

As to the first part of the contention, page 3-50 of the Licensing Report indicates that a minimum of 8.2 hours will elapse before boiling occurs if all pool cooling capability was lost, under worst-case assumptions. Intervenor's expert witness does not dispute this statement, and in fact concedes that 8.2 hours would adequately allow resolution of the problems which might bring about pool boiling (Resnikoff Tr. at 22).

The assumption that boiling of the spent fuel pool will have any significant effects upon the spent fuel stored therein during the operating life of the reactor, whether or not such fuel is defected, is simply not credible. Zircaloy-clad fuel is exposed to extreme temperatures in the reactor vessel which are not approached even at spent fuel pool boiling temperatures. (Resnikoff Tr. at 35, 42). As the fuel cools in the SFP environment, pressure within the fuel decreases, tending to retain fission products within the rods. (Lobel et al. affidavit, at 5). Also, the UO_2 pellets should not dissolve if exposed to pool water through defected cladding. (Lobel et al. affidavit, at 3). Last, it should be recognized that adequate makeup water exists to "cool down" the pool water, and to make up all evaporative water loss. (Tramm affidavit at 11; Resnikoff Tr. at 67, 98). Thus, the postulated boiling of pool water, with or without resultant damage to the fuel, is simply not credible.

The second part of the contention is incorrect, as Licensing Report Figures 3.6-3 through 3.6-6 indicate that the heat removal capacity of the Spent Fuel pool Cooling System is adequate to support the expanded pool capacity. To assume failure of <u>both</u> of the redundant spent fuel pool cooling trains, i.e. "no cooling," see Resnikoff Tr. at 20, is to disregard the Single Failure criterion set forth in 10 CFR Part 50, Appendix A. To that extent, this assumption constitutes an impermissible challenge to the Commission's regulations. 10 CFR §2.758.

In light of the above-cited references, there remain no genuine issues of material fact regarding spent fuel pool boiling and its potential consequences, and Contention 7 should be struck.

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AFFIDAVIT OF RICHARD M. LOBEL, EDWARD LANTZ AND JACK N. DONOHEW, JR.

We, Richard Lobel, Edward Lantz and Jack Donohew, being duly sworn, do state as follows:

We are employed by the Nuclear Regulatory Commission in the Division of Operating Reactors. Statements of our professional qualifications are attached to this affidavit.

This affidavit addresses the following contention:

> 7. The Applicant's discussion of spent fuel boiling is inadequate in that (1) there is no consideration given to the possibility that the pool might boil and (2) there is no discussion of possible damage to fuel cladding or of the consequent release of radionuclides under such conditions; therefore there is no assurance that public health and safety will not be endangered.
>
> In addition, the heat removal capacity of the Spent Fuel Pool Cooling Systems has not been shown to be adequate to support the expanded pool capacity.

The first part of this contention is without merit. Contrary to part one of this contention, the licensee has given consideration to the possibility that the pool might boil. On page 3-50 of the licensee's submittal the minimum time to boiling, if fuel pool cooling is lost, is given as 8.2 hours. Since the consequences of spent fuel pool boiling have been studied and documented in past proposals and hearings (such as the Trojan Spent Fuel Hearing) this statement is sufficient.

Contrary to the second part of this contention the licensee has shown, via the curves plotted on Figures 3.6-3 through 3.6-6 of its proposal, that the heat removal capacity of the Spent Fuel Pool Cooling System is adequate to support the expanded pool capacity.

Boiling, as used in this contention, is not clearly defined. There are several modes of boiling. At the conditions of the spent fuel pool with loss of cooling, the coolant surrounding the fuel rods would be in the nucleate boiling mode. Nucleate boiling is a highly efficient mode of heat transfer. In the pressurized water reactor core, at full power operation, a small number of the fuel rods normally operate in nucleate boiling. In a boiling water reactor core most of the fuel rods operate in nucleate boiling.

If the density of water bubbles were to increase at the surface of the fuel rod so that the mode of boiling changed from nucleate boiling to film boiling, the cladding temperature would increase significantly over that in nucleate boiling. However, because of the low heat flux of a fuel rod in a spent fuel pool (with all its power coming only from decay heat), such a fuel rod would not undergo film boiling. Therefore, no damage is expected to fuel rods due to boiling of the spent fuel pool.

Cumulative spent fuel pool experience as recent as June 1978 has shown that "no commercial water reactor fuel has yet been observed to develop defects while stored in spent fuel pools" at normal spent fuel pool conditions. (Reference 1). Also, available evidence shows that a fuel rod which was already defected from operation in the reactor would not undergo any further degradation. At the temperatures of fuel rods in a boiling spent fuel pool there should be no dissolving of the UO_2 pellets if exposed to fuel pool water through a cladding defect. Observations at Karlsruhe, West Germany showed no detectable dissolving of fuel pellets at normal spent fuel pool temperatures (Reference 1). We would expect that the increased temperatures due to loss of spent fuel pool cooling would not change this result.

Oxidation of Zircaloy cladding at boiling conditions can be assumed to be negligible based on data from Zircaloy 2 tubes exposed to treated Columbia

River water (less pure than spent fuel pool water) at approximately 90°C* (Reference 1). Extrapolation of this data to 100 years yielded a conversion of Zircaloy to oxide of less than 0.1% (clad wall thickness).

In conclusion, the spent fuel pool boiling mode would be nucleate boiling. PWR fuel rods are designed to operate in the reactor core in nucleate boiling at heat fluxes which are orders of magnitude higher than those which could occur in the spent fuel pool. Therefore, failures of fuel rods in the spent fuel pool due to boiling would not be expected. Data also exists to show that a fuel rod defect would not be further degraded if boiling were to occur.

The additional spent fuel in the pool because of the pool modification would have decayed for several years. The volatile radioactive nuclides in the defective failed fuel would have, therefore, either decayed or diffused into the pool water. The remaining radioactivity in the spent fuel would then be non-volatile. For this activity, the leakage of activity from the fuel pin during pool boiling would not be significantly different from that at normal pool operations. Under normal conditions, experience indicates that there is little radionuclide leakage from spent fuel stored in pools after the fuel has cooled for several months. The predominance of radionuclides in the spent fuel pool water appears to be radionuclides that were present in the reactor coolant system prior to refueling (which becomes mixed with water in the spent fuel pool during refueling operations) or crud dislodged from the surface of the spent fuel during transfer from the reactor core to the spent fuel pool. During and after refueling, the spent fuel pool cleanup system reduces the radioactivity concentrations considerably. It is theorized that most failed fuel contains small, pinhole-like perforations in the fuel cladding at the reactor operating conditions. A few weeks after refueling, the spent fuel cools in the spent fuel pool so that fuel clad temperature is relatively cool. This substantial temperature reduction should reduce the rate of release of fission products from the fuel pellets and decrease the gas pressure in the fuel rod, thereby tending to retain the fission products within the fuel rod.

In addition, most of the gaseous fission products have short half-lives and decay to insignificant levels within a few months. Based on the operational reports submitted by the Licensees or discussions with the operators, there has not been any significant leakage of fission products from spent light water reactor fuel stored in the Morris Operation (MO) (formerly Midwest Recovery Plant) at Morris, Illinois, or at Nuclear Fuel Services' (NFS) storage pool at West Valley, New York. Spent fuel has been stored in these two pools which, while it was in a reactor, was determined to have significant leakage and was therefore removed from the core. After storage in the onsite spent fuel pool, this fuel was later shipped to either MO or NFS for extended storage. Although the fuel exhibited significant leakage at reactor operating conditions, there was no significant leakage from this fuel in the offsite storage facility.

The conditions in the spent fuel during pool boiling which will affect the leakage of radioactivity from this additional spent fuel are not significantly different from the conditions in the pellet-cladding gap during normal pool operations. Based on the experience discussed above for normal pool conditions, we would not expect boiling of the pool to result in a significant increase, if any, in the leakage of activity from the additional spent fuel in the pool. Under normal pool conditions, any non-volatile radioactivity leaking from spent fuel into the pool water should remain in the pool water to be removed by the pool purification system. Under conditions of the pool boiling, this radioactivity may be entrained in water droplets in the air above the pool. These droplets will condense out on surfaces in the fuel building and a fraction of these droplets could be entrained in the building ventilation air flow. In the ventilation system, the droplets will condense out on the ducts or be filtered by the filtration system. The filtration system has prefilters, HEPA filters and charcoal filters. These filters will remove the water droplets and the radioactivity from the air until the pool cooling system and purification system is repaired or the hot spent fuel is returned to the reactor vessel.

Thus, it is our conclusion (1) that fuel pool boiling, and its resultant effects on spent fuel stored therein, does not consitute a credible threat to public health and safety, and (2) that Contention 7 is without merit. (To the extent that boiling off of all water in the pool is considered, such a condition is not a credible accident as ample makeup water sources are available. See Resnikoff depositicn at p. 67, and p. 98).

PROFESSIONAL QUALIFICATIONS

OF

RICHARD M. LOBEL

I am employed as a Reactor Engineer with the Division of Operating Reactors, USNRC.

I graduated from California State University at San Jose with a B.S. in Mechanical Engineering in 1966. I then began work as a Mechanical Engineer at Lawrence Livermore Laboratory, Livermore, California. At the same time I began work towards an M.S. degree in Mechanical Engineering at California State University at San Jose which I received in 1970. Since my masters degree I have taken an additional number of university courses in nuclear and mechanical engineering.

In my present work at NRC I am responsible for reviewing reactor fuel reload applications and other safety matters concerning operating reactors. My prime responsibility is in the areas of nuclear fuel thermal behavior and thermal hydraulic aspects of reactor behavior during steady state, anticipated transients and accidents.

Prior to my current assignment I worked for three years in the Core Performance Branch where I was responsible for fuel rod thermal performance including reviews of computer programs used by fuel vendors for predicting fuel conditions during steady state and transient conditions, fuel densification and analysis of fuel rods during a Loss-of-Coolant Accident.

During the period of 1966 to 1973 while I was employed by Lawrence Livermore Laboratory I was responsible for the mechanical design of nuclear physics experiments.

I have been a lecturer on nuclear fuel behavior at two University short courses titled "Nuclear Power, Safety and the Public" and "Nuclear Power Reactor Safety Analysis."

PROFESSIONAL QUALIFICATIONS

OF

EDWARD LANTZ

As an Engineering Systems Analyst in the Plant Systems Branch I am responsible for technical reviews and evaluations of component and system designs and operating characteristics of licensed nuclear power reactors.

I have a Bachelor of Science degree in Engineering Physics from the Case Institute of Technology and a Masters of Science degree in Physics from Union College and a total of 28 years of professional experience, with over 20 years in the nuclear field. My experience includes work on reactor transients and safeguards analysis, nuclear reactor analysis and design, research and development on nuclear reactor and reactor control concepts and investigations of their operational and safety aspects.

I have held my present position with the Commission since December 1975. My previous position, which I held for about two and one half years, was Project Manager in the Gas Cooled Reactors Branch, Division of Reactor Licensing, U.S. Nuclear Regulatory Commission, where I was responsible for the technical review, analysis, and evaluation of the nuclear safety aspects of applications for construction and operation of nuclear power plants. For about ten years prior to that I was Head of the Nuclear Reactor Section in NASA. My section was responsible for the development and verification of nuclear reactor analysis computer programs, conceptual design engineering, and development engineering contracting. Prior to my employment with NASA, I was a nuclear engineer at the Knolls Atomic Power Laboratory for about six years, where I worked on the safeguards and nuclear design of the S3G reactors and the initial development of the nuclear design of the S5G reactors. Previous experience includes system engineering and electrical engineering with the General Electric Company and electronic development engineering with the Victoreen Instrument Company.

PROFESSIONAL QUALIFICATIONS

OF

JACK N. DONOHEW, JR.

My name is Jack N. Donohew, Jr. I am a Senior Nuclear Engineer in the Environmental Evaluation Branch in the Division of Operating Reactors, U.S. Nuclear Regulatory Commission (NRC). My duties include the review of rad-waste treatment systems and engineered safety feature ventilation systems for operating reactors.

I received a Bachelor of Engineering Physics Degree from Cornell University in 1965, a Masters of Science Degree in Nuclear Engineering from Massachusetts Institute of Technology in 1968, and a Doctor of Science Degree in Nuclear Engineering from Massachusetts Institute of Technology in 1970. I received my Professional Engineers License in Nuclear Engineering from the Commonwealth of Pennsylvania in 1974.

After graduation, I worked for Stone and Webster Engineering Corporation as an engineer in the Radiation Protection Group. I was responsible for estimating source terms, release rates and resulting doses for the Safety Analysis Report, Environmental Report and response to NRC questions for boiling water nuclear reactors. I was also responsible for shielding design for the reactor water cleanup system.

In February, 1973, I became a Power Engineer in the Process Engineering Group, Stone and Webster Engineering Corporation. I was lead engineer for the Shoreham Project and the equipment specialist for all nuclear plants for the containment iodine spray removal system, ventilation filter assemblies, and Boiling Water Reactor and Pressurized Water Reactor gaseous waste treatment system.

In June 1975, I joined the Nuclear Regulatory Commission as a senior nuclear engineer in the Effluent Treatment Systems Branch, Directorate of Licensing. I was involved in rad-waste system licensing reviews of nuclear power plants. I have conducted generic studies of the degradation of charcoal adsorbers in ventilation filter assemblies.

In December 1975, I joined the Environmental Evaluation Branch in the Division of Operating Reactors.

We have prepared the foregoing affidavit and swear that it is true and correct to the best of our knowledge.

Richard M. Lobel
Richard M. Lobel

Edward Lantz
Edward Lantz

Jack N. Donohew, Jr.
Jack N. Donohew, Jr.

Subscribed and sworn to before me this 22 day of January, 1979.

Michael M. Gross
Notary Public

My Commission expires: July 1, 1982

LICENSING REPORT §3.2

(Enclosure to Licensee's Motion)

NUCLEAR SERVICES CORPORATION

3.6 Thermohydraulic Analysis

To determine heat generation rates in the spent fuel pools and the performance characteristic of the pool cooling system, a thermohydraulic analysis was performed (see Appendix A). The two major sections of the analysis are the heat generation and pool temperature calculation, and the calculation of natural circulation flow rates in the fuel storage racks.

3.6.1 Heat Generation Calculations

The heat generation calculations were performed assuming a fuel burnup of 33,000 MWD/ton for normal fuel discharges and a realistic burnup for a full core discharge after two months reactor operation. Refer to Table 3.6.1 "Normal Discharge Sequence and Full Core Discharge".

Decay energy release rates were determined per ANS 5.1, "Proposed Standard, Decay Energy Release Rates Following Shutdown of Uranium-Fueled Thermal Reactors", revised edition October 1973. The method of calculation regarding finite reactor operating time was used with uncertainty factors applied to the differences of power fraction values as follows:

$$\frac{P}{P_o}(t_o, t_s) = \left[\frac{P}{P_o}(\infty, t_s) - \frac{P}{P_o}(\infty, t_o + t_s)\right](1 + k); \; k \text{ @ } t_s$$

where:

t_o = reactor operating time or irradiation time in seconds

t_s = cooling time in seconds

$\frac{P}{P_o}$ = the fraction of operating power

k = uncertainty correction factor

An uncertainty correction factor of 15 percent is added to the ANS 5.1, Standard Decay Heat Curve for cooling times between 10^3 and 10^7 seconds. This 15 percent is adequate to cover uncertainties in both fission product decay and contributions from heavy metals. For cooling times greater than 10^7 seconds, a 25 percent uncertainty correction factor is added to the ANS 5.1, Standard Decay Heat Curve. These uncertainty factors have proven to be very conservative (refer to Nuclear Science and Engineering; 56, 241-262 (1975), "Measured and Calculated Rates of Decay Heat in Irradiated U^{235}, U^{233}, Th^{232}" by S. B. Gunst, D. E. Conway, and J. C. Connor).

Based on the input data and the above ANS 5.1 standard, the heat generation calculation yielded a maximum of 2.0401 x 10^7 Btu/hr heat generated in the spent fuel pool for the normal refueling case and 3.5191 x 10^7 Btu/hr for the full core discharge case. In both cases, the heat generation rate begins to rise 4 days after shutdown. This is due to the initial transfer of fuel from the reactor to the spent fuel pool. Refueling is assumed to be continuous and transfer of spent fuel is completed in 6 days. Therefore the heat generation rate rises and reaches a maximum 10 days after shutdown. Until the next fuel transfer, heat generation decreases as fission product decay rates decrease and heavy element decay disappears. Refer to Figures 3.6-1 and 3.6-2.

Using the heat generation rate, the pool water bulk temperature was calculated as a function of time for the following cases:

(A) Normal refueling case

1 - one spent fuel pool heat exchanger in service

2 - two spent fuel pool heat exchangers in service

(B) Full Core discharge case

1 - one spent fuel pool heat exchanger in service

2 - two spent fuel pool heat exchangers in service

The heat generation and pool temperature were calculated using the NSC computer code POOLHT.

POOLHT performs analysis of fuel pool temperature as a function of heat input from spent fuel, heat rejection through the pool cooling systems, pool water mass and time. The heat rejection rate in the heat exchangers is calculated based on heat exchanger inlet temperatures, heat transfer coefficient, effective heat transfer surface area, and primary and secondary water flow rates. Finally, the time-dependent pool temperature is calculated by an energy balance on the spent fuel pool water. The results of this analysis are shown in Figure 3.6-3 to 3.6-6.

If fuel pool cooling capability is lost, the pool temperature would reach the boiling point after 8.2 hours. This assumes:

(1) Full core discharge completed 10 days after shutdown.

(2) Initial fuel pool temperature of 150°F.

(3) Complete mixing of the water.

3.6.2 Calculation of Natural Circulation Flow Rates in Spent Fuel Assemblies

The purpose of the natural circulation flow calculation is to provide ΔT values for the thermal load calculations of the Structural and Seismic Analysis and determine the potential for boiling on the fuel.

A Nuclear Services Corporation computer code CIRCUS has been developed for analysis of natural circulation in spent fuel assemblies. The code treats a series of fuel assemblies fed by a single downcomer through a series of inlet flow areas. Viscous losses through the downcomer, inlet, and fuel channels are balanced with bouyant forces developed by heat generation in the fuel channels. The upper pool is assumed to be maintained at a constant temperature. Outlet temperatures are computed based on an energy balance. An iterative procedure is used to balance the forces. The code is applicable for subcooled laminar flow in the fuel.

Natural circulation cooling in the spent fuel pool was modeled as shown in Figure 3.6-7 and 3.6-8. A peak power fuel assembly was assumed to be stored in the center of the pool at the end of a row of average power fuel assemblies (fuel assemblies whose decay heat is based on the average bundle power in the core). Flow to this row of fuel assemblies was assumed to follow a path which takes the cooling water from the upper pool, down the side of the pool (between the fuel racks and the pool wall) and under the fuel storage racks. This model gives an upper bound for outlet temperature, since flow between the racks, and contributions from other directions, are neglected.

Also, the effect of the flow distribution header for cooler inlet water around the periphery of the pool was neglected.

The calculations were based on an assumed 100 hour cooling time following reactor shutdown, prior to discharging the fuel to the pool. Heat generation in the fuel assemblies was based on the ANS 5.1 standard as described in Section 3.6-1. The maximum change in temperature calculated for the peak power fuel assembly was 32.38°F based on a bulk pool temperature of 120°F.

TABLE 3.6-1

NORMAL DISCHARGE SEQUENCE AND
FULL CORE DISCHARGE

BATCH NUMBER	NUMBER OF ASSEMBLIES	COOLING TIME (Days) NORMAL REFUELING	FULL CORE DISCHARGE	IRRADIATION TIME (Days)
1	64	5140	5200	621
2	64	5110	5170	621
3	64	4775	4835	931
4	64	4745	4805	931
5	64	4410	4470	1241
6	64	4380	4440	1241
7	64	4045	4105	931
8	64	4015	4075	931
9	64	3680	3740	931
10	64	3650	3710	931
11	64	3315	3375	931
12	64	3285	3345	931
13	64	2950	3010	931
14	64	2920	2980	931
15.	64	2585	2645	931
16	64	2555	2615	931
17	64	2220	2280	931
18	64	2190	2250	931
19	64	1855	1915	931
20	64	1825	1885	931
21	64	1490	1550	931
22	64	1460	1520	931
23	64	1125	1185	931
24	64	1095	1155	931
25	64	760	820	931
26	64	730	790	931
27	64	395	455	931

TABLE 3.6-1 (Continued)

BATCH NUMBER	NUMBER OF ASSEMBLIES	COOLING TIME (Days) NORMAL REFUELING	FULL CORE DISCHARGE	IRRADIATION TIME (Days)
28	64	365	425	931
29	64	30	90	931
30	64	0	60	931
31	64	-	0	672
32	64	-	0	361
33	64	-	0	51

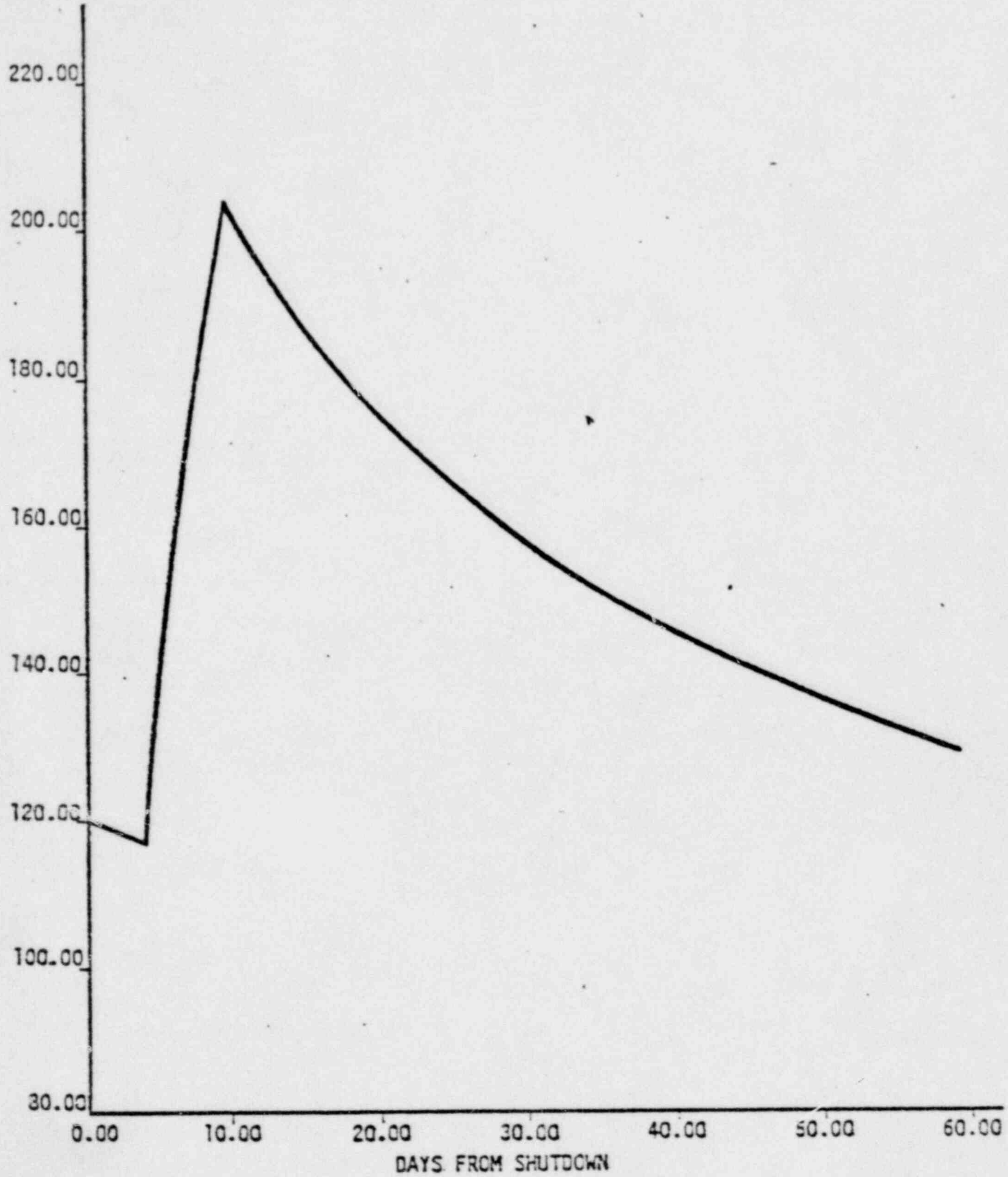

Figure 3.6-1. Zion, Normal Refueling
Heat Generation vs. Time

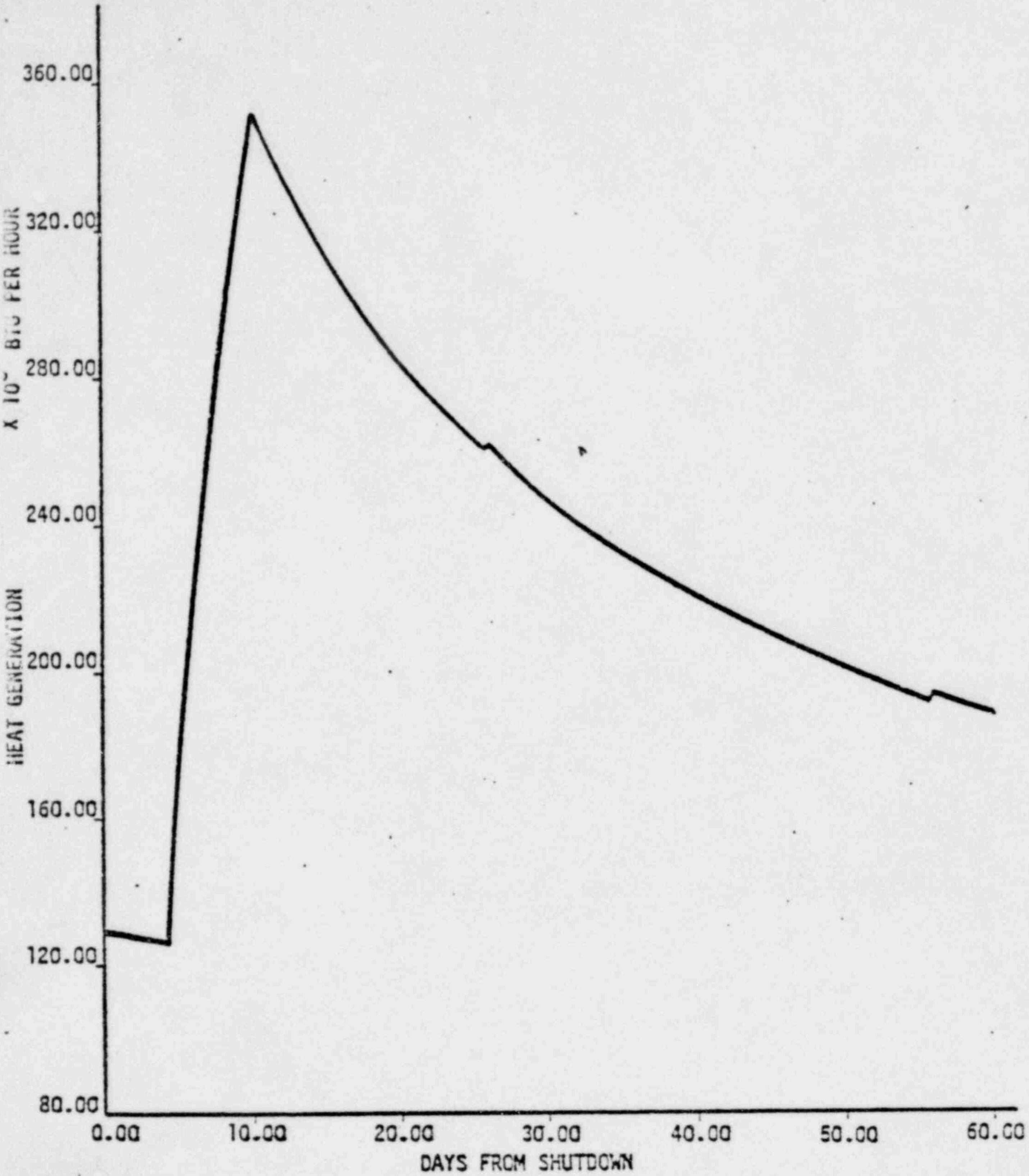

Figure 3.6-2. Zion, Full Core Discharge
Heat Generation vs. Time

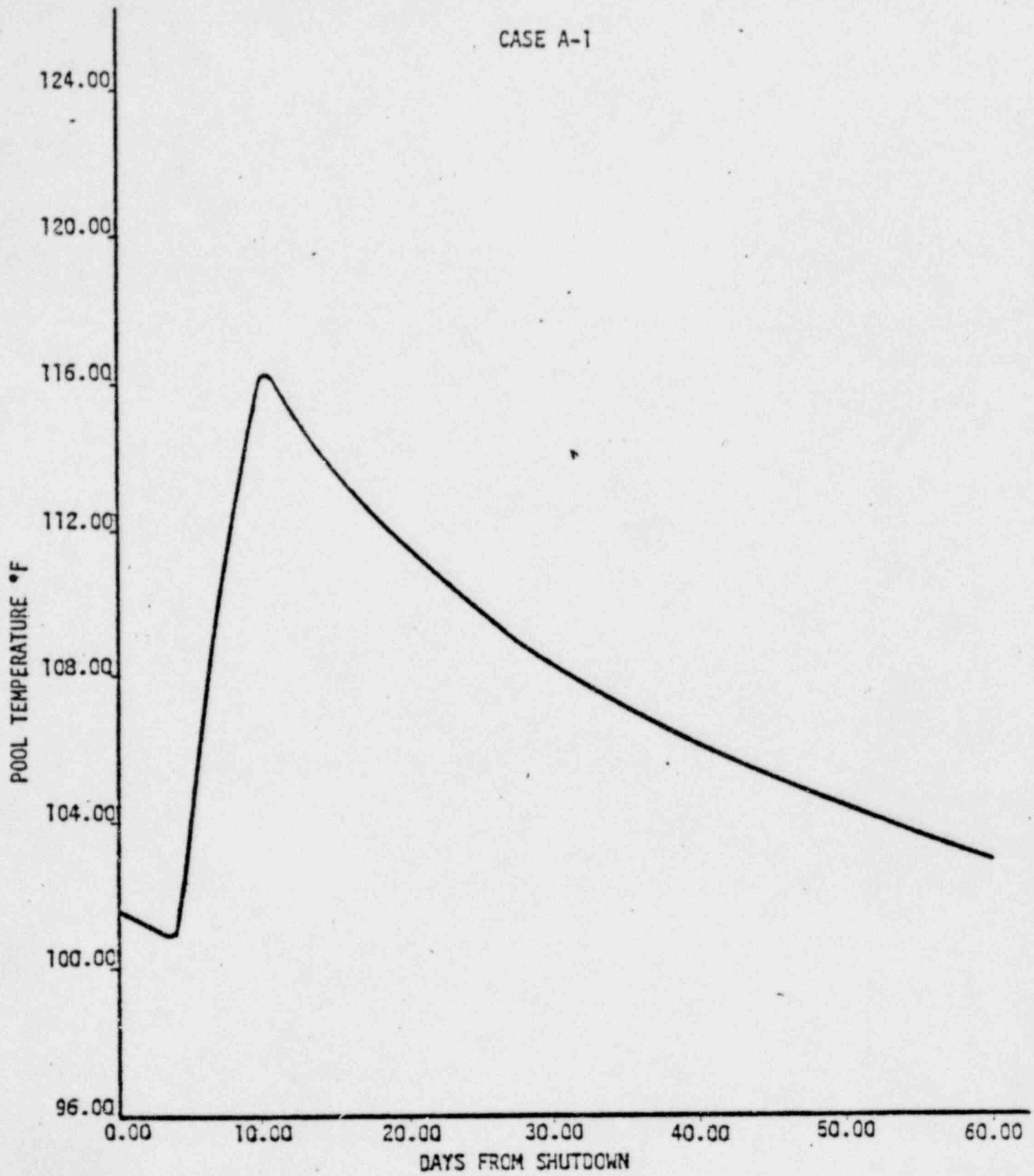

Figure 3.6-3. Zion, Normal Refueling 1 HX
Pool Temperature vs. Time

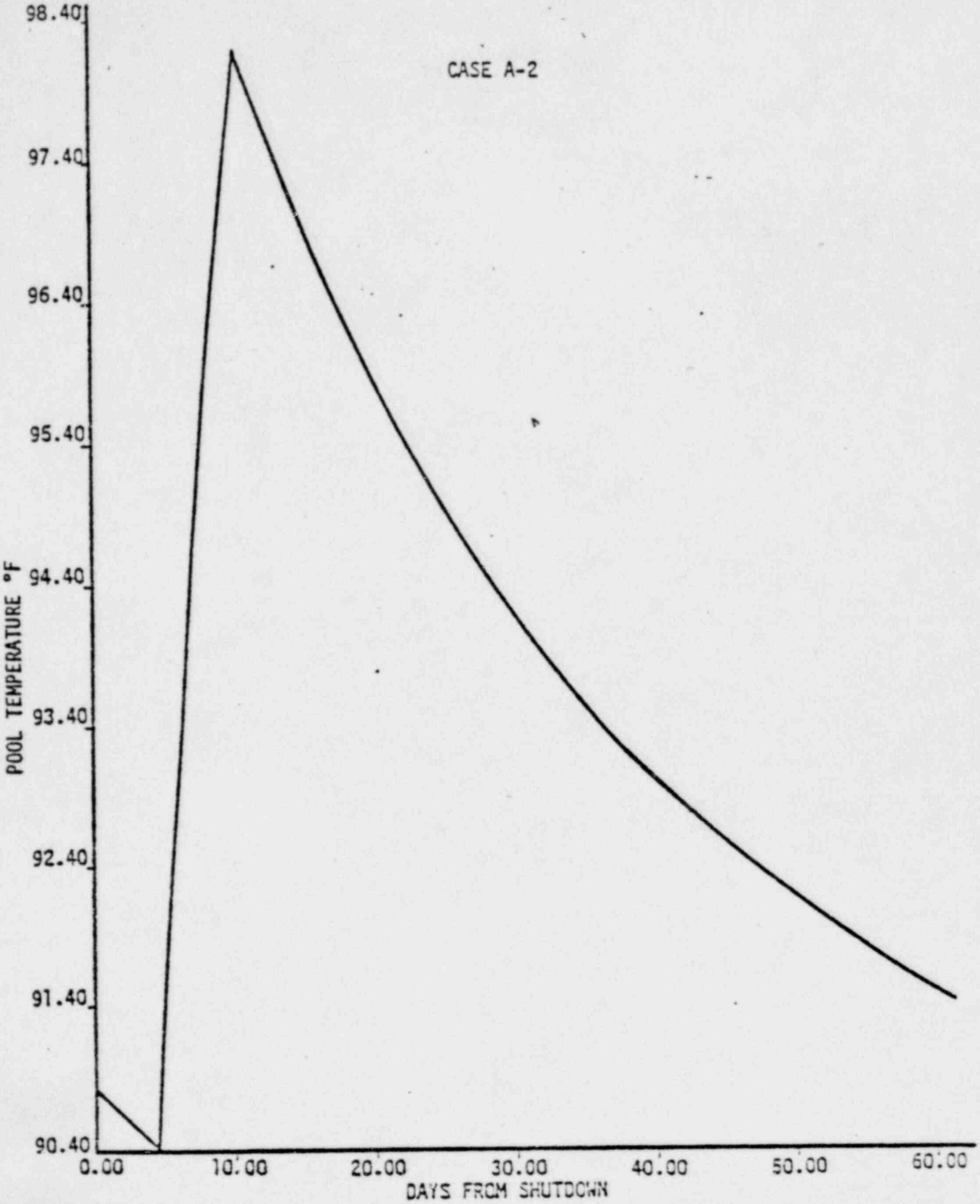

Figure 3.6-4. Zion, Normal Refueling 2 HX
Pool Temperature vs. Time

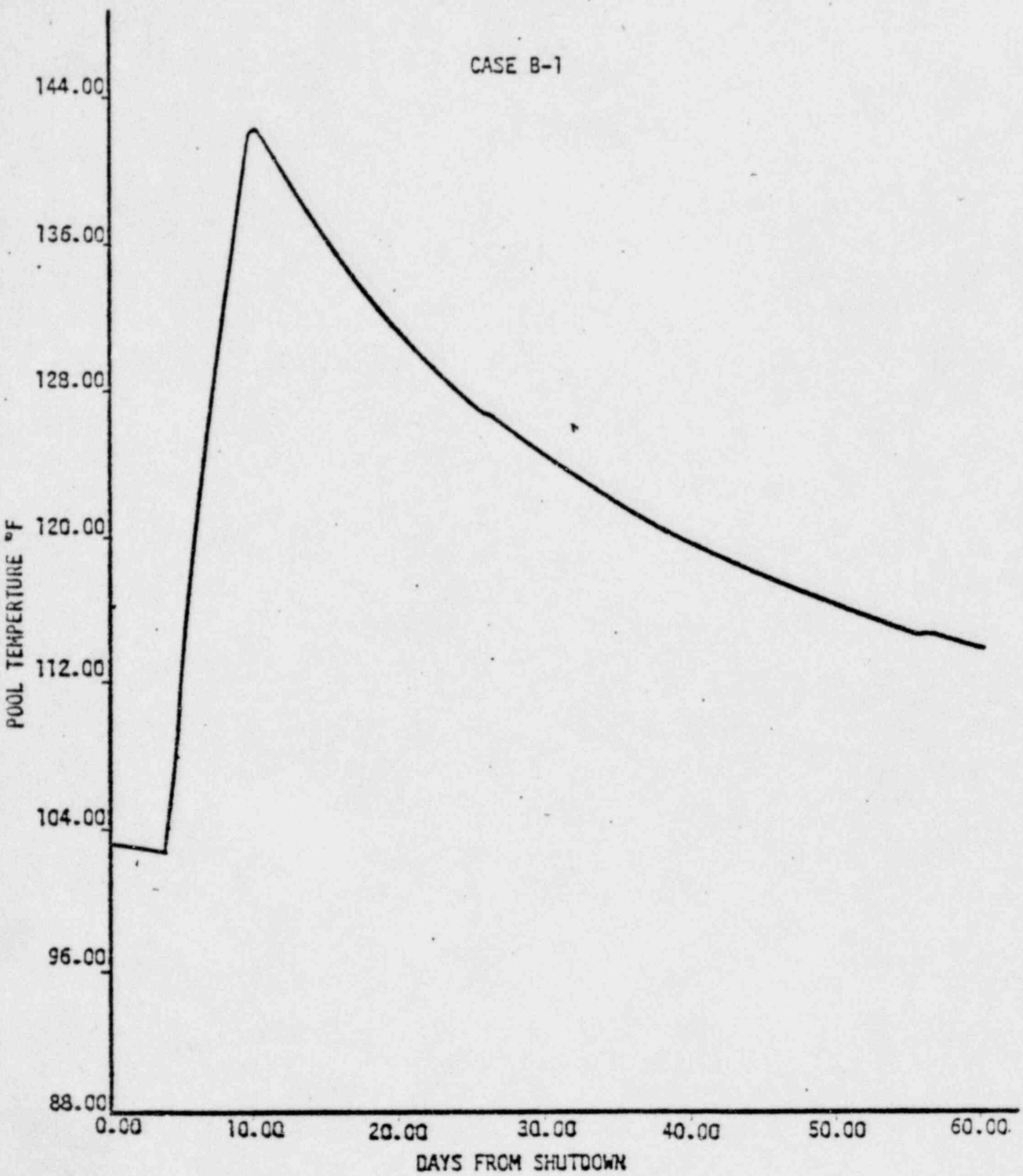

Figure 3.6-5. Zion, Normal Refueling 1 HX
Pool Temperature vs. Time

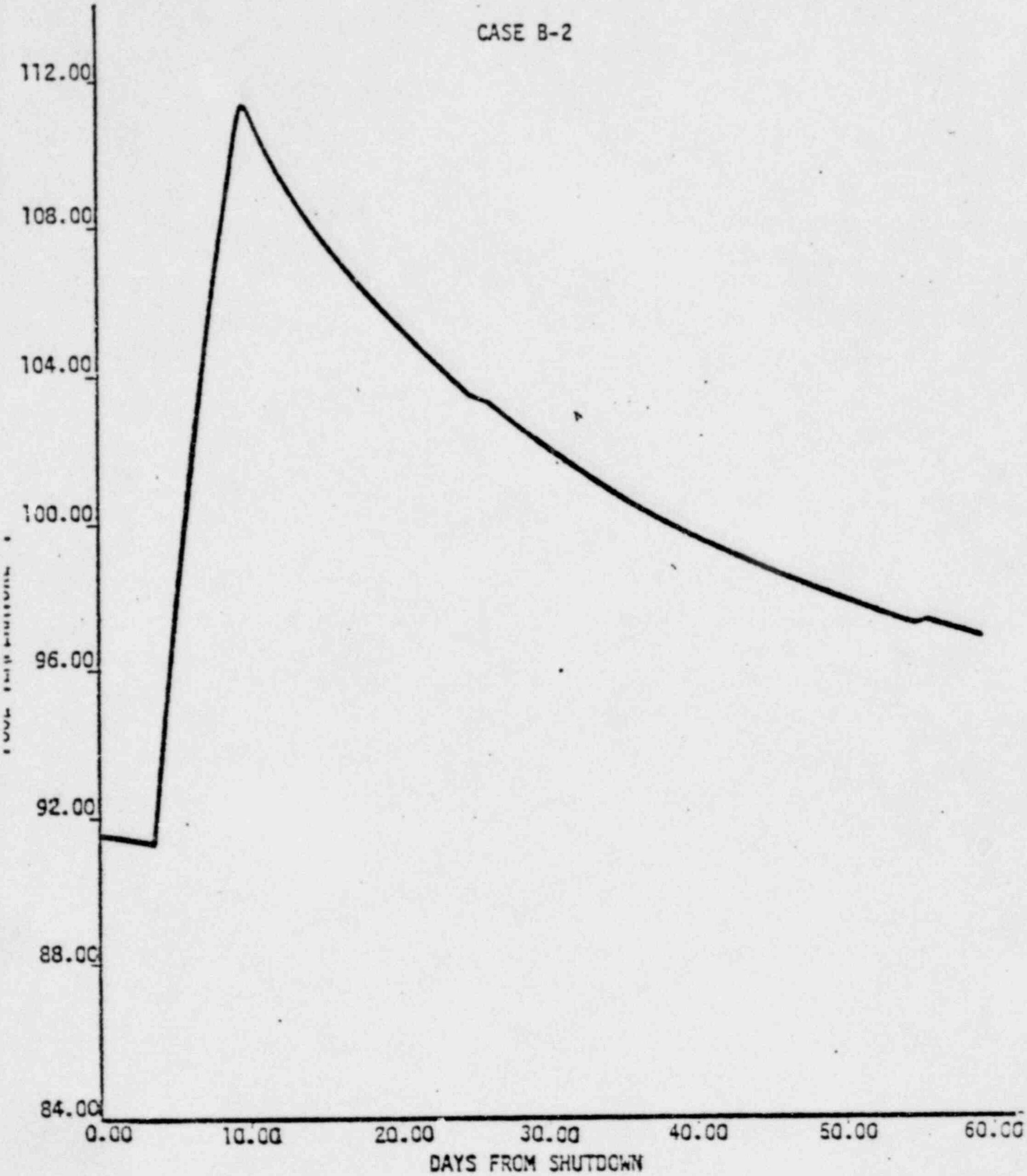

Figure 3.6-6. Zion, Full Core Discharge 2HX
Pool Temperature vs. Time

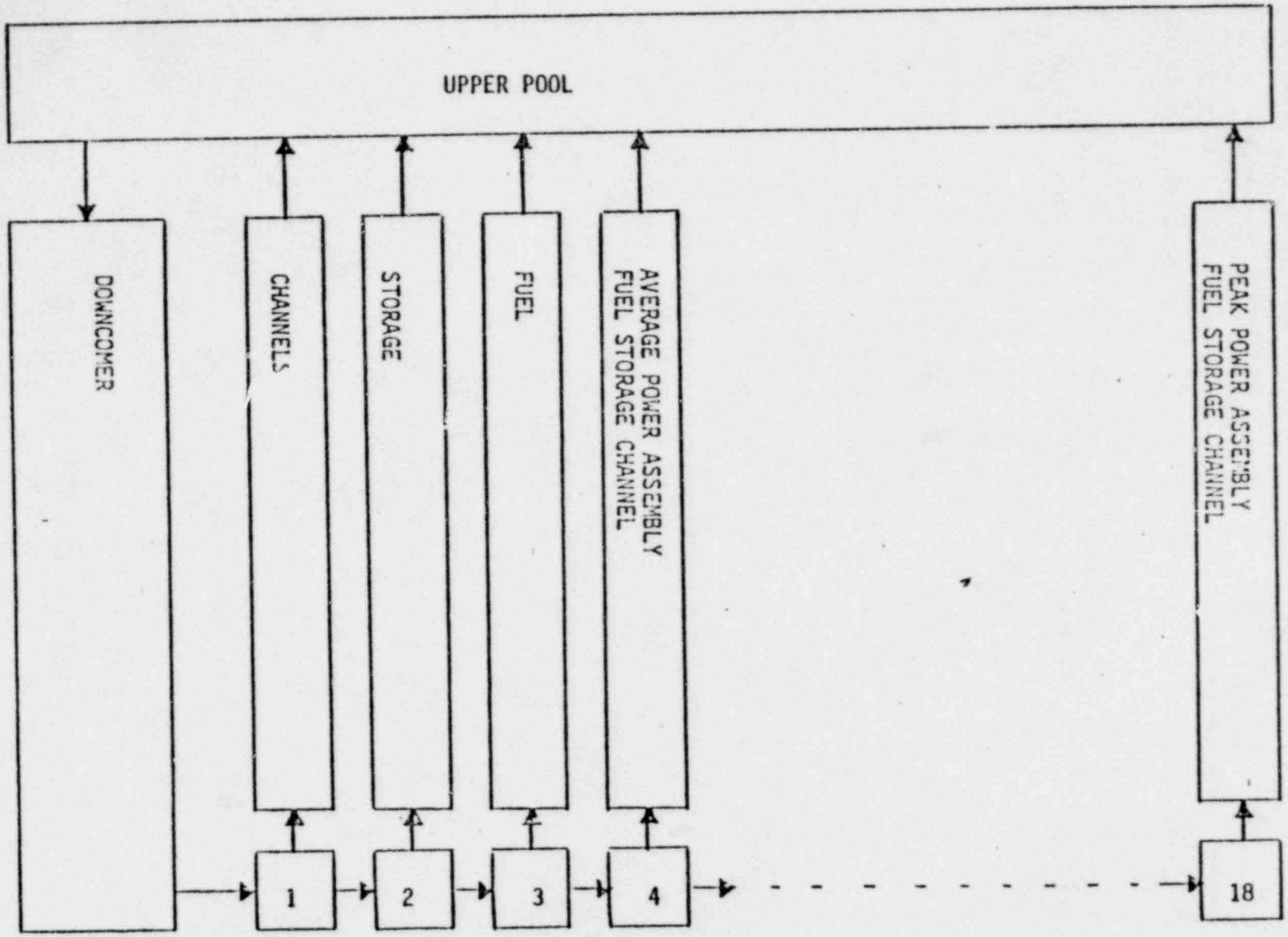

FIGURE 3.6-7: ZION
FLOW MODEL
NATURAL CIRCULATION

AFFIDAVIT OF TOM R. TRAMM

(Enclosure to Licensee's Motion)

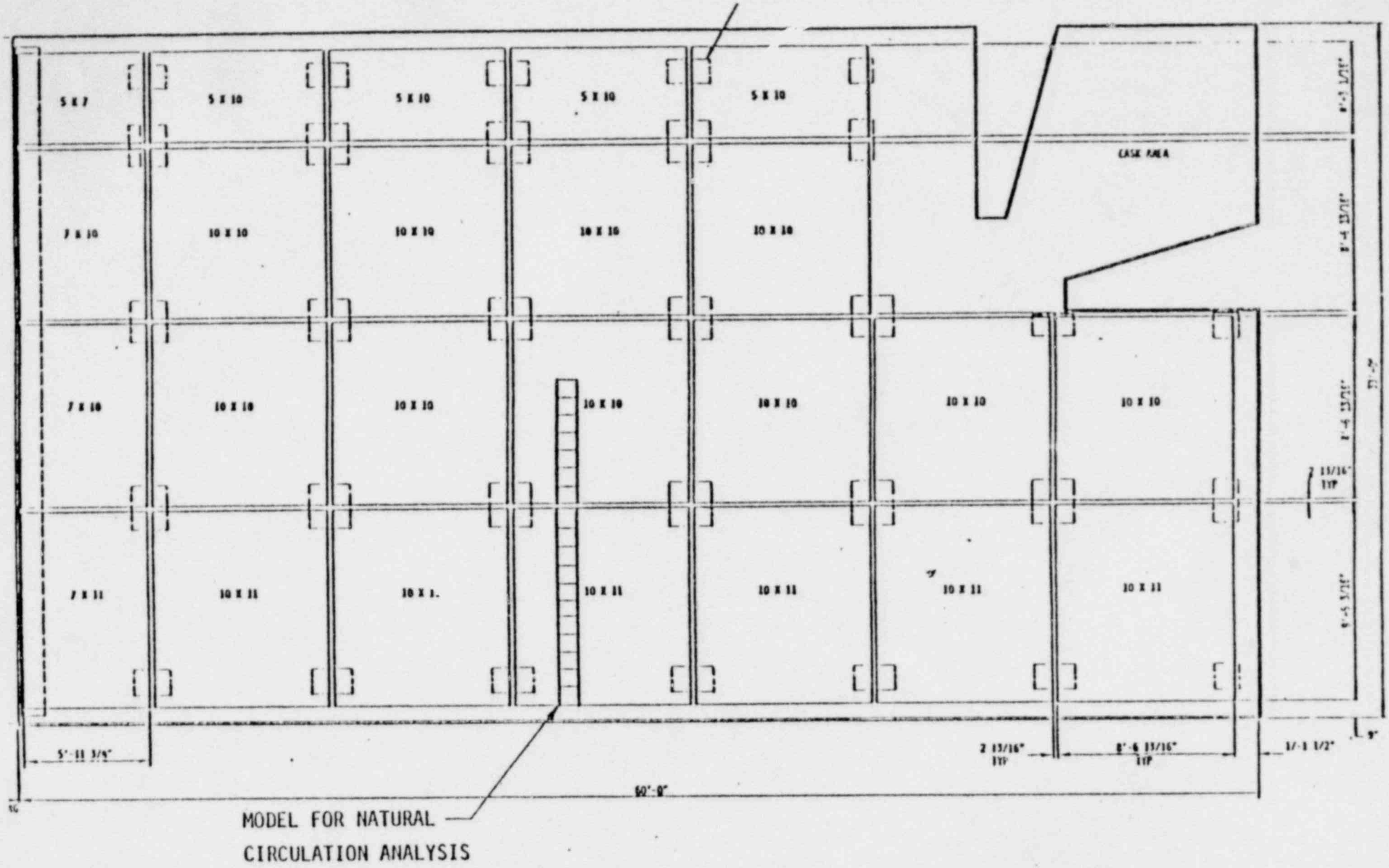

Figure 3.6-8 Zion Spent Fuel Pool
Model for Natural Circulation

ZION FSAR, §§ 9.3, 9.5

(Enclosure to Licensee's Motion)

CONTENTION 8

I. Contention 8 states:

> The amendment request and supporting documentation have not analyzed the long term* electrolytic corrosion effects of using dissimilar al[illegible] or the pool liners, pipes, storage racks and stor[illegible] ack bases, such as the galvanic corrosion between unanodized aluminum, as is used in Brooks and Perkins storage racks, and the stainless steel pool liner.
>
> ---
>
> * "Long term" storage would include storage during the operating life of the reactor.

II. Material Facts As To Which There Is No Genuine Issue To Be Heard

A. The metals and alloys present in the Zion spent fuel pool, as modified, would be stainless steel, Inconel, Zircaloy, and Boral, clad in unanodized aluminum, which is completely encapsulated inside stainless steel tubes.

B. Each of the above substances, save the encapsulated Boral and unanodized aluminum, exist in the present spent fuel pool.

C. Chemical corrosion would be of no significant effect upon the stainless steel, Inconel, Zircaloy, and unanodized aluminum during the operating life of the reactor.

D. Electrolytic Corrosion will not affect the stainless steel, Inconel and Zircaloy because their electrolytic potential vis-a-vis each other is small.

E. Galvanic corrosion could occur only with regard to the unanodized aluminum of the Boral plates, and it should not have any significant effect upon either (a) structural integrity of the racks or (b) neutron absorption capability of the Boral.

F. The high quality pool water does not constitute a suitable electrolytic solution to allow galvanic or electrolytic corrosion between non-contacting components.

These material facts are supported by the Affidavits of Frank M. Almeter, attached hereto, and Wyvil R. Kendall, enclosure to Licensee's Motion.

III. Argument

Contention 8 asserts that Licensee has not analyzed long-term corrosive effects brought about by use of dissimilar metals in the spent fuel pool. The referenced affidavits have attempted to analyze each possible corrosive interaction between the pool's components, and lead to the conclusion that no significance can be attached to the minute corrosive impacts which will occur. The cited galvanic corrosion between unanodized aluminum in the racks and the stainless steel pool liner cannot occur, as only stainless steel components of the racks will contact the pool liner, thus yeilding no differential in electrolytic potential.

As pointed out in both affidavits, any corrosive effects upon the Boral and its aluminum cladding would be a very slow process, which would have no effect upon the neutron absorption or structural capabilities of the racks.

Thus, based upon the foregoing affidavits, it is submitted that Contention 8 is without merit, and should be struck.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket Nos. 50-295
COMMONWEALTH EDISON COMPANY	)	50-304
	)	
(Zion Station, Units 1 and 2)	)	

AFFIDAVIT OF FRANK M. ALMETER

I, Frank M. Almeter, being duly sworn, do state as follows:

I am employed by the United States Nuclear Regulatory Commission as an Applied Mechanics/Material Engineer in the Engineering Branch, Engineering and Projects, Division of Operating Reactors, Office of Nuclear Reactor Regulation. A statement of my professional qualifications is attached to this affidavit.

This affidavit addresses the following contentions:

> 8. The amendment request and supporting documentation have not analyzed the long term* electrolytic corrosion effects of using dissimilar alloys for the pool liners, pipes, storage racks and storage rack bases, such as the galvanic corrosion between unadnodized aluminium, as is used in Brooks and Perkins storage racks, and the stainless steel pool liner.
>
> ---
>
> * "long term" storage would include storage during the life of the reactor.

Contention 8 assumes that electrolytic corrosion will affect the long term integrity of dissimilar alloys, such as the galvanic corrosion between unadnodized aluminum and stainless steel in the pool water environment.

The spent fuel pool components of the Zion facility that are exposed to the pool water are:

1. Pool liner - stainless steel,
2. Spent fuel assemblies - Zircaloy clad fuel rods, stainless steel tie plates, and Inconel spacers,
3. Storage Rack base - stainless steel, and
4. Storage racks - Square tubes of inner and outer shrouds of stainless steel completely encapsulating Boral neutron absorber plates. Boral is a composite panel of B_4C/aluminum matrix clad with aluminum.

Corrosion is the deterioration that occurs in metals because of either a chemical or electrochemical reaction with its environment. The Zion spent fuel storage pool environment is oxygen-saturated high purity demineralized water containing boron as Boric acid, normally at a temperature range of 70° to 150°F.

Corrosion by chemical reaction results in a uniform surface attack that forms a protective film which decreases the corrosion rate. The Zircaloy, stainless steel, and Inconel in the spent fuel assemblies removed from the reactor vessel would have an initial protective oxide layer which would decrease the corrosion rate once the assemblies were placed in the pool water environment. Zircaloy and Inconel have greater corrosion resistance than stainless steel. A ZrO_2 layer of less than 3.15×10^{-4} inches was measured on fuel rods that had been in the HalJen (England) reactor for approximately 8 years and also on other fuel rods that had been in the Shippingport reactor after 12 years. According to B. Cox, Atomic Energy of Canada, the initial corrosion kinetics decrease on a quasi-cubic rate and, after formation of the initial protective ZrO_2 layer, become linear after an oxide thickness of 7.9×10^{-5} to 2.76×10^{-4} inches is attained. In the absence of neutron irradiation Zircaloy is quite resistant to oxygen in aqueous environments and the passivity will remain in either weak acid or weak alkaline solutions. By extrapolation of data to the 70° to 150°F temperature and oxygen-saturated high purity demineralized water environment of the spent fuel pool, it may be calculated that the additional linear growth of the ZrO_2 layer should be not more than 2×10^{-5} inches after 100 years, which is minute relative to the initial thickness.

Stainless steel has performed satisfactorily in the reactor as fuel cladding and in spent fuel pools without significant deterioration being detected over a 15-year period. Based on the observations of stainless steel fuel cladding in spent fuel storage pools, the corrosion rate of the stainless steel pool liner and the stainless steel storage racks in pool environments should not exceed 5.96 x 10^{-5} inches in 100 years.

J. E. Draley and W. E. Ruther, Argonne National Laboratory, have reported an average corrosion rate of 3.5 x 10^{-5} inches/year for unanodized aluminum in oxygen-saturated high purity water at 120°F which corresponds to an oxide layer of 3.5 x 10^{-3} inches in 100 years. This small amount of corrosion should not impair the structural integrity of the unanodized aluminum components in the spent fuel pool.

The electrochemical (electrolyic) nature of corrosion is a reaction which involves oxidation and reduction. Acceleration of the reaction in high purity water requires metals that have a large electrical potential differential and which are in close contact with each other or an electrical current flow in the aqueous environment. The electroytic potential of stainless steel and Inconel are about the same, and they can be coupled without experiencing significant electrolytic corrosion or galvanic effects. Zircaloy is very resistant to electrolytic corrosion and galvanic effects because of its nonconducting ZrO_2 protective layer.

Recent surveys by G. Versterlund and T. Olsson in Sweden, A. B. Johnson of Battelle Northwest Laboratories, and J. R. Weeks at Brookhaven National

Laboratories reveal that Zircaloy or stainless steel cladding, stainless steel tie plates, and Inconel spacers in BWR and PWR fuel bundle assemblies have been stored in water pools for the past 20 years without evidence of accelerated corrosion. Defective fuel placed in the water pools at Windscale (England) and examined after 9 years storage showed no indication of accelerated corrosion, metallurgical changes, crack propagation and hydrogenation of the Zircaloy cladding, or oxidation of the UO_2 fuel. Release of fission products from the high burn-up fuel decreased rapidly to a relatively low and steady rate after 100 days. The detection of only 1 microcurie of Cs-137 and less than 10 ppb iodine in the pool water further indicates no degradation during water pool storage of high burn-up fuel.

Galvanic corrosion is an accelerated electro chemical reaction which occurs when dissimilar metals are in contact or near each other and connected by an ionic electrical conductor. Significant deterioration can occur only when one metal is more noble than the other, i.e., where there is a major difference in electrical potential. The aluminum in the Boral neutron absorber plates is more reactive than stainless steel and it will experience galvanic corrosion if the stainless steel tubes encapsulating the Boral are vented to the pool water environment. Carolinas-Virginia Nuclear Power Associates, Inc. and Exxon Nuclear corrosion tests of Boral with a leak in the stainless steel covering have shown a corrosion rate of 1.8×10^{-4} to 3.4×10^{-4} inches/year for the aluminum in the Boral composite plates. The deterioration was in the form of pitting and edge attack confined to the area of the leak path. Pitting had no effect on the dislodgement of the B_4C particles in the Boral core. In fact, the B_4C particles are inert to pool water environment and galvanic corrosion and became embedded in the aluminum oxide corrosion product which forms on the edges of the Boral plate. The more noble stainless steel showed no attack by the galvanic coupling. Although galvanic corrosion does occur in the unanodized aluminum of the Boral plates, it should not have any significant effect on the neutron absorption capability of the Boral, and certainly no effect on storage rack structural integrity for a period far in excess of 40 years.

The stainless steel pool liner would not be affected by interaction with the aluminum in the Boral plates for the following reasons:

1. Stainless steel is more noble than aluminum and will not suffer galvanic or electrolytic corrosion,
2. The Boral plates are completely encapsulated in the stainless steel tubes of the storage rack module, thus isolating them from the pool liner. The stainless steel storage rack base forms a further protective layer between the Boral plates and the floor of the pool.

3. The spacing between the storage racks (containing the Boral) and the pool liner is sufficient enough to cause electrical discontinuity.
4. The high purity pool water is not a sufficiently strong electrolytic solution to provide a conducting path which would allow galvanic or electrolytic corrosion to occur between any of the components in the modified pool which are not in actual physical contact with each other.

CONCLUSION

Although acknowledgement has been made that corrosion will occur in the Zion spent fuel storage pool environment, it will be of no significance for at least 40 years. All the components in the Zion spent fuel storage pool, excluding the aluminum in the Boral neutron absorber plates, are constructed of alloys with the same electrical potential (or a minute differential) that have a high resistance to general chemical corrosion, electrolytic corrosion, and galvanic corrosion. The only spent fuel pool components of concern are the storage rack modules which have a galvanic coupling between the stainless steel tubes and the unanodized aluminum in the Boral. The deterioration of the aluminum in the Boral by galvanic corrosion, however, would not be of such significance as to affect neutron shielding properties of the Boral. The B_4C neutron absorber particles are inert to the pool water environment.

Based on the preceding facts, it can be concluded that such corrosion as occurs will have no significant effects upon the spent fuel pool components.

PROFESSIONAL QUALIFICATIONS OF FRANK M. ALMETER

I joined the Commission in October, 1974 as a Materials Engineer and I am presently an Applied Mechanics/Material Engineer in the Engineering Branch, Engineering and Projects, Division of Operating Reactors, Office of Nuclear Reactor Regulation. Since October, 1974 my duties and responsibilities have involved the review and evaluation of materials application in nuclear power plants with specific emphasis on corrosion and water chemistry in PWR and BWR systems. I have been appointed to the Electrical Power Research Institute (EPRI) Corrosion Advisory Committee and the NRC Corrosion Review Group for Reactor Systems. I have the primary responsibility for the safety evaluation regarding the corrosion problems of PWR steam generator tubing, spent fuel storage pools, BWR and PWR piping systems, and snubbers.

I also have the responsibility for the evaluation of reactor coolant chemistry in both Pressurized Water Reactors and Boiling Water Reactors. I have provided the Division of Regulatory Standards with the technical bases required for the revision of Regulatory Guide 1.56, "Maintenance of Water Purity in Boiling Water Reactors."

I presented testimony on "Steam Generator Tube Integrity" at the Beaver Valley Unit 1, Pilgrim Station Unit 2, Jamesport Station Units 1 and 2, Byron/Braidwood Stations Units 1 and 2, and Prairie Island public hearings. I also assisted in the preparation of testimony on this same subject for the South Texas Project Units 1/2 and the Washington Nuclear Project One public hearings.

I have a Ph.D. in metallurgy from the University of London (1959) and a D.I.C. degree in metallurgy from the Imperial College (London 1956). I received a B.Sc. degree in Metallurgical Engineering from the University of Missouri at Rolla in 1953.

From June, 1973 to October, 1974, I was associated with the U.S. Consumer Projects Safety Commission as a metallurgist responsible for the evaluation of engineering, manufacturing and quality control procedures within the consumer product industry to insure production of non-hazardous products. I developed safety tests and basic engineering factors relative to the modification of product safety standards.

In 1971 I joined the Office of Saline Water, Department of the Interior, as Assistant to the Chief, Materials Division. My duties and responsibilities were the planning and directing of contracts for the development, testing, and evaluation of materials utilized in the various desalination processes. I prepared contracts for the development of economic materials to reduce the capital and maintenance costs of desalination plants and increase their reliability. I also conducted inspections to evaluate the corrosion performance of materials in operating plants. I performed highly technical studies of the corrosion, mechanical, physical, and fabrication properties of a wide range of materials.

From 1968 to 1971 I was Chief Metallurgist of corporate materials technology for the Burndy Corporation with duties and responsibilities for the technical/administrative management of materials pertinent to process and product development. As manager of the metallurgical R & D laboratory, I was responsible for program planning, cost estimates, budget control and recruiting. I established, staffed and managed a new Metallurgical Service Center to support Engineering, Manufacturing, Purchasing, and Sales/Marketing Departments.

Before I became Chief Metallurgist with the Burndy Corporation, I was a research scientist for 10 years in the aerospace industry where I conducted basic and applied research in the areas of surface science, precious metal coatings, corrosion of metals, mechanical/physical metallurgy, fibrous composite materials, simulated high altitude environmental effects on materials, fracture and surface damage in metals, alloy development, heat treating, ferrous and nonferrous alloys, ceramic/ dielectric materials, and HERF forming of metals.

From 1955 to 1958 I was a Consulting Metallurgist in the United Kingdom. I specialized in the areas of precipitation-hardening, fatigue and tensile properties of Beryllium Bronzes.

I am listed in the American Men of Science, 12th edition and Who's Who in America, 14th edition. I was Guest Lecturer, Fairleigh Dickinson University course on "Desalination Operations," Dec. 1972. I was invited by the Electrical Power Research Institute (EPRI) to be secretary to the "First U.S. - Japan Joint Symposium on Light Water Reactors" (May 29 - June 2, 1978).

I have authored 17 publications in my professional field.

Current Publication: "An Overview of Water Chemistry for Nuclear Power Plant Safety by F. M. Almeter, Vol 28, pp 582-583, 1978 Transactions of the American Nuclear Society.

I am a member of the American Society for Metals, AIME Metallurgical Society, and National Association of Corrosion Engineers.

I have prepared the foregoing affidavit and swear that it is true and correct to the best of my knowledge.

____
Frank M. Almeter

Subscribed and sworn to before me
this ______ day of January, 1979.

____
Notary Public

My Commission expires:________________________.

AFFIDAVIT OF WYVIL R. KENDALL

(Enclosure to Licensee's Motion)

CONTENTION 9

Based upon the Affidavit of Frank M. Almeter, attached hereto, and the Affidavit of Dr. Wyvil R. Kendall, enclosure to Licensee's Motion for Summary Disposition, the NRC Staff supports Licensee's Motion for Summary Disposition of Contention 9.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
COMMONWEALTH EDISON COMPANY	)	Docket Nos. 50-295
	)	50-304
(Zion Station, Units 1 and 2)	)	

AFFIDAVIT OF FRANK M. A'' fER

I, Frank M. Almeter, being duly sworn, do state as follows:

I am employed by the United States Nuclear Regulatory Commission as an Applied Mechanics/Material Engineer in the Engineering Branch, Engineering and Projects, Division of Operating Reactors, Office of Nuclear Reactor Regulation. A statement of my professional qualifications is attached to my affidavit regarding Contention 8.

This affidavit addresses the following contention:

> 9. The Applicant has not discussed whether the proposed modification and long term* storage may cause the following effects on the stored fuel: accelerated corrosion, microstructural changes, alterations in mechanical properties, stress corrosion cracking, intergranular corrosion, and hydrogen absorption and precipitation by the zirconium alloys.

I have read the Licensee's Motion for Summary Disposition of this contention, which deals in part with matters which I discussed in my affidavit in regard to Contention 8. I have also reviewed the affidavit of Dr. Wyvil R. Kendall, in support of Licensee's Motion.

Based upon my analysis of the contention, and my review of the foregoing materials, I am of the opinion that the proposed modification will not result in any significant effects upon the spent fuel as set forth in the contention.

I have prepared the foregoing affidavit and swear that it is true and correct to the best of my knowledge.

____
Frank M. Almeter

Subscribed and sworn to before me
this ____ day of January, 1979.

____
Notary Public

My Commission expires: ______________________.

AFFIDAVIT OF WYVIL R. KENDALL

(Enclosure to Licensee's Motion)

CONTENTION 14

Based upon the Affidavit of Seymour Block and Jack N. Donohew, Jr., attached hereto, and the materials referenced therein, the NRC Staff supports Licensee's Motion for Summary Disposition of Contention 14.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	Docket Nos. 50-295
COMMONWEALTH EDISON COMPANY	)	50-304
	)	
(Zion Station, Units 1 and 2)	)	

AFFIDAVIT OF SEYMOUR BLOCK AND JACK N. DONOHEW, JR.

We, Seymour Block and Jack N. Donohew, Jr., being duly sworn, do state as follows:

We are employed by the Nuclear Regulatory Commission in the Division of Operating Reactors. As statement of Seymour Block's professional qualifications are attached to this affidavit, and Jack N. Donohew's professional qualifications are attached to his affidavit regarding Contention 7.

This affidavit addresses the following contention:

> There is insufficient information regarding the occupational radiation dosage to workers who wi'' 'e engaged in rearranging stored spent fuel, installing .ew spent fuel racks and disposing of contaminated racks and.additional radwaste to assure that occupational exposur levels will be "as low as reasonably achievable" as required by 10 CFR Part 20.

We have reviewed the Licensee's Motion for Summary Disposition of this contention, as well as the Affidavit of John P. Leider and the Deposition of Dr. Herman Cember.

Based upon our analysis of this contention, and our review of the foregoing materials, we are of the opinion that the information provided by Licensee, and our analysis thereof, is sufficient to assure the conclusion that occupational exposure levels will be ALARA.

PROFESSIONAL QUALIFICATIONS

OF

SEYMOUR BLOCK

I am employed as a member of the Staff of the Environmental Evaluation Branch, Division of Operating Reactors, U. S. Nuclear Regulatory Commission, Washington, D. C. My duties include the determination and evaluation of the design and operation of operating nuclear power plants with respect to safety and environmental impact considerations including matters related to Health Physics Radiation Protection Programs.

I first became associated with the atomic energy program in 1944 when I was trained and educated as a Health Physicist at Clinton Laboratories in Oak Ridge, Tennessee, during the Manhattan Engineering Project. I later joined the Brookhaven National Laboratories as a Health Physicist responsible for radiological safety of Chemistry and Reactor operations. In 1953 I transferred to the University of California Radiation Laboratory and set up a small Health Physics program at the Livermore site. When the Livermore Hazards Control Department was formed in 1959, I was made Section Leader of the Special Projects Research and Development Group. For twelve years I engaged in Research and Development in Radiological Instrumentation and Applied Health Physics.

I am a Certified Health Physicist and former Treasurer of the Health Physics Society. I am Past President of the Northern California Chapter of the HPS and a former consultant to Physics International Corporation in San Leandro, California.

From 1938 - 1941 I attended City College in New York. I was inducted into the Army Air Force in 1942 and attended the University of Pennsylvania, Moore School of Electrical Engineering from 1943 - 1944.

I have published numerous articles in technical journals on instrumentation development and radiation dosimetry. I am a member of the Health Physics Society.

We have prepared the foregoing affidavit and swear that it is true and correct to the best of our knowledge.

Seymour Block

Jack N. Donohew, Jr.

Subscribed and sworn to before me this 3rd day of January, 1979.

Notary Public

My Commission expires: July 1, 1982.

III. Conclusion

For the reasons noted above, the NRC Staff asks that summary disposition be granted on Contentions 6C, 7, 8, 9, and 14 listed in Part II of this Motion.

Respectfully submitted,

for Richard J. Goddard
Counsel for NRC Staff

Dated at Bethesda, Maryland
this 31st day of January, 1979.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
COMMONWEALTH EDISON COMPANY	)	Docket Nos. 50-295
	)	50-304
(Zion Station, Units 1 and 2)	)	

CERTIFICATE OF SERVICE

I hereby certify that copies of "NRC STAFF'S MOTION FOR SUMMARY DISPOSITION", in the above-captioned proceeding have been served on the following by deposit in the United States mail, first class, or, as indicated by an asterisk, through deposit in the Nuclear Regulatory Commission's internal mail system, this 31st day of January, 1979.*

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

Dr. Linda W. Little
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, N. Carolina 27709

Dr. Forrest J. Remick
305 E. Hamilton Avenue
State College, Pennsylvania 16801

John W. Rowe, Esq.
Isham, Lincoln and Beale
One First National Plaza
Chicago, Illinois 60690

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

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

Docketing and Service Section
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

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* Personal service on John W. Rowe, Esq. for Licensee and on Susan N. Sekuler, Esq. for Intervenor for the State of Illinois is contemplated. An amended certificate of service, reflecting the date of such personal service will be filed.

The affidavits of Frank M. Almeter are not signed due to absence from the area on official travel. Upon his return, properly signed and executed copies of these affidavits will be served upon the Board and all parties.

Susan N. Sekuler, Esq.
Russell R. Eggert, Esq.
Assistant Attorney General
Environmental Control Division
188 West Randolph Street, Suite 2315
Chicago, Illinois 60601

Mr. Rick Konter
617 Piper Lane
Lake Villa, Illinois 60046

for Richard J. Goddard
Counsel for NRC Staff