**Jeffrey T. Gasser**
Executive Vice President
and Chief Nuclear Officer

**Southern Nuclear**
**Operating Company, Inc.**
40 Inverness Center Parkway
Post Office Box 1295
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SOUTHERN COMPANY
*Energy to Serve Your World℠*

December 15, 2004

NL-04-2459

Docket Nos.: 50-424
50-425

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555-0001

Vogtle Electric Generating Plant
10 CFR 21 Report
Electric Power Research Institute
Motor Operated Valve Performance Prediction Methodology
Versions 1.0 through 3.2

Ladies and Gentlemen:

In accordance with 10 CFR 21.21(d)(3), Southern Nuclear Operating Company (SNC) is making notification of a defect in a basic component for Vogtle Electric Generating Plant. Enclosure 1 contains a 10 CFR 21 report which describes a defect associated with potential application of the Electric Power Research Institute (EPRI) Motor Operated Valve Performance Prediction Methodology (PPM), Versions 1.0 through 3.2. Enclosure 2 contains the transfer of information regarding this concern that was received from EPRI in accordance with 10 CFR 21.21(b). This letter satisfies both the 2-day and 30-day reporting requirements contained in 10 CFR 21.21(d)(3).

This letter contains no NRC commitments. If you have any questions, please advise.

Sincerely,

Jeffrey T. Gasser

JTG/TMM

Enclosures: 1. 10 CFR 21 Report
2. EPRI Transfer of Information Per 10 CFR 21.21(b)

IE19

cc: Southern Nuclear Operating Company
Mr. D. E. Grissette, Vice President
Mr. W. F. Kitchens, General Manager – Plant Vogtle
RType: CVC7000

U. S. Nuclear Regulatory Commission
Dr. W. D. Travers, Regional Administrator
Mr. C. Gratton, NRR Project Manager – Vogtle
Mr. G. J. McCoy, Senior Resident Inspector – Vogtle

Enclosure 1

Vogtle Electric Generating Plant
10 CFR 21 Report
Electric Power Research Institute
Motor Operated Valve Performance Prediction Methodology
Versions 1.0 through 3.2

The following 10 CFR 21 written report is provided by Southern Nuclear Operating Company (SNC) for Vogtle Electric Generating Plant (VEGP). The content is in accordance with 10 CFR 21.21(d)(4).

(i) Name and Address of Individual Making Notification

Mr. Jeffrey T. Gasser
Executive Vice President and Chief Nuclear Officer
Southern Nuclear Operating Company
40 Inverness Center Parkway
Post Office Box 1295
Birmingham, AL 35201

(ii) Identification of Basic Component

Electric Power Research Institute (EPRI) Motor Operated Valve (MOV) Performance Prediction Methodology (PPM), Versions 1.0 through 3.2

(iii) Basic Component Supplier

Electric Power Research Institute
3412 Hillview Avenue
Palo Alto, CA 94304

(iv) Nature of Defect and Potential Safety Hazard

By letter dated October 26, 2004, as provided in Enclosure 2, EPRI notified affected members in accordance with 10 CFR 21.21(b), of a non-conservatism in the EPRI MOV PPM, Versions 1.0 through 3.2, to predict total required dynamic torque under compressible flow conditions for actuators for butterfly valves with single disc offset designs. Details concerning the issue are discussed in PPM Software Error Notice 2004-2 dated October 22, 2004, which was provided by EPRI in their October 26, 2004, notification and is included in Enclosure 2. As explained in the error notice, the non-conservatism could be as much as 45 percent. This non-conservatism could potentially jeopardize the design basis operation of associated safety related applications.

(v) Date on Which Information Regarding Potential Defect Was Obtained

The EPRI notification was received by SNC on October 29, 2004. SNC subsequently performed an engineering evaluation based on the EPRI notification as it related to VEGP and determined it was reportable under the provisions of 10 CFR 21 on December 15, 2004.

(vi) Location of Basic Component Containing Defect

The EPRI MOV PPM is a software product available for use at SNC Engineering. Accordingly, an assessment of PPM Software Error Notice 2004-2 was performed for VEGP which identified butterfly valves with single offset disc designs that are used in safety related applications with compressible flow configurations (e.g., containment mini-purge system), whose postulated failure could create a substantial safety hazard if their total required dynamic torque had been determined using the EPRI MOV PPM, Versions 1.0 through 3.2. However, it is must be emphasized that this assessment did not identify any instances where the PPM had actually been used for such purposes at VEGP. Therefore, since there was a potential to use the PPM in certain applications at VEGP, with consequences that could create a substantial hazard, it is concluded that a defect in a basic component (EPRI MOV PPM, Versions 1.0 through 3.2) as defined in 10 CFR 21.3 does exist.

(vii) Corrective Action

This issue has been entered into the SNC Corrective Action Program. SNC will evaluate the restrictions, adjustments, and recommendations regarding use of the EPRI MOV PPM, Versions 1.0 through 3.2, that were communicated in EPRI PPM Software Error Notice 2004-2.

(viii) Advice to Affected Licensees

Follow restrictions, adjustments, and recommendations regarding use of the EPRI MOV PPM, Versions 1.0 through 3.2, contained in EPRI PPM Software Error Notice 2004-2.

Enclosure 2

Transfer of Information Per 10 CFR 21.21(b)

Electric Power Research Institute
Motor Operated Valve Performance Prediction Methodology
Versions 1.0 through 3.2

ELECTRIFY THE WORLD

EPRI

October 26, 2004

Mr. Thomas Milton
Senior Engineer
Southern Nuclear Operating Co.
40 Inverness Center Pkwy (Bin B048)
Birmingham, AL 35242-4809

Dear Mr. Milton:

Please find enclosed a notification letter sent on October 26, 2004 to your EPRI Nuclear Power Council Representative by Mr. David Modeen, EPRI's Vice-President and Chief Nuclear Officer. This letter is being provided to you as your company's point of contact for Title 10 Code of Federal Regulations Part 21 notification.

This letter constitutes notification to your utility according to § 21.21(b) of Title 10 of the Federal Code of Regulations Part 21, which states that you must be notified within 5 days in the event that we do "not have the capability to perform the evaluation to determine if a defect exists". This is primarily because EPRI does not have knowledge as to how the PPM software in question has been used at your utility and for what valves.

If you have any questions, please feel free to contact me at either roehlber@epri.com or (650) 855-2082.

Sincerely,

Richard N. Oehlberg

Richard N. Oehlberg, PhD
EPRI Quality Assurance Manager

Enclosures (2)

CHARLOTTE OFFICE
1300 W T Harris Blvd | Charlotte NC 28262-8550 USA | 704.547.6100 | Fax 704.547.6168
CORPORATE HEADQUARTERS
3412 Hillview Avenue | Palo Alto CA 94304-1395 USA | 650.855.2000 | Customer Service 800.313.3774 | www.epri.com

ELECTRIFY THE WORLD

EPRI

October 26, 2004

**Subject:** Potential Non-Conservatism of EPRI's MOV Performance Prediction Methodology (PPM) Butterfly Valve Model Under Compressible Flow Conditions

**References:** (1) Letter from M. S. Kalsi (Kalsi Engineering Inc.) to John Hosler (EPRI) "Potential Non-conservatism in EPRI's PPM Butterfly Valve Model Under Compressible Flow Conditions", September 10, 2004.

(2) EPRI MOV Performance Prediction Methodology (PPM) Error Notice 2004-2

This letter is to apprise you of recent actions taken by EPRI to notify users of the EPRI MOV Performance Prediction Methodology (PPM) of a potential non-conservatism in PPM Butterfly Valve Model predictions of maximum required dynamic torque under compressible flow conditions. Based on review of data from recent testing (Reference 1), EPRI has issued a PPM Software Error Notice (Reference 2) defining restrictions to the PPM's applicability and adjustments needed to ensure conservatism in butterfly valve model predictions.

Reference 2 (attached) has been sent to the EPRI MOV PPM technical and procurement contacts at your utility.

It is recommended that each PPM licensee evaluate any effects that the information provided in this Error Notice may have on PPM analyses conducted for butterfly valves in safety-related applications at your facilities.

Sincerely,

David Modeen
Vice President & Chief Nuclear Officer

Attachment

CHARLOTTE OFFICE
1300 W T Harris Blvd | Charlotte NC 28262-8550 USA | 704.547.6100 | Fax 704.547.6168
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ELECTRIFY THE WORLD

EPRI

October 22, 2004

To: All EPRI MOV Performance Prediction Methodology (PPM) Licensees

**Subject: Transmittal of EPRI PPM Error Notice 2004-2**

Dear PPM Licensee:

This letter transmits EPRI PPM Error Notice 2004-2. The notice pertains to use of Versions 1.0 through 3.2 of the EPRI MOV Performance Prediction Methodology (PPM) for evaluating total required dynamic torque for butterfly valves operated with the disc shaft downstream in compressible flow conditions and in the closing direction.

This Notice was prompted by information provided by Kalsi Engineering Inc. Kalsi Engineering has recently completed an extensive test program to assess hydrodynamic torque requirements for a wide range of butterfly valve disc designs and under both incompressible and compressible flow conditions. Based on limited comparisons completed to date, Kalsi Engineering reported that for some butterfly valve disc designs, predictions of maximum required dynamic torque made using the PPM have been found to be non-conservative.

Following detailed review of Kalsi Engineering's findings, EPRI has decided to issue the attached Error Notice. The Error Notice imposes restrictions on the applicability of the PPM, requires adjustments to PPM total required dynamic torque predictions and recommends actions to assess the adequacy of previous analyses.

It is recommended that each PPM licensee evaluate any effects that the information provided in this Error Notice may have on PPM analyses conducted for safety-related butterfly valves in your facilities.

EPRI is unable to make a determination as to the safety significance of this information relative to your plant-specific configuration and use. Therefore, we are not filing a 10 CFR 21 notification but will provide a copy of the Error Report to the NRC MOV program manager as a courtesy.

This notice has also been sent to the EPRI Nuclear Power Council executive at your utility.

Please sign and return the attached receipt acknowledgment form to Colette Handy at the address provided.

If you have any questions regarding the information provided herein please feel free to contact me.

Sincerely,

John Hosler
MOV Program Manager
Science and Technology Development
704-717-6428
jhosler@epri.com

c: Martin Bridges
Jack Lance
Leonard Loflin
David Modeen
James Riley (NEI)
Paul Damerell (MPR Associates)
Colette Handy
James Lang
Theodore Marston
Richard Oehlberg
M. S. Kalsi (Kalsi Engineering)

October 22, 2004

# PPM Software Error Notice 2004-2 (Potential Non-Conservatism in Butterfly Valve Model Predictions under Compressible Flow Conditions)

**Error Classification:** Class 1 [1]

**Affected Versions of PPM:** Versions 1.0 through 3.2

## Background

The EPRI MOV Performance Prediction Methodology (PPM) is a validated tool for predicting the thrust or torque required to stroke gate, globe and butterfly valves (see References 1, 2 and 3). Version 1.0 of the PPM was issued in 1995. Version 2.0, which corrected minor errors in Version 1.0, was issued in 1998. Version 3.0, which included an upgraded user interface developed for the Windows operating system, was issued in 2001. Version 3.1 was issued in late 2001 and corrected a coding error found in Version 3.0. Version 3.2 was issued in 2003 and revised the PPM Prediction Report output headings for the PPM Butterfly valve model.

The PPM Butterfly valve model currently applies to both compressible and incompressible (water) flow conditions. For compressible flow conditions, the PPM model validation was based on data available from testing conducted by the Idaho National Engineering Laboratory (INEL) on three butterfly valves (see References 4 and 5). The INEL testing included an 8-inch, 150 lb and a 24-inch, 150 lb valve from Henry Pratt, and an 8-inch, 150 lb valve from Allis Chalmers. All valves were of non-symmetric, single offset disc design and were tested with the disc oriented in the shaft upstream and shaft downstream positions. All three valve discs had flat faces on one side and full-length prismatic shaped faces on the other disc side (shown to scale in Figure 1). The valves were tested under blowdown conditions using nitrogen at pressure drops up to 60 psid.

The PPM validation (Reference 2) showed that the maximum predicted total required dynamic torque bounded the maximum measured dynamic torque for all three valves tested by INEL. From an MOV application stand point, it is only necessary to bound the maximum required torque in order to ensure that the torque switch would not trip during the stroke. Per Reference 3, pages 6-11 and 6-12, under compressible flow conditions, the maximum predicted total required dynamic torque must be applied over the entire stroke (beyond seating) for valves with actuators having variable output torque capability i.e., air-operated valves.

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**(1) A Class 1 error is an error that allows the program to execute to completion and, under certain circumstances, report incorrect results that are not easily identifiable as incorrect.**

During the course of developing position-dependent prediction methodologies for quarter-turn AOV applications, Kalsi Engineering Inc. conducted an extensive test program which included compressible flow testing on a variety of butterfly valve disc designs (see Reference 6). Figures 2(A) through 2(H) show the butterfly valve disc geometries (to scale) used in these tests. The valves were tested under blowdown conditions using air with various pressure drops up to 60 psid with different upstream and downstream resistances. Kalsi Engineering observed that for some disc designs under certain conditions, the PPM butterfly valve model did not bound test results.

**Purpose**

The purpose of this Error Notice is to: a) report that for some butterfly valve disc designs, predictions of maximum required hydrodynamic torque values made using the PPM butterfly valve model have been found to be non-conservative by as much as 45 percent, b) require adjustments to predicted total required dynamic torque values and, c) impose restrictions on the use of the PPM butterfly valve model for compressible flow applications.

**Description of Error**

Comparisons completed to date show that under compressible flow conditions, the PPM butterfly valve predictions of maximum required hydrodynamic torque in the closing direction for the disc design shown in Figures 2(C) and 2(D) were found to be non-conservative by as much as 5 percent and 45 percent, respectively. The disc design shown in Figure 2(C) has similar geometric features to those tested by INEL. The disc design shown in Figure 2(D) is somewhat different than the INEL test valves disc shapes used to validate the PPM for compressible flow conditions, in that it has a shallow concave recess in the front face. The reported non-conservatism in hydrodynamic torque is based on limited comparisons between the PPM predictions and test data. Under compressible flow blowdown conditions, the hydrodynamic torque is the major component of the total required dynamic torque that is used for actuator sizing

Table 1 shows the applicability criteria for the PPM Butterfly Valve Model (Reference 1, page 7-24). The Table indicates applicable disk designs must have prismatic or conical back faces and flat front faces. The disk shown in Figure 2(C) is clearly applicable for PPM evaluations based on these criteria. The disk shown in Figure 2(D) has a shallow concave recess in the front face. Reference 2, page 2-1, under Terminology: Non-symmetric disk with single offset stem states, "The disk face away from the stem is typically flat or has a small curvature and is commonly referred to as the flat face". Based on this statement, the shallow concavity of the disc shown in Figure 2 (D) can be interpreted to be within the applicability of the PPM. Table 1 also indicates that the disc must have a prismatic or conical back face. The disc shown Figure 2(D) has features that could be interpreted as being prismatic and therefore within the applicability of the PPM.

Based on the discussion above, the following restrictions, adjustments and recommendations are made:

## PPM Applicability Restriction

The following restriction on use of the PPM Butterfly Valve Model is imposed:

1. Pending further EPRI evaluation, for butterfly valves with non-symmetric discs with the shaft in the downstream orientation, in compressible flow applications and in the closing direction, use of the PPM Butterfly Valve Model should be restricted to valves with a completely flat front face, e.g., the PPM butterfly model shall not be applied to butterfly valves with a recessed (curved or flat) front face.

## Required PPM Adjustment

Pending further EPRI evaluation, the following adjustment to the predicted maximum required total dynamic torque shall be made:

1. For butterfly valves with non-symmetric discs with the shaft in the downstream orientation, in compressible flow applications and in the closing direction, meeting all PPM applicability requirements and accounting for the restriction described above, the predicted maximum required total dynamic torque shall be multiplied by 1.05.

## Recommended Actions

Previous PPM butterfly valve analyses for non-symmetric discs with shaft downstream orientation under compressible flow applications, in the closing direction, should be reviewed to determine if the disc design has a recessed front face (flat or concave):

- If the front face is recessed, the user should evaluate the potential impact of a 45 percent increase in the maximum total required dynamic torque prediction.

- If the front face is truly flat and is not recessed, the user should evaluate the potential impact of a 5 percent increase in the maximum total required dynamic torque prediction.

## EPRI's On Going Assessment

EPRI is initiating a detailed assessment of the MOV PPM for butterfly valves with compressible flows using Kalsi Engineering air blowdown test results. The objective of this assessment is to better identify dependency and magnitude of non-conservatism in the PPM butterfly valve model based on the disc geometrical features, installation parameters and operating conditions. This assessment is expected to be completed in the first quarter of 2005.

**References:**

1. *EPRI MOV Performance Prediction Program; Topical Report- Revision 2*; EPRI TR-103237-R2; April 1997.

2. *EPRI MOV Performance Prediction Program; Butterfly Valve Model Description Report*; EPRI TR-103224; September 1994.

3. *EPRI MOV Performance Prediction Program: Performance Prediction Methodology (PPM) Version 3.2 User Manual and Implementations Guide:* EPRI, Palo Alto, CA: 2003, 1006206.

4. J. C. Watkins, R. Steele, R. C. Hill, and K. K. DeWall, **A study of Typical Nuclear Containment Purge Valves in an Accident Environment**, NUREG/CR-4648, AUGUST 1986.

5. R. Steele and J.C. Watkins. **Containment Purge and Vent Valve Test Program Final Report**, U.S. Nuclear Regulatory Commission, NUREG/CR-4141, Oct 1985.

6. *Effect of Butterfly Valve Disc Shape Variations on Torque Requirements for Power Plant Applications*, Proceedings of the Eighth NRC/ASME Symposium on Valve and Pump Testing, NUREG/CP-0152, Vol. 5, July 2004.

## Table 1

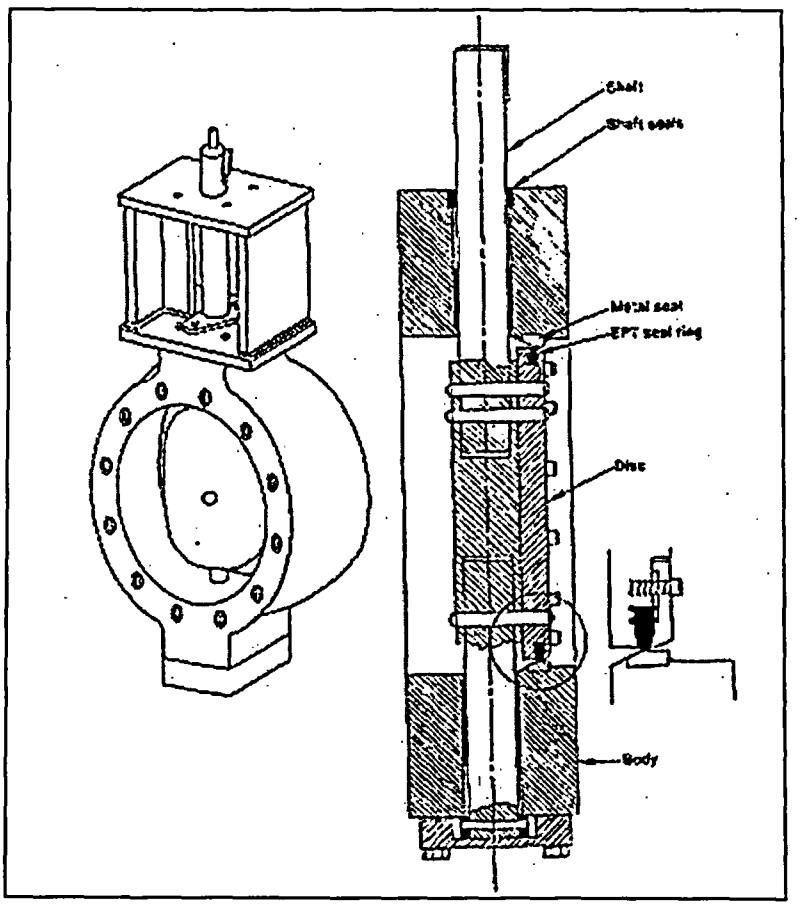
### Recommended Applicability of Butterfly Valve Prediction Method

| Parameter | Range of Applicability |
|---|---|
| Valve Design | • AWWA and ANSI high performance types.<br>• All sizes in nuclear power plants. |
| Disk Design | • Symmetric<br>• Single-offset with prismatic or conical back face and flat front face.<br>• Up to 0.35 aspect ratio for symmetric and single-offset disks in compressible and incompressible flow; up to 0.47 aspect ratio for single-offset disks in incompressible flow with the shaft upstream. |
| Seat Design | • No seat.<br>• Interference type.<br>• Others with supporting data. |
| Bearing Design | • Bronze and non-bronze sleeve type.<br>• Other types with supporting data. |
| Packing Design | • Any |
| Stem Orientation | • Full range relative to gravity.<br>• Shaft upstream or downstream relative to flow direction. |
| Fluid Type | • Incompressible (normal and choked)<br>• Choked compressible (single-phase) flow.<br>• Downstream pipe rupture. |
| Upstream Disturbance | • Elbow.[1] |

NOTE:

1. The elbow model was validated with test data for a 90° upstream elbow; however, it is expected to apply to tees and 45° elbows.

(From Reference 1, page 7-24)



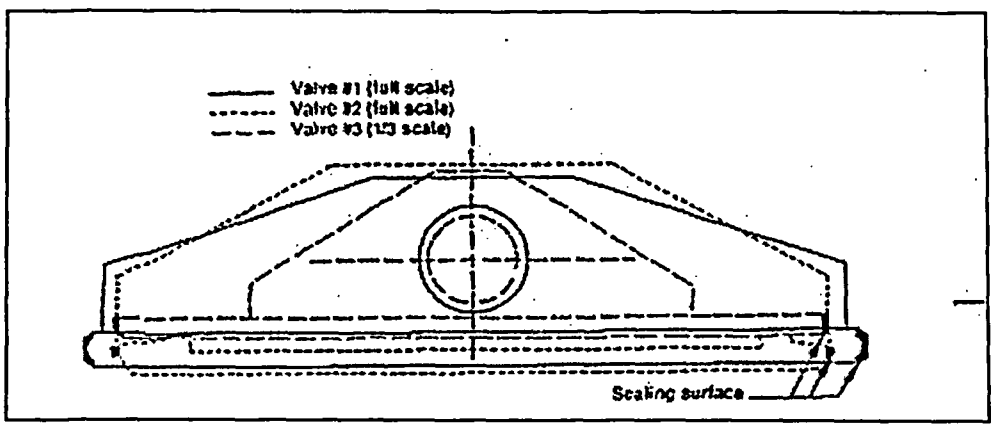




**Figure 1**
**Typical design of the single-offset butterfly valve (top) and a scaled composite drawing (bottom) showing detailed geometric comparisons of the disc cross-sections of 3 different disc shapes tested by NRC/INEL (References 4 & 5). Note: These designs have a flat front face and a full-length prismatic back face.**

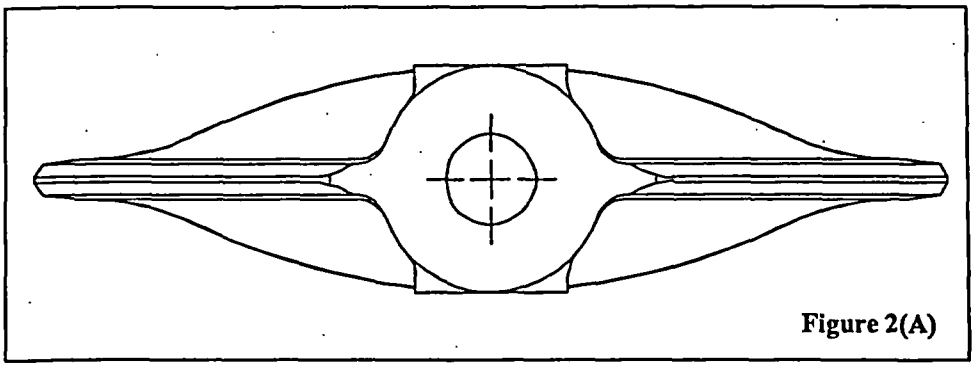


Figure 2(A)

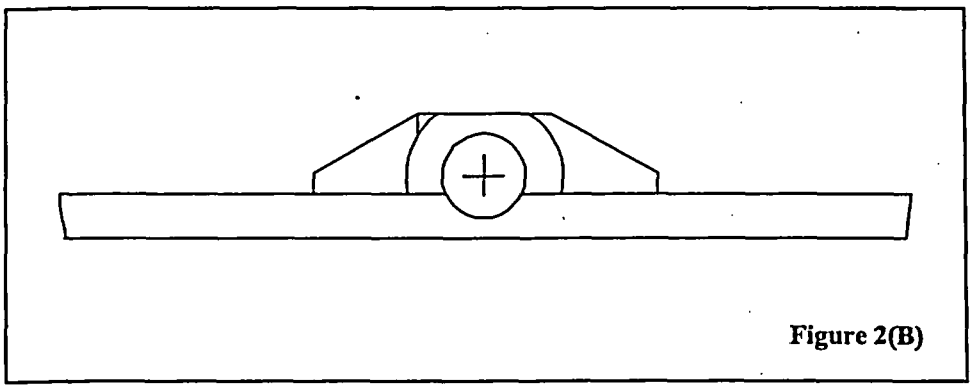


Figure 2(B)

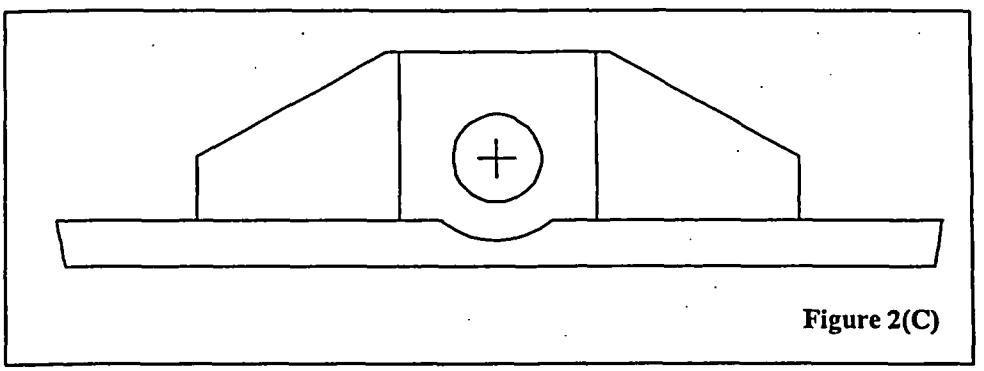


Figure 2(C)

**Figure 2 (cont. on following pages)**
**Butterfly Valve Disc Shapes (shown to scale) Used in Compressible Flow Tests Performed by Kalsi Engineering, Inc.**

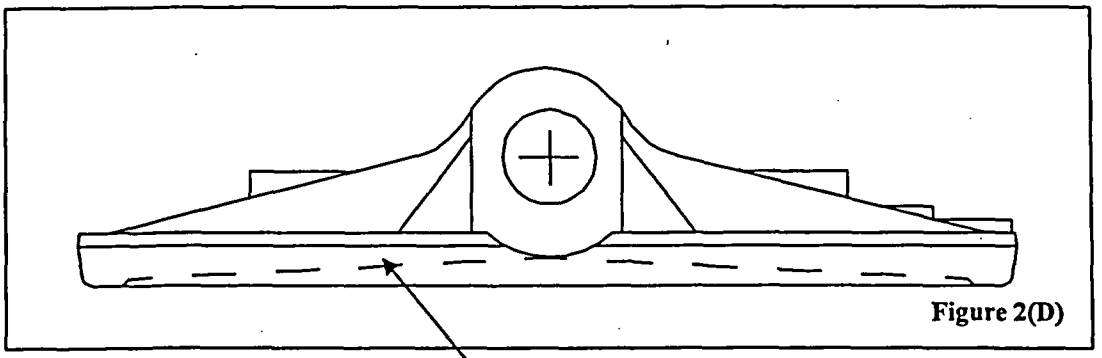



Figure 2(D)

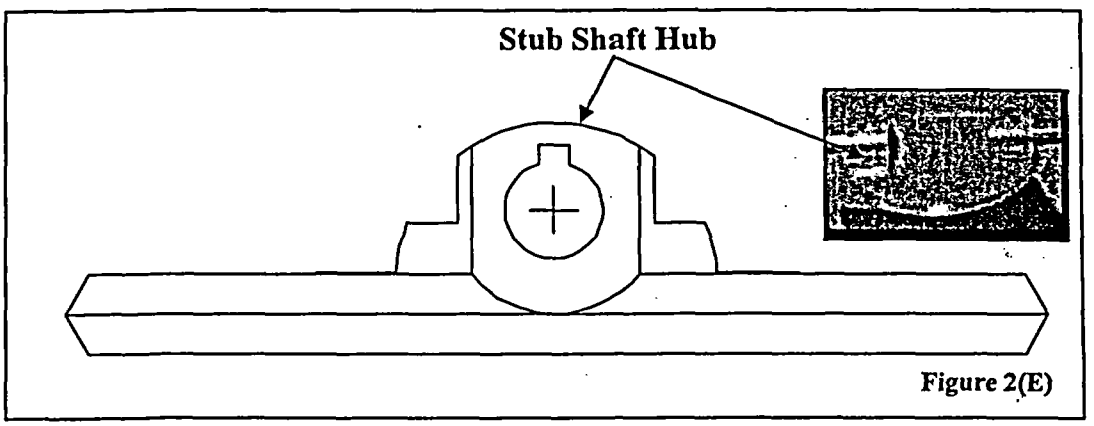



Figure 2(E)

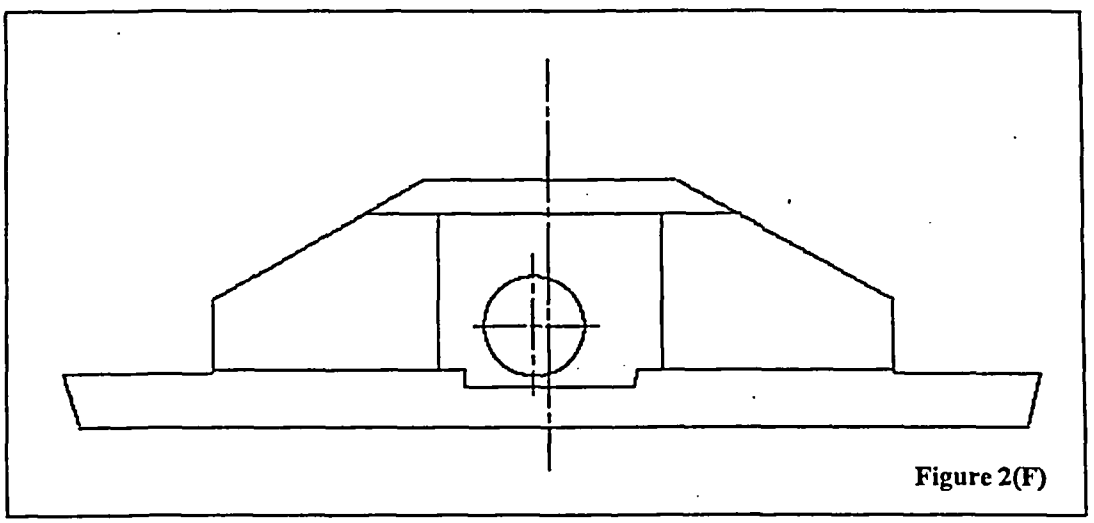


Figure 2(F)

**Figure 2 (Cont.)**
**Butterfly Valve Disc Shapes (shown to scale) Used in Compressible Flow Tests Performed by Kalsi Engineering, Inc.**

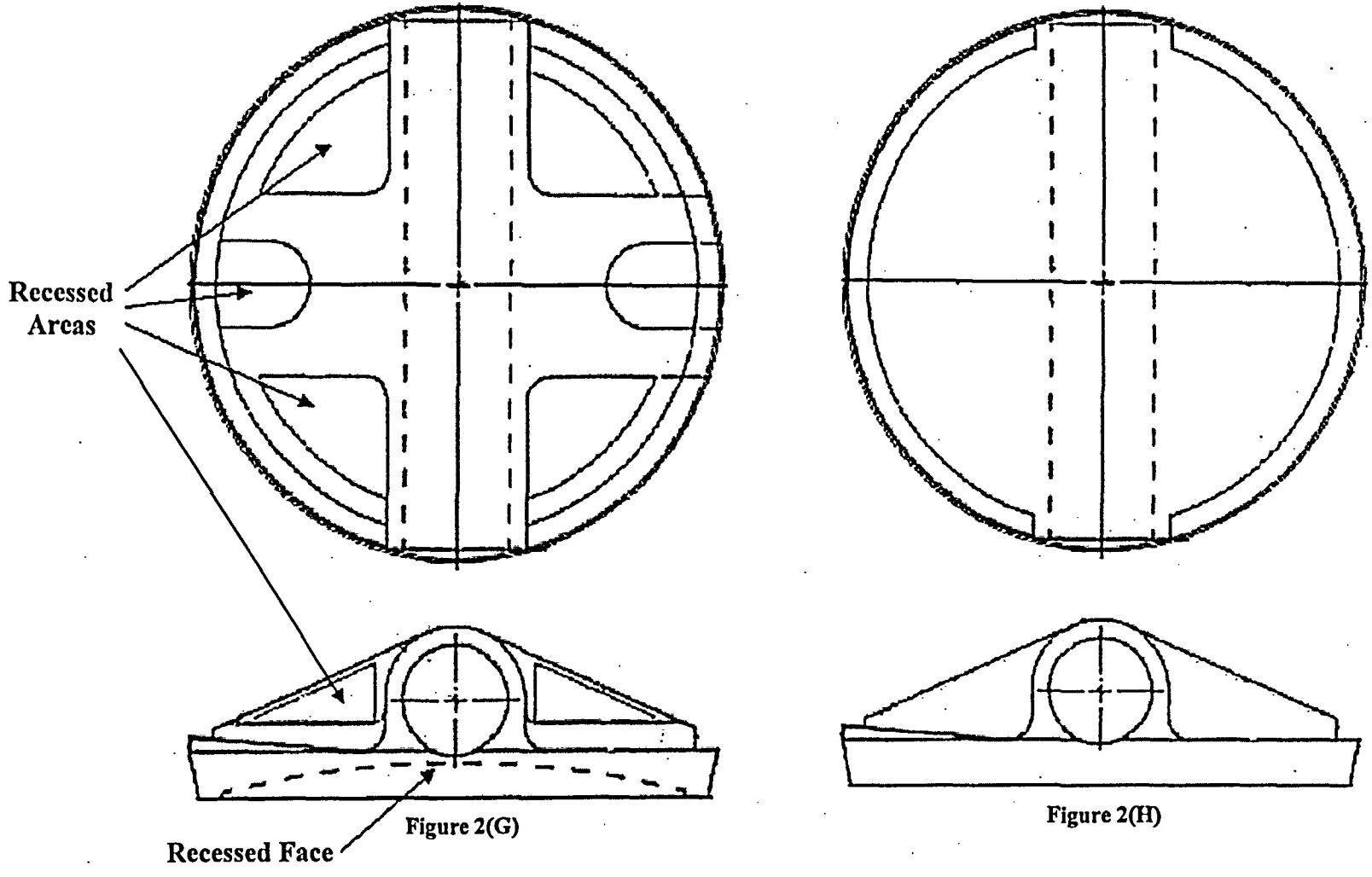



**Figure 2 (Cont.)**
**Butterfly valve disc shapes (shown to scale) used in compressible flow tests performed by Kalsi Engineering, Inc. Cast disc with recesses as supplied by the manufacturer is shown on the left, and the disc streamlined by using a filler is shown on the right**