The Light company Houston Lighting & Power P.O. Box 1700 Houston, Texas 77001 (713) 228-9211

January 23, 1986
ST-HL-AE-1586
File No.: G9.17

Mr. Vincent S. Noonan, Project Director
PWR Project Directorate #5
U. S. Nuclear Regulatory Commission
Washington, DC 20555

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
Diablo Canyon
Natural Circulation Tests

Reference: Letter ST-HL-AE-1515 dated 11/18/85: M. R. Wisenburg to G. W. Knighton

Dear Mr. Noonan:

This letter is provided to address Draft Safety Evaluation Report (DSER) Item #53 (see reference) regarding natural circulation capabilities in the South Texas Project reactor coolant system. The attachment provides a comparison of hydraulic resistance coefficients between STP and Diablo Canyon which demonstrates the applicability of natural circulation tests being performed at Diablo Canyon. Based on the comparison in the attachment, HL&P requests that this item be considered "confirmatory".

If you should have any questions on this matter, please contact Mr. M. E. Powell at (713) 993-1328.

Very truly yours,

M. R. Wisenburg
Manager, Nuclear Licensing

JSP/yd

Attachment: Comparison of STP to Diablo Canyon

B001
1/1

L1/NRC/lh

cc:

Hugh L. Thompson, Jr., Director
Division of PWR Licensing - A
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Robert D. Martin
Regional Administrator, Region IV
Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, TX 76011

N. Prasad Kadambi, Project Manager
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, MD 20814

Claude E. Johnson
Senior Resident Inspector/STP
c/o U.S. Nuclear Regulatory
Commission
P.O. Box 910
Bay City, TX 77414

M.D. Schwarz, Jr., Esquire
Baker & Botts
One Shell Plaza
Houston, TX 77002

J.R. Newman, Esquire
Newman & Holtzinger, P.C.
1615 L Street, N.W.
Washington, DC 20036

Director, Office of Inspection
and Enforcement
U.S. Nuclear Regulatory Commission
Washington, DC 20555

T.V. Shockley/R.L. Range
Central Power & Light Company
P.O. Box 2121
Corpus Christi, TX 78403

H.L. Peterson/G. Pokorny
City of Austin
P.O. Box 1088
Austin. TX 78767

J.B. Poston/A. vonRosenberg
City Public Service Board
P.O. Box 1771
San Antonio, TX 78296

Brian E. Berwick, Esquire
Assistant Attorney General for
the State of Texas
P.O. Box 12548, Capitol Station
Austin, TX 78711

Lanny A. Sinkin
Christic Institute
1324 North Capitol Street
Washington, D.C. 20002

Oreste R. Pirfo, Esquire
Hearing Attorney
Office of the Executive Legal Director
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Charles Bechhoefer, Esquire
Chairman, Atomic Safety &
Licensing Board
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dr. James C. Lamb, III
313 Woodhaven Road
Chapel Hill, NC 27514

Judge Frederick J. Shon
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Mr. Ray Goldstein, Esquire
1001 Vaughn Building
807 Brazos
Austin, TX 78701

Citizens for Equitable Utilities, Inc.
c/o Ms. Peggy Buchorn
Route 1, Box 1684
Brazoria, TX 77422

Docketing & Service Section
Office of the Secretary
U.S. Nuclear Regulatory Commission
Washington, DC 20555
(3 Copies)

Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
1717 H Street
Washington, DC 20555

Revised 12/2/85

COMPARISON OF SOUTH TEXAS TO DIABLO CANYON

The South Texas Project and Diablo Canyon Unit 1 have been compared in detail to ascertain any differences between the two plants that could potentially affect natural circulation flow and attendant boron mixing. Because of the similarity between the plants, it was concluded that the natural circulation capabilities would be similar; and, therefore, the results of prototypical natural circulation cooldown tests being conducted at Diablo Canyon will be representative of the capability at South Texas.

The general configuration of the piping and components in each reactor coolant loop is the same in both South Texas and Diablo Canyon. The elevation head represented by these components and the system piping is similar in both plants.

To compare the natural circulation capabilities of South Texas and Diablo Canyon, the hydraulic resistance coefficients were compared. The coefficients were generated on a per loop basis. The hydraulic resistance coefficients applicable to normal flow conditions are as follows:

HYDRAULIC FLOW COEFFICIENTS

	Diablo Canyon Unit 1 [Ft/(Loop GPM)²]	South Texas Units 1 and 2 [Ft/(Loop GPM)²]
Reactor Core & Internals	125.0×10^{-10}	149.9×10^{-10}
Reactor Nozzles	36.7×10^{-10}	27.3×10^{-10}
RCS Piping		
R.V. Outlet to SG Inlet	4.0×10^{-10}	4.0×10^{-10}
SG Outlet to RC Pump Inlet	10.0×10^{-10}	10.0×10^{-10}
RC Pump Discharge to RV Inlet	10.0×10^{-10}	4.0×10^{-10}
R.C. Loop	24.0×10^{-10}	18.0×10^{-10}
Steam Generator	114.5×10^{-10}	132.1×10^{-10}
Total Hydraulic Flow Coefficient (HFC_{Tot})	300.2×10^{-10}	327.3×10^{-10}

$$\text{Flow Ratio Per Loop} = \left[\frac{HFC_{Tot} \text{ for Diablo Canyon}}{HFC_{Tot} \text{ for South Texas}}\right]^{1/2} = \left[\frac{300.2}{327.3}\right]^{1/2} = 0.957$$

The general arrangement of the reactor core and internals is the same in Diablo Canyon and South Texas. The coefficients indicated represent the resistance seen by the flow in one loop.

The reactor vessel outlet nozzle configuration for both plants is the same. The radius of curvature between the vessel inlet nozzle and downcomer section of the vessel on the two plants is different. Based on 1/7 scale model testing performed by Westinghouse and other literature, the radius on the vessel nozzle/downcomer juncture influences the hydraulic resistance of the flow turning from the nozzle to the downcomer. The Diablo Canyon vessel inlet nozzle radius is significantly smaller than that of South Texas, as reflected by the higher coefficient for Diablo Canyon.

Steam generator units were also compared to ascertain any variation that could affect natural circulation capability by changing the effective elevation of the heat sink or the hydraulic resistance seen by the primary coolant. It was concluded that there are no differences in the original design of the steam generators in the two plants that would adversely affect the natural circulation characteristics.

It is expected that the relative effect of the coefficients would be the same under natural circulation conditions such that the natural circulation loop flowrate for South Texas would be within four percent of that for Diablo Canyon.

Although the total hydraulic flow resistance is higher for South Texas, the natural circulation flow is expected to be higher. This is because the plant flowrate under natural circulation conditions is approximated by:

$$\text{Natural Circulation Flow (NCF)} \propto \left[\frac{Q\Delta y}{K_{Tot}}\right]^{1/3}$$

Where Q = heat generated

Δy = elevation difference between steam generator and core average

K_{Tot} = total plant's hydraulic resistance

$$\text{Natural Circulation Flow Ratio} = \frac{\text{NCF for South Texas}}{\text{NCF for Diablo Canyon}} = 1.02$$

South Texas has greater flow largely because the decay heat level is higher.

The quantity which most affects upper head cooling capability is the head cooling time constant which is proportional to the product of the head volume and the square root of the head bypass flow resistance. The smaller the time constant, the more easily the head is cooled.

$$\text{Head Cooling Time Constant (T)} \propto V_H \left[\frac{K_{SN}}{A_{SN}^2}\right]^{1/2}$$

Where V_H = Head Volume

K_{SN} = Spray Nozzle Resistance Factor

A_{SN} = Spray Nozzle Flow Area

$$\text{Head Cooling Time Constant Ratio} = \frac{T \text{ for South Texas}}{T \text{ for Diablo Canyon}} = 0.862$$

Since the Head Cooling Time Constant Ratio is less than one (1) the South Texas plant responds more rapidly and is more easily cooled.

Thus, it is concluded that the results of the Diablo Canyon test will be representative of the same phenomena at South Texas.