June 1, 1989

Docket Nos. 50-361
50-362

FACILITIES: San Onofre Nuclear Generating Station, Unit Nos. 2 and 3

LICENSEE: Southern California Edison Company

SUBJECT: SUMMARY OF MEETING HELD ON MAY 23, 1989 TO DISCUSS CAPACITY OF STEAM GENERATOR SAFETY VALVES

On May 23, 1989, the NRC staff met with representatives of Southern California Company (SCE) to discuss the relief capacity of the steam generator safety valves at SONGS 2 and 3. Persons attending are identified on Enclosure 1. Viewgraphs presented at the meeting are shown on Enclosure 2. The meeting was held pursuant to notice issued on May 15, 1989. Highlights of the meeting are summarized below.

Following issuance of NRC Information Notice No. 86-05 on January 31, 1986 on main steam safety valves, a Westinghouse Owners Group Subcommittee was formed representing about sixteen licensees of plants fitted with Crosby safety valves to investigate why the Seabrook and Vogtle valves had low capacities. The test program involved four valve types, eleven different springs, five different nozzle and guide ring settings and various set pressures involving some 235 tests. The test report prepared by the owner's group subcommittee will be formally transmitted to NRC in about two weeks. An advance copy was delivered at the meeting. Each licensee will need to evaluate the results for its specific plant, e.g., current ring settings, and evaluate the effect of changing ring settings as required.

As applied to SONGS 2 and 3, the currently installed valves have about 75% of the nameplate rating, whereas only 66% capacity is needed to meet the capacity requirements for the worst overpressure transient (loss of load w/no turbine bypass). SCE plans to restore nameplate capacity by adjustments to both the guide and nozzle rings at each unit's next refueling outage (September 1989 for Unit 2; March 1990 for Unit 3).

SCE will be issuing a Licensee Event Report on this matter within 30 days.

/s/
Charles M. Trammell, Senior Project Manager
Project Directorate V
Division of Reactors Projects III,
IV, V and Special Projects
Office of Nuclear Reactor Regulation

Enclosures:
1. Attendance List
2. Viewgraphs

cc w/enclosures
See next page

SUMMARY MEETING 5/23-SO23
LOG p6 5/25

DISTRIBUTION

| | | | | |
|---|---|---|---|---|
| Docket File | NRC & Local PDRs | PD #5 Reading | MVirgilio | JLee |
| CTrammell | OGC (f/info only) | EJordan | BGrimes | |

| | |
|---|---|
| PD5/DRSP | D:PDV:DRSP |
| CTrammell:rw | GKnighton |
| 5/31/89 | 6/1 /89 |



DFO1
1/1

memo 4

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

June 1, 1989

Docket Nos. 50-361
50-362

FACILITIES: San Onofre Nuclear Generating Station, Unit Nos. 2 and 3

LICENSEE: Southern California Edison Company

SUBJECT: SUMMARY OF MEETING HELD ON MAY 23, 1989 TO DISCUSS CAPACITY OF STEAM GENERATOR SAFETY VALVES

On May 23, 1989, the NRC staff met with representatives of Southern California Company (SCE) to discuss the relief capacity of the steam generator safety valves at SONGS 2 and 3. Persons attending are identified on Enclosure 1. Viewgraphs presented at the meeting are shown on Enclosure 2. The meeting was held pursuant to notice issued on May 15, 1989. Highlights of the meeting are summarized below.

Following issuance of NRC Information Notice No. 86-05 on January 31, 1986 on main steam safety valves, a Westinghouse Owners Group Subcommittee was formed representing about sixteen licensees of plants fitted with Crosby safety valves to investigate why the Seabrook and Vogtle valves had low capacities. The test program involved four valve types, eleven different springs, five different nozzle and guide ring settings and various set pressures involving some 235 tests. The test report prepared by the owner's group subcommittee will be formally transmitted to NRC in about two weeks. An advance copy was delivered at the meeting. Each licensee will need to evaluate the results for its specific plant, e.g., current ring settings, and evaluate the effect of changing ring settings as required.

As applied to SONGS 2 and 3, the currently installed valves have about 75% of the nameplate rating, whereas only 66% capacity is needed to meet the capacity requirements for the worst overpressure transient (loss of load w/no turbine bypass). SCE plans to restore nameplate capacity by adjustments to both the guide and nozzle rings at each unit's next refueling outage (September 1989 for Unit 2; March 1990 for Unit 3).

SCE will be issuing a Licensee Event Report on this matter within 30 days.

Charles M Trammell

Charles M. Trammell, Senior Project Manager
Project Directorate V
Division of Reactors Projects III,
IV, V and Special Projects
Office of Nuclear Reactor Regulation

Enclosures:
1. Attendance List
2. Viewgraphs

cc w/enclosures
See next page

Mr. Kenneth P. Baskin
Southern California Edison Company

San Onofre Nuclear Generating Station, Units 2 and 3

cc:
Charles R. Kocher, Esq.
James A. Beoletto, Esq.
Southern California Edison Company
2244 Walnut Grove Avenue
P. O. Box 800
Rosemead, California 91770

Orrick, Herrington & Sutcliffe
ATTN: David R. Pigott, Esq.
600 Montgomery Street
San Francisco, California 94111

Alan R. Watts, Esq.
Rourke & Woodruff
701 S. Parker St. No. 7000
Orange, California 92668-4702

Mr. Sherwin Harris
Resource Project Manager
Public Utilities Department
City Hall of Riverside
City Hall
3900 Main Street
Riverside, California 92522

Mr. Charles B. Brinkman
Combustion Engineering, Inc.
12300 Twinbrook Parkway, Suite 330
Rockville, Maryland 20852

Mr. Dennis F. Kirsh
U.S. Nuclear Regulatory Commission
Region V
1450 Maria Lane, Suite 210
Walnut Crekk, California 94596

Mr. Don Womeldorf
Chief Environmental Mangement Branch
California Department of Health
714 P Street, Room 616
Sacramento, California 95814

Mr. Mark Medford
Southern California Edison Company
2244 Walnut Grove Avenue
P. O. Box 800
Rosemead, California 91770

Mr. Robert G. Lacy
Manager, Nuclear Department
San Diego Gas & Electric Company
P. O. Box 1831
San Diego, California 92112

Mr. Paul Szalinski, Chief
Radiological Health Branch
State Department of Health Services
714 P Street, Building #8
Sacramento, California 95814

Resident Inspector, San Onofre NPS
c/o U.S. Nuclear Regulatory Commission
Post Office Box 4329

Mayor, City of San Clemente
San Clemente, California 92672

Regional Administrator, Region V
U.S. Nuclear Regulatory Commission
1450 Maria Lane/Suite 210
Walnut Creek, California 94596

Chairman, Board Supervisors
San Diego County
1600 Pacific Highway, Room 335
San Diego, California 92101

ENCLOSURE 1

Attendance List

May 23, 1989 Meeting

NRC

G. Knighton
C. Trammell
G. Hammer
P. T. Kuo
K. Desai
J. Bradfute
S. Juergens
F. Cherny

SCE

F. Nandy
M. Kerschthal
A. Sistos
T. McLeod

Other

T. Hicks, Southern Technical Services

ENCLOSURE 2

# Main Steam Safety Valve

# San Onofre Nuclear Generating Station

# Units 2 and 3

## AGENDA

I. Introduction

II. Background

III. Westinghouse Owner's Group Subcommittee on Main Steam Safety Valves

- A. Objective
- B. Test Program
- C Safety Valve Computer Model
- D. Extended Blowdown Analysis

IV. SONGS 2 and 3 Assessment

- A. Main Steam Safety Valve Configuration and Data
- B. Design Basis
- C SONGS 2 Trip
- D. Recent Secondary System Pressure Evaluation

V. Long Term Modifications

VI. Technical Specification Changes

VII. Conclusions

## BACKGROUND

2 Seabrook MSSVs were high flow tested at Wylie laboratories and found to have low lifts. (Testing was performed in 1984 and 1985)

5 Plant Vogtle MSSVs were high flow tested at Wylie laboratories and found to have low lifts. (Testing was performed in May, 1986)

In both instances, the large positive guide ring settings were changed to a negative setting

Information Notice No. 86-05 was issued January 31, 1986.

Supplement 1 to IEN 86-05 was issued October 16, 1986

On August 12, 1986, SONGS 2 experienced a spurious MSIS challenging the secondary overpressure protection system. All MSSVs actuated. No design parameters were exceeded.

SCE requested Crosby to evaluate the adequacy of the SONGS 2 & 3 MSSVs in November 1986

SCE joined the Westinghouse Owner's Group MSSV Subcommittee in January 1987

# WESTINGHOUSE OWNERS GROUP

## MSSV SUBCOMMITTEE

* **Subcommittee formed in September 1986 to address the issues raised by Information Notice 86-05**

* **Subcommittee Members:**

    * Several Licensees
    * Crosby Valve & Gage Company
    * EPRI
    * Continuum Dynamics

## SUBCOMMITTEE OBJECTIVES

* Formed to determine the root cause for the inadequate capacities of the Seabrook and Vogtle MSSVs

* Establish "generic" ring settings to provide rated capacity at 3% accumulation and a maximum 10% blowdown

* Determine the effects of spring rate and ring settings on blowdown and accumulation

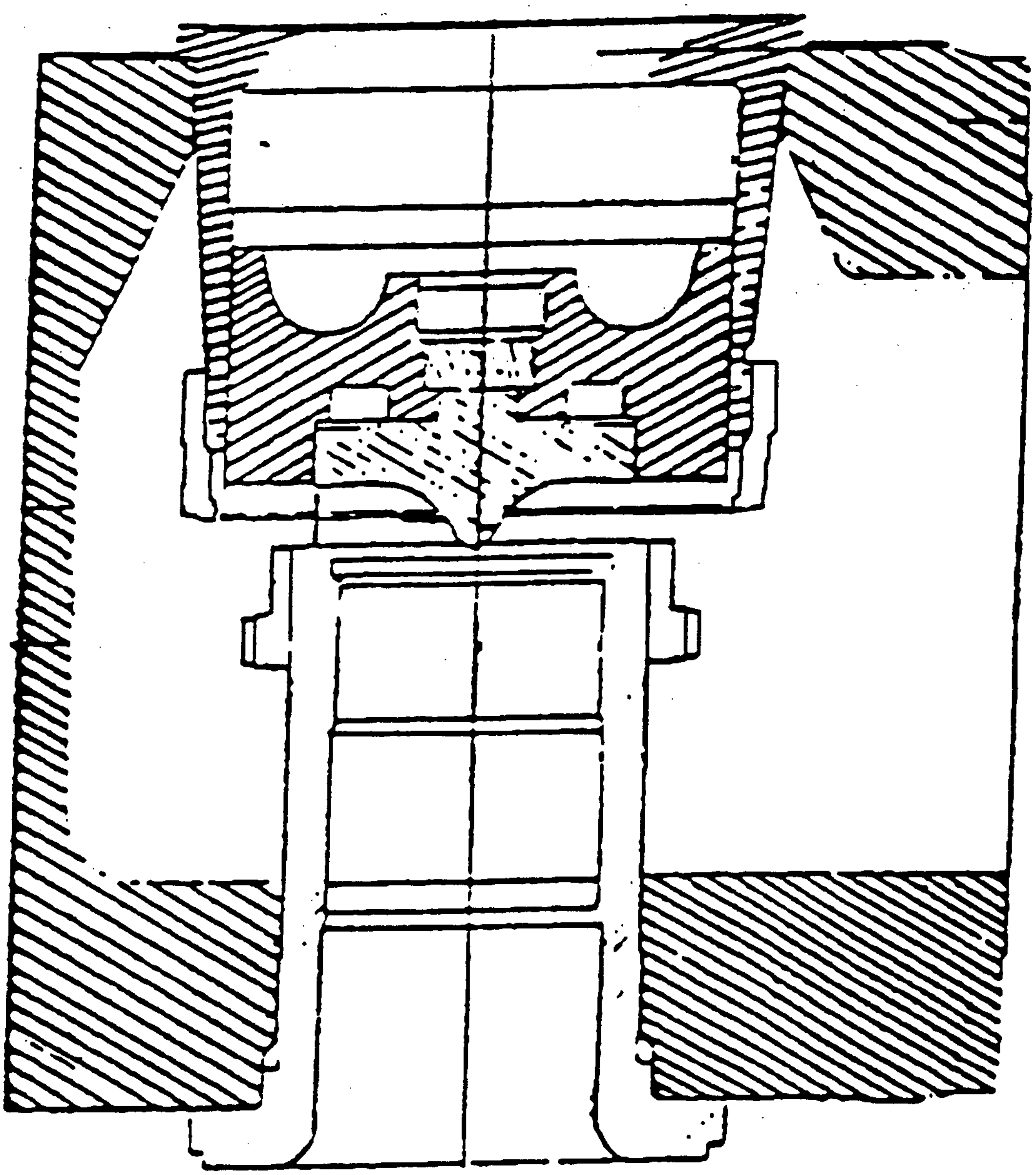
* Develop an analytical model which can predict valve performance:

    * Blowdown
    * Lift

Given:

* Ring Settings
* Geometry
* Spring rate
* Accumulation

# MSSV INTERNALS



# TEST PROGRAM

* A matrix of high flow tests were performed at Crosby Valve Gage Company

* Test procedure was written by Crosby and approved by the Subcomittee

* The following MSSV transient data was recorded for each test:

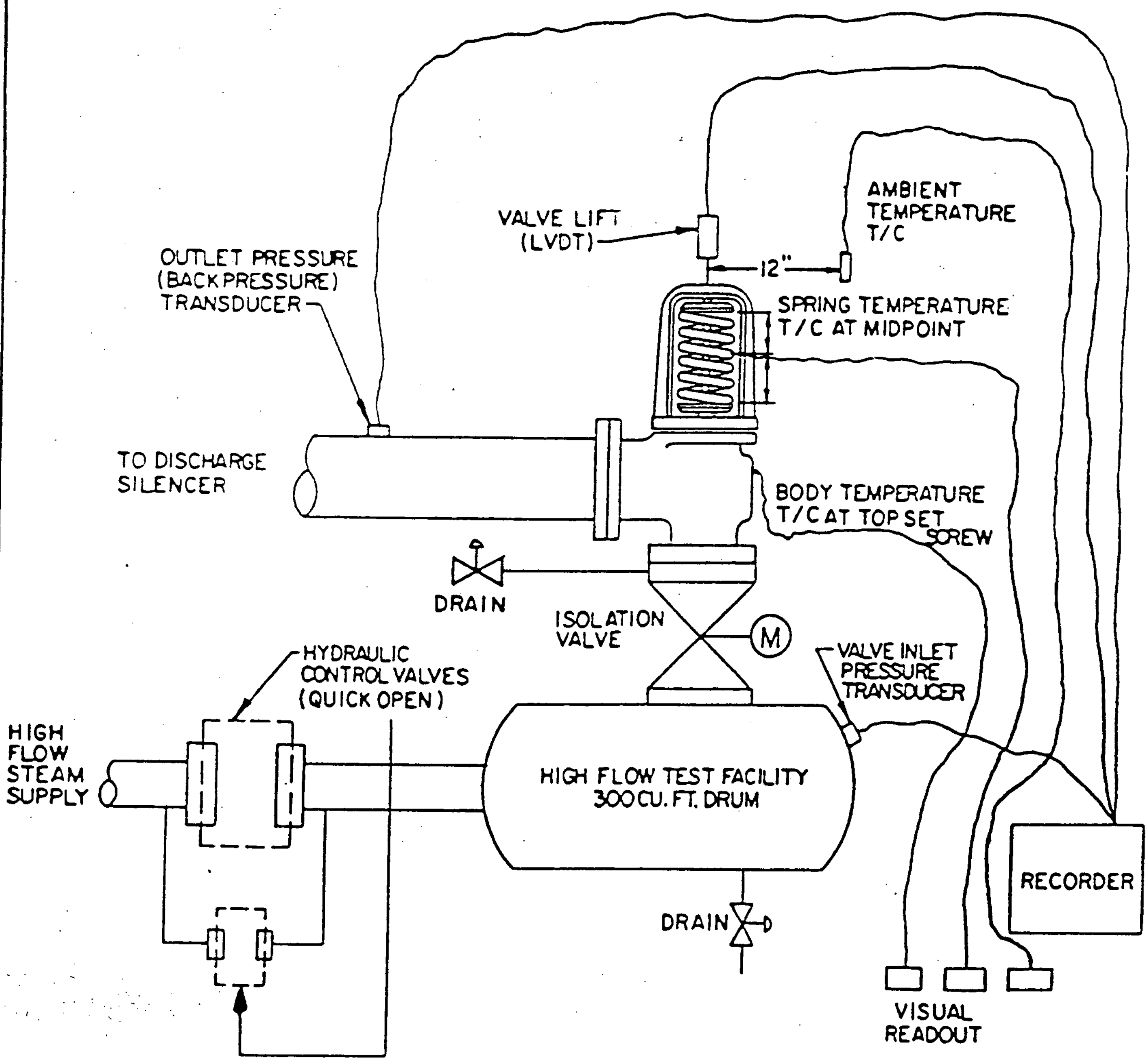
    * Inlet pressure
    * Outlet pressure
    * Valve lift

* Test data was copied to a computer

* Test data was sent to Continuum Dynamics for development and verification of the COUPLE Code

* Analysis of test data performed by Crosby and Continuum Dynamics

FIGURE 2


VALVE LIFT
(LVDT)
AMBIENT
TEMPERATURE
T/C
12"
OUTLET PRESSURE
(BACK PRESSURE)
TRANSDUCER
SPRING TEMPERATURE
T/C AT MIDPOINT
TO DISCHARGE
SILENCER
BODY TEMPERATURE
T/C AT TOP SET
SCREW
DRAIN
ISOLATION
VALVE
M
HYDRAULIC
CONTROL VALVES
(QUICK OPEN)
VALVE INLET
PRESSURE
TRANSDUCER
HIGH
FLOW
STEAM
SUPPLY
HIGH FLOW TEST FACILITY
300 CU. FT. DRUM
RECORDER
DRAIN
VISUAL
READOUT

# TEST PROGRAM

* All of the Crosby MSSVs were tested:

  * 6R10
  * 6Q8
  * 6Q8x8

* Eleven springs with spring rates bounding design limits were tested

* Five different ring settings were tested:

| Nozzle Ring | Guide Ring |
|---|---|
| -75 | -100 |
| -100 | -75 |
| -100 | -50 |
| -50 | -75 |
| -75 | -75 |

* Large number of set pressures were tested

# FIGURE 1

| | Test Number | Valve | Spring | Set Pressure (psig) | Ring* Setting | Number Cycles |
|---|---|---|---|---|---|---|
| Phase I | 1 | 1 (6R10 #1) | DK | 1064 | 1 | 3 |
| | 2 | 1 (6R10 #1) | DK | 1064 | 2 | 3 |
| | 3 | 1 (6R10 #1) | DK | 1064 | 3 | 3 |
| | 4 | 1 (6R10 #1) | DK | 1090 | 3 | 3 |
| | 5 | 1 (6R10 #1) | DK | 1090 | 2 | 3 |
| | 6 | 1 (6R10 #1) | DK | 1090 | 1 | 3 |
| | 7 | 1 (6R10 #1) | DK | 1115 | 1 | 3 |
| | 8 | 1 (6R10 #1) | DK | 1115 | 2 | 3 |
| | 9 | 1 (6R10 #1) | DK | 1115 | 3 | 3 |
| | 10 | 1 (6R10 #1) | DK | 1140 | 3 | 3 |
| | 11 | 1 (6R10 #1) | DK | 1140 | 2 | 3 |
| | 12 | 1 (6R10 #1) | DK | 1140 | 1 | 3 |
| | 13 | 1 (6R10 #1) | DK + 10% | 1140 | 1 | 3 |
| | 14 | 1 (6R10 #1) | DK + 10% | 1140 | 2 | 3 |
| | 15 | 1 (6R10 #1) | DK + 10% | 1140 | 3 | 3 |
| | 16 | 1 (6R10 #1) | DK + 10% | 1115 | 3 | 3 |
| | 17 | 1 (6R10 #1) | DK + 10% | 1115 | 2 | 3 |
| | 18 | 1 (6R10 #1) | DK + 10% | 1115 | 1 | 3 |
| | 19 | 1 (6R10 #1) | DK + 10% | 1090 | 1 | 3 |
| | 20 | 1 (6R10 #1) | DK + 10% | 1090 | 2 | 3 |
| | 21 | 1 (6R10 #1) | DK + 10% | 1090 | 3 | 3 |
| | 22 | 1 (6R10 #1) | DK + 10% | 1064 | 3 | 3 |
| | 23 | 1 (6R10 #1) | DK + 10% | 1064 | 2 | 3 |
| | 24 | 1 (6R10 #1) | DK + 10% | 1064 | 1 | 3 |
| | 25 | 2 (6R10 #2) | DK | 1140 | 3 | 3 |
| | 26 | 3 (6R10 #3) | DK + 10% | 1064 | 3 | 3 |
| | 27 | 4 (6R10 #4) | DK | 1140 | 3 | 3 |
| | 28 | 2 (6R10 #2) | DK + 10% | 1064 | 3 | 3 |
| | 29 | 3 (6R10 #3) | DK | 1140 | 3 | 3 |
| | 30 | 4 (6R10 #4) | DK + 10% | 1064 | 3 | 3 |
| Phase II | 31 | 1 (6R10 #1) | EK | 1170 | 3 | 3 |
| | 32 | 1 (6R10 #1) | EK | 1260 | 3 | 3 |
| | 33 | 1 (6R10 #1) | EK + 10% | 1260 | 3 | 3 |
| | 34 | 1 (6R10 #1) | EK + 10% | 1170 | 3 | 3 |
| | 35 | 2 (6R10 #2) | EK(-0%,+10%) | 1170 | 3 | 3 |
| | 36 | 2 (6R10 #2) | EK(-0%,+10%) | 1260 | 3 | 3 |

CROSBY — CROSBY VALVE & GAGE COMPANY
WRENTHAM, MASS

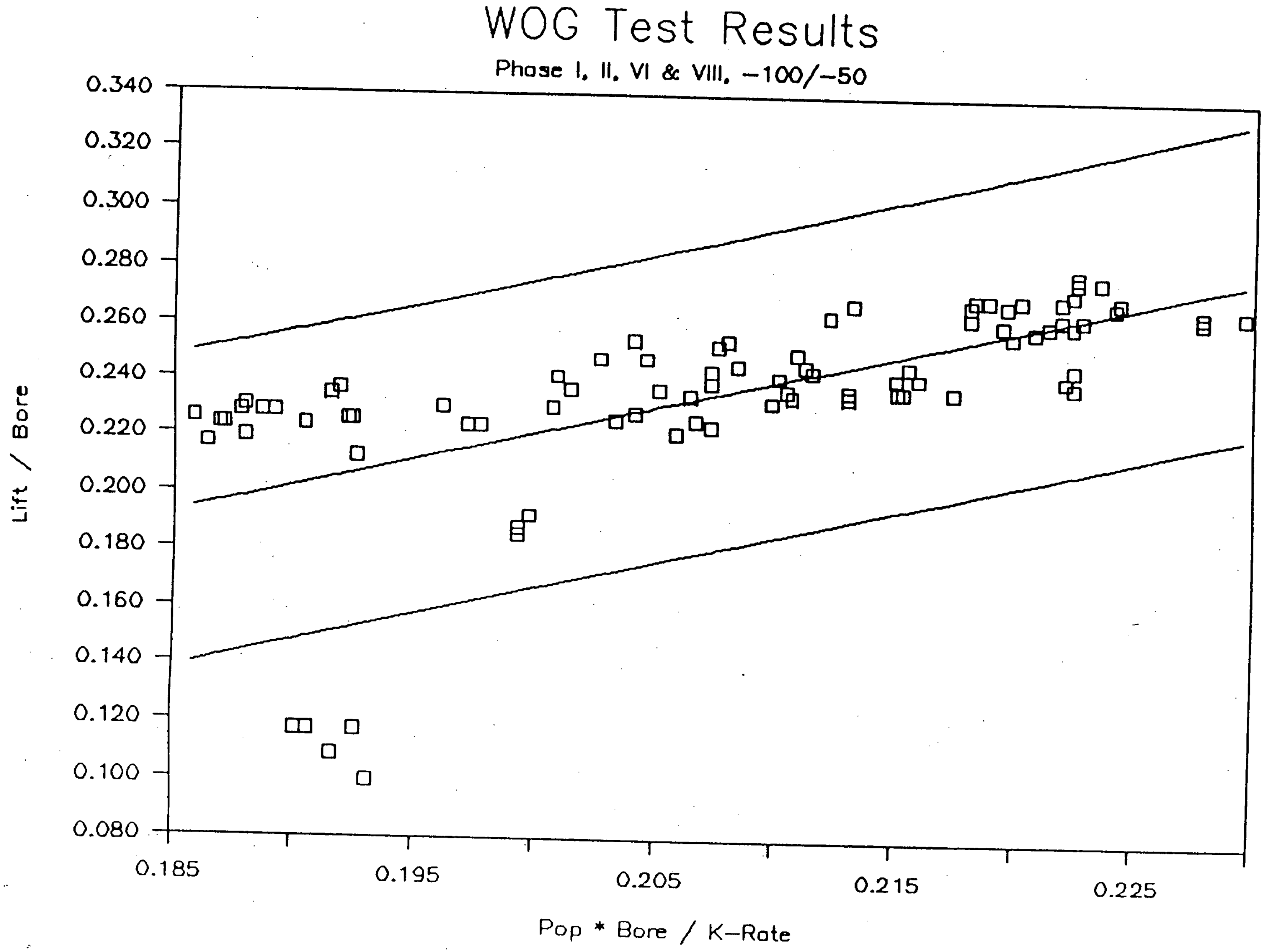


## FIGURE 1

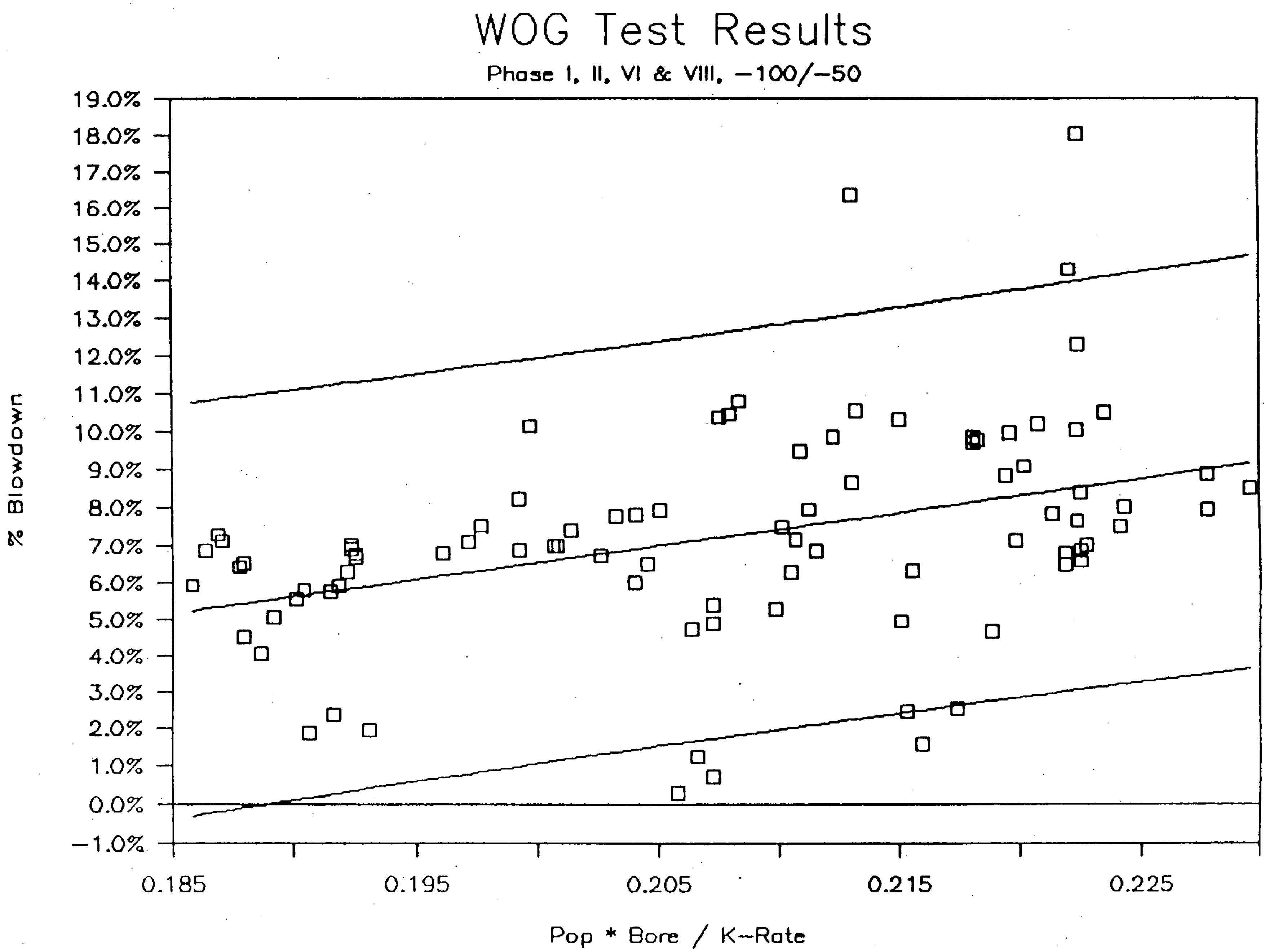
| | Test Number | Valve | Spring | Set Pressure (psig) | Ring* Setting | Number Cycles |
|---|---|---|---|---|---|---|
| Phase II (cont) | | | | | | |
| | 37 | 3 (6R10 #3) | EK(-0%,+10%) | 1260 | 3 | 3 |
| | 38 | 3 (6R10 #3) | EK(-0%,+10%) | 1170 | 3 | 3 |
| Phase III | 39 | 5 (6Q8 #1) | BK | 1050 | 4 | 3 |
| | 40 | 5 (6Q8 #1) | BK | 1050 | 5 | 3 |
| | 41 | 5 (6Q8 #1) | BK | 1105 | 5 | 3 |
| | 42 | 5 (6Q8 #1) | BK | 1105 | 4 | 3 |
| | 43 | 5 (6Q8 #1) | BK + 10% | 1105 | 4 | 3 |
| | 44 | 5 (6Q8 #1) | BK + 10% | 1105 | 5 | 3 |
| | 45 | 5 (6Q8 #1) | BK + 10% | 1050 | 5 | 3 |
| | 46 | 6 (6Q8 #1) | BK + 10% | 1050 | 4 | 3 |
| | 47 | 6 (6Q8 #2) | BK(-0%,+10%) | 1050 | 4 | 3 |
| | 48 | 6 (6Q8 #2) | BK(-0%,+10%) | 1105 | 4 | 3 |
| Phase IV | 49 | 6 (6Q8 #2) | AK | 1035 | 4 | 3 |
| | 50 | 6 (6Q8 #2) | AK | 985 | 4 | 3 |
| | 51 | 6 (6Q8 #2) | AK + 10% | 985 | 4 | 3 |
| | 52 | 6 (6Q8 #2) | AK + 10% | 1035 | 4 | 3 |
| | 53 | 5 (6Q8 #1) | AK(-0%,+10%) | 1035 | 4 | 3 |
| | 54 | 5 (6Q8 #1) | AK(-0%,+10%) | 985 | 4 | 3 |
| Phase V | 55 | 5 (6Q8 #1) | CK | 1175 | 4 | 3 |
| | 56 | 5 (6Q8 #1) | CK | 1190 | 4 | 3 |
| | 57 | 5 (6Q8 #1) | CK + 10% | 1190 | 4 | 3 |
| | 58 | 5 (6Q8 #1) | CK + 10% | 1175 | 4 | 3 |
| | 59 | 6 (6Q8 #2) | CK(-0%,+10%) | 1175 | 4 | 3 |
| | 60 | 6 (6Q8 #2) | CK(-0%,+10%) | 1190 | 4 | 3 |
| Phase VI | 61 | 7 (6R8x8 #1) | EK | 1235 | 3 | 3 |
| | 62 | 7 (6R8x8 #1) | EK | 1185 | 3 | 3 |
| | 63 | 8 (6R8x8 #2) | EK + 10% | 1185 | 3 | 3 |
| | 64 | 8 (6R8x8 #2) | EK + 10% | 1235 | 3 | 3 |
| Phase VII | 65 | 9 (6Q8x8 #1) | CK | 1200 | 4 | 3 |
| | 66 | 9 (6Q8x8 #1) | CK | 1130 | 4 | 3 |
| | 67 | 10 (6Q8x8 #2) | CK + 10% | 1130 | 4 | 3 |
| | 68 | 10 (6Q8x8 #2) | CK + 10% | 1200 | 4 | 3 |
| Phase VIII | 69 | 2 (6R10 #2) | FK(-0%,+10%) | 985 | 3 | 3 |
| | 70 | 2 (6R10 #2) | FK(-0%,+10%) | 1025 | 3 | 3 |
| | 71 | 1 (6R10 #1) | FK(-0%,+10%) | 1025 | 3 | 3 |
| | 72 | 1 (6R10 #1) | FK | 985 | 3 | 3 |

## TEST PROGRAM

* **Test results plotted lift and blowdown:**
    * Nondimensional lift (lift/bore, L/D) plotted vs. nondimensional pressure (opening pressure*bore/spring rate, D*Pop/K-rate)
    * Blowdown plotted vs. nondimensional pressure



WOG Test Results
Phase I, II, VI & VIII, -100/-50
0.340
0.320
0.300
0.280
0.260
0.240
0.220
0.200
0.180
0.160
0.140
0.120
0.100
0.080
Lift / Bore
0.185
0.195
0.205
0.215
0.225
Pop * Bore / K-Rate


WOG Test Results
Phase I, II, VI & VIII, -100/-50
19.0%
18.0%
17.0%
16.0%
15.0%
14.0%
13.0%
12.0%
11.0%
10.0%
9.0%
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
-1.0%
% Blowdown
0.185
0.195
0.205
0.215
0.225
Pop * Bore / K-Rate

## TEST PROGRAM

* Additional testing performed in late 1988 to determine the cause of low lift/high blowdown test results

* Valve springs were also tested by Continuum Dynamics at Princeton University to determine if large eccentricities caused anamolous test results

    * Large eccentricities can result in excessive stem to bearing friction affecting valve performance

* Additional testing resulted in expected MSSV lift and blowdowns

* One spring was found to have an exceptionally large eccentricity

# FIGURE 1

| | Test Number | Valve | Spring | Set Pressure (psig) | Ring* Setting | Number Cycles |
|---|---|---|---|---|---|---|
| Additional Tests | 73 | 7 (6R8x8 #1) | EK + 10% | 1185 | 3 | 3 |
| | 74 | 7 (6R8x8 #1) | EK + 10% | 1235 | 3 | 3 |
| | 75 | 8 (6R8x8 #2) | EK | 1185 | 3 | 3 |
| | 76 | 8 (6R8x8 #2) | EK | 1235 | 3 | 3 |
| | 77 | 7 (6R8x8 #1) | EK(-0%,+10%) | 1170 | 3 | 3 |
| | 78 | 8 (6R8x8 #2) | EK(-0%,+10%) | 1170 | 3 | 3 |

# TEST PROGRAM

* Meeting conducted with the NRC on March 8, 1988 to discuss the program

* Crosby Test Report 4388, rev. 1 was issued Nov. 30, 1988

* Crosby Test Report 4388, Supplement 1, was issued Feb. 2, 1989

    * Supplement report includes test runs 73 through 78

* Continuum Dynamics Test Report and Model Report will be issued in June, 1989

## TEST PROGRAM

* **Each licensee is to utilize the results of the Owner's Group:**

    * Evaluate the effect of the current MSSV ring settings on continued plant operation

    * Evaluate the effect of changing ring settings (if required)

## MSSV Computer Model

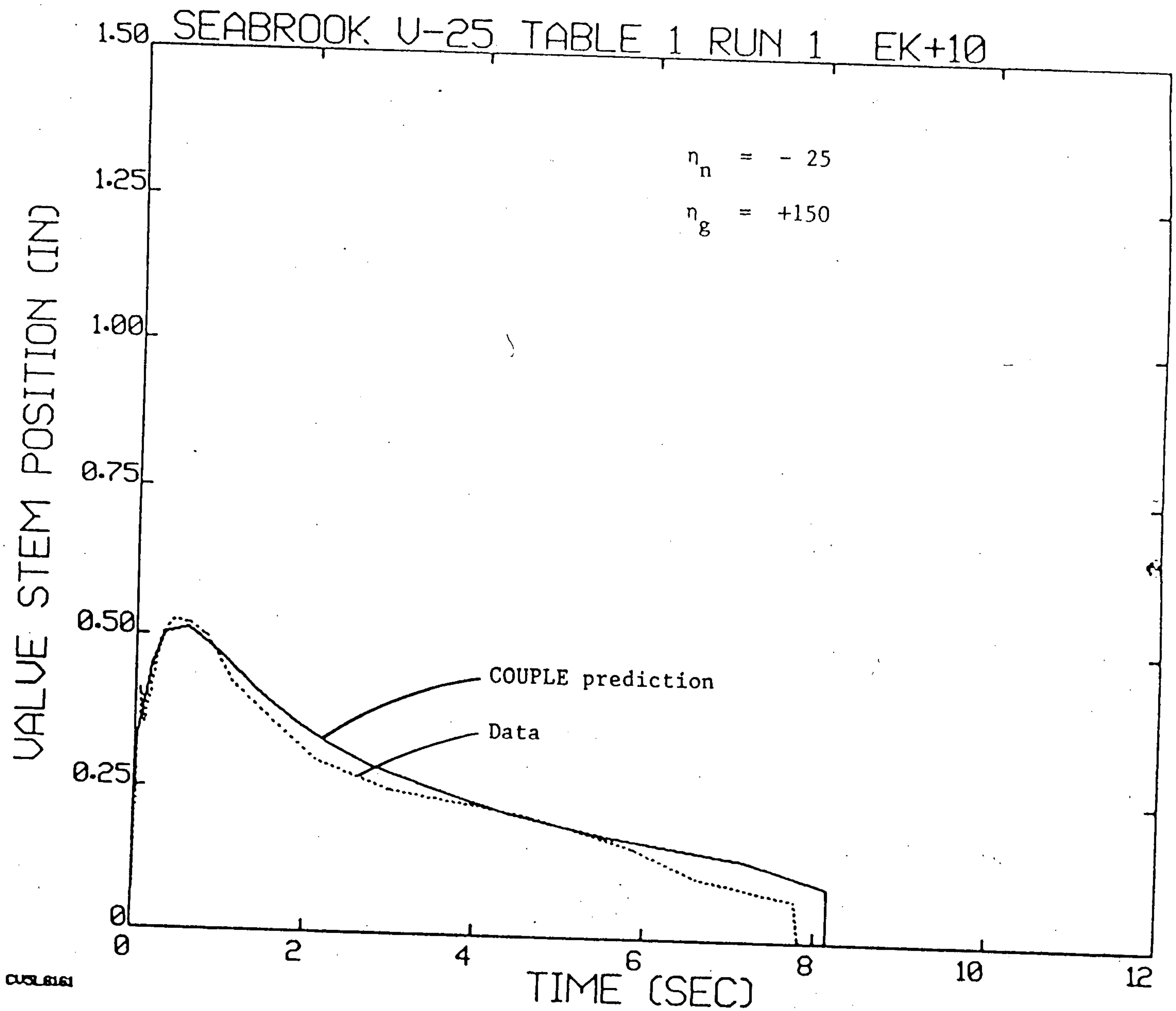
* COUPLE code developed by Continuum Dynamics and EPRI as part of the primary Safety Valve test program in early 1980's

* Predicts safety valve lift and blowdown given:

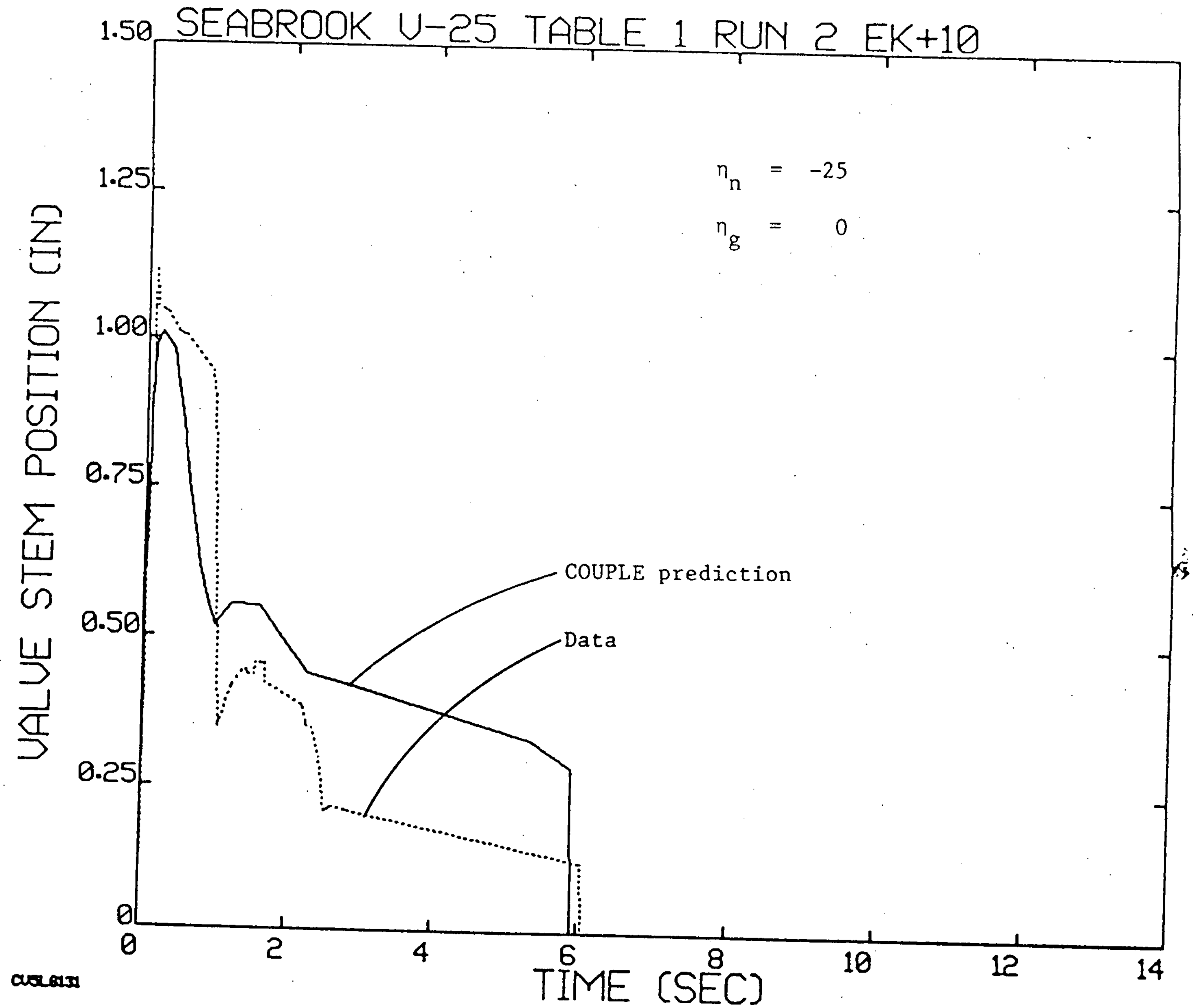
    * Ring setting
    * Inlet pressure
    * Spring rate
    * Valve geometry

* COUPLE has been refined and verified using high flow MSSV tests performed at Crosby and 1986 Seabrook MSSV test results

* Code showed that even though rated capacity was not achieved at 3% accumulation, rated capacity would be achieved at a higher accumulation

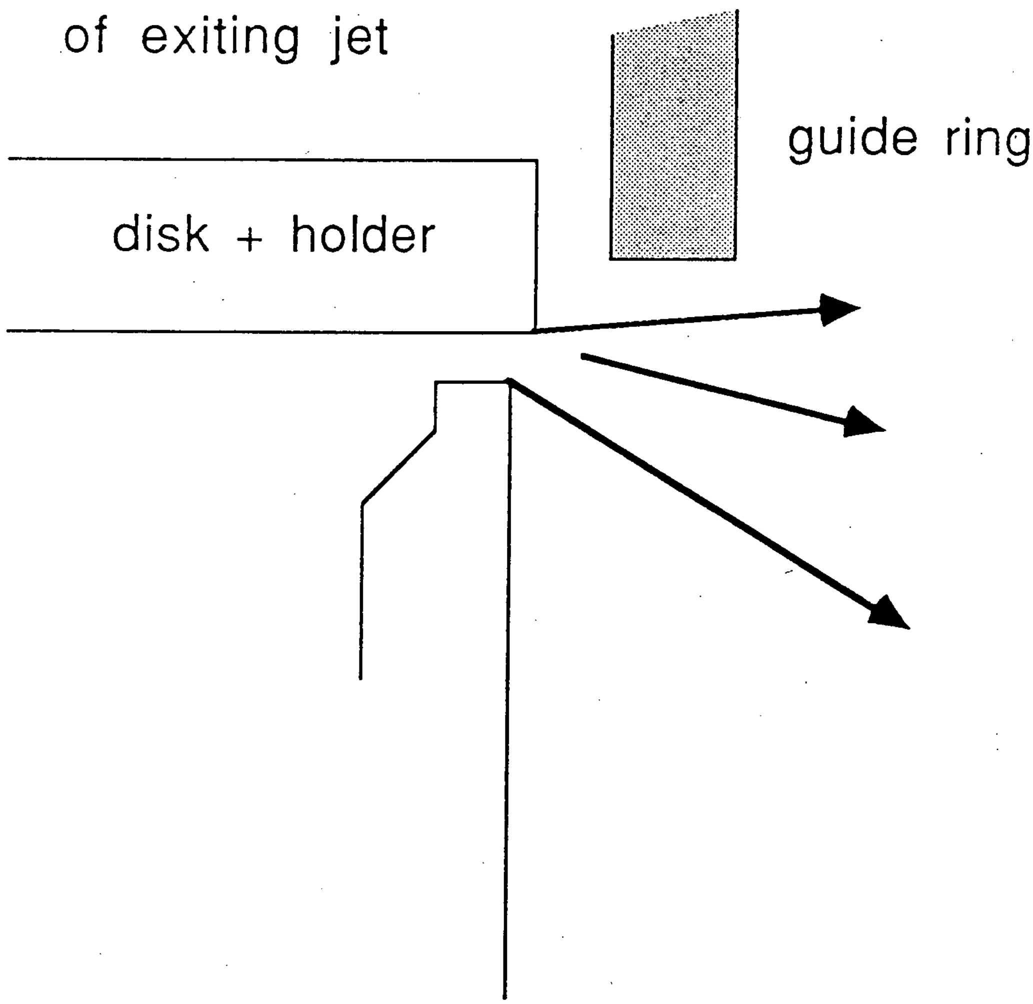


SEABROOK V-25 TABLE 1 RUN 1 EK+10
1.50
1.25
1.00
0.75
0.50
0.25
0
VALVE STEM POSITION (IN)
$\eta_n$ = - 25
$\eta_g$ = +150
COUPLE prediction
Data
0
2
4
6
8
10
12
TIME (SEC)
CVSL8161


SEABROOK V-25 TABLE 1 RUN 2 EK+10
1.50
1.25
1.00
0.75
0.50
0.25
0
VALVE STEM POSITION (IN)
$\eta_n$ = -25
$\eta_g$ = 0
COUPLE prediction
Data
0
2
4
6
8
10
12
14
TIME (SEC)
CUSL6131

# MODIFICATIONS REQUIRED TO PREDICT LIMITED LIFT SEABROOK DATA

When disk is below guide ring
 guide ring doesn't control deflection
 of exiting jet



# EXTENDED BLOWDOWN ANALYSIS

Westinghouse prepared and issued "Analytical Report For The Effect Of Increased MSSV Blowdown" in Nov., 1988

* Larger blowdowns than those used in Safety Analyses may occur as a result of implementing ring setting changes to provide stronger lifts

* Conservative analysis of the effects of larger blowdowns on the Loss of Load and Steam Generator Tube Rutpure Events was performed

* Analysis shows that increasing the blowdown to 15% and 20% does not result in exceeding any plant safety limit or 10CFR100 off site dose limits

IV. SONGS 2 & 3 Assessment

- Plant Configuration & Main Steam Safety Valve Data

  - 18 valves total, 9 per steam generator

  - Valves are Crosby, Spring loaded, enclosed bonnet, safety valves with an "R" orfice (16 $in^2$ orfice area)

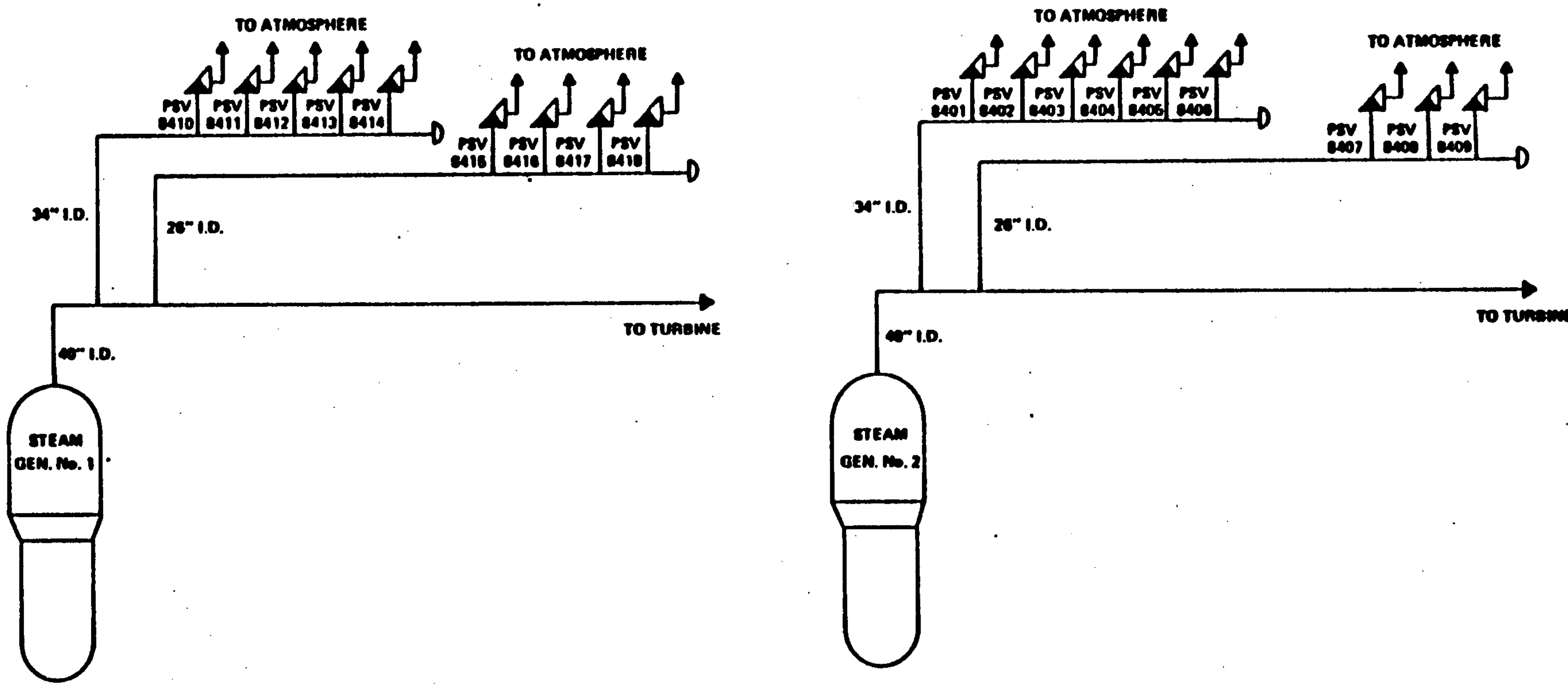
  - The valves were designed, manufactured and certified in accordance with Section III of the ASME Boiler & Pressure Vessel Code, 1974 Edition.

  - The valves lift sequentially in pairs, the first two valves lift at 1100 psia (Main Steam Design Pressure) and the last two at 1155 psia (105% design pressure)

  - Figure 1 illustrates the main steam pressure relief schematic

SOUTHERN CALIFORNIA EDISON Co.
San Onofre Units 2 and 3

# SECONDARY SIDE PRESSURE RELIEF SCHEMATIC




STEAM LINE SAFETY VALVES PER LOOP

| | VALVE NUMBER Line No. 1 | Line No. 2 | LIFT SETTING (± 1%)* | ORIFICE SIZE |
|---|---|---|---|---|
| a. | 2PSV-8401 | 2PSV-8410 | 1100 psia | 16 in² |
| b. | 2PSV-8402 | 2PSV-8411 | 1107 psia | 16 in² |
| c. | 2PSV-8403 | 2PSV-8412 | 1114 psia | 16 in² |
| d. | 2PSV-8404 | 2PSV-8413 | 1121 psia | 16 in² |
| e. | 2PSV-8405 | 2PSV-8414 | 1128 psia | 16 in² |
| f. | 2PSV-8406 | 2PSV-8415 | 1135 psia | 16 in² |
| g. | 2PSV-8407 | 2PSV-8416 | 1142 psia | 16 in² |
| h. | 2PSV-8408 | 2PSV-8417 | 1149 psia | 16 in² |
| i. | 2PSV-8409 | 2PSV-8418 | 1155 psia | 16 in² |

FIG. 1

- <u>DESIGN BASIS</u>

  - The sizing calculation for the Main Steam Safety Valves was issued by Bechtel on 11/17/75.

  - The design basis for sizing the Safety Valves is as follows:

    In accordance with subarticle NC-7300 of Section III of the ASME Code, the total rated releiving capacity of the Safety Valves shall be sufficient to prevent a rise in pressure of more than 10% above the design pressure under the most severe anticipated operational transient. The design pressure of the Main Steam Safety Valve is 1100 psia.

- In the absence of specific FSAR transient analysis, the Safety Valves were conservatively design to handle the "valves wide open" steam flow rate of 15.1 x $10^6$ lb/hr (100% of rated reactor power, 3410 MWt)

- The valves rated capacity at their lift settings range from 818,685 to 859,646 lb/hr at 3% overpressure.

- On 7/82, Combustion Engineering issued Rev. 2 of the overpressure protection report for the Nucleas Steam Supply Systems.

- The Following assumptions were used:

  - Reactor power at 3480 (rated power plus 2% uncertainty)

  - Reactor does not trip on loss-of-load but will trip on high pressurizer pressure

  - No credit for letdown, charging, pressurizer spray, secondary bypass, nor feedwater flow

  - Safety valves lift at their maximum popping pressure

- The most severe anticipated transient was concluded to be a loss of turbine generator load with a delayed reactor trip.

- Under this transient, the maximum steam generator pressure achieved was 1150 psia with only 16 valves lifting

- The results of this analysis are summarized in appendix 5.2A of the FSAR.

- For more detailed evaluation of the loss-of-load transients, Appendix 5.2A refers to Section 15.2 of the FSAR.

FSAR ACCIDENT ANAYSIS

- Section 15.2 of the FSAR addresses loss of external load incidents. The most severe of this incidents was determined to be a loss of condenser vacuum with a concurrent single failure
- The postulated failure of a pressurizer level measurement channel is considered to produce the most adverse effects following a loss of condenser vacuum
- FSAR Table 15.2-2 lists the assumptions used for the loss of condenser vacuum
- FSAR Table 15.2-5 summarizes the sequence of events and results obtained in this analysis
- The analysis concludes that for the most severe operational transient, the main steam peak pressure remains below 110% of design pressure

## SONGS 2 TRIP

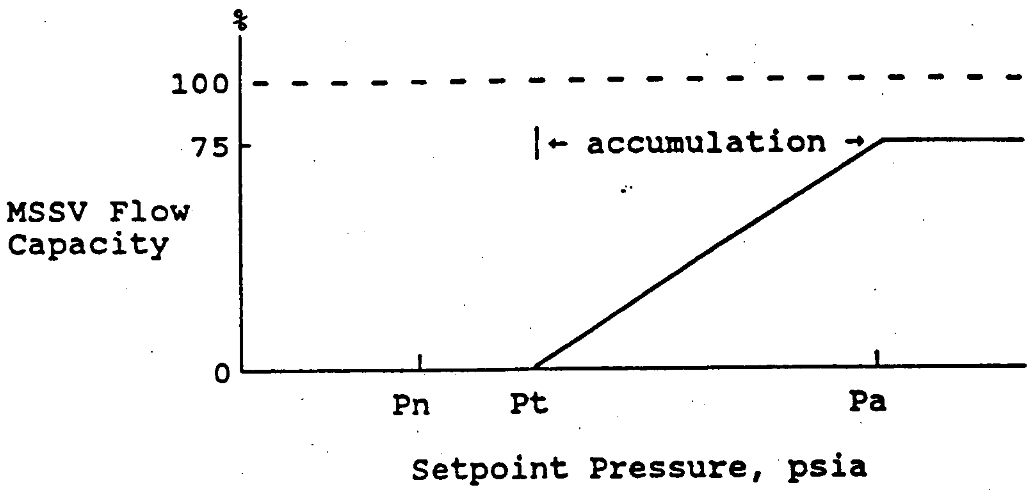
* On Aug. 12, 1986, a spurious Main Steam Isolation Signal (MSIS) resulted in the closure of both Main Steam Isolation Valves (MSIVs) and a Loss of Load transient

* Event parallels Loss of Condenser Vacuum (LOCV) event described in FSAR section 15.2

* Plant response from this transient was reviewed and no design parameters were exceeded

* Transient was modelled using RETRAN in an effort to determine installed MSSV characteristic (i.e., flow vs. accumulation)

Fig. 2 RETRAN Model of Main Steam Safety Valve Lifting Characteristics (MSSV Model B).

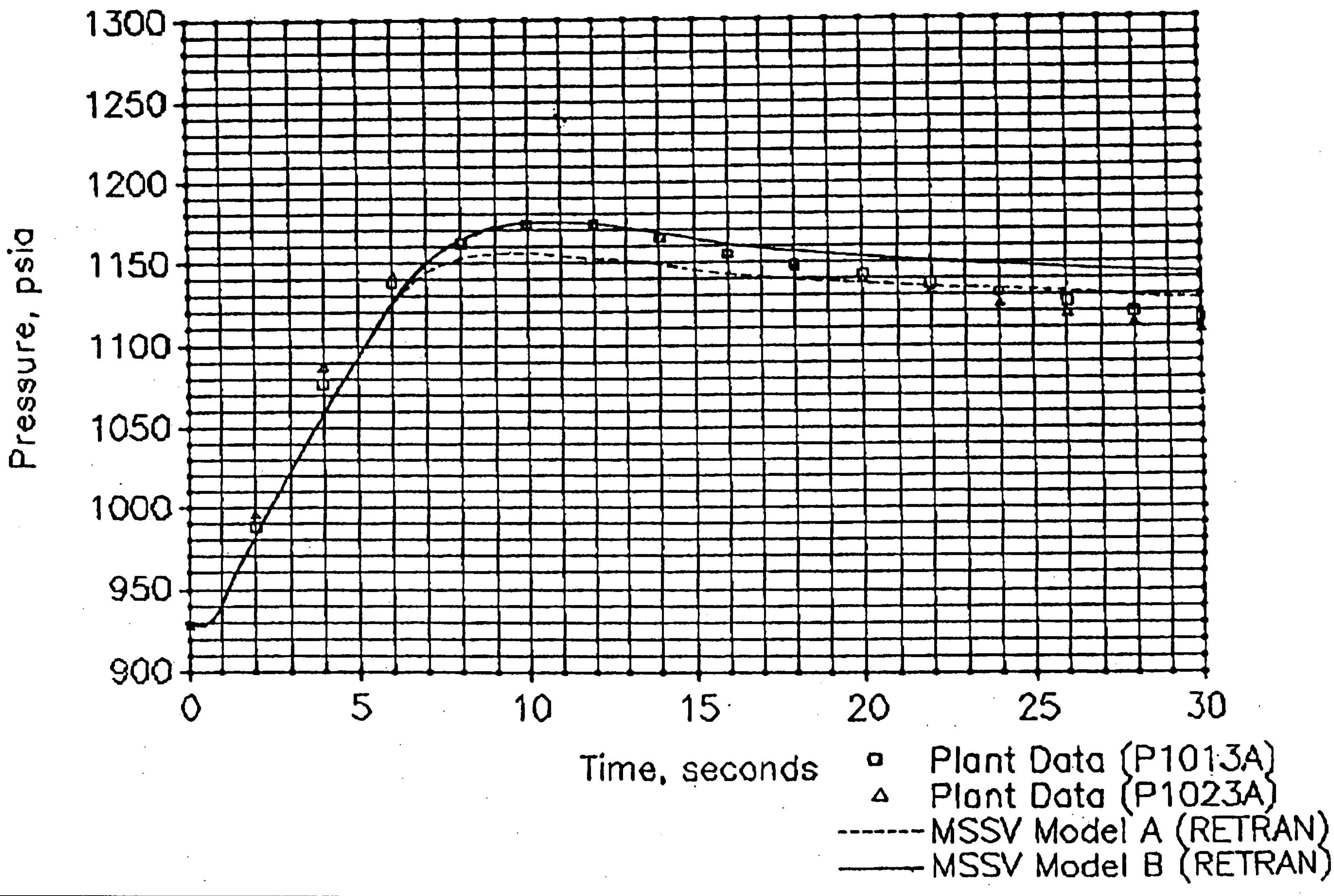


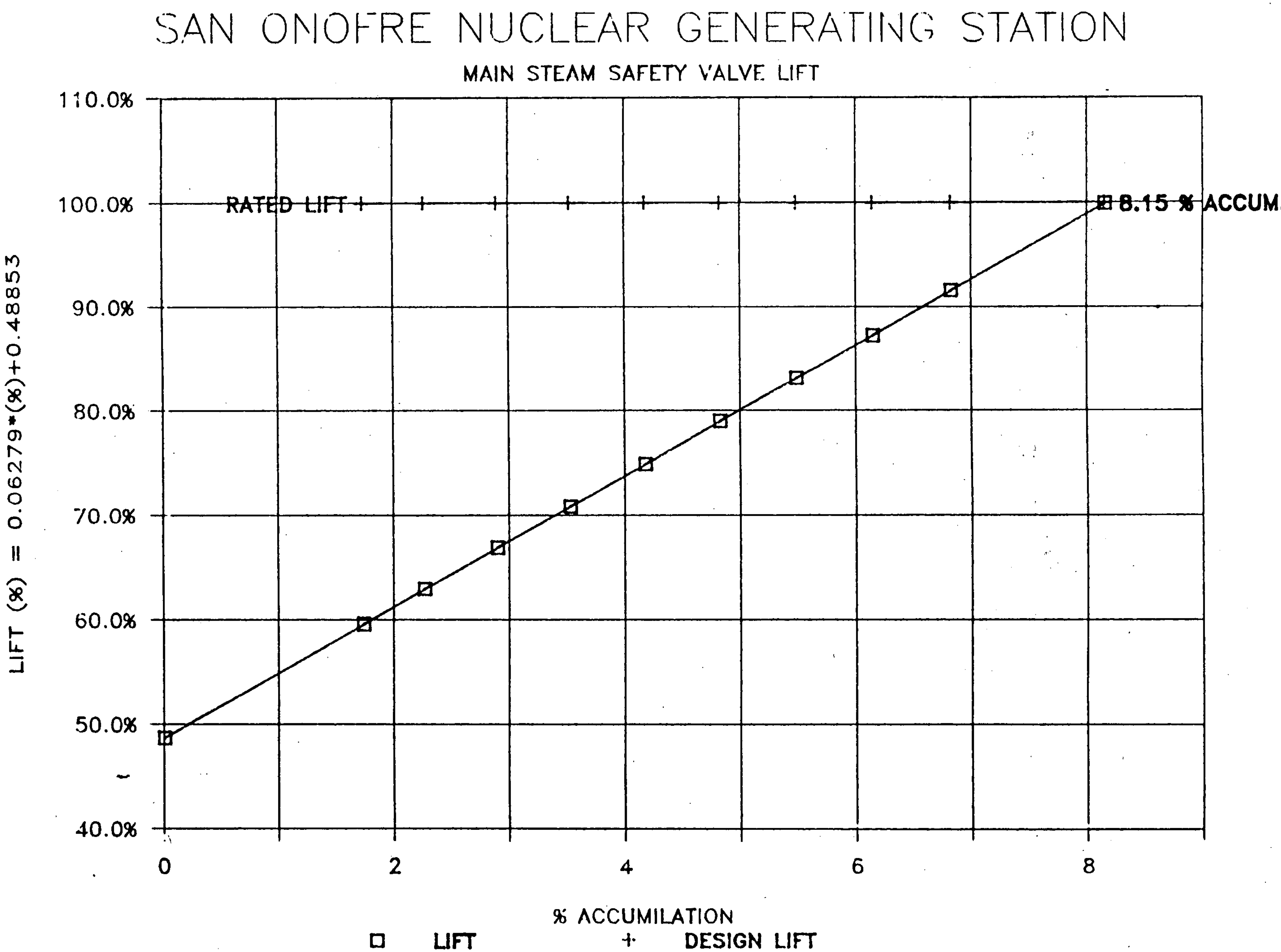

Pn = nominal safety valve setpoint pressure, see Table 3.

Pt = safety valve lifting pressure with positive tolerance, see Table 3.

Pa = accumulation pressure
= 105% of Pt

Fig. 8 Steam Generator Pressure Response to the SONGS 2 8/12/1986 MSIV Closure Event




SAN ONOFRE NUCLEAR GENERATING STATION
MAIN STEAM SAFETY VALVE LIFT
110.0%
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
RATED LIFT
8.15 % ACCUM.
LIFT (%) = 0.06279*(%)+0.48853
0
2
4
6
8
% ACCUMILATION
LIFT
DESIGN LIFT

## SAFETY ANALYSIS EVALUATION

* **Combustion Engineering (CE) has modelled the LOCV event using CESEC code**

* **Initial conditions have been modified to maximise peak secondary pressure**

* **Two MSSV models were used:**

    * Linear flowrate vs. accumulation (0 % flow capacity at 0% accumulation and 75% flow capacity, max., at 3% accumulation)

    * "Best estimate" model using COUPLE code and RETRAN analysis of SONGS 2 trip

    * Additional analysis will be performed and the MSSV models will be refined

SOUTHERN CALIFORNIA EDISON COMPANY
San Onofre Nuclear Generating Station

## Initial Conditions For The Loss Of Condenser Vacuum Analysis

| PARAMETER | FSAR ASSUMPTIONS | SONGS UNIT 2 TRIP | CE ANALYSIS |
|---|---|---|---|
| Initial core power level, MWt. | 3,478 | 3,410 | 3,478/3,478 |
| Core inlet coolant temperature, degrees F. | 542 | 553 | 560/560 |
| Core mass flowrate, $10^6$ $lb_m$/hr. | 164.9 | --- | ---- |
| Reactor coolant system pressure, lb/in.$^2$a. | 2,050 | 2,250 | 2,050/2,050 |
| Steam generator pressure, lb/in.$^2$a. | 810 | 930 | 954.5/954.5 |
| Moderator temperature coefficient, $10^{-4}$ % / F | +0.13 | -2.09 | -0.7/0.0 |
| Steam Bypass control system | Inoperative | Not available | Inop/Inop |
| Reactor trip on turbine trip | Inoperative | Ocurred after High Pzr Trip | Inop/Inop |
| Pressurizer level control system | Inoperative | Operable | Inop/Inop |
| Pressurizer pressure control system | Inoperative | Operable | Inop/Inop |

SOUTHERN CALIFORNIA EDISON COMPANY
San Onofre Nuclear Generating Station

## Sequence Of Events For The Loss Of Condenser Vacuum

| EVENT | FSAR TIME SECONDS | FSAR VALUES | SONGS Unit 2 Trip TIME SECONDS | SONGS Unit 2 Trip VALUES | CE Analysis TIME SECONDS | CE Analysis VALUES |
|---|---|---|---|---|---|---|
| Closure of turbine stop valves on turbine trip due to loss of condenser vacuum. (Unit 2 event was a spurious trip of the MSIVs) | 0.0 | ------ | 0.0 | ------ | 0.0/0.0 | ------ |
| High-pressurizer trip signal condition, $lb/in.^2a$. | 8.4 | 2,422 | 3.5 | 2,378 | 5.9/5.9 | 2,422/2,422 |
| High-pressurizer trip signal condition generated. | 9.5 | ------ | 3.7 | ------ | 7.0/7.0 | ------ |
| Pressurizer safety valves begin to open, $lb/in.^2a$. | 10.0 | 2,525 | DID NOT REACH PRESSURE TO LIFT | | 8.1/8.1 | 2,525/2,525 |
| Steam generator safety valves begin opening, $lb/in.^2a$. | 10.1 | 1,100 | 4.5 | 1,100 | 3.95/3.95 | 1,111/1,111 |
| CEAs begin to drop into core. | 10.3 | ------ | 6.0 | ------ | 8.91/8.91 | ------- |
| Maximum core power. | 10.3 | 103.2% OF FULL POWER | 0.0 | 100% | ---- | ------- |
| Maximum RCS pressure, $lb/in.^2a$. | 12.4 | 2,746 | 7.0 | 2,480 | 8.65/8.65 | 2,631/2,636 |
| Maximum pressurizer liquid volume, $ft.^3$. | 15.0 | 935 | 12.0 | 65% LEVEL | ---- | ------- |
| Pressurizer safety valves closed, $lb/in.^2a$. | 15.5 | 2,463 | NEVER OPENED | | 11.20/12.55 | 2,400/2,400 |
| Maximum steam generator pressure, $lb/in.^2a$. | 16.9 | 1,154 | 10.0 | 1,175 | 14.8/14.2 | 1208.5/1199.5 |
| Steam generator safety valves close, $lb/in.^2a$. | 650.0 | 1,056 | ---- | ---- | ---- | ------- |
| Operator opens atmospheric steam dump valves to begin plant cooldown to shutdown cooling. | 1,800.0 | ------ | 27.0 | ---- | ---- | ------- |
| Shutdown cooling initiated. | 11,600.0 | ------ | | | | |

## SAFETY ANALYSIS RESULTS

* **Using linear MSSV model:**

    * Using MTC=-0.7x10e-4 %$\Delta\rho$/°F (corresponds to current SONGS 3 MTC at 250 EFPD, SONGS 2 MTC is more negative), peak secondary pressure is 1208.5 psia

    * Using MTC=0.0x10e-4$\Delta\rho$/°F (Technical Specification maximum), peak secondary pressure is 1214 psia

* **Using best estimate MSSV model:**

    * Peak secondary pressure is 1199.5 psia

## LONG TERM MODIFICATIONS

* Change ring settings:

    * Nozzle ring to -100 notches
    * Guide ring to -50 notches

* Measure spring rates of all MSSVs

* Modifications to be performed at cycle 5 refueling outages on Units 2 & 3 concurrent with valve overhauls

## 3/4.7.1 TURBINE CYCLE

### 3/4.7.1.1 SAFETY VALVES

The OPERABILITY of the main steam line code safety valves ensures that the secondary system pressure will be limited to within 110% (1210 psig) of its design pressure of 1100 psig during the most severe anticipated system operational transient. The maximum relieving capacity is associated with a turbine trip from 100% RATED THERMAL POWER coincident with an assumed loss of condenser heat sink (i.e., no steam bypass to the condenser).

The specified valve lift settings and relieving capacities are in accordance with the requirements of Section III of the ASME Boiler and Pressure Vessel Code, 1974 Edition. The total relieving capacity for all valves on all of the steam lines is 15,473,628 lbs/hr which is 102.3 percent of the total secondary steam flow of 15,130,000 lbs/hr at 100% RATED THERMAL POWER. A minimum of 1 OPERABLE safety valves per steam generator ensures that sufficient relieving capacity is available for removing decay heat.

STARTUP and/or POWER OPERATION is allowable with safety valves inoperable within the limitations of the ACTION requirements on the basis of the reduction in secondary system steam flow and THERMAL POWER required by the reduced reactor trip settings of the Power Level-High channels. The reactor trip setpoint reductions are derived on the following bases:

For two loop, four pump operation

$$SP = \frac{(X) - (Y)(V)}{X} \times 111.3$$

where:

SP = reduced reactor trip setpoint in percent of RATED THERMAL POWER.

V = maximum number of inoperable safety valves per steam line.

111.3 = Power Level-High Trip Setpoint for two-loop operation.

X = Total relieving capacity of all safety valves per steam line in lbs/hour (15,473,628 lbs/hr at 1190 psia).

Y = Maximum relieving capacity of any one safety valve in lbs/hour (859,646 lbs/hr at 1190 psia).