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DOMER,J.A. Tennessee Valley Authority
RECIP.NAME RECIPIENT AFFILIATION
DENTON,H.R. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards addl info re NRC concerns on structural adequacy of containment vent & purge valves discussed in NRC 830913 memo to reactor branch chiefs & 840810 & 1009 telcons. Analysis performed on 10-inch Fisher valve adequate.

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TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

January 25, 1985

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton:

In the Matter of the) Docket No. 50-259
Tennessee Valley Authority)

Enclosed is additional information regarding the structural adequacy of containment vent and purge valves in the Browns Ferry Nuclear Plant. The enclosed information is being submitted in response to verbal requests from your staff made during telephone conferences with TVA on August 10 and October 9, 1984. We believe the enclosed information demonstrates the structural integrity of the subject valves and acceptability of the valves for continued use in Browns Ferry.

If you have any questions or need additional clarification, please get in touch with us through the Browns Ferry Project Manager.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

James A. Domer

James A. Domer
Nuclear Engineer

Subscribed and sworn to before
me this 25th day of January 1985.

Bryant M. Lowery
Notary Public
My Commission Expires 4/8/86

Enclosures
cc (Enclosures):
U.S. Nuclear Regulatory Commission
Region II
ATTN: James P. O'Reilly, Regional Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

Mr. R. J. Clark
Browns Ferry Project Manager
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, Maryland 20814

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ENCLOSURE
BROWNS FERRY NUCLEAR PLANT
RESPONSE TO NRC CONCERNS ON CONTAINMENT PURGE VALVE OPERABILITY

Listed below are NRC's outstanding concerns on the Browns Ferry Nuclear Plant (BFN) containment purge valve operability analysis as detailed in the NRC memorandum from G. C. Lainas and J. P. Knight to Operating Reactor Branch Chiefs dated September 13, 1983 and TVA's responses. These concerns were further clarified in telephone conferences with the NRC staff on August 10, 1984 and October 9, 1984.

Concern 1

The Staff concurs with the approach stated in the licensee's response. However, confirmation in the form of drawings, meeting minutes, or other verification is required to demonstrate the similarity of valve design.

Response 1

Drawings of our BFN 18- and 20-inch Rockwell Edwards and 10-inch Fisher purge valves as well as comparative drawings of a symmetrical disc Henry Pratt valve were provided under separate cover. The drawings provided were: (1) Rockwell drawing No. 225449; (2) Fisher Controls Company drawing No. F-39237; and (3) Henry Pratt Company drawing No. E-3347. The Henry Pratt valve is the same type of valve from which the torque coefficients used in our analysis were derived. As can be seen from the referenced drawings, the valve dics are very similar in shape.

The cover letter from the Henry Pratt Company which transmitted the torque coefficient data is provided as attachment A. This letter illustrates the nature of the conversations which took place between TVA and the Henry Pratt Valve Company that led to the determination of the correct torque coefficient data to utilize.

Finally on this concern, an aspect ratio comparison was made with the Henry Pratt Mk II valve. That comparison is provided as attachment B. As can be seen from that attachment, they compare favorably.

Concern 2

The Licensee's response on this item is acceptable to the staff.

Response

No response required.

Concern 3

In order for the Staff to confirm the structural adequacy of the valve assembly under the postulated accident condition as claimed by the licensee, supporting documentation should include as a minmum a summary of stress analysis results with calculated stresses and code allowable stresses to demonstrate that the allowable stresses in the valve-operator extended structure and associated interfacing hardware are not exceeded.

Response 3

Table 1 provides a breakdown of the calculated stresses of the pertinent valve components as compared to the allowables. As can be seen, a large margin exists between the calculated and the allowable stresses. Similar results can be expected for the pertinent components of the operator and the interfacing hardware. This is based upon the fact that the design torque for these components exceeds the maximum operating torque (design basis loss of coolant accident (LOCA) plus seismic event) by a comfortable margin.

Concern 4

Operator spring torque curves are required as part of the evaluation to assure that adequate torque margin exists for the entire valve stroke when compared to the calculated dynamic and seating torques.

Table 1 included in the June 3, 1981, response includes the spring torques for valve angles of 0 and 90 only (full open and full closed). This is unacceptable to the Staff since it does not include the region of peak dynamic torques encountered during closure. If a table is submitted instead of a curve, it should be set up in angular increments of valve stroke no less than 10 degress.

Response 4

Figures 1, 2 and 3 provide spring torque data for all 18-inch and 20-inch Rockwell Edwards containment purge valves installed at Browns Ferry.

Concern 5

The staff finds the Licensee's response to this item acceptable.

Response

No response required.

Concern 6

Until the data pertaining to the Fisher valves is received and evaluated, the Staff has no basis on which to draw conclusions with regard to either the ability or inability of the 10-inch valves to close during a DBA/LOCA at BFN 1-3. These circumstances have existed for several years now.

Response 6

As stated in TVA letter dated June 7, 1983 from L. M. Mills to H. R. Denton, we entered into negotiations with Fisher Valve Company to obtain an operability analysis of our 10-inch Fisher N_2 supply valve.

The Fisher Valve Company indicated that an analysis could be obtained for a valve similar to our BFN valve. Because of the fact that the analysis was not for our specific valve and also, because we had considered this issue closed when no response had been received after several months from our June 7, 1983, submittal to your 50.54(f) request, it was determined that a contract for analysis of our 10-inch Fisher valves would be inappropriate.

It should be pointed out that the 10-inch Fisher valve has a symmetrical disc. By inspection of the Henry Pratt drawing No. E-3347 referenced in the response to question 1, it can be seen that the disc is similar in shape to the Henry Pratt valve disc, indicating that the torque coefficients used in the TVA analysis of the Fisher valve are appropriate. This position is further justified by the aspect ratios calculated for this valve disc as shown in attachment B.

The adequacy of this analysis can be further demonstrated by pointing out some of the conservatisms that it contains. (1) Although this valve is used only during the 24-hour period, limited by our technical specifications, when the unit is being re-inerted, the analysis assumes that an instantaneous large break in combination with a seismic event is occurring during this period of operation. (2) Even though this valve is over 130 feet from the drywell, the associated line losses and other losses from the upstream debris screen, purge valves, and flow directional changes were not accounted for in this analysis. Furthermore, no credit was taken for the increased back pressure from the N_2 supply which would serve to reduce the flow through the valve. Finally, this valve is in series with and secondary to the upstream Rockwell Edwards containment isolation purge valves.

The 10-inch Fisher vavle seismic qualification is addressed by Fisher Controls report "Seismic Analysis of 10-inch Butterfly Valve Assemblies," dated December 14, 1973. The report is available within TVA.

In summary, we believe that the analysis performed on our 10-inch Fisher valve is completely adequate and the available conservatisms should more than offset any oustanding concerns.

Table 1

STRUCTURAL EVALUATION OF BFVP CONTAINMENT PURGE BUTTERFLY VALVES FOR D[illegible]A-LOCA AND SEISMIC COND[illegible]NS

FOR 10, 18 and 20 INCH SIZE VALVES

COMPONENTS MATERIAL: 17-4PH STEEL
MIN YIELD STRENGTH ~ F_{ty} = 125 KSI
MIN ULT. TENSILE STRENGTH – F_{tu} = 145 KSI

REPRESENTS VALVE SIZE(S)	VALVE COMPONENT	COMPONENT SIZE	LOADS IMPOSED	CRITICAL STRESSES IN COMPONENT (PSI)	ALLOWABLE STRESS (PSI)	STRUCTURAL FACTOR of SAFETY F.S.	COMMENTS / REFERENCES
18" & 20"	SHAFT	$1\frac{3}{4}$ inch DIA	MAX. OPER. OUTPUT TORQUE of 15,000 IN-LBS + 3g SEISMIC + MAX DBA-LOCA ΔP of 41 PSI ACROSS DISC	20,360 (SHEAR)	62,500 (0.5 F_{ty})	3.1	MAX. DBA-LOCA TORQUE IS LESS THAN MAX. OPER. TORQUE
				11,150 (BENDING)	112,500 (0.9 F_{ty})	10.1	ASSUME PINNED ENDS AT BUSHINGS. CRITICAL LOCATION AT OUTER EDGE of DISC.
			DBA-LOCA MAXIMUM ROTATIONAL ENERGY OF DISC @ CLOSED POSITION	10,400 (SHEAR)	62,500 (0.5 F_{ty})	6.0	ASSUME KINETIC ENERGY of DISC = TORSIONAL STRAIN ENERGY IN SHAFT. SEE NOTE 3.
18" & 20"	DISC	$19\frac{9}{32}$ inch DIA, t = .39 inch	MAX DBA-LOCA ΔP of 41 PSI ACROSS DISC + 3g SEISMIC	3035 (BENDING)	112,500 (.9 F_{ty})	VERY LARGE	
18" & 20"	SHEAR PINS (CONNECTS DISC & SHAFT)	5/8 inch DIA	MAX. OPER OUTPUT TORQUE of 15,000 IN-LBS + 3g SEISMIC	27,950 (SHEAR)	62,500 (0.5 F_{ty})	2.2	MAX DBA-LOCA TORQUE IS LESS THAN MAX. OPER TORQUE
18" & 20"	SHAFT BUSHINGS (UPPER & LOWER)	$1\frac{3}{4}$ inch DIA by 1 inch long	MAX DBA-LOCA ΔP of 41 PSI ACROSS DISC + 3g SEISMIC	3520 (BEARING)		VERY LARGE	
10"	SHAFT.	1 inch DIA	DBA-LOCA MAX FLUID TORQUE (≅ 1400 IN-LBS) + 3g SEISMIC	7135 (SHEAR)	62500 (0.5 F_{ty})	8.8	MAX DBA-LOCA TORQUE IS LESS THAN VENDOR'S (FISHER) ALLOWED TORQUE OR OPERATOR TORQUE.
10"	DISC	10 inch	MAX DBA-LOCA ΔP of 44 PSI ACROSS DISC + 3g SEISMIC	NOT CALCULATED SEE COMMENTS	112,500 (0.9 F_{ty})	VERY LARGE	FURNISHED VALVE ASSY RATED AT 150 LBS.

NOTES: (1) THIS STRUCTURAL EVALUATION HAD TWO PRIMARY CONSIDERATIONS, i.e.;
(a) WHAT IS THE COMPARISON BETWEEN THE MAXIMUM DBA-LOCA FLUID TORQUE VERSUS THE COMPONENTS DESIGN OR OPERATOR OUTPUT TORQUE?
(b) WHAT IS THE MAXIMUM DISC KINETIC ENERGY AT CLOSED POSITION WITH DBA-LOCA?

(2) FOR EACH SIZE VALVE, THE MAXIMUM DBA-LOCA FLUID TORQUE IS LESS THAN THE DESIGN OR OPERATOR OUTPUT TORQUE. AS NOTED IN TABLE, THE MAX OPERATOR OUTPUT TORQUE IS 15,000 IN-LBS WHEREAS THE MAX DBA-LOCA FLUID TORQUES ARE 7100 & 9800 IN-LBS RESPECTIVELY FOR THE 18 & 20 INCH SIZES. ALSO THE 10 INCH VALVE DESIGN OR OPERATOR TORQUES ARE GREATER THAN THE MAX DBA-LOCA FLUID TORQUE OF APPROXIMATELY 1400 IN-LBS.

(3) FOR EACH SIZE VALVE, THE DISC TORQUE IS VERY SMALL OR AT A MINIMUM DURING APPROXIMATELY THE LAST 3rd of DISC CLOSING MOVEMENT AND THEREFORE THE CORRESPONDING DISC ROTATIONAL VELOCITY (ω) AND KINETIC ENERGY IS MINIMUM, AS IN ABOVE EXAMPLE FOR 18 & 20 INCH SIZES, THE SHAFT STRESS RESULTS FROM ASSUMING A CONSERVATIVE AND CONSTANT DISC NET TORQUE OF 100 IN-LBS WITH AN ACTUAL DISC CALCULATED ROTATIONAL MASS MOMENT of INERTIA (I_m) OF 0.344 SLUG-FT². THE DISC KINETIC ENERGY ($0.5 I_m \omega^2$) WAS THEN CALCULATED TO BE 13 FT-LBS WHICH WAS ASSUMED EQUAL TO THE SHAFT TORSIONAL STRAIN ENERGY OF $0.5\frac{T^2L}{GJ}$, T BEING RESULTING SHAFT TORQUE FROM WHICH STRESS $\left(\frac{TR}{J}\right)$ WAS CALCULATED.

VALVE OPERATOR NO. **732-SR60**

(20-INCH ROCKWELL EDWARDS VALVE)

YOKE ARM ANGLE (degrees)	SPRING TORQUE (in lb)	PRESSURE TORQUE (50)psi	PRESSURE TORQUE (60)psi	PRESSURE TORQUE (70)psi	PRESSURE TORQUE (80)psi
0	8576	10177	13927	17678	21428
15	7266	6187	8878	11568	14259
30	6757	4491	6741	8991	11240
45	6941	3685	5811	7936	10061
60	7937	3311	5560	7810	10060
75	10309	3145	5835	8526	11216
90	15922	2831	6581	10332	14082

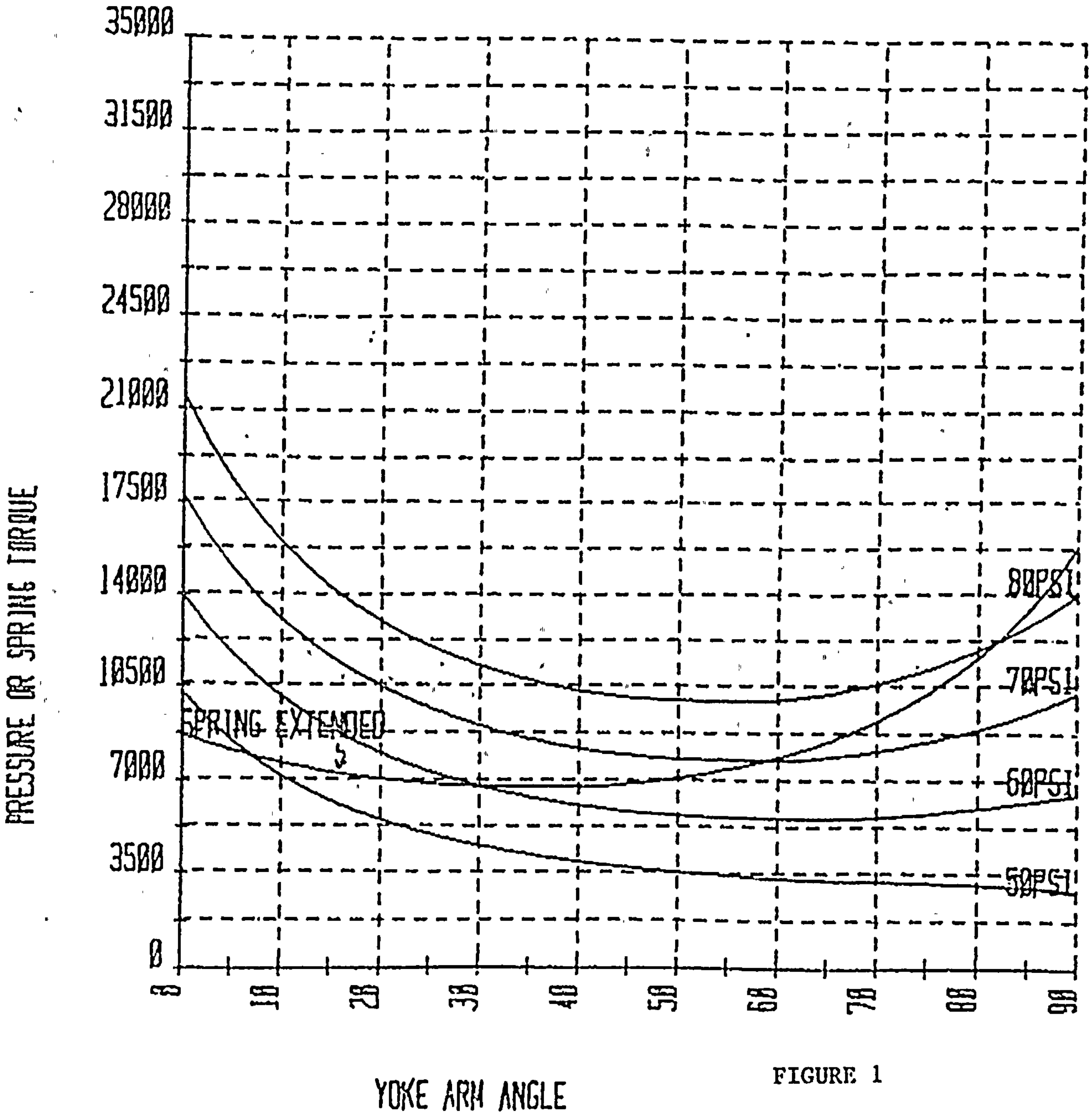


FIGURE 1

VALVE OPERATOR NO. 732-SR80

(18-INCH ROCKWELL EDWARDS VALVE)

YOKE ARM ANGLE (degrees)	SPRING TORQUE (in lb)	PRESSURE TORQUE (70)psi	PRESSURE TORQUE (80)psi	PRESSURE TORQUE (90)psi	PRESSURE TORQUE (100)psi
0	9776	16478	20228	23979	27729
15	8494	10340	13031	15721	18412
30	8009	7739	9988	12238	14488
45	8308	6569	8694	10820	12945
60	9579	6168	8418	10668	12917
75	12541	6293	8984	11674	14365
90	19546	6707	10458	14208	17959

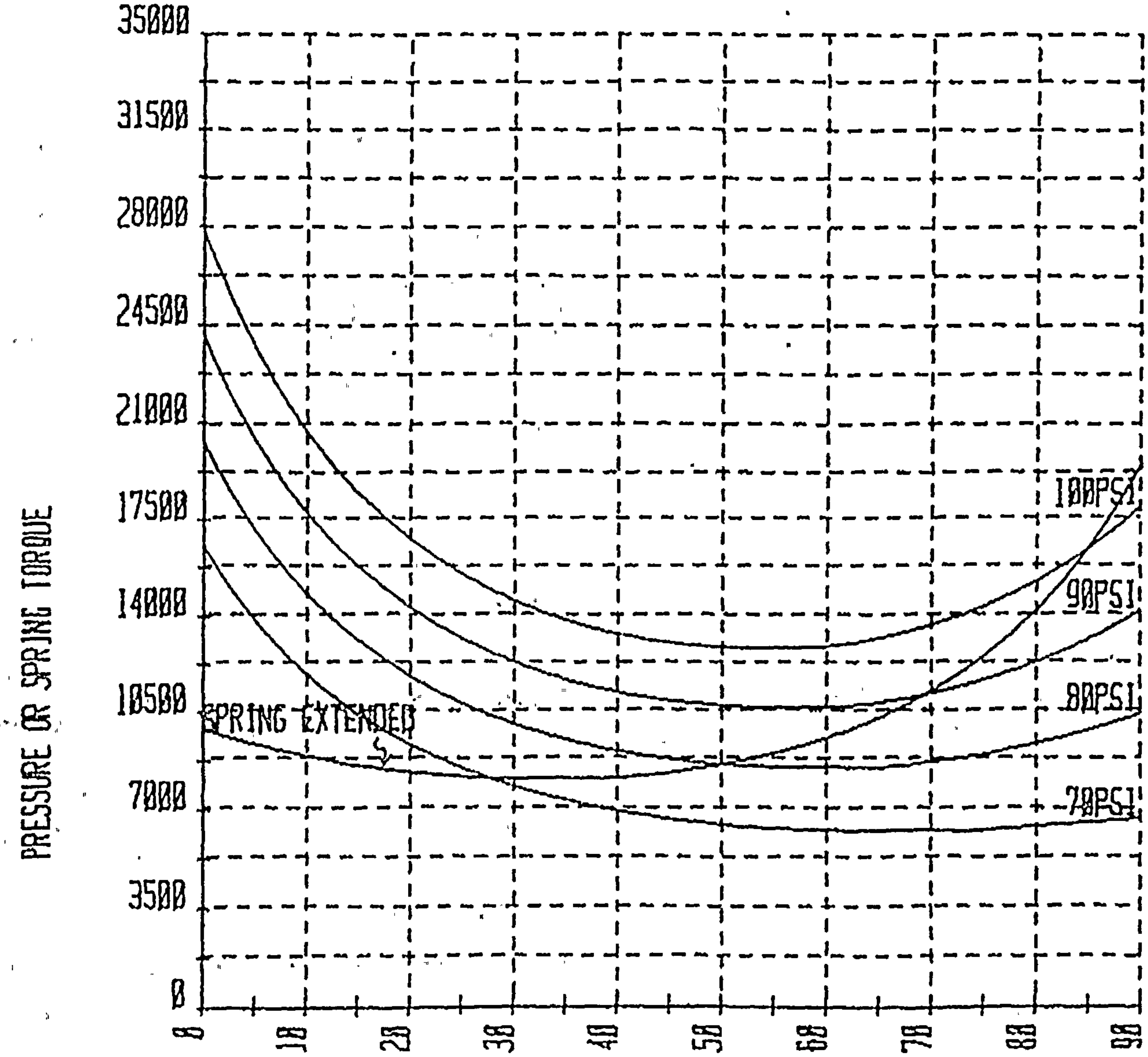


FIGURE 2

VALVE OPERATOR NO. 722-SR80

(18-INCH ROCKWELL EDWARDS VALVE)

YOKE ARM ANGLE (degrees)	SPRING TORQUE (in lb)	PRESSURE TORQUE (70)psi	PRESSURE TORQUE (80)psi	PRESSURE TORQUE (90)psi	PRESSURE TORQUE (100)psi
0	7470	12444	15289	18134	20979
15	6496	7790	9831	11872	13913
30	6127	5818	7524	9231	10937
45	6358	4927	6539	8151	9763
60	7333	4612	6319	8025	9732
75	9603	4684	6725	8766	10807
90	14970	4944	7789	10634	13479

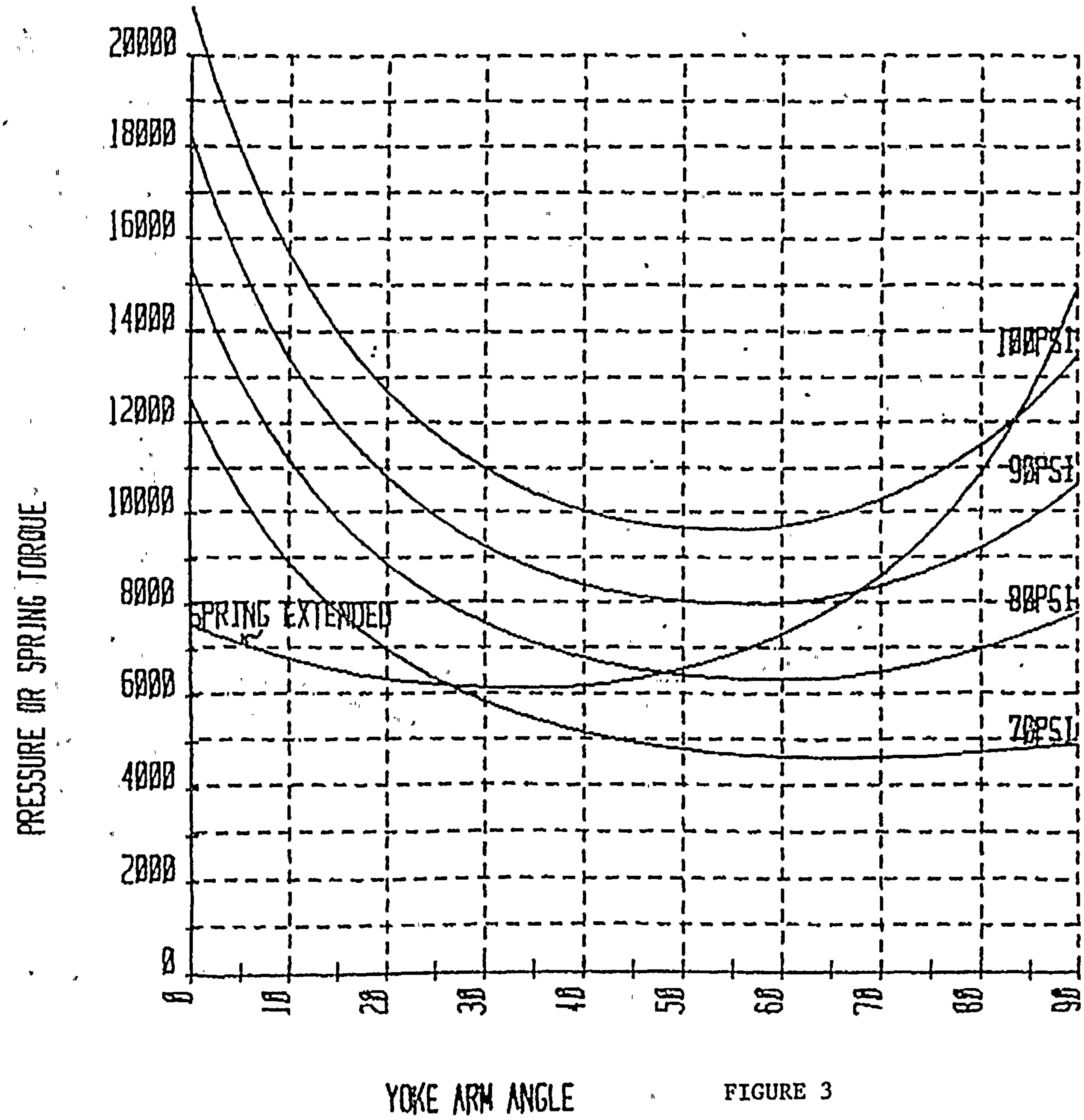


FIGURE 3

TACHMENT A

HENRY PRATT COMPANY

401 SOUTH HIGHLAND AVENUE

AURORA, ILLINOIS

GREGORY A. KURKJIAN, JR.
VICE PRESIDENT
AND
MANAGER-MARKETING

844-4020

April 25, 1980

Tennessee Valley Authority
400 Commerce Avenue
W9C155
Knoxville, TN 37901

Attention: R. Bryon

Dear Mr. Bryon:

In response to our recent phone conversation, enclosed herewith are two (2) copies of various coefficients associated with Pratt valves that can be used in determining the pressure drop and torque for the Rockwell valves you described.

For the valve size you indicated, I would expect the maximum fluidynamic torque to occur somewhere from the 40° to 50° position range. Torques are calculated as noted in the Appendix, page 13 of AWWA - C504, copy enclosed.

If you have any questions regarding the use of this material, please feel free to contact me.

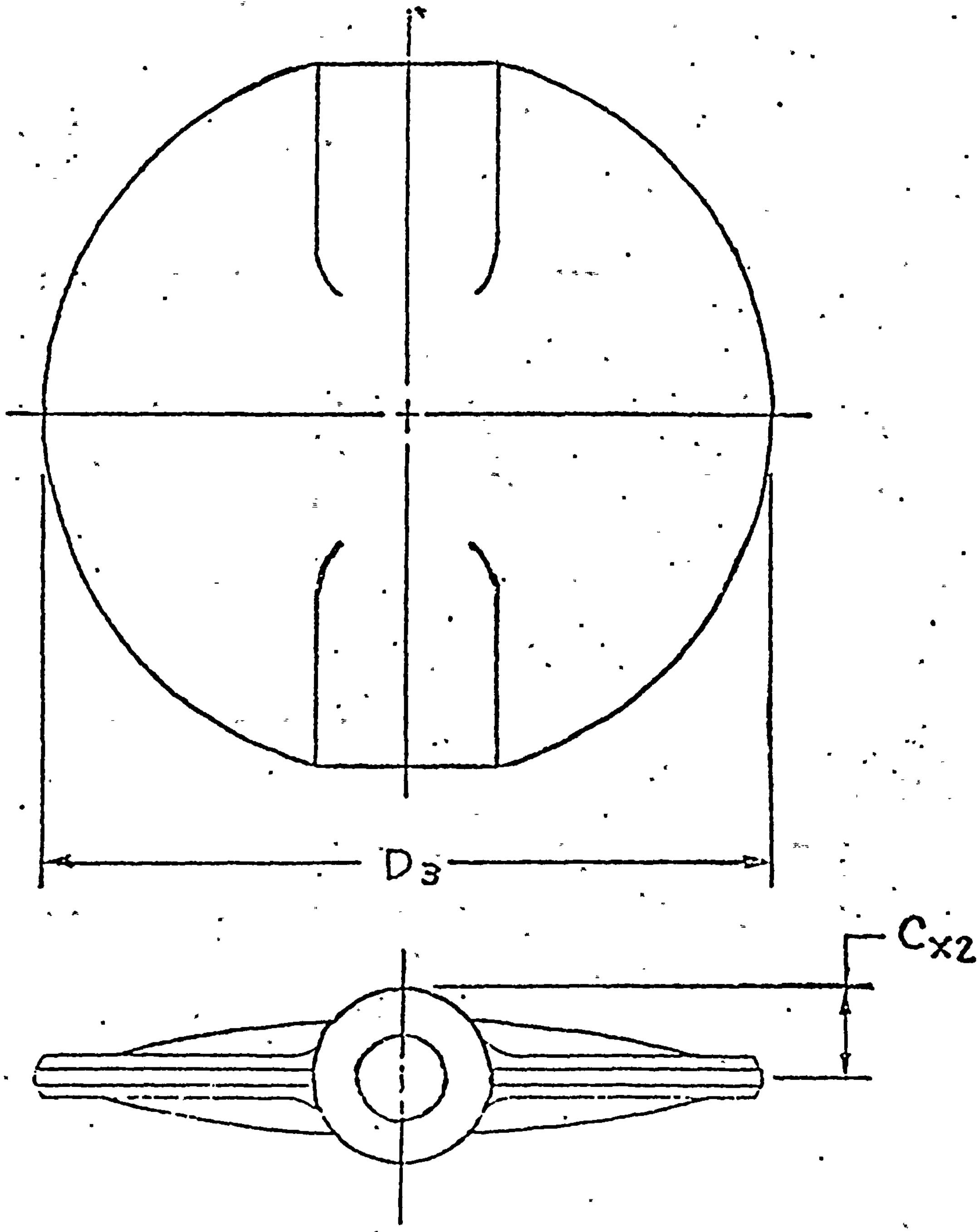
Very truly yours,

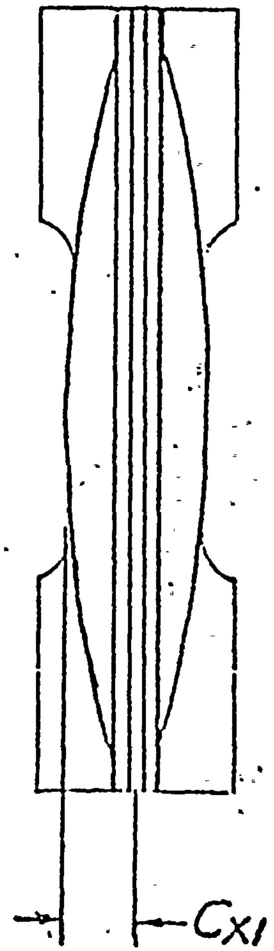
Greg Kurkjian

G. A. Kurkjian

GAK:jb

Enclosures





GENERAL FEATURES OF DISC

FIGURE 4

Henry Pratt

N-SL-2F II. Valve.

ATTACHMENT B

1. The aspect ratio data for the Rockwell-Edwards 18- and 20-inch butterfly valves and Fisher Controls 10-inch valve for comparison with a Henry Pratt valve with a geometrically similar disk was obtained. The flow coefficient data used in TVA's operability analysis for the Fisher and Rockwell-Edwards valves is representative of this particular Henry Pratt valve.

Aspect ratio is defined as the ratio of disk thickness at a particular position to the overall disk diameter. The tabulation below shows aspect ratios at two positions (the disk center and the disk edge) for TVA's Fisher and Rockwell-Edwards valve types and the representative Henry Pratt valve.

	Aspect Ratio	
	Center	Edge
Rockwell-Edwards 18-inch	0.212	0.025
Rockwell-Edwards 20-inch	0.209	0.022
Fisher Controls 10-inch	0.228	0.000*
Henry Pratt MKII	0.232	0.022

*The edge is rounded based on data provided by the site, making determination of this value difficult.