Entergy

Entergy Operations, Inc.
P.O. Box B
Killona, LA 70066-0751
Tel 504 739 6660

Charles M. Dugger
Vice President, Operations
Waterford 3

W3F1-97-0270
A4.05
PR

December 12, 1997

U.S. Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, DC 20555

Subject: Waterford 3 SES
Docket No. 50-382
License No. NPF-38
Request For Additional Information (RAI) Regarding
Technical Specification Change Request NPF-38-193

Gentlemen:

By letter dated March 27, 1997, Waterford 3 proposed to amend Operating License NPF-38 to increase the Spent Fuel Pool storage capacity and increase the maximum fuel enrichment. The NRC review staff requested additional information, in their letter dated November 19, 1997, regarding the proposed changes. This information is included in the enclosure entitled "Additional Information Regarding Technical Specification Change Request NPF-38-193." This additional information has no effect on the previously provided no significant hazards determination.

1/1

A001

Drawing in Central Files

Should you have any questions or comments concerning the additional information, please contact Roy Prados at (504) 739-6632.

Very truly yours,

TRLeonard for

C.M. Dugger
Vice President, Operations
Waterford 3

CMD/RWP/tmm

Enclosures: Affidavit
Attachments

cc: E.W. Merschoff, NRC Region IV
C.P. Patel, NRC-NRR
NRC Resident Inspectors Office

(w/o attachments)
J. Smith
N.S. Reynolds
Administrator Radiation Protection Division
(State of Louisiana)
American Nuclear Insurers

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the matter of	)	
	)	
Entergy Operations, Incorporated	)	Docket No. 50-382
Waterford 3 Steam Electric Station	)	

AFFIDAVIT

Theodore Roy Leonard, being duly sworn, hereby deposes and says that he is General Manager Plant Operations - Waterford 3 of Entergy Operations, Incorporated; that he is duly authorized to sign and file with the Nuclear Regulatory Commission the attached Additional Information Regarding Technical Specification Change Request NPF-38-193; that he is familiar with the content thereof; and that the matters set forth therein are true and correct to the best of his knowledge, information and belief.

Theodore Roy Leonard

Theodore Roy Leonard
General Manager Plant Operations - Waterford 3

STATE OF LOUISIANA)
) ss
PARISH OF ST. CHARLES)

Subscribed and sworn to before me, a Notary Public in and for the Parish and State above named this 2nd day of December 1997.

Notary Public

My Commission expires at death.

ADDITIONAL INFORMATION REGARDING TECHNICAL SPECIFICATION CHANGE REQUEST NPF-38-193

Item 1

Entergy Operations Inc. (EOI) proposes to increase the Spent Fuel Pool (SFP) storage capacity from the currently licensed capacity of 1088 fuel assemblies to 2398 fuel assemblies. This increase of SFP storage capacity will be achieved by reracking the SFP with new high-density racks of 1849 cells, installing additional high-density racks of 255 storage cells in the Cask Storage Pit, and after permanent shutdown installing additional high-density racks of 294 cells in the Refueling Canal. Please provide the following information:

* Decay heat generation rates from the spent fuel assemblies stored in the Cask Storage Pit and the Refueling Canal as a function of time.
* Cask Storage Pit and Refueling Canal water temperature as a function of time.
* Detailed description of how the decay heat generated from the spent fuel assemblies stored in the Cask Storage Pit and the Refueling Canal will be removed. Information should include: cooling system design parameters, equipment redundancy, seismic category, etc., and drawings to show cooling system configuration.
* Detailed description to demonstrate how the drains in the Cask Storage Pit and the Refueling Canal will be plugged to preclude any water loss through the drains.
* Discussion of the probability that the water level in the Cask Storage Pit and the Refueling Canal will be inadvertently drained below a point approximately 10 feet above the top of the spent fuel.
* In the event of complete loss of cooling in the Cask Storage Pit and the Refueling Canal, how long will it take the water to boil. Discuss the means for providing make-up water to these areas.

Response 1: first asterisk

The time variation of the decay heat from the fuel assemblies stored in the Cask Storage Pit is shown in the figure provided in Attachment 1. The decay heat load in the Cask Storage Pit consists of the decay heat from 217 freshly discharged assemblies and 38 "old" or previously discharged assemblies. The corresponding curve for the Refueling Canal is presented in the figure provided in Attachment 2. The decay heat load in the Refueling Canal consists of the decay heat from 294 previously discharged assemblies. These heat generation rates have been computed using Auxiliary Systems Branch procedures, (ASB 9.2), which as stated in Holtec Position Paper WS-101, included as Attachment 3, overstates the heat load by a considerable margin.

Response 1: second asterisk

Figures 5.8.1 and 5.8.2 of Holtec International Report HI-971628 (previously submitted on March 27, 1997 as part of Technical Specification Change Request NPF-38-193) provide the average bulk pool temperature for the aggregate of the water mass in the Spent Fuel Pool, Cask Pit, and Refueling Canal. The spatial average temperature (i.e., bulk temperature) in each of the three bodies of water deviates from the overall bulk average by a small amount, because of the extensive interface (interconnection) between the three pools. The bulk average temperature within each body of water can be computed by utilizing the computational fluid dynamic (CFD) solution which provides a complete articulation of the temperature field in each "computation cell" throughout the three regions. Using the CFD solution, the peak bulk temperature in the Spent Fuel Pool, Cask Pit, and Refueling Canal for the limiting case (full core offload with 72 hour hold time followed by fuel transfer at the rate of four assemblies per hour) was calculated. The following results were obtained:

Aggregate bulk pool temperature (Figure 5.8.2):	151.6°F
Cask Pit average bulk temperature:	155.5°F (temperature difference of 3.9°F relative to the bulk pool temperature)
Refueling Canal average bulk temperature:	158.5°F (temperature difference of 6.9°F relative to the bulk pool temperature)

The above temperature differences can be applied to Figure 5.8.2 to obtain the Cask Pit and Refueling Canal average bulk temperatures as a function of time. The differential between the bulk temperatures in the three bodies will become smaller at non-peak instants. Even at the point in time when the transient effect is most pronounced (i.e., the instant of peak aggregate bulk temperature), the inter-body temperature differentials are quite small. Similarly, the Cask Pit and the Refueling Canal average bulk temperatures for the normal discharge scenario will be slightly higher than the temperature shown in Figure 5.8.1 (i.e., peak temperature slightly above 140°F). The aggregate bulk pool temperature, as shown in Figure 5.8.1, remains less than 140°F. The above data confirms the conclusions drawn in previous dockets that the thermosiphon effect in wet storage tends to homogenize the temperature field.

Response 1: third asterisk

The spent fuel decay heat in all three pools will be removed by a combination of the spent fuel pool cooling system and heat loss to the pool surroundings. The latter process consists primarily of evaporative heat loss. Therefore, the method of heat removal remains unchanged from those previously relied upon prior to the proposed change.

The temperatures in the three pools are expected to be relatively equalized, as stated above. This equalization will take place primarily through interchange of water mass between the three regions. This water mass exchange process is driven by natural convection which takes place from the changes in water density due to small variations in temperatures. It is well documented that this process of natural convection also takes place within storage cells and adjacent pool walls forming convection cells. The warmer water rises in the cell, cools at the top of the racks, and falls along the racks outside perimeter in what is referred to as the "downcomer."

Convection cells will also be formed at the gate openings separating each of the regions. Through this convection process, the water masses in each of the regions will be constantly exchanged. Heat will flow from the warmer to cooler areas of the regions producing mixing and a nearly homogeneous fluid temperature throughout all three regions. Figures 5.8.9 and 5.8.10 of Holtec International Report HI-971620 depict the results of the full core discharge CFD analysis, which included the dimensional characteristics of the three regions. Figure 5.8.10 provides velocity vector plots of the fluid mass in all three regions. This figure clearly indicates the inter-mixing of the regions.

Administrative controls will be implemented to ensure that the gates are not installed when spent fuel is present in the Cask Storage Pit and/or the Refueling Canal.

Consistent with the practice over the past 10 years, the sparger lines in the Spent Fuel Pool will be truncated. In-depth analyses of temperature fields in fuel pools has shown that spargers do little to smear the temperature differentials. The remainder of the spent fuel pool cooling system remains essentially unchanged from its condition prior to the proposed change.

The cooling system is described in detail in Section 5.2 of Holtec International Report HI-971628 (included as part of the March 27, 1997 submittal) and in much greater detail in Section 9.1.3 of the Waterford 3 FSAR. The following specific highlights are extracted from Holtec International Report HI-971628 and the FSAR:

> The cooling system is a closed loop consisting of two half capacity pumps and one full capacity heat exchanger. A backup fuel pool heat exchanger is also available, when the primary exchanger is out of

service. These components are all designated Nuclear Safety Related - Seismic Category I.

A drawing showing the Spent Fuel Pool cooling system configuration is provided herein as Attachment 4. The pump head/flow curves are provided herein as Attachment 5. The data sheets for the primary and backup heat exchangers are provided herein respectively as Attachments 6 and 7. Component cooling water at a maximum temperature of 90°F is supplied to the shell side of each heat exchanger. The component cooling water total maximum flow, for fuel pool cooling, is 5000 gpm.

Response 1: fourth asterisk

The 4" diameter drain holes in the Cask Storage Pit and Refueling Canal will be sealed by being covered with a plate measuring approximately 6"X6"X ¼". The Refueling Canal drain cover plate will not be installed until just prior to the installation of the racks in the Refueling Canal. An all around fillet weld will secure the plate to the ¼" liner surrounding the hole.

Response 1: fifth asterisk

Draining of the Spent Fuel Pool was not a previously postulated event because the Spent Fuel Pool was designed to preclude draining. The construction of the Cask Storage Pit and Refueling Canal is very similar in nature to the Spent Fuel Pool, using reinforced concrete and the same liner thickness. The drains at the bottom of these two regions represent the only new significant difference between these regions and the Spent Fuel Pool with regard to the possibility of draining. Therefore, the drains will be welded shut, as discussed above in Response 1: fourth asterisk, to eliminate this possible drain path. The closure design provides the same level of leakage protection as that afforded by the liner welds and the underlying leak chase system previously existing in all three regions (liner leakage would be detected by the leak chase system; any leakage past the cover plate is not a credible event, but would be contained within the piping downstream of the welded closed drains; the isolation valves downstream of the welded closed drains will be maintained closed through administrative controls). The probability that the water level in the Cask Storage Pit and Refueling Canal will be lowered due to draining is negligible because of the same level of drainage preclusion as is presently provided for the Spent Fuel Pool. In addition, if leakage did occur it would be detected by the Spent Fuel Pool low level monitor/alarm. Leakage from the Refueling Canal (into containment) through the fuel transfer tube is not a credible event, during normal operation, because the containment side of the fuel transfer tube is sealed with a bolted on cover (which is pressure tested each outage). Administrative controls in place for the installation and testing of the cover are procedures RF-006-001 "Reactor Vessel Head and Internals Installation" and STA-001-004 "Local Leak Rate Test (LLRT) respectively. Leakage from the Cask Storage Pit into the Cask

Decontamination Pit through gate 3a is also not a credible event because this gate is seal welded closed. This seal weld will be in place until just prior to removal of spent fuel from the Fuel Handling Building. Therefore, drainage of the Cask Storage Pit and Refueling Canal is not a postulated event. Drainage of the Spent Fuel Pool is also currently not a postulated event. The Cask Storage Pit, and Refueling Canal were originally designed to accommodate short term storage or movement of spent fuel. Therefore, the proposed long term storage of spent fuel in these pools represents little, if any, change from the standpoint of protecting fuel from the possibility of being left with limited cooling/shielding coverage. Since all of the fuel in the proposed increased storage configuration is located at the same elevation and the pool gates will remain open at all times, lowering of the water level after the proposed modification represents the same consequence as prior to the modification. However, this point is moot, since drainage of these two regions will be precluded.

Response 1: sixth asterisk

The time-to-boil in the aftermath of loss of all forced cooling paths to the water mass represented by the three regions (SFP, Cask Pit, and Refueling Canal) is presented in Section 5.8 of Holtec International Report HI-971628. Data on water level change subsequent to bulk boiling conditions with and without make-up is provided in graphical form in Figures 5.8.5 through 5.8.8 for the four postulated discharge scenarios. Since three regions of the pool are connected through large interfaces and the bulk temperatures in the three regions are very close to each other, the time-to-boil and post-boiling information presented in the above mentioned figures is applicable to all three bodies of water. It is not possible to produce bulk boiling (with regions connected and administrative controls in place) in any one region while maintaining a sub-boiling condition in others, because of extensive gravity induced heat and mass transfer fluxes.

Item 2

With regard to the calculated decay heat loads following the proposed pool expansion, provide the decay heat generation rate as a function of decay time for both the routine refueling discharge and unplanned full-core offload conditions (information should clearly show the decay heat generation rate from each batch of the previously discharged spent fuel assemblies and the freshly discharged full core in the Spent Fuel Pool).

Response 2

The requested data is provided in Attachments 8A through 8C.

Item 3

Reracking of the SFP and installing additional racks in the Cask Storage Pit would only provide an increase in storage capacity which would maintain the plant's capacity to accommodate a full-core discharge through the end of Cycle 19 in 2018. However, EOI plans to operate for two additional cycles until 2022 without a full-core offload capability. Provide detailed justifications for the deviation to the guidance described in SRP Section 9.1.2 regarding spent fuel storage capacity.

Response 3

Entergy Operations, Inc. (EOI) plans to operate Waterford 3 until at least the year 2024, the last year of the current operating license. The proposed reracking provides full core discharge capability until the year 2018, based on projected fuel cycle data. Therefore, the proposed reracking does not provide end of plant life spent fuel storage capability. Also, EOI is not proposing to operate Waterford 3 without full core discharge capability. The proposed reracking does provide Waterford 3 with an additional eighteen years of spent fuel storage capacity. It is hoped that this additional time will allow the Department of Energy time to fulfill its obligation to take possession of and store the Waterford 3 spent fuel. EOI plans to monitor and assess the Waterford 3 spent fuel storage situation as time progresses and will take the appropriate actions to safely store the Waterford 3 spent fuel and also maintain full core discharge capability.

Section 9.1.2.III.1. of NUREG-0800 (SRP) states that "... for a single unit facility the storage capacity shall equal or exceed one full core discharge plus the maximum normal fuel discharge cycle ... ." This is the minimum recommended spent fuel pool storage capacity and is a hold over from the time when reprocessing of commercial spent nuclear fuel was planned in the United States. Part I of Section 9.1.2 of NUREG-0787 (Safety Evaluation Report related to the operation of Waterford Steam Electric Station, Unit No. 3) states that the current Waterford 3 spent fuel pool "... facility provides high density underwater storage for 1088 fuel assemblies or approximately 5 full core loads." The proposed reracking will provide storage for 2398 fuel assemblies or approximately 11 full core loads; therefore, the proposed reracking does not deviate from the guidance given in SRP Section 9.1.2.

Item 4

Discuss the procedure to be utilized by the Waterford staff to monitor and control the SFP water temperature and decay heat load so as to remain within the design basis limit values for routine refueling and planned or unplanned full-core offload events. Include discussion of the location of needed instrumentation, means of monitoring it and integration of operation staff activities with engineering staff activities in order to implement the procedure(s).

Response 4

Spent Fuel Pool temperature is monitored by a temperature probe which provides a Spent Fuel Pool temperature high alarm at 135°F in the Control Room. This alarm setting is conservative in relation to the normal (partial core) refueling limit of 140°F and the Waterford 3 self imposed abnormal (full core discharge) refueling limit of 155°F.

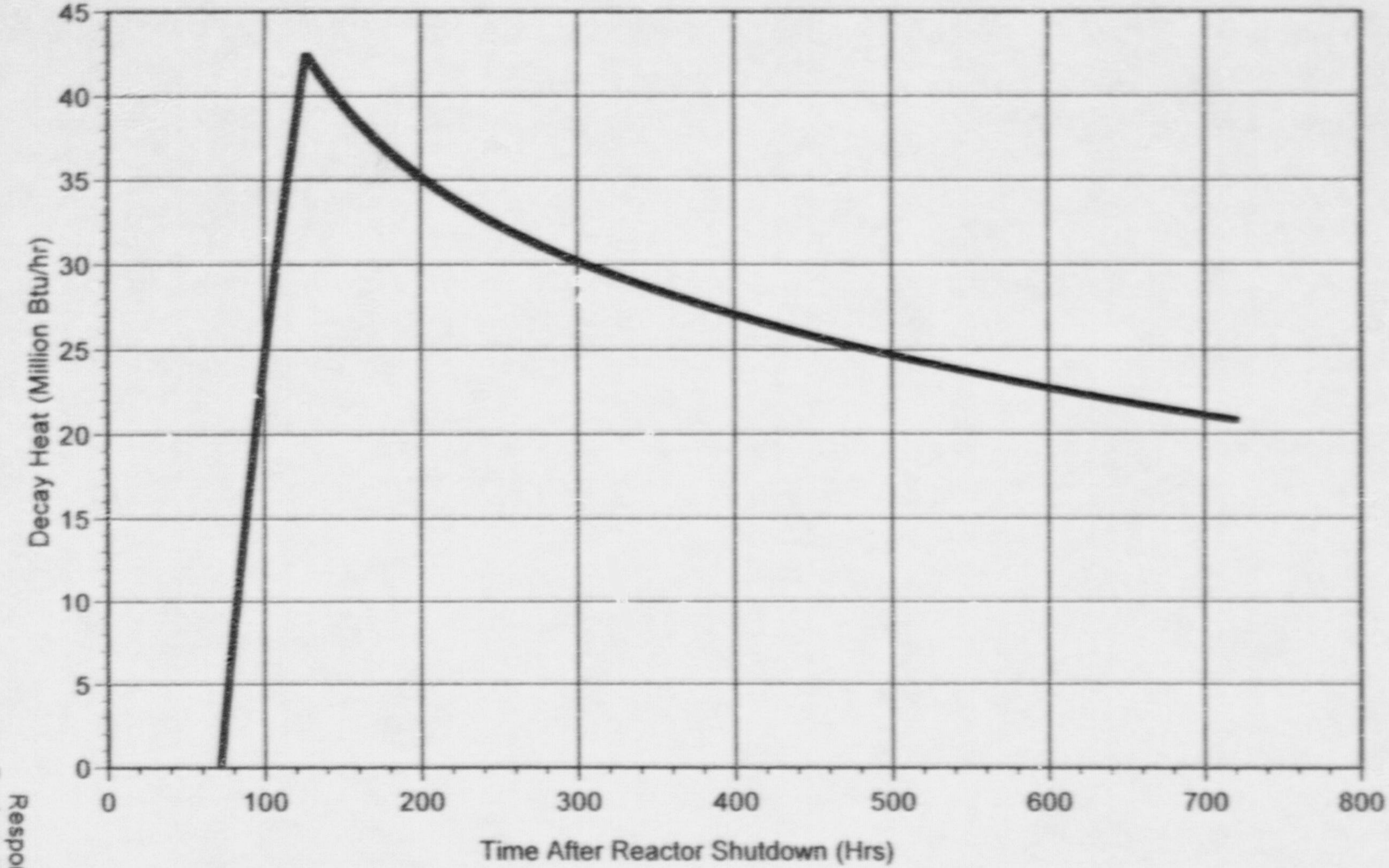
The thermal-hydraulic analyses were performed using limiting heat loads for two postulated normal and two postulated abnormal heat load conditions. These limiting heat loads were calculated using parameters that bound the actual conditions under the worst cases for each of the postulated scenarios. In the thermal-hydraulic analysis of the system (Chapter 5 of Holtec International Report HI-971628) the total number of stored fuel assemblies is conservatively assumed to be greater than the installed storage capacity (i.e., 2485 assemblies vs. the proposed 2398 assemblies). Other parameters such as fuel burnup and radial and axial peaking factors were routinely assigned values that conservatively bound the expected as-built parameters. The thermal-hydraulic analyses for reracking are routinely performed in this manner to alleviate any need to perform outage specific heat load calculations or monitoring. Engineering review and input to the Reload Fuel Safety Analysis Groundrules Document (Groundrules) will ensure that these limiting parameters are not exceeded. This review occurs during the design process for each new batch of reload fuel.

The first barrier for ensuring that spent fuel pool decay heat load and water temperature limits are not exceeded is an engineering review of the Groundrules. The second barrier is system operating procedure OP-002-006, "Fuel Pool Cooling and Purification." This procedure directs the operators to maintain fuel pool temperature less than 130°F. The third barrier is the actual monitoring of the Spent Fuel Pool temperature high alarm by operations personnel. In the event that the alarm did sound due to high fuel pool temperature, procedure OP-901-513 entitled "Spent Fuel Pool Cooling Malfunction," and the Waterford 3 corrective action process, Site Directive W2.501, entitled "Corrective Action," would ensure that the appropriate corrective actions are taken.

LIST OF ATTACHMENTS

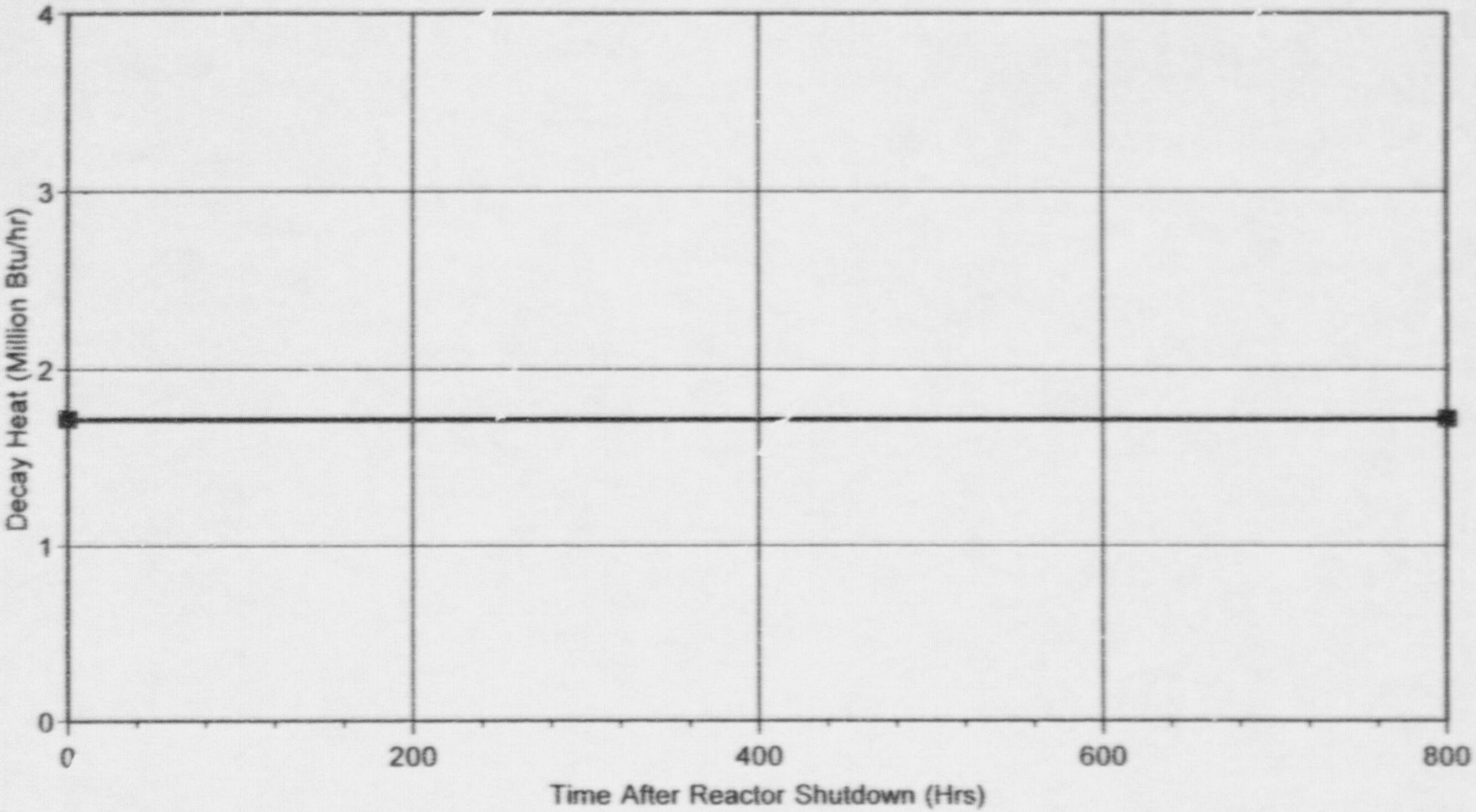
ATTACHMENT 1:	Waterford 3 Cask Pit Decay Heat Variation with Time
ATTACHMENT 2:	Waterford 3 Refueling Canal Decay Heat Variation with Time
ATTACHMENT 3:	Holtec International Position Paper WS-101, Spent Fuel Pool Heat Loads and Pool Bulk Temperatures
ATTACHMENT 4:	Waterford 3 drawing G-169, Flow Diagram Fuel Pool System
ATTACHMENT 5:	Waterford 3 drawing 1564-1275R1, Fuel Pool Pump Curves
ATTACHMENT 6:	Primary Heat Exchanger Specification Sheet
ATTACHMENT 7:	Backup Heat Exchanger Specification Sheet
ATTACHMENT 8A:	Decay Heat Input to Waterford 3 Fuel Pool From A Freshly Discharged Full Core
ATTACHMENT 8B:	Decay Heat Input to Waterford 3 Fuel Pool From a Normal (Partial Core) Discharge
ATTACHMENT 8C:	Decay Heat Generation Rate From Previously Discharged Assemblies

ATTACHMENT 1



ATTACHMENT 1: WATERFORD-3 CASK PIT DECAY HEAT VARIATION WITH TIME

ATTACHMENT 2



ATTACHMENT 2: WATERFORD-3 REFUELING CANAL DECAY HEAT VARIATION WITH TIME

ATTACHMENT 3

HOLTEC INTERNATIONAL POSITION PAPER WS-101

SPENT FUEL POOL HEAT LOADS AND POOL BULK TEMPERATURES

Revision 0: December 21, 1995

It is common knowledge in the nuclear power industry that the heat load burden on the spent fuel pool cooling system is grossly overestimated. There are two sources of the overestimate: (i) heat loss through evaporation of pool water, (ii) huge conservatism in the decay heat load calculations. The net result of these overestimations is an overly conservative assessment of the magnitude of the pool bulk temperature. Maximum pool water temperatures are routinely overpredicted by as much as 20°F to 30°F, because of the above-mentioned conservatisms in the calculations.

In 1989, this deficiency in the state-of-the-art was partially remedied when Holtec International performed a series of pool evaporative heat loss measurements at Millstone Unit 3 under the sponsorship of Northeast Utilities. These so-called "pool evaporative loss" experiments, carried out under Holtec's 10CFR50 Appendix B Q.A. program, were correlated with a theoretical formulation, resulting in a reliable formalism for estimating heat loss in spent fuel pools.

The second, and more important, source of error arises from the inaccuracy in the NRC's ASB 9.2 and ANS' standard 5.1, customarily used to compute decay heat loads. Neither of these two calculational methods correlated well with benchmark data. The attached figure shows a comparison between the ASB 9.2 and Oak Ridge National Labs' code ORIGEN 2. ORIGEN is known to have considerable built-in conservatism, the ASB 9.2 result is even more conservative. Fortunately, this limitation, too, is a thing of the past. Holtec International has recently implemented a fully benchmarked decay heat code - named DECOR - based on work done at the Oak Ridge National Laboratory. This program, along with the evaporative heat loss, results in pool bulk temperature predictions which are projected to be modestly conservative (by roughly 2°F - 5°F compared to the actual pool water temperature).

Implementation of these enhancements in the pool bulk temperature evaluations would help utilities plan the reactor decay time (time for passive decay of fuel before transfer to the pool commences) by utilizing a reliable pool temperature predictive vehicle, instead of the coarse, grossly conservative methodology in use today.

DECAY HEAT COMPARISON BETWEEN ASB9-2 and ORIGEN2
Millstone Unit 1, 2011 MW(t), 3.97% enrichment, 46000 MWD/MTU

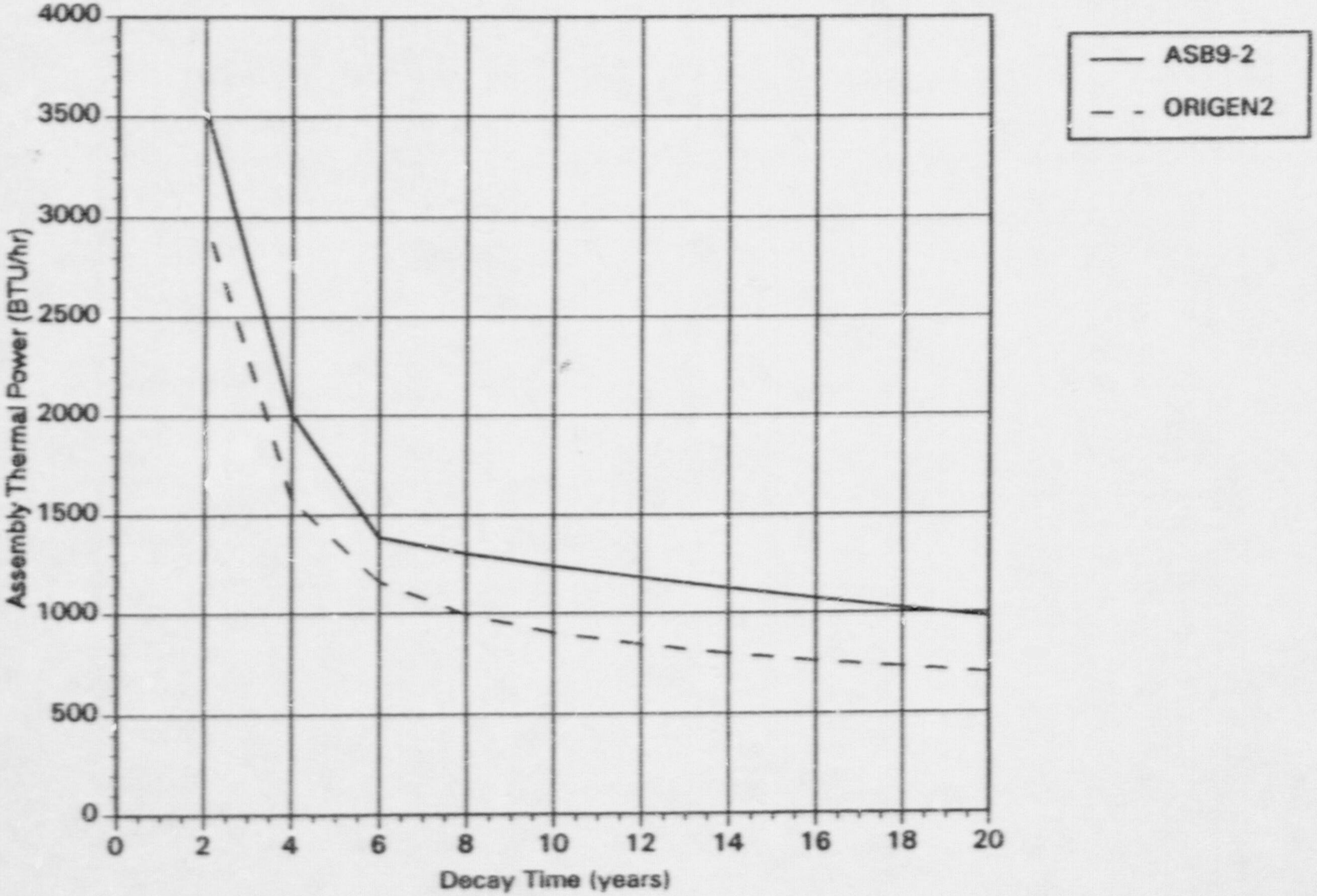
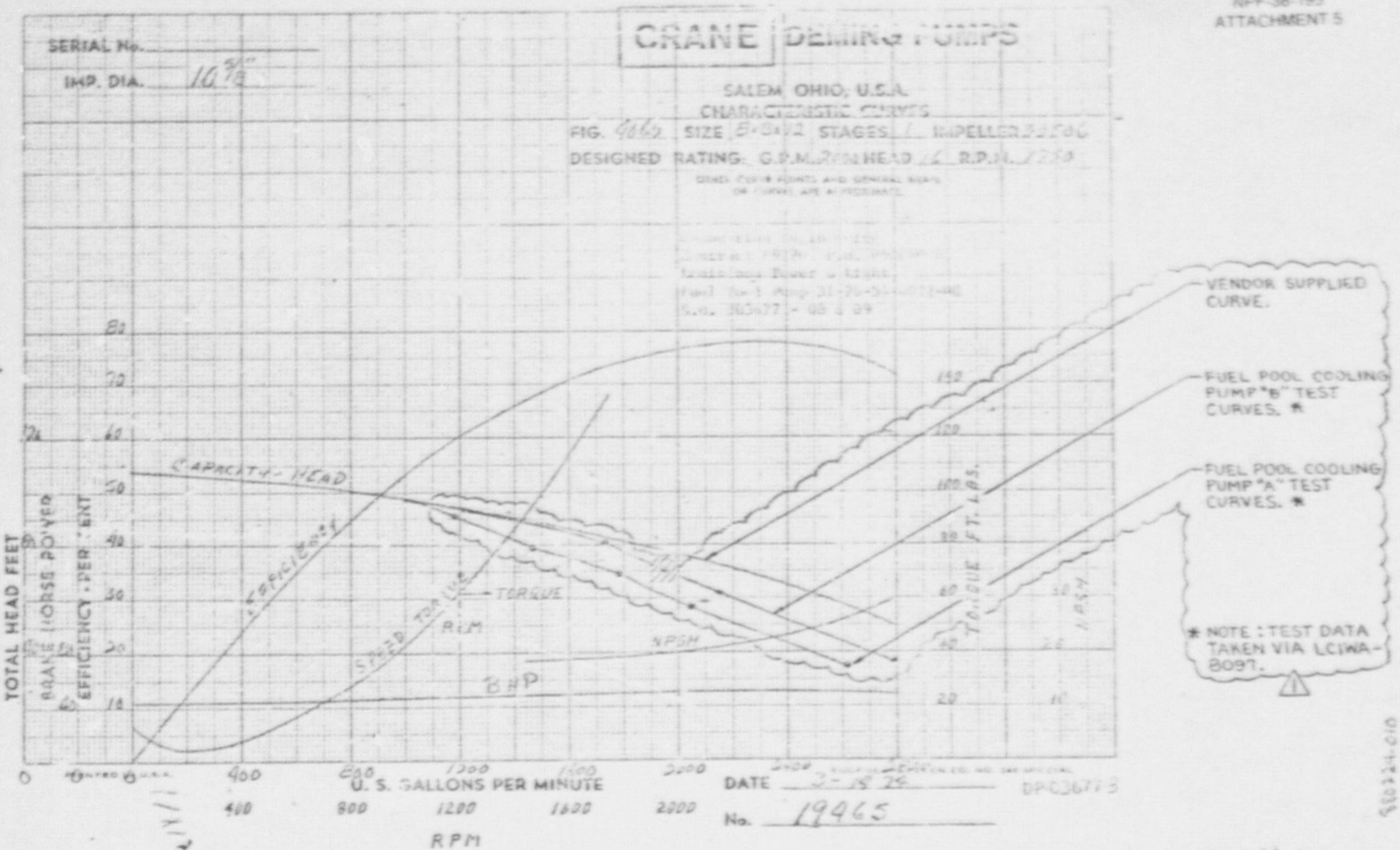


FIGURE WS-10LI

ATTACHMENT 4

ATTACHMENT 5

Technical Specification Change Request
NPF-38-193
ATTACHMENT 5



INFORMATION ONLY

1	2-12-88	INCORP.: SMP. 947 RO.	DNS		
NO.	DATE	REVISION DESCRIPTION	BY	CH.	APPROVED

DIST.	DESIGN	W.C.C.
	MECHANICAL	
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	RADWASTE	
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	SHIELDING	
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	FOR INFO ONLY	

1564-1275R

LOUISIANA POWER & LIGHT COMPANY
WATERFORD S.E.S. UNIT NO. 3
1976 – 1165 MW INSTALLATION

PO CE 400 ITEM

A		REVIEWED WITHOUT COMMENTS	1
		REVIEWED WITH COMMENTS AS NOTED	2
		NOT APPLICABLE	3
		NO COMMENTS, NO PRINT RETURNED	4
		NOT FOR INSTALLATION	5
B		NO FURTHER REPRODUCIBLE REQUIRED	4
		RESUBMIT REVISED REPRODUCIBLE — SEE NOTE BELOW IF CHECKED HERE	5
		RESUBMIT CLOTH OR MYLAR REPRODUCIBLE AS SHOWN	6
		DO NOT PROCEED WITH FABRICATION. RESUBMIT REVISED REPRODUCIBLE	7

PRINT INCLUDED — NOTE

CURVES

REVIEWED BY	DATE	ORIG. DIV.	DAYS TO COMMENT
WKS		M	

THE FOREGOING SHALL IN NO WAY RELIEVE CONTRACTOR FROM ENTIRE RESPONSIBILITY FOR ENGINEERING, DESIGN, WORKMANSHIP, MATERIAL AND ALL OTHER LIABILITY UNDER THE CONTRACT

EBASCO SERVICES INCORPORATED
AGENT
2 RECTOR ST. NEW YORK, N.Y. 10006

880224-010

60 EP

CRANE DEMING

SERIAL No. ____________

IMP. DIA. 10 5/8"

SALEM, OHIO, U.S.A.

CHARACTERISTIC CURV

FIG. 4660 SIZE 8×8×12 STAGES

DESIGNED RATING: G.P.M. 2000 HEA

OTHER CURVE POINTS AND GENERAL
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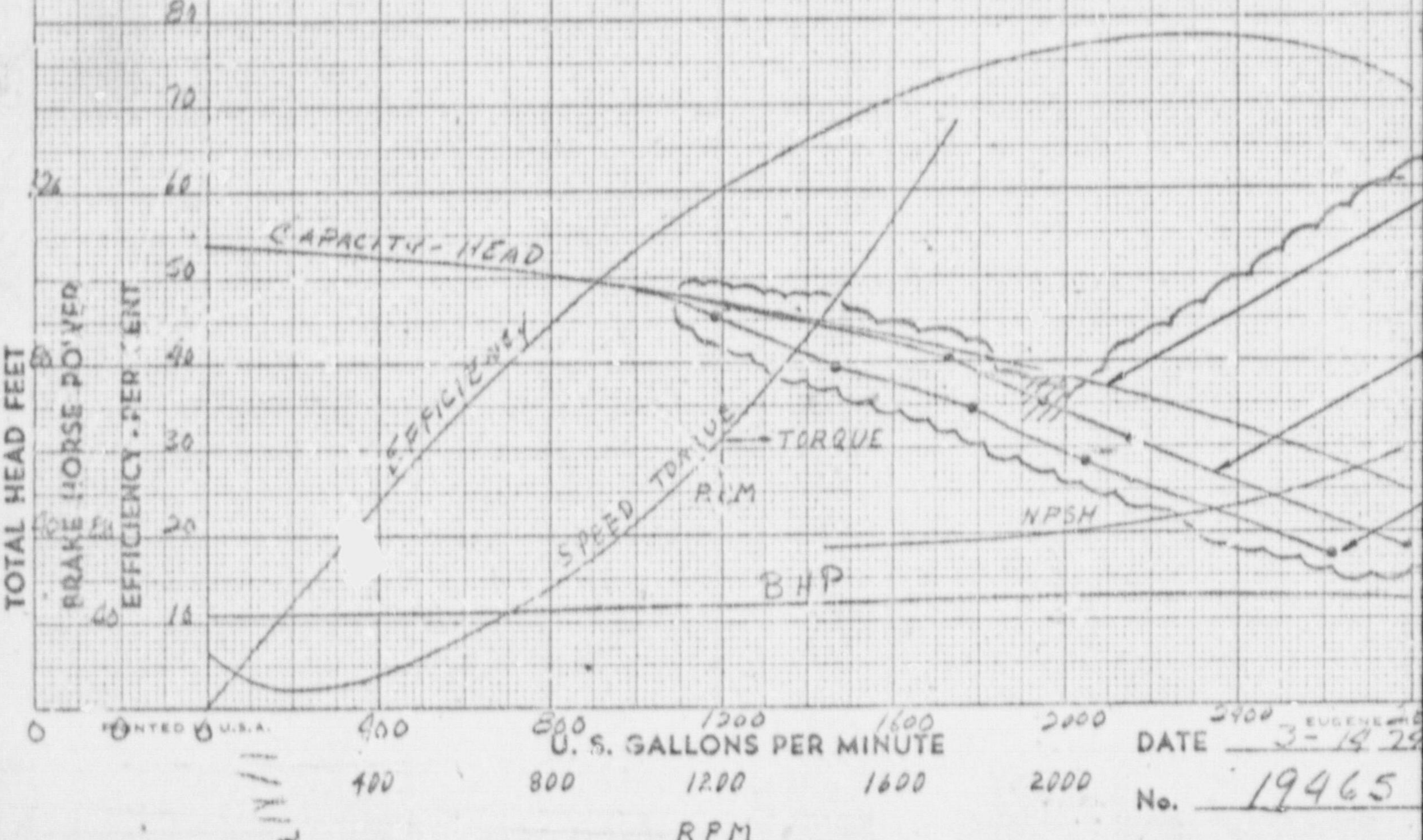
Combustion Engineering
Contract #9270 P.O. #92
Louisiana Power & Light
Fuel Pool Pump 31-76-54-
S.O. #03677 - 08 & 09



DATE 3-18-7

No. 19465

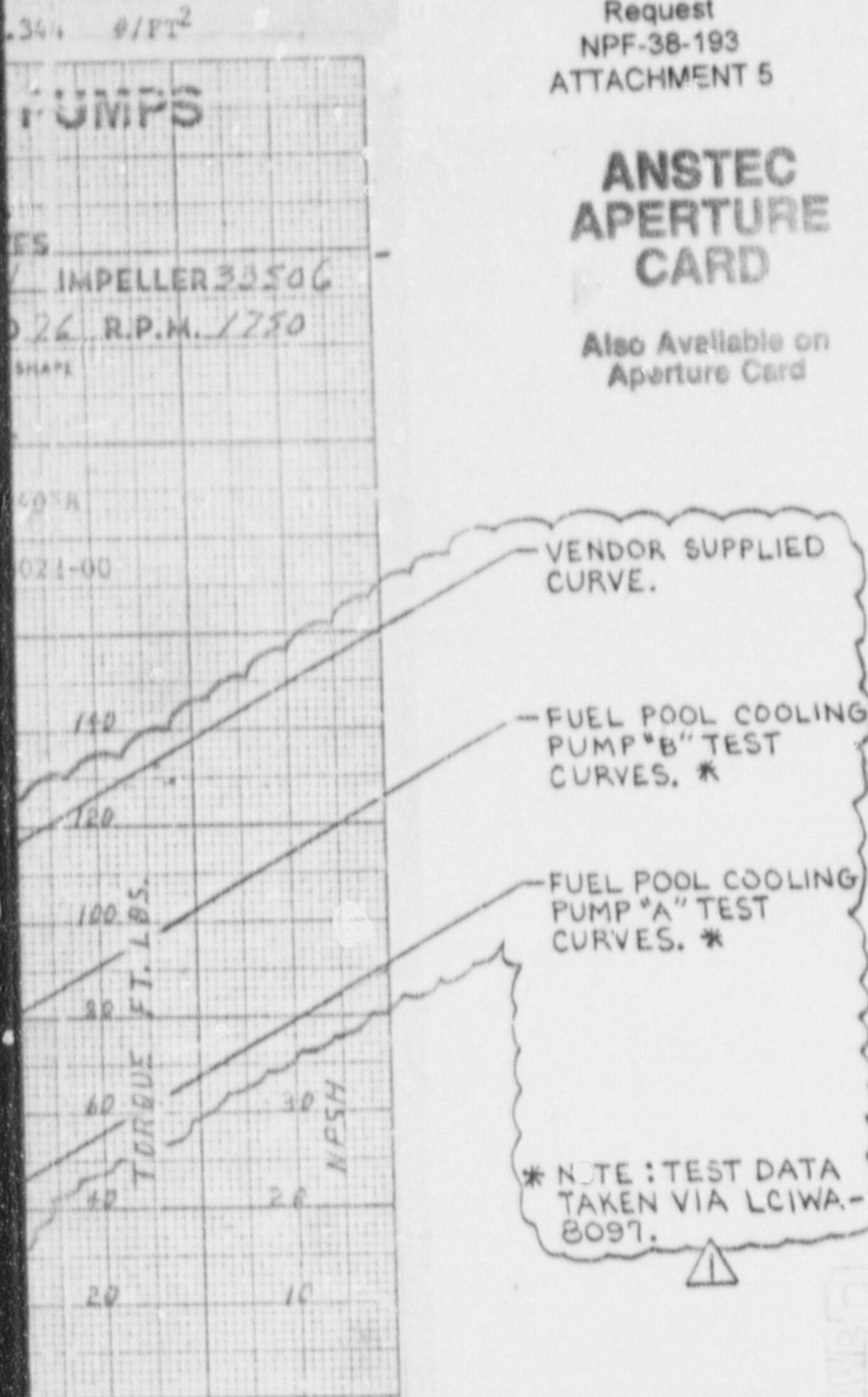
1	2-12-8
NO.	DATE

Response to Questions on
Technical Specification Change
Request
NPF-38-193
ATTACHMENT 5

**ANSTEC
APERTURE
CARD**

Also Available on
Aperture Card

SEP 6 1978



DP-03677-3

9712160254-1

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	HVAC		
	PLUMBING		
	ENGINEERING		
X	MECHANICAL	O	X
	CONC-HYD		
	ARCH-STR		
	ELECTRICAL		
	INSTR & CONT		
	BLDGS ENGR		
	WTR TREAT		
	RADWASTE		
	STRESS		
	SHIELDING		
	LICENSING		
	MATERIALS		
	CONSTRUCTION		
	STANDARD DIST		
	FOR INFO ONLY		

1564-1275R 1 — DATE REC. 2 16 ?

LOUISIANA POWER & LIGHT COMPANY
WATERFORD S.E.S. UNIT NO. 3
1976 – 1165 MW INSTALLATION

P.O. CE 400 ITEM

A	DRAWING REVIEW	REVIEWED WITHOUT COMMENTS *	1
		REVIEWED WITH COMMENTS AS NOTED *	2
		NOT APPLICABLE *	3
		NO COMMENTS. NO PRINT RETURNED	4
		NOT FOR INSTALLATION	5
B	PROCEED WITH FABRICATION	NO FURTHER REPRODUCIBLE REQUIRED	4
		RESUBMIT REVISED REPRODUCIBLE — SEE NOTE BELOW IF CHECKED HERE	5
		RESUBMIT CLOTH OR MYLAR REPRODUCIBLE AS SHIPPED	6
		DO NOT PROCEED WITH FABRICATION RESUBMIT REVISED REPRODUCIBLE	7

* PRINT INCLUDED — NOTE:

FUEL POOL PUMP
CURVES

REVIEWED BY	DATE	ORIG. DIV.	DAYS TO COMMENT
WLS	12/12/78	M	

THE FOREGOING SHALL IN NO WAY RELIEVE CONTRACTOR FROM ENTIRE RESPONSIBILITY FOR ENGINEERING, DESIGN, WORKMANSHIP, MATERIAL AND ALL OTHER LIABILITY UNDER THE CONTRACT.

EBASCO SERVICES INCORPORATED
AGENT
2 RECTOR ST., NEW YORK, N.Y. 10006

INFORMATION ONLY

8	INCORP.: SMP. 947 RO.	JHS	[illegible]	[illegible] 19FEB88
	REVISION DESCRIPTION	BY	CH.	APPROVED

ATTACHMENT 6

ATLAS INDUSTRIAL MFG. CO.
CLIFTON, NEW JERSEY
EXCHANGER SPECIFICATION SHEET

CUSTOMER	Combustion Engineering Company	JOB NO.	
ADDRESS	Windsor, Connecticut	REFERENCE NO.	9270
PLANT LOCATION	Taft, Louisiana	INQUIRY NO.	A-669-71
SERVICE OF UNIT	Fuel Pool Heat Exchanger	DATE	7-29-71
SIZE	44 264 TYPE CEN	ITEM NO.	
SURFACE PER UNIT	4313 SHELLS PER UNIT 1	CONNECTED IN	
Alternate Condition		SURFACE PER SHELL	4313

Rev. #4

PERFORMANCE OF ONE UNIT

		SHELL SIDE	TUBE SIDE
FLUID CIRCULATED		Inhibited Water	Boric Acid Solution
TOTAL FLUID ENTERING	#/HR.	2498924.438	1000000.000
VAPOR	#/HR.		
LIQUID	#/HR.		
STEAM	#/HR.		
NON-CONDENSABLES	#/HR.		
FLUID VAPORIZED OR CONDENSED			
STEAM CONDENSED			
MOLECULAR WEIGHT-VAPORS			
LATENT HEAT-VAPORS	B.T.U./#		
SPECIFIC HEAT	B.T.U./#	1.000	0.999
DENSITY	#/CU.FT.	61.950	61.800
VISCOSITY	CP.	0.711	0.630
THERMAL CONDUCTIVITY		0.364	0.365
TEMPERATURE IN	F	100.000	120.000
TEMPERATURE OUT	F	104.960	107.600
OPERATING PRESSURE	#/SQ.IN.	125.000	50.000
FOULING RESISTANCE		0.00050	0.000575
NUMBER OF PASSES		1	2
VELOCITY	FT./SEC.	4.463	3.879
PRESSURE DROP	#/SQ.IN.	14.706	2.694

HEAT EXCHANGED-B.T.U./HR. 12389335.625 MTD(CORRECTED) 9.856
TRANSFER RATE-SERVICE 300.817 CLEAN 444.587

CONSTRUCTION PER SHELL

		SHELL SIDE	TUBE SIDE
DESIGN PRESSURE	#/SQ.IN.	150.000	75.000
TEST PRESSURE	#/SQ.IN.	225.000	112.500
DESIGN TEMPERATURE	F	250.000	250.000

TUBES SS-304, SA-249 O.D. 0.750 PITCH 0.9375 TRI
NUMBER OF TUBES 1000 BWG. 18 LENGTH 22.00
SHELL CS, SA-285-C I.D. O.D. 44" THICKNESS 0.5"
SHELL COVER FLT'G HEAD COVER
CHANNEL SS-304; SA-240 CHANNEL COVER SS-304 SA-240
TUBESHEETS-STATIONARY SS-304F SA-182 FLOATING
BAFFLES SA-36 THICKNESS 0.500 PITCH 37" TYPE SEGMENTAL
BAFFLE-LONG THICKNESS TYPE
GASKETS
CONNECTIONS-SHELL IN 18.000 OUT 18.000 SERIES B.W.
CHANNEL-IN 12.000 OUT 12.000 SERIES B.W.
CORROSION ALLOWANCE-SHELL SIDE 1/8" TUBE SIDE None
CODE REQUIREMENTS SEC III C&3 1971 ED TEMA CLASS R
WEIGHTS-EACH SHELL 20,590# BUNDLE FULL OF WATER 32,382
REMARKS: VIBRATION ANALYSIS
STR: RATIO= 8.747 SPAN= 20.900
NOZ: RATIO= 5.401 SPAN= 13.933

Response to Questions on Technical Specification Change Request
NPF-38-193
ATTACHMENT 6

ATTACHMENT 7

YUBA HEAT TRANSFER CORPORATION

P. O. BOX 3188 • TULSA, OKLAHOMA 74101 • (918) 939-2201

EXCHANGER SPECIFICATION SHEET

YUBA INDUSTRIES, INC.

AS BUILT
74-N-010-2
Rev. 1, 3-4-7

	CUSTOMER	Jersey Central Power and Light Company	DATE	6-4-73
		Burns and Roe, Inc.	CUST. NO.	[illegible]51035
	PLANT LOCATION	Forked River Nuclear Station, Unit 1	PROPOSAL NO.	[illegible]-193-73
1	SERVICE OF UNIT	Spent Fuel Cooling Heat Exchanger	ITEM NO.	SP-C-[illegible]A 1B
2	SIZE	31-213 TYPE AEL	POSITION	[illegible]orizontal
3	SURF/UNIT (EFF.)	1652 Ft² /Shell SHELLS PER UNIT Two	SURF./SHELL (EFF.)	[illegible]680 Ft² Gross
4	NO. OF UNITS	One SHELL ARRANGEMENT —— PARALLEL - SERIES -	ENGRS.	RJS

PERFORMANCE OF ONE SHELL

			SHELL SIDE	TUBE SIDE
7	FLUID CIRCULATED		Buff. Demin. Water	Demin. Borated Water
8	TOTAL FLUID ENTERING	#/HR.	1,000,000 (2000 GPM)	875,000 (1750 GPM)
9	VAPOR	#/HR.		
10	LIQUID	#/HR.	1,000,000 (2000 GPM)	875,000 (1750 GPM)
11	STEAM	#/HR.		
12	NON-CONDENSABLES	#/HR.		
13	FLUID VAPORIZED OR CONDENSED	#/HR.		
14	STEAM CONDENSED	#/HR.		
15	GRAVITY-LIQUID	°API		
16	VISCOSITY-LIQUID	CP.		
17	MOLECULAR WEIGHT-VAPORS			
18	SP. HEAT-BTU/#/°F ENTHALPY-BTU/#			
19	TEMPERATURE IN	°F.	95	129
20	TEMPERATURE OUT	°F.	106.4	116
21	OPERATING PRESSURE	P.S.I.G.	110	45
22	NUMBER OF PASSES	PER SHELL	One	Two
23	VELOCITY	FT./SEC.		7.0
24	PRESSURE DROP	P.S.I.	10 ALLOWED 5 CALC.	10 ALLOWED 6 CALC.
25	FOULING RESISTANCE		0.0005	0.0005
26	HEAT EXCHANGED-B.T.U./HR.		11,400,000	M.T.D. (CORRECTED) °F. 20.6
27	TRANSFER RATE-SERVICE		335	

CONSTRUCTION-EACH SHELL

			SHELL SIDE	TUBE SIDE
29	DESIGN PRESSURE	P.S.I.	150	150
30	TEST PRESSURE	P.S.I.	225	225
31	DESIGN TEMPERATURE	°F.	175	200
32	TUBES SA-249, Tp. 304	NO. 482	O.D. 3/4	18 BWG. AVG. WALL
33			LENGTH 17'-9"	PITCH 1-1/8" Δ
34	SHELL	C. S.	NOM. I. D. 31"	O. D. 31. 7/8" Rev. 1
35	SHELL COVER (INTEGRAL REMOVABLE)	-	FLTG. HD. COVER	-
36	CHANNEL	SA-240, Tp. 304	CHANNEL COVER	CS w/SS Overlay
37	TUBE SHEETS-STATIONARY	SA-240, Tp. 304	FLOATING	-
38	BAFFLES-SEGMENTAL	C. S. Mod. 2 PITCH	% CUT	FLOW
39	BAFFLE-LONG	-	IMP'T.	S. S.
40	TYPE JOINTS-SHELL	Welded	TUBES	Bolted
41	GASKETS-SHELL	- FLTG. HD. -	CHANNEL	Comp. Asbestos
42	CONNECTIONS-SHELL-IN	12 OUT 12	SERIES	150 lb. RF
43	CHANNEL-IN	10 OUT 10	SERIES	150 lb. RF
44	CORROSION ALLOWANCE-SHELL SIDE	1/16"	TUBE SIDE	1/16"
45	CODE REQUIREMENTS-ASME	Section III, Class 3	STAMP (YES)	TEMA CLASS "R"
46	WEIGHTS-EACH SHELL AND BUNDLE	12,200 BUNDLE ONLY ---	FULL OF WATER	18,000

47 REMARKS.- Tubes welded and rolled to tubesheets. Hinged channel covers provided.

Min. Hydro Test Temp Shell 60°F

Response to Questions on Technical Specification Change Request
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ATTACHMENT 7

ATTACHMENT 8A

ATTACHMENT 8A: DECAY HEAT INPUT TO WATERFORD-3 FUEL POOL FROM A FRESHLY DISCHARGED FULL CORE

Time After Reactor Shutdown (Hrs)	Decay Heat (Million Btu/Hr)
DURING FUEL TRANSFER OPERATIONS	
72	0
100	24.09
127	42.05
POST FUEL TRANSFER	
151	39.11
175	36.79
201	34.81
250	32.01
299	29.93
347	28.30
404	26.66
453	25.44
509	24.20
595	22.53
697	20.86

ATTACHMENT 8B

ATTACHMENT 8B: DECAY HEAT INPUT TO WATERFORD-3 FUEL POOL FROM A NORMAL (PARTIAL CORE) DISCHARGE

Time After Reactor Shutdown (Hrs)	Decay Heat (Million Btu/Hr)
DURING FUEL TRANSFER OPERATIONS	
72	0.00
101	25.08
POST FUEL TRANSFER	
149	21.25
196	19.02
249	17.37
311	15.99
371	14.97
419	14.27
503	13.23
602	12.20
680	11.51

ATTACHMENT 8C

ATTACHMENT 8C: DECAY HEAT GENERATION RATE FROM PREVIOUSLY DISCHARGED FUEL ASSEMBLIES

Cycle Number	Batch Size	Years Since Discharge	Non-Dimensional Decay Power
1	92	39.4	0.0041
2	84	38.0	0.0039
3	84	36.6	0.0040
4	84	35.1	0.0041
5	84	33.6	0.0043
6	92	32.1	0.0049
7	96	30.6	0.0053
8	96	29.1	0.0055
9	88	27.5	0.0052
10	92	25.7	0.0057
11	100	24.0	0.0064
12	116	22.0	0.0079
13	116	20.0	0.0082
14	116	18.0	0.0086
15	116	16.0	0.0091
16	116	14.0	0.0095
17	116	12.0	0.0100
18	116	10.0	0.0105
19	116	8.0	0.0110
20	116	6.0	0.0117
21	116	4.0	0.0134
22	116	2.0	0.0213
(TOTAL)			0.1746

SPECIFIC ASSEMBLY POWER = 57.64 Million Btu/Hr
TOTAL BACKGROUND = 0.1746 x 57.64 Million = 10.06 Million Btu/Hr

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