

Allis-Chalmers Corporation  
York, Pennsylvania

Operability Analysis of Purge and Vent Valves

for

"Nine Mile Point"

Niagara Mohawk Power Corporation  
Syracuse, New York 13202

Customer P.O.# 86724

Allis-Chalmers Order# 44142

Allis-Chalmers Mfg.# 78740

Calculation by:

*G. W. Anzulis*  
G. W. Anzulis

Checked by:

*R. H. Zeiders*  
R. H. Zeiders

8311170393 831114  
PDR ADOCK 05000220  
P PDR





ALLIS-CHALMERS

BOX M-93 • YORK, PENNSYLVANIA 17405/717-848-1126

YORK PLANT  
VALVE DIVISION

November 8, 1983

Niagara Mohawk Power Corporation  
300 Erie Blvd., West  
Syracuse, New York 13202

ATTENTION: D. CiFonelli

SUBJECT: Torque Analysis of Purge & Vent Valves

REFERENCE: Docket 50-220 September 21, 1983 Correspondence  
NRC Comments Regarding the Previously Submitted  
Allis-Chalmers Operability Analysis

Dear Mr. CiFonelli:

You have received, under separate cover, our reanalysis of the subject  
Purge and Vent Valves.

As stated in my November 4, 1983 correspondence to S. W. Wilczek  
accompanying that analysis, the revised calculation was based upon the  
following service parameters supplied by Niagara Mohawk Power Corporation.

1. New ramp curves for suppression chamber and drywell  
(copies attached)
2. Valve operating = 30 seconds
3. 0, 1 and 3 second delay respectively before valve  
disc movement
4. Valve orientation and upstream piping as indicated  
by confirming site inspection, verified by Rich Neild
5. All valves are blocked at 50° open

In regards the specific comments contained in Docket #50-220 from the NRC,  
these have been addressed as follows:

- 4.1 This is correct, all torque analyses have been corrected  
to show the bearing torque as negative and additive to  
dynamic torque.
- 4.3 The analyses were modified to reflect different ramp  
curves for drywell and suppression chamber locations.  
In addition, all valves were analyzed based upon  
closing in 0, 1 and 3 seconds delay from the 50°  
position.

ALLIS-CHALMERS CORPORATION

2/2452



Valve closure time was revised to 30 seconds in accordance with Niagara Mohawk's information.

- 4.4 Stress analysis of critical valve parts has been indicated as outside the scope of the Allis-Chalmers operability analysis.

This, I believe represents complete resolution of all of the items of Docket 50-220. If you desire any clarification of the above, please feel free to call me at 717-848-1126, ext. 280.

Very truly yours,



G. W. Andzulis

GWA/sy  
2/1265  
Attachment



Loss of Coolant Accident  
Drywell Pressure

95-LIX  
P.S.I.G.

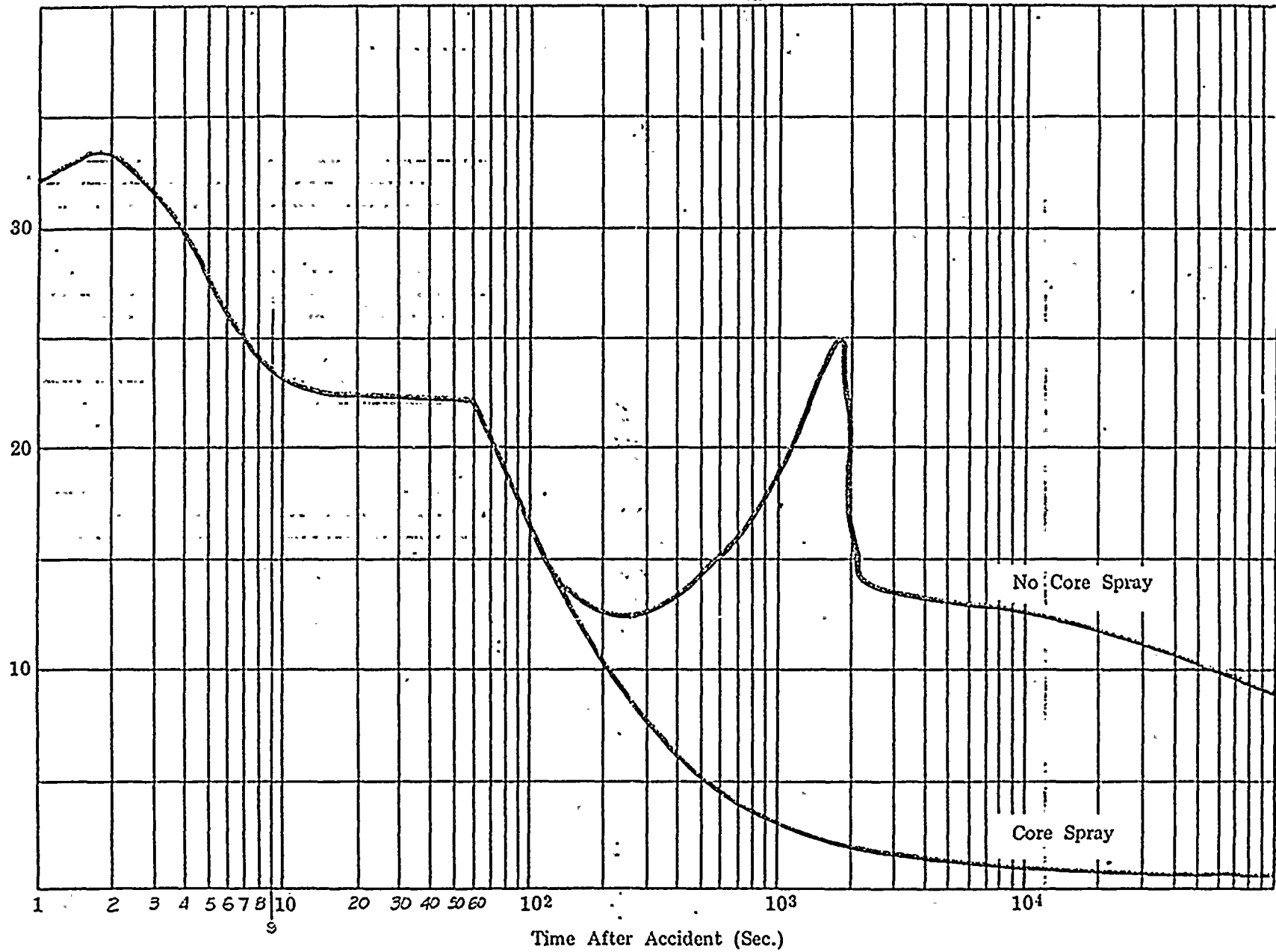


Figure V-2





Loss of Coolant Accident  
Suppression Chamber Pressure  
Stretch Power

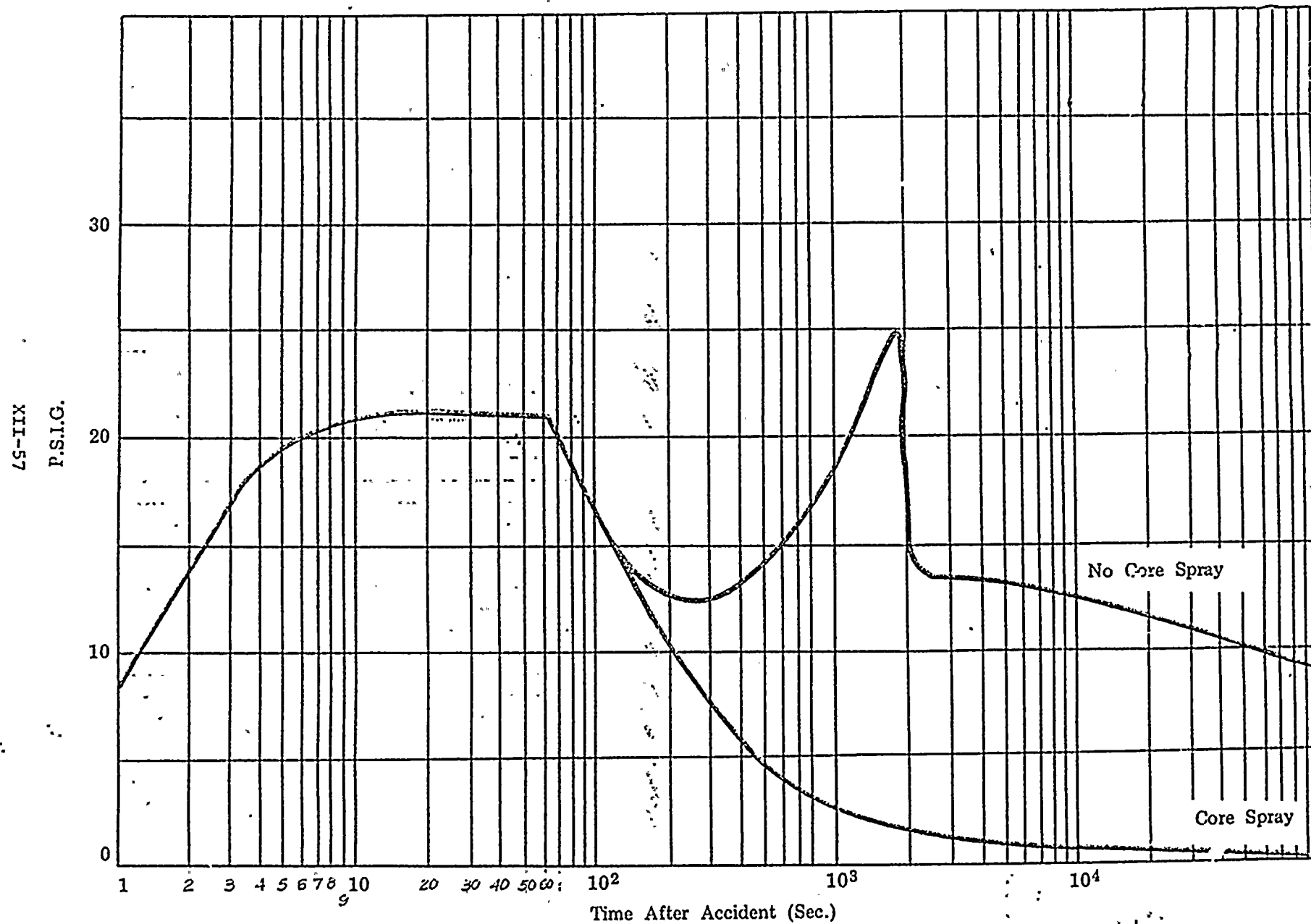


Figure V-3

3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100



101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150

|                                                                           |  |                        |             |                                   |  |
|---------------------------------------------------------------------------|--|------------------------|-------------|-----------------------------------|--|
| CUSTOMER<br><b>Niagara Mohawk Power Corporation</b>                       |  | DATE                   |             | SHEET OF                          |  |
| SUBJECT<br><b>Dynamic Torque Analysis - Emergency Close of Porge Unit</b> |  | PRELIM.                |             | FINAL                             |  |
| DRAWING NUMBER                                                            |  | LITHO IN U.S.A. - A.C. |             | CALCULATED BY<br><i>W. L. ...</i> |  |
| <b>ENGINEERING CALCULATION SHEET</b>                                      |  |                        |             |                                   |  |
| ALLIS-CHALMERS                                                            |  |                        | FORM 6715-1 |                                   |  |

## Dynamic Torque Summary

| Value Tag No. | Operator   | Torque Min.              | Max. Dynamic Torque with delay |             |             |
|---------------|------------|--------------------------|--------------------------------|-------------|-------------|
|               |            |                          | 0                              | 1           | 3           |
| 201-07        | Limitorque | 1100 Ft. lbs             | 476 ft. lbs                    | 464 ft. lbs | 476 ft. lbs |
| 201-17        | Limitorque | 1100 Ft. lbs             | 476                            | 464         | 476         |
| 201-08        | Bettis     | 556 Ft. lbs <sup>2</sup> | 518                            | 400         | 518         |
| 201-09        | Limitorque | 1100 Ft. lbs             | 964                            | 964         | 960         |
| 201-31        | Limitorque | 1100 Ft. lbs             | 964                            | 964         | 960         |
| 201-10        | Bettis     | 1169 <sup>2</sup>        | 953                            | 964         | 960         |
| 201-16        | Bettis     | 556 <sup>2</sup>         | 478                            | 478         | 477         |
| 201-32        | Bettis     | 1169 <sup>2</sup>        | 880                            | 824         | 853         |

1 Minimum Bettis Torque may not occur at the same Angle as the maximum dynamic Torque. - See graph attached to Bettis equipped valve calculations.

**Conclusion:** In all cases, the minimum available operator torque is in excess of the required dynamic torque at that valve position.

In addition, in all cases, the maximum required dynamic Torque is less than the maximum safe shaft Torque.



|                |  |                               |         |                    |  |
|----------------|--|-------------------------------|---------|--------------------|--|
| CUSTOMER       |  | DATE                          |         | SHEET OF           |  |
| SUBJECT        |  |                               | PRELIM. | FINAL              |  |
| DRAWING NUMBER |  | LITHO IN U.S.A.-A.C           |         | CALCULATED BY      |  |
|                |  | ENGINEERING CALCULATION SHEET |         | <i>W. J. G. J.</i> |  |
|                |  | ALLIS-CHALMERS                |         | FORM 6715-1        |  |

the following sheets contain dynamic  
torque analysis applicable to valves #:

201-07

201-17

item description: item #1

20" Suppression Chamber Valve w/ Limitorque Operator

upstream piping: straight pipe

valve shaft: vertical

closing time: 30 seconds

100





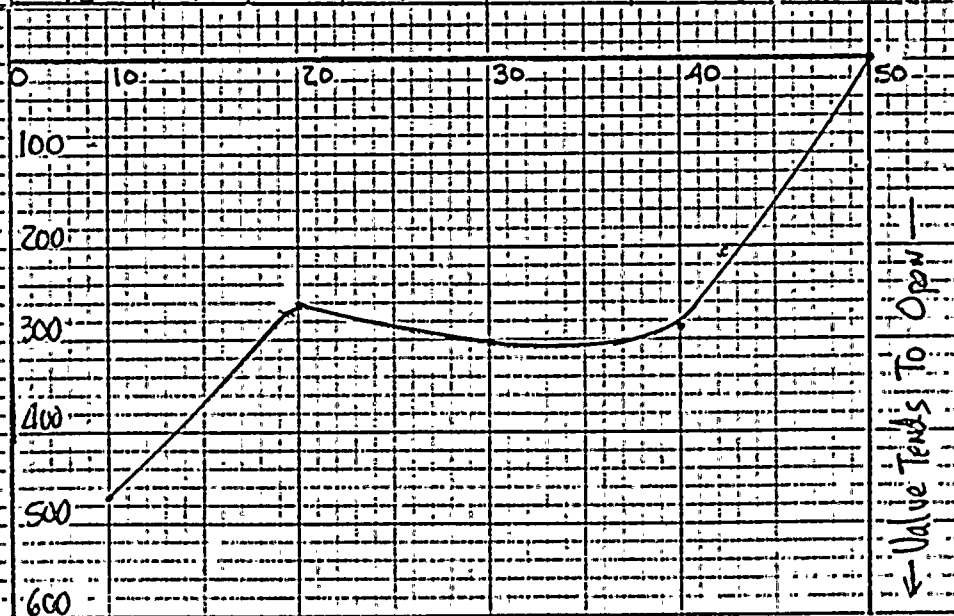




|                                                     |                     |             |                                                                      |  |
|-----------------------------------------------------|---------------------|-------------|----------------------------------------------------------------------|--|
| CUSTOMER<br><b>Niagara Mohawk Power Corporation</b> |                     | DATE        | SHEET OF                                                             |  |
| SUBJECT<br><b>Emergency Close Torque Analysis</b>   |                     | PRELIM.     | FINAL                                                                |  |
| DRAWING NUMBER                                      | LITHO IN U.S.A.-A-C |             | CALCULATED BY<br><i>Callan Guli</i><br>CHKD.<br><i>R. J. 11/4/83</i> |  |
| ENGINEERING CALCULATION SHEET                       |                     | FORM 6715-1 |                                                                      |  |
| ALLIS-CHALMERS                                      |                     |             |                                                                      |  |

Valve #201-07 Location: Suppression Chamber Valve Size: 20"  
 valve seat: upstream operator: Limit Torque closes: clockwise  
 closing Time: 30 seconds  
 Upstream piping: straight pipe  
 Valve shaft: vertical 0 seconds delay  
 Reference: Allis Chalmers VER 0209  
 Test #21 figure #9

| Disc Angle | P <sub>i</sub> | AP   | C <sub>T</sub> | T <sub>a</sub> | T <sub>b</sub> | T <sub>o</sub> |
|------------|----------------|------|----------------|----------------|----------------|----------------|
| 50         | 0              | 0    | 0              | 0              | 0              | 0              |
| 40         | 20.1           | 13.3 | -3.8           | 234            | 52             | 286            |
| 30         | 21.1           | 17.9 | -2.8           | 232            | 70             | 302            |
| 20         | 21.2           | 20.5 | -1.9           | 180            | 81             | 261            |
| 10         | 21.3           | 21.2 | -4.0           | 393            | 83             | 476            |







4 2  
1 4  
1 1

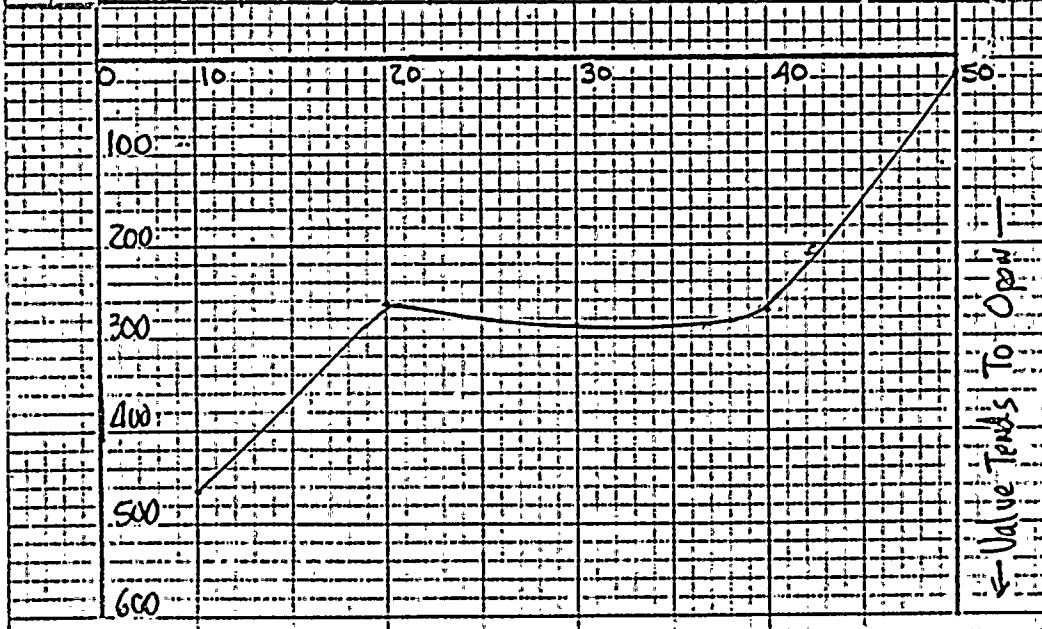


|                                                     |  |                               |  |                                                                         |  |
|-----------------------------------------------------|--|-------------------------------|--|-------------------------------------------------------------------------|--|
| CUSTOMER<br><b>Niagara Mohawk Power Corporation</b> |  | DATE                          |  | SHEET OF                                                                |  |
| SUBJECT<br><b>Emergency Close Torque Analysis</b>   |  | PRELIM.                       |  | FINAL                                                                   |  |
| DRAWING NUMBER                                      |  | LITHO IN U.S.A. - A-C         |  | CALCULATED BY<br><i>William J. ...</i><br>CHKD.<br><i>R. J. 11/4/84</i> |  |
|                                                     |  | ENGINEERING CALCULATION SHEET |  |                                                                         |  |
|                                                     |  | ALLIS-CHALMERS                |  | FORM 6715-1                                                             |  |

Valve # 201-07      Location: Suppression Chamber      Valve Size: 20"  
 valve seat: upstream      operator: Limitorque      closes: clockwise  
                                                                  closing Time: 30 seconds  
 Upstream piping: straight pipe  
 Valve shaft is vertical      1 seconds delay  
 Reference: Allis Chalmers UER 0209  
 Test # 21      Figure # 9

$$T_D = 4.63 C_T \Delta P \quad T_b = 3.93 \Delta P \quad T_o = T_D + T_b$$

| Disc Angle | P <sub>1</sub> | ΔP   | C <sub>T</sub> | T <sub>D</sub> | T <sub>b</sub> | T <sub>o</sub> |
|------------|----------------|------|----------------|----------------|----------------|----------------|
| 50         | 9              | 4.25 | 0              | 0              | 18             | 18             |
| 40         | 20.3           | 13   | -3.7           | 223            | 51             | 274            |
| 30         | 21.2           | 17.4 | -2.7           | 218            | 68             | 286            |
| 20         | 21.3           | 20.7 | -1.9           | 182            | 81             | 263            |
| 10         | 21.2           | 21.1 | -3.9           | 381            | 83             | 464            |







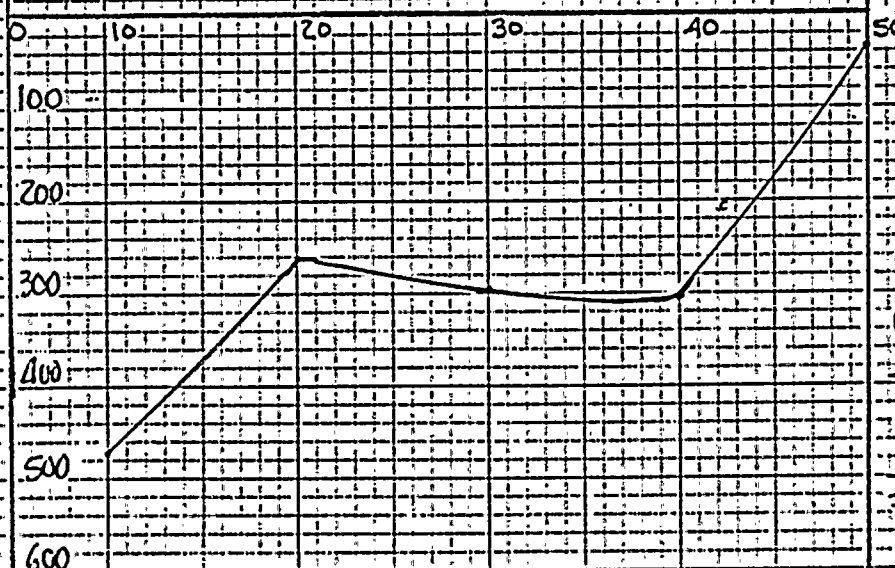




|                                              |  |                               |         |                                |  |
|----------------------------------------------|--|-------------------------------|---------|--------------------------------|--|
| CUSTOMER<br>Niagara Mohawk Power Corporation |  | DATE                          |         | SHEET OF                       |  |
| SUBJECT<br>Emergency Close Torque Analysis   |  |                               | PRELIM. | FINAL                          |  |
| DRAWING NUMBER                               |  | LITHO IN U.S.A. - A-C         |         | CALCULATED BY<br>G. J. 11/4/83 |  |
|                                              |  | ENGINEERING CALCULATION SHEET |         | FORM 6715-1                    |  |
|                                              |  | ALLIS-CHALMERS                |         |                                |  |

Valve # 201-07      Location: Suppression Chamber      Valve Size: 26"  
 valve seat: upstream      operator: Limit Torque      closes: clockwise  
                                                                                  closing Time: 30 seconds  
 Upstream piping: straight pipe  
 Valve shaft is vertical      3 seconds delay  
 Reference: Allis Chalmers VER 0209  
 Test # 21      Figure # 9

| Disc Angle | P <sub>1</sub> | ΔP   | C <sub>T</sub> | T <sub>d</sub> | T <sub>b</sub> | T <sub>o</sub> |
|------------|----------------|------|----------------|----------------|----------------|----------------|
| 50         | 17             | 7.6  | -2             | 7              | 30             | 37             |
| 40         | 20.7           | 13.7 | -3.9           | 247            | 54             | 301            |
| 30         | 21.2           | 17.6 | -2.8           | 228            | 69             | 297            |
| 20         | 21.3           | 20.5 | -1.9           | 180            | 81             | 261            |
| 10         | 21.1           | 21.2 | -4.0           | 393            | 83             | 476            |



← Valve Tends To Open







|                                              |  |                               |  |                                                      |  |
|----------------------------------------------|--|-------------------------------|--|------------------------------------------------------|--|
| CUSTOMER<br>Niagara Mohawk Power Corporation |  | DATE                          |  | SHEET OF                                             |  |
| SUBJECT<br>Emergency Close Torque Analysis   |  | PRELIM.                       |  | FINAL                                                |  |
| DRAWING NUMBER                               |  | LITHO IN U.S.A.-A-C           |  | CALCULATED BY<br>G. Wangli<br>CHKD.<br>R. J. 11/4/83 |  |
|                                              |  | ENGINEERING CALCULATION SHEET |  |                                                      |  |
|                                              |  | ALLIS-CHALMERS                |  | FORM 6715-1                                          |  |

Value # 201-08 Location: Suppression Chamber Value Size: 20"  
 valve seat: upstream operator: Bettis closes: clockwise  
 closing Time: 30 seconds

Upstream piping: 90° elbow, valve shaft is 90° out of  
 plane with upstream elbow 3 seconds delay

Reference: Allis Chalmers UER 0209

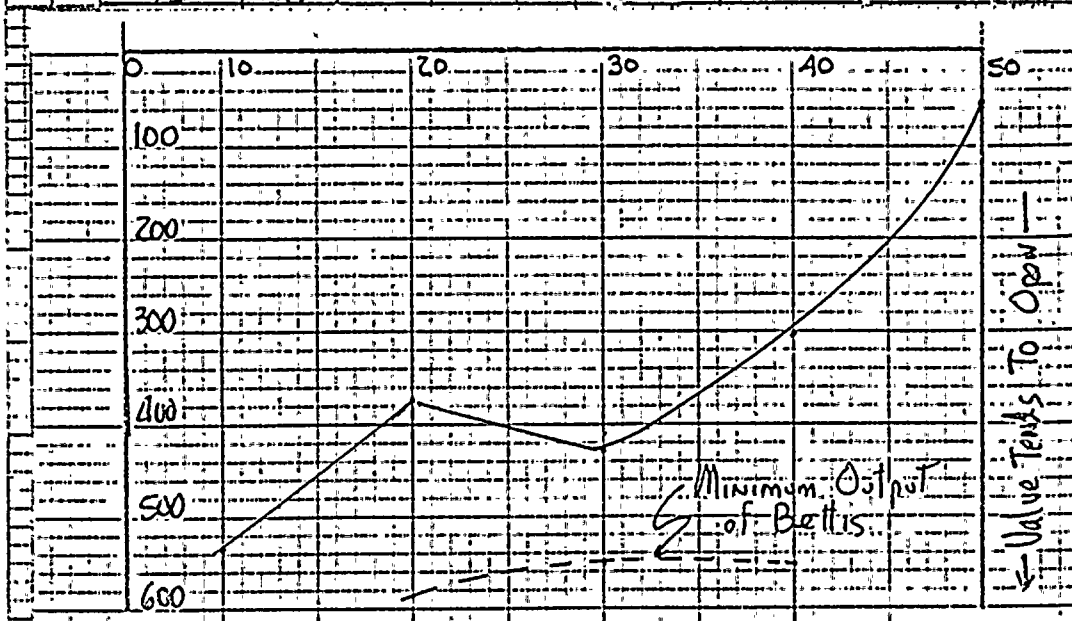
Test # 24 Figure # 10

valve shaft diameter =  $d = 2.5"$

$f =$  coefficient of friction = .12

$T_D = 4.63 \text{ GAP}$   $T_D = 3.93 \text{ AP}$

| Disc Angle | $P_1$ | $\Delta P$ | $C_T$ | $T_d$ | $T_b$ | $T_o$ |
|------------|-------|------------|-------|-------|-------|-------|
| 50         | 17    | 7.5        | -8    | -28   | 30    | -58   |
| 40         | 20.5  | 13.4       | -4.   | -248  | 53    | -301  |
| 30         | 21.1  | 17.7       | -4.2  | -344  | 70    | -414  |
| 20         | 21.1  | 20.7       | -3.0  | -288  | 81    | -369  |
| 10         | 21.3  | 21.3       | -4.4  | -434  | 84    | -518  |



24



|                |  |                               |         |                      |  |
|----------------|--|-------------------------------|---------|----------------------|--|
| CUSTOMER       |  | DATE                          |         | SHEET OF             |  |
| SUBJECT        |  |                               | PRELIM. | FINAL                |  |
| DRAWING NUMBER |  | LITHO IN U.S.A.-A-C           |         | CALCULATED BY        |  |
|                |  | ENGINEERING CALCULATION SHEET |         | <i>Allen Jenkins</i> |  |
|                |  | ALLIS-CHALMERS                |         | FORM 6715-1          |  |

the following sheets contain dynamic  
torque analysis applicable to valves #

201-09

201-31

item description: item #3

24" Drywell Valve

w/ Limit torque Operator

upstream piping: preceded by valve #201-10

valve shaft: vertical

closing time: 30 seconds





|                                                             |                       |                                       |                |
|-------------------------------------------------------------|-----------------------|---------------------------------------|----------------|
| CUSTOMER<br><i>Niagara Mohawk - Nine Mile Point</i>         |                       | DATE                                  | SHEET <i>C</i> |
| SUBJECT<br><i>Pressure Drop Across (2) Valves in Series</i> |                       | PRELIM.                               | FINAL          |
| DRAWING NUMBER                                              | LITHO IN U.S.A. - A-C | CALCULATED BY<br><i>R. J. 11/5/83</i> |                |
| ENGINEERING CALCULATION SHEET                               |                       | FORM 6715-1                           |                |
| ALLIS-CHALMERS                                              |                       |                                       |                |

*Two valves are in series in a pipeline. One valve is blocked at 50° open and does not move. The other valve closes from 50° open in 30 sec.*

*0 seconds delay Drywell Limit Torque*

| Valve Closing Time (sec) | Disc Angle Fixed Valve | K Fixed Valve | Disc Angle Closing Valve | K Closing Valve | K <sub>T</sub> (Fixed valve + closing valve) | Coef. Discharge | Equivalent Disc Angle | P <sub>1</sub> | ΔP <sub>T</sub> | ΔP <sub>EV</sub> | ΔP <sub>MV</sub> |
|--------------------------|------------------------|---------------|--------------------------|-----------------|----------------------------------------------|-----------------|-----------------------|----------------|-----------------|------------------|------------------|
| 0                        | 50°                    | 12            | 50                       | 12              | 24                                           | .2              | 42                    | 0              | 0               | 0                | 0                |
| 1                        |                        |               | 48                       | 13.8            | 25.8                                         | .193            | 41                    | 32.6           | 28.9            | 13.4             | 15.5             |
| 2                        |                        |               | 47                       | 15              | 27.0                                         | .189            | 40                    | 33.3           | 29.5            | 13.1             | 16.4             |
| 3                        |                        |               | 45                       | 18              | 30                                           | .180            | 39                    | 31.5           | 28              | 11.2             | 16.8             |
| 4                        |                        |               | 43                       | 21.7            | 33.7                                         | .170            | 38                    | 29.5           | 26.9            | 9.6              | 17.3             |
| 5                        |                        |               | 42                       | 24              | 36                                           | .164            | 38                    | 27.6           | 25.5            | 8.5              | 17               |
| 6                        |                        |               | 40                       | 28.2            | 40.2                                         | .156            | 36                    | 26.2           | 24.3            | 7.3              | 17.              |
| 7                        |                        |               | 38                       | 33.6            | 45.6                                         | .146            | 35                    | 25             | 23.3            | 6.1              | 17.2             |
| 8                        |                        |               | 37                       | 38              | 50                                           | .140            | 34                    | 24.2           | 22.5            | 5.4              | 17.1             |
| 9                        |                        |               | 35                       | 46.6            | 58.6                                         | .130            | 33                    | 23.7           | 22              | 4.5              | 17.5             |
| 10                       |                        |               | 33                       | 58.2            | 70.2                                         | .128            | 31                    | 23.1           | 21.8            | 3.7              | 18.              |
| 11                       |                        |               | 32                       | 63              | 75                                           | .115            | 30                    | 22.9           | 21.7            | 3.5              | 18.2             |
| 12                       |                        |               | 30                       | 81.6            | 93.6                                         | .103            | 28                    | 22.8           | 22              | 2.8              | 19.2             |
| 14                       |                        |               | 28                       | 99              | 111                                          | .094            | 27                    | 22.6           | 22              | 2.4              | 19.7             |
| 16                       |                        |               | 23                       | 243             | 255                                          | .063            | 22                    | 22.5           | 22.1            | 1.0              | 21               |
| 18                       |                        |               | 20                       | 330             | 342                                          | .054            | 20                    | 22.4           | 22.4            | .78              | 21.2             |
| 20                       |                        |               | 17                       | 540             | 552                                          | .043            | 17                    | 22.4           | 22.4            | .5               | 21.9             |
| 22                       |                        |               | 13                       | 1371            | 1383                                         | .027            | 13                    | 22.4           | 22.4            | .2               | 22.2             |
| 24                       |                        |               | 10                       | 3085            | 3097                                         | .018            | 10                    | 22.4           | 22.4            | .09              | 22.3             |
| 26                       |                        |               | 7                        | 8263            | 8275                                         | .011            | 7                     | 22.4           | 22.4            | .03              | 22.4             |
| 28                       |                        |               | 6                        | 9999            | 10011                                        | .010            | 6                     | 22.3           | 22.3            | .03              | 22.3             |
| 30                       |                        |               |                          |                 |                                              |                 |                       | 22.3           | 22.3            |                  | 22.3             |



|                                              |  |                               |         |                                 |  |
|----------------------------------------------|--|-------------------------------|---------|---------------------------------|--|
| CUSTOMER<br>Niagara Mohawk Power Corporation |  | DATE                          |         | SHEET OF                        |  |
| SUBJECT<br>Emergency Close Torque Analysis   |  |                               | PRELIM. | FINAL                           |  |
| DRAWING NUMBER                               |  | LITHO IN U.S.A. - A-C         |         | CALCULATED BY<br>G. J. 11/13/83 |  |
|                                              |  | ENGINEERING CALCULATION SHEET |         | CHKD.                           |  |
|                                              |  | ALLIS-CHALMERS                |         | FORM 6715-1                     |  |

Valve # 201-09      Location: Drywell      Valve Size: 24"  
 valve seat: upstream      operator: Limit Torque      closes: clockwise  
                                                                  closing Time: 30 seconds  
 Upstream piping: preceded by 201-10  
                                  shaft vertical      0 seconds delay  
 Reference: Allis Chalmers VER 0209  
                                  Test # 24      figure # 10

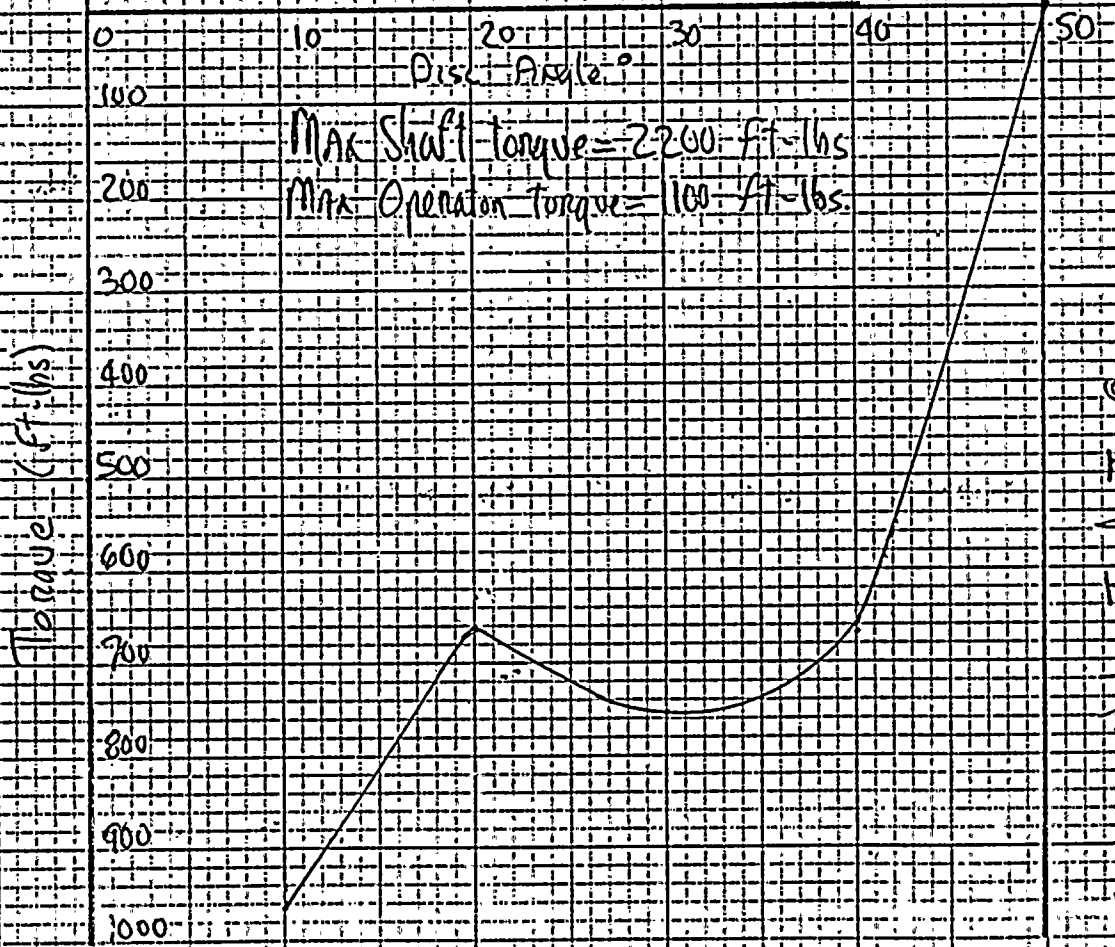
| Disc Angle | P <sub>1</sub> | ΔP   | C <sub>T</sub> | T <sub>d</sub> | T <sub>b</sub> | T <sub>0</sub> |
|------------|----------------|------|----------------|----------------|----------------|----------------|
| 50         | 0              | 0    | 0              | 0              | 0              | 0              |
| 40         | 26.2           | 17   | -4.2           | 571            | 96             | 667            |
| 30         | 22.8           | 19.2 | -4.2           | 645            | 108            | 753            |
| 20         | 22.4           | 21.2 | -3.2           | 543            | 120            | 663            |
| 10         | 22.4           | 22.3 | -4.7           | 838            | 126            | 964            |



Niagara Mohawk Power Corporation  
Valve 201-09 24" Daywell Valve w/ Limit Torque

0 Second delay

Torque vs Disc Angle



Valve Tends To Open

Eq. 201-09









|                                              |  |                     |         |                                                       |  |
|----------------------------------------------|--|---------------------|---------|-------------------------------------------------------|--|
| CUSTOMER<br>Niagara Mohawk Power Corporation |  | DATE                |         | SHEET OF                                              |  |
| SUBJECT<br>Emergency Close Torque Analysis   |  |                     | PRELIM. | FINAL                                                 |  |
| DRAWING NUMBER                               |  | LITHO IN U.S.A.-A-C |         | CALCULATED BY<br>C.W. Aubrey<br>CHLD.<br>R.J. 11/3/83 |  |
| ENGINEERING CALCULATION SHEET                |  |                     |         | FORM 6715-1                                           |  |
| ALLIS-CHALMERS                               |  |                     |         |                                                       |  |

Valve # 201-09      Location: Drywell      Valve Size: 24"  
 valve seat: upstream      operator: Limit Torque      closes: clockwise  
                                                                  closing Time: 30 seconds  
 Upstream piping: preceded by 201-10  
                                                                  shaft: vertical      1 seconds delay  
 Reference: Allis Chalmers UER 0209  
                                                                  Test # 24      figure # 10

$$T_D = 8 C_T \Delta P \quad T_b = 5.65 \Delta P \quad T_o = T_D + T_b$$

| Disc Angle | P <sub>1</sub> | ΔP   | C <sub>T</sub> | T <sub>d</sub> | T <sub>b</sub> | T <sub>o</sub> |
|------------|----------------|------|----------------|----------------|----------------|----------------|
| 50         | 32.6           | 14.5 | -7.1           | -824           | 82             | 906            |
| 40         | 25             | 16.3 | -5.9           | -769           | 92             | 861            |
| 30         | 28             | 19.2 | -4.3           | -660           | 108            | 768            |
| 20         | 22.4           | 21.6 | -3.2           | -553           | 122            | 675            |
| 10         | 22.4           | 22.3 | -4.7           | -838           | 126            | 964            |



Niagara Mohawk Power Corporation

Value 201-09

24"

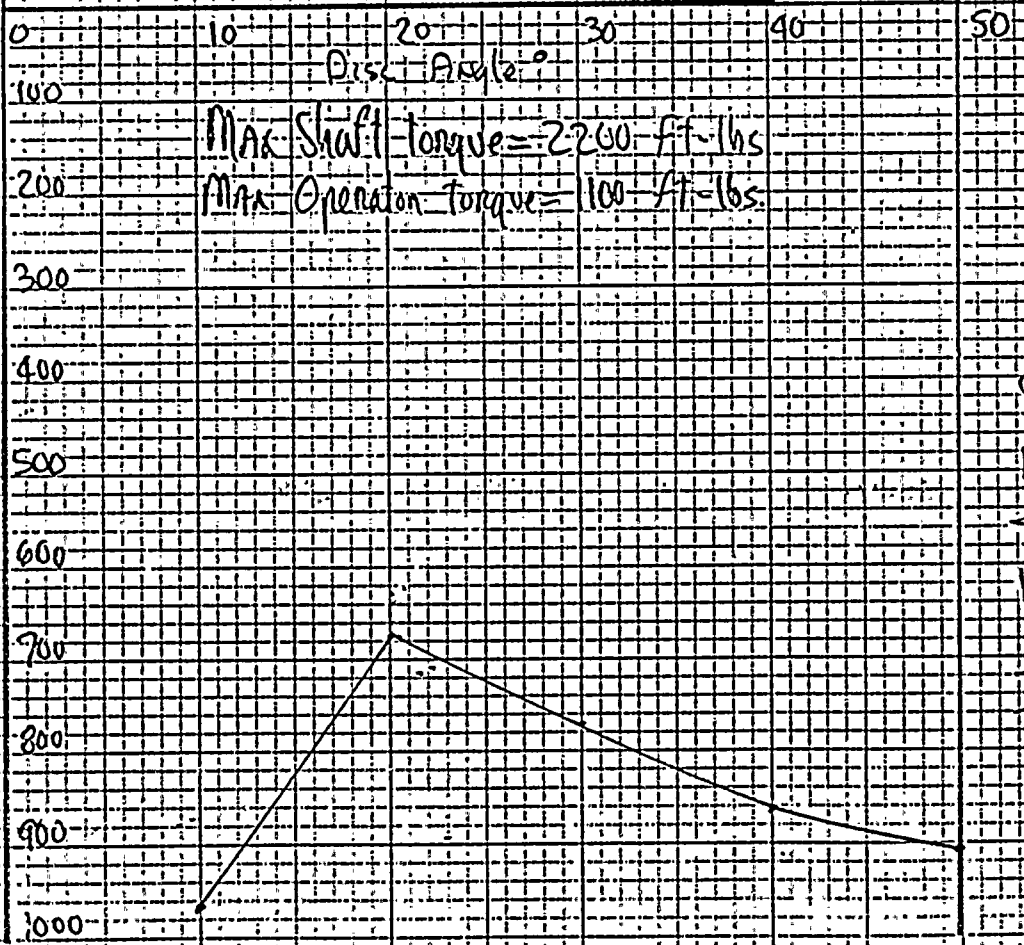
Discwell

Value w/ Limit Torque

Second delay

Torque vs Disc Angle

Torque (ft-lbs)



Max Shaft Torque = 2200 ft-lbs  
Max Operation Torque = 100 ft-lbs

Value Trends To Open

By: G. W. G. Jr.





24



|                                                     |  |                               |  |                                                              |  |
|-----------------------------------------------------|--|-------------------------------|--|--------------------------------------------------------------|--|
| CUSTOMER<br><b>Niagara Mohawk Power Corporation</b> |  | DATE                          |  | SHEET OF                                                     |  |
| SUBJECT<br><b>Emergency Close Torque Analysis</b>   |  | PRELIM.                       |  | FINAL                                                        |  |
| DRAWING NUMBER                                      |  | LITHO IN U.S.A. - A-C         |  | CALCULATED BY<br><i>AW/Andy</i><br>CHKD. <i>R.J. 11/3/83</i> |  |
|                                                     |  | ENGINEERING CALCULATION SHEET |  |                                                              |  |
|                                                     |  | ALLIS-CHALMERS                |  | FORM 6713-1                                                  |  |

Valve # **201-09**      Location: **Daywell**      Valve Size: **24"**  
 valve seat: **upstream**      operator: **Limitorque**      closes: **clockwise**  
                                                                                          closing Time: **30 seconds**  
 Upstream piping: **preceded by valve #201-10**  
                                          shaft is **vertical**      **3 seconds delay**  
 Reference: **Allis Chalmers UER 0209**  
                                  **Test #24**      figure # **10**

| Disc Angle | P <sub>1</sub> | ΔP   | C <sub>T</sub> | T <sub>a</sub> | T <sub>b</sub> | T <sub>0</sub> |
|------------|----------------|------|----------------|----------------|----------------|----------------|
| 50         | 31.5           | 14   | -7.2           | 806            | 79             | 885            |
| 40         | 23.7           | 15.4 | -6             | 739            | 87             | 826            |
| 30         | 22.5           | 19.2 | -4.2           | 645            | 108            | 753            |
| 20         | 22.4           | 21.6 | -3.2           | 553            | 122            | 675            |
| 10         | 22.3           | 22.2 | -4.7           | 435            | 125            | 660            |





Niagara Mohawk Power Corporation

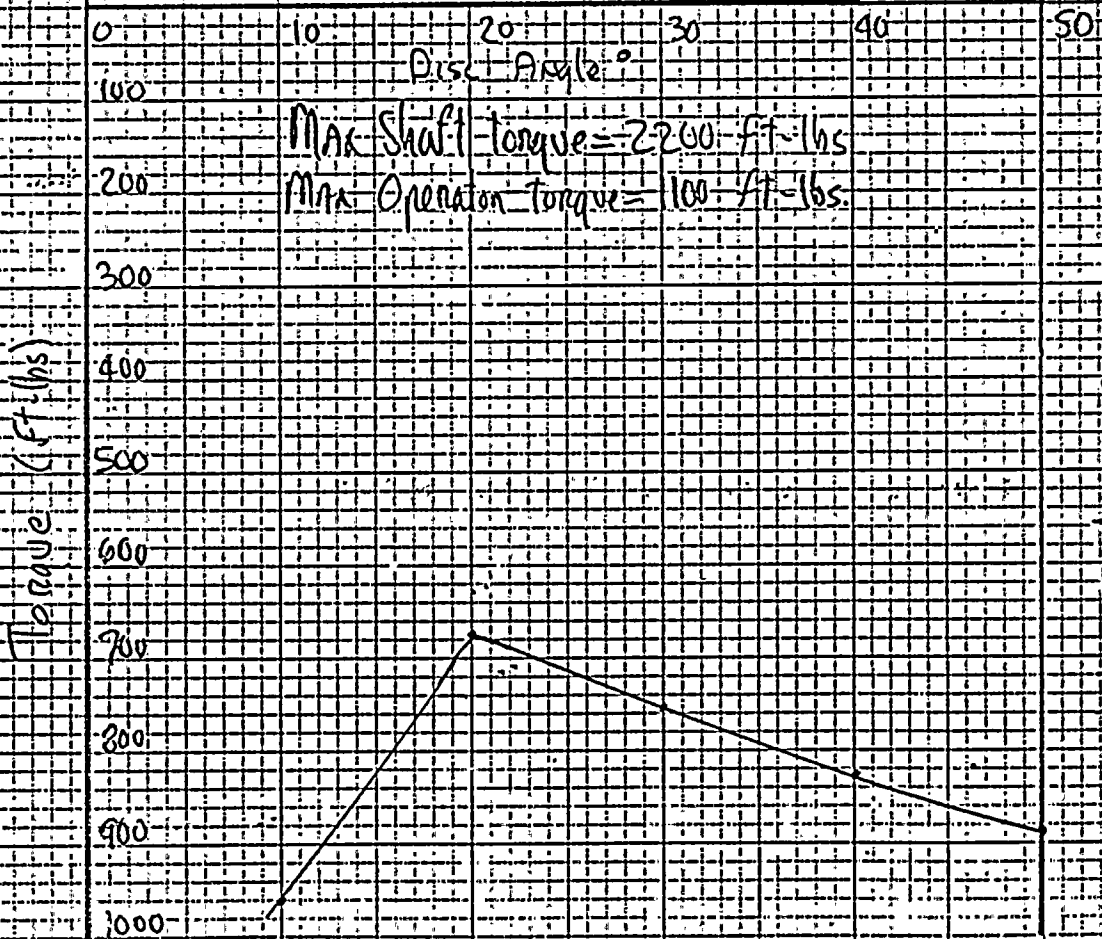
Valve 201-09

24"

Daywell Valve w/ Limit torque

3 Second delay

Torque vs Disc Angle



Valve Tends To Open

V

by G.W. G. L.



|                |  |                               |         |                      |  |
|----------------|--|-------------------------------|---------|----------------------|--|
| CUSTOMER       |  | DATE                          |         | SHEET OF             |  |
| SUBJECT        |  |                               | PRELIM. | FINAL                |  |
| DRAWING NUMBER |  | LITHO IN U.S.A. - A-C         |         | CALCULATED BY        |  |
|                |  | ENGINEERING CALCULATION SHEET |         | <i>Carroll J. L.</i> |  |
|                |  | ALLIS-CHALMERS                |         | FORM 6715-1          |  |

the following sheets contain dynamic  
Torque Analysis applicable to valves #  
201-10

item description: item #4

24" Drywell Valve... w/ Bettis Operator

upstream piping: 45° el preceded by 90° el

valve shaft: vertical, in plane with 90° el, perpendicular  
to 45° el

closing Time: 30 seconds



|                                                             |  |                                      |  |                                                                       |  |
|-------------------------------------------------------------|--|--------------------------------------|--|-----------------------------------------------------------------------|--|
| CUSTOMER<br><b>Niagara Mohawk - Nine Mile Point</b>         |  | DATE                                 |  | SHEET OF                                                              |  |
| SUBJECT<br><b>Pressure Drop Across (2) Valves in Series</b> |  | PRELIM.                              |  | FINAL                                                                 |  |
| DRAWING NUMBER                                              |  | LITHO IN U.S.A.-A-C                  |  | CALCULATED BY<br><i>Glenn J. ...</i><br>CHKD.<br><b>R. J. 11/3/83</b> |  |
|                                                             |  | <b>ENGINEERING CALCULATION SHEET</b> |  |                                                                       |  |
|                                                             |  | ALLIS-CHAMBERS                       |  | FORM 6715-1                                                           |  |

Two valves are in series in a pipeline. One valve is blocked at 50° open and does not move. The other valve closes from 50° open in 30 seconds.

Valve location: Druml  
Delay time: 0 sec.

Be this operation  
 $T/A = 24$

| Valve Closing Time (sec.) | Disc Angle Fixed Valve | K Fixed Valve | Disc Angle Closing Valve | K Closing Valve | K <sub>T</sub> (Fixed valve + closing valve) | Cat Discharge Coef. | Equivalent Disc Angle | P <sub>1</sub> | ΔP <sub>T</sub> | ΔP <sub>FEV</sub> | ΔP <sub>PMV</sub> |
|---------------------------|------------------------|---------------|--------------------------|-----------------|----------------------------------------------|---------------------|-----------------------|----------------|-----------------|-------------------|-------------------|
| 0                         | 50°                    | 12            | 50°                      | 12              | 24                                           | .2                  | 42                    | 0              | 0               | 0                 | 0                 |
| 1                         |                        |               | 48                       | 13.8            | 25.8                                         | .193                | 41                    | 32.6           | 28.9            | 13.4              | 15.5              |
| 2                         |                        |               | 46                       | 16.7            | 28.7                                         | .183                | 40                    | 33.3           | 29.5            | 12.3              | 17.2              |
| 3                         |                        |               | 44                       | 19.7            | 31.7                                         | .175                | 39                    | 31.5           | 28              | 10.6              | 17.4              |
| 4                         |                        |               | 42                       | 24              | 36                                           | .164                | 38                    | 29.5           | 26.9            | 9.                | 17.9              |
| 5                         |                        |               | 40                       | 28.2            | 40.2                                         | .156                | 36                    | 27.6           | 25.5            | 7.5               | 18.               |
| 6                         |                        |               | 38                       | 33.6            | 45.6                                         | .146                | 35                    | 26.2           | 24.3            | 6.4               | 17.9              |
| 7                         |                        |               | 36                       | 40.6            | 52.6                                         | .137                | 34                    | 25             | 23.3            | 5.3               | 18                |
| 8                         |                        |               | 34                       | 50              | 62                                           | .126                | 32                    | 24.2           | 22.5            | 4.4               | 18.1              |
| 9                         |                        |               | 32                       | 63              | 75                                           | .115                | 30                    | 23.7           | 22              | 3.5               | 18.5              |
| 10                        |                        |               | 30                       | 81.6            | 93.6                                         | .103                | 28                    | 23.1           | 21.8            | 2.8               | 19                |
| 11                        |                        |               | 28                       | 101             | 113                                          | .094                | 28                    | 22.9           | 21.7            | 2.3               | 19.4              |
| 12                        |                        |               | 26                       | 134.2           | 146.2                                        | .082                | 25                    | 22.8           | 22              | 1.8               | 20.2              |
| 14                        |                        |               | 22                       | 243             | 255                                          | .063                | 22                    | 22.6           | 22              | 1.04              | 21.0              |
| 16                        |                        |               | 20                       | 362             | 374                                          | .052                | 20                    | 22.5           | 22.1            | .71               | 21.3              |
| 18                        |                        |               | 15                       | 692             | 709                                          | .038                | 16                    | 22.4           | 22.4            | .38               | 22                |
| 20                        |                        |               | 12                       | 1735            | 1747                                         | .024                | 12                    | 22.4           | 22.4            | .15               | 22.3              |
| 22                        |                        |               | 10                       | 3085            | 3097                                         | .018                | 10                    | 22.4           | 22.4            | .09               | 22.3              |
| 24                        |                        |               | 7                        | 8263            | 8275                                         | .011                | 7                     | 22.4           | 22.4            | .03               | 22.4              |
| 26                        |                        |               | 6                        | 9999            | 10011                                        | .010                | 6                     | 22.4           | 22.4            | .03               | 22.4              |
| 28                        |                        |               |                          |                 |                                              |                     |                       | 22.3           |                 |                   |                   |
| 30                        |                        |               |                          |                 |                                              |                     |                       | 22.3           |                 |                   |                   |



|                                                     |  |                               |  |                                                        |  |
|-----------------------------------------------------|--|-------------------------------|--|--------------------------------------------------------|--|
| CUSTOMER<br><b>Niagara Mohawk Power Corporation</b> |  | DATE                          |  | SHEET OF                                               |  |
| SUBJECT<br><b>Emergency Close Torque Analysis</b>   |  | PRELIM.                       |  | FINAL                                                  |  |
| DRAWING NUMBER                                      |  | LITHO IN U.S.A. - A-C         |  | CALCULATED BY<br><i>CHICD.</i><br><b>R. J. 11/3/83</b> |  |
|                                                     |  | ENGINEERING CALCULATION SHEET |  |                                                        |  |
|                                                     |  | ALLIS-CHALMERS                |  | FORM 6715-1                                            |  |

Valve #201-10      Location: Daywell      Valve Size: 24"  
 valve seat: upstream      operator: Bettis      closes: clockwise  
                                                                  closing Time: 30 seconds

Upstream piping: 45° elbow preceded by 90° elbow  
 valve shaft is vertical, and in plane with 90° el. 1 to 45° el.      0 seconds delay

Reference: Allis Chalmers UER 0209

Test # 24      Figure # 10

$$T_D = 8 C_T \Delta P \quad T_b = 5.6 S \Delta P \quad T_o = T_D + T_b$$

| Disc Angle | P <sub>1</sub> | ΔP   | C <sub>T</sub> | T <sub>d</sub> | T <sub>b</sub> | T <sub>o</sub> |
|------------|----------------|------|----------------|----------------|----------------|----------------|
| 50         | 0              | 0    | 0              | 0              | 0              | 0              |
| 40         | 27.6           | 18   | -5.9           | -850           | 102            | 952            |
| 30         | 23.1           | 19   | -4.2           | 638            | 107            | 745            |
| 20         | 22.5           | 21.3 | -3.2           | 545            | 120            | 665            |
| 10         | 22.4           | 22.3 | -4.7           | -827           | 126            | 953            |

243



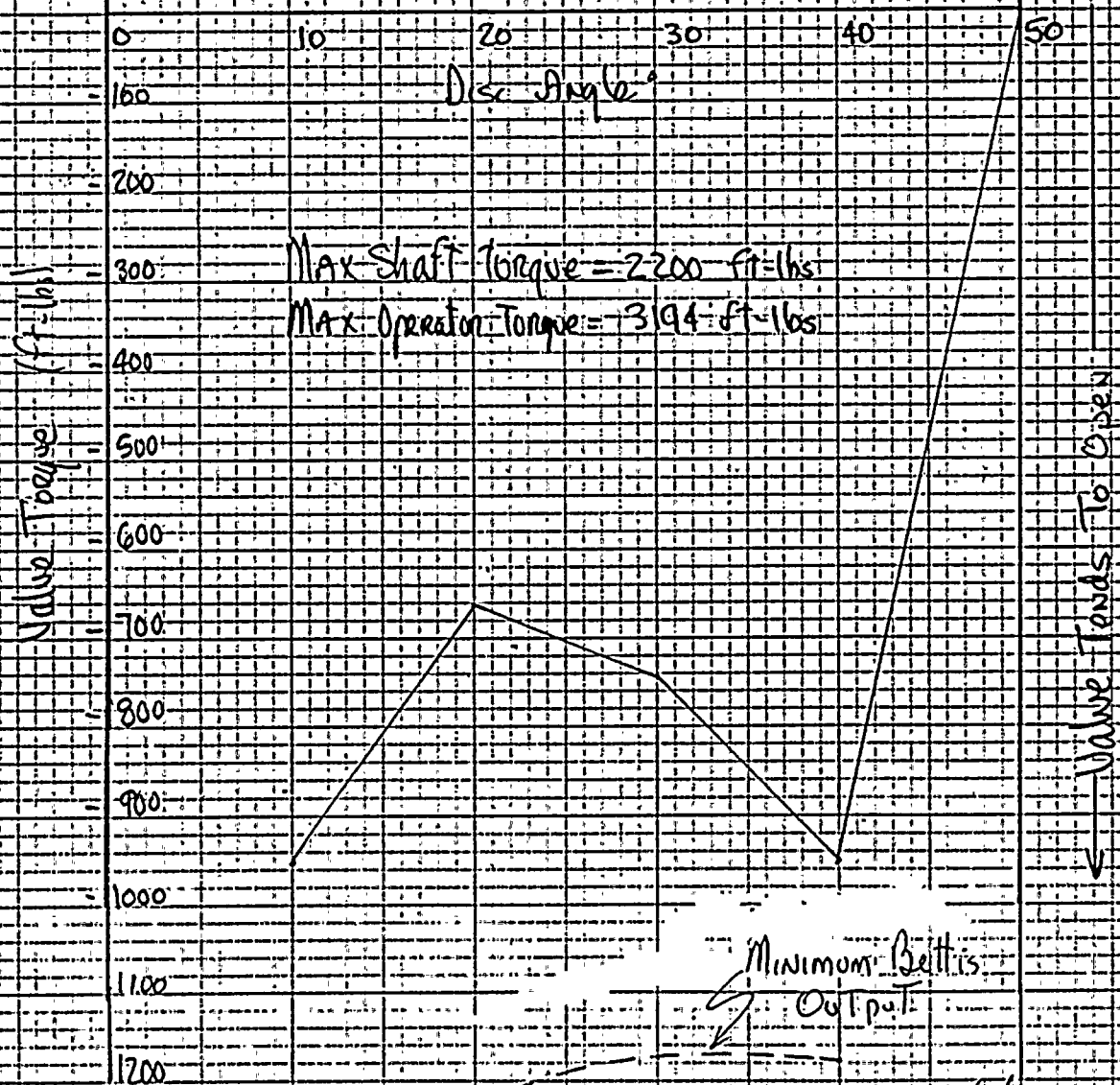


Niagara Mohawk Power Corporation

Valve # 201-10-24" Drywell Valve w/ Bettis Operator

0 second delay

Torque vs. Disc Angle



Minimum Bettis  
Output

by CW Aug 1961





24



|                                              |  |                     |         |                                                            |  |
|----------------------------------------------|--|---------------------|---------|------------------------------------------------------------|--|
| CUSTOMER<br>Niagara Mohawk Power Corporation |  | DATE                |         | SHEET OF                                                   |  |
| SUBJECT<br>Emergency Close Torque Analysis   |  |                     | PRELIM. | FINAL                                                      |  |
| DRAWING NUMBER                               |  | LITHO IN U.S.A.-A-C |         | CALCULATED BY<br><i>Chadwick</i><br>CHKD.<br>R. J. 11/3/83 |  |
| ENGINEERING CALCULATION SHEET                |  |                     |         | FORM 6713-1                                                |  |
| ALLIS-CHALMERS                               |  |                     |         |                                                            |  |

Valve # 201-10      Location: Drywell      Value Size: 24"  
 valve seat: upstream      operator: Bettis      closes: clockwise  
                                                                  closing Time: 30 seconds  
 Upstream piping: 45° elbow preceded by 90° elbow  
 valve shaft is vertical and in plane with 90° el. L to 45° el      1 seconds delay  
 Reference: Allis Chalmers UER 0209  
                                  Test # 24      Figure # 10

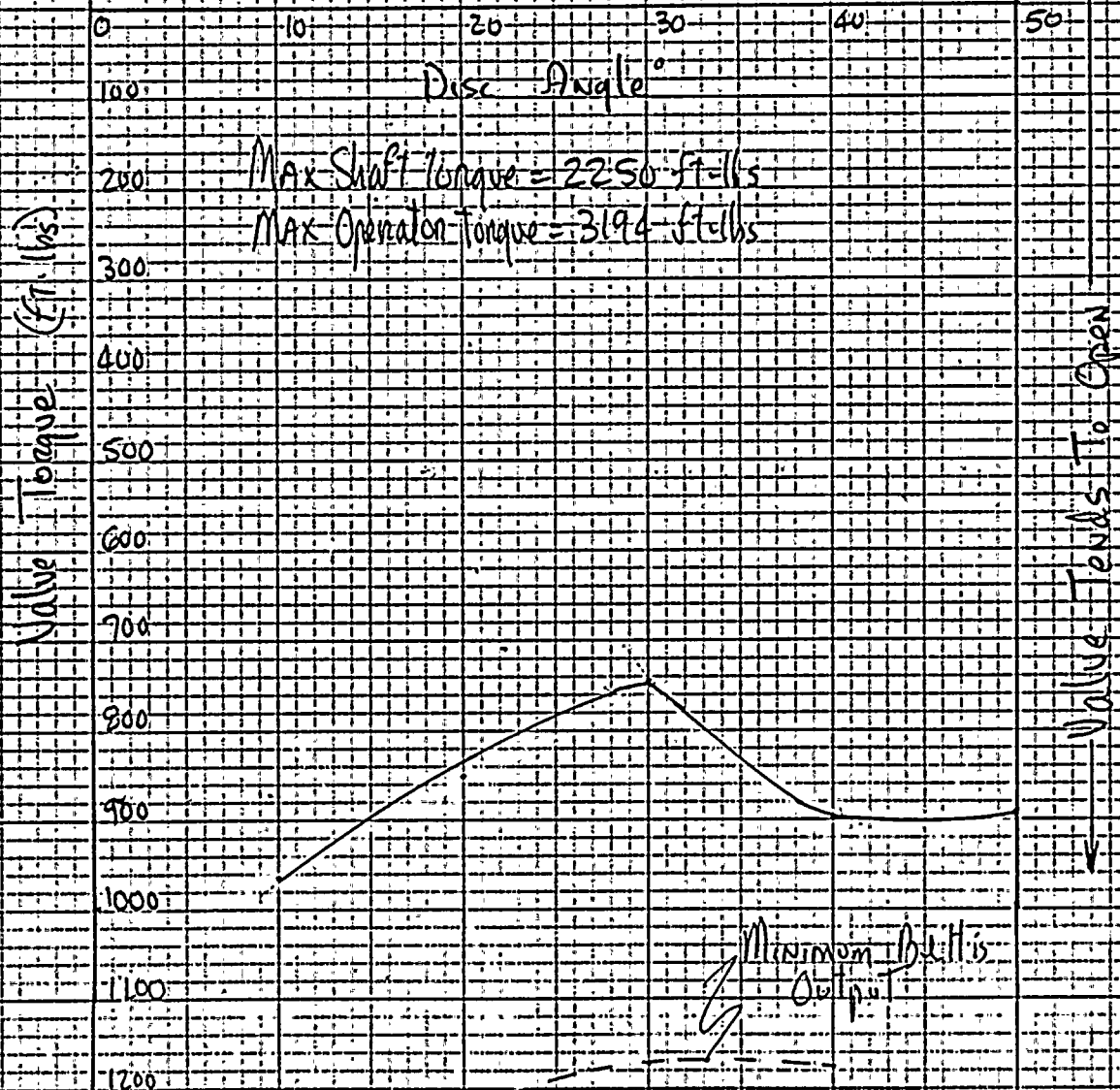
$$T_D = 8 C_T \Delta P \quad T_b = 5.65 \Delta P \quad T_0 = T_D + T_b$$

| Disc Angle | P <sub>1</sub> | ΔP   | C <sub>T</sub> | T <sub>D</sub> | T <sub>b</sub> | T <sub>0</sub> |
|------------|----------------|------|----------------|----------------|----------------|----------------|
| 50         | 32.6           | 14.5 | -7.2           | -812           | 82             | 894            |
| 40         | 26.2           | 17   | -5.9           | -802           | 96             | 898            |
| 30         | 22.9           | 18.9 | -4.2           | -635           | 107            | 742            |
| 20         | 22.4           | 21.4 | -4.3           | -736           | 121            | 857            |
| 10         | 22.4           | 22.3 | -4.7           | -838           | 126            | 964            |



Niagara Mohawk Power Corporation  
Valve # 201-10 24" Daywell Valve w/ Bellis Operator  
1 second delay

Torque vs. Disc Angle



Max Shaft Torque = 2250 ft-lbs

Max Operator Torque = 3194 ft-lbs

Minimum Output

by G. W. Anderson







2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100



|                                                     |  |                       |  |                                                                           |  |
|-----------------------------------------------------|--|-----------------------|--|---------------------------------------------------------------------------|--|
| CUSTOMER<br><b>Niagara Mohawk Power Corporation</b> |  | DATE                  |  | SHEET OF                                                                  |  |
| SUBJECT<br><b>Emergency Close Torque Analysis</b>   |  | PRELIM.               |  | FINAL                                                                     |  |
| DRAWING NUMBER                                      |  | LITHO IN U.S.A. - A-C |  | CALCULATED BY<br><b>G.W. Andzula</b><br><b>CHRD.</b> <b>R. J. 11/3/83</b> |  |
| ENGINEERING CALCULATION SHEET                       |  |                       |  | FORM 6715-1                                                               |  |
| ALLIS-CHALMERS                                      |  |                       |  |                                                                           |  |

Valve #201-10      Location: Drywell      Valve Size: 24"  
 valve seat: upstream      operator: Bettis      closes: clockwise  
                                                                  closing Time: 30 seconds  
 Upstream piping: 45° elbow preceded by 90° elbow  
 valve shaft is vertical and in plane with 90° el. L To 45° el.      3 seconds delay  
 Reference: Allis Chalmers UER 0209  
 Test # 24      Figure # 10

$$T_D = 8 C_T DP \quad T_b = 5.65 DP \quad T_o = T_D + T_b$$

| Disc Angle | P <sub>1</sub> | DP   | C <sub>T</sub> | T <sub>D</sub> | T <sub>b</sub> | T <sub>o</sub> |
|------------|----------------|------|----------------|----------------|----------------|----------------|
| 50         | 31.5           | 14   | -7.1           | -795           | 79             | 874            |
| 40         | 24.2           | 15.8 | -6.            | -758           | 89             | 847            |
| 30         | 22.7           | 19.2 | -4.2           | -645           | 108            | 754            |
| 20         | 22.4           | 21.4 | -3.2           | 548            | 121            | 669            |
| 10         | 22.3           | 22.2 | -4.7           | -835           | 125            | 960            |



Niagara Mohawk Power Corporation

Valve # 201-10 24" Drywell Valve w/BeTlis Operator

3 second delay

Torque vs. Disc. Angle

Valve Torque (ft-lbs)

0

100

200

300

400

500

600

700

800

900

1000

1100

1200

10

20

30

40

50

Disc. Angle

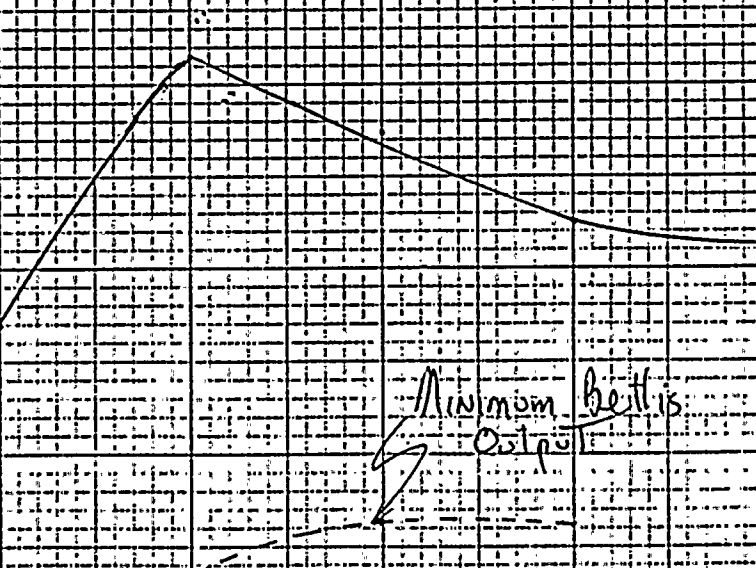
Max Shaft Torque = 2250 ft-lbs

Max Operator Torque = 3194 ft-lbs

Value Tends To Open

Minimum BeTlis Output

By G.W. Anderson



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|----------------|--|-------------------------------|--|---------------|-------|
| CUSTOMER       |  | DATE                          |  | SHEET OF      |       |
| SUBJECT        |  |                               |  | PRELIM.       | FINAL |
| DRAWING NUMBER |  | LITHO IN U.S.A. - A-C         |  | CALCULATED BY |       |
|                |  | ENGINEERING CALCULATION SHEET |  | G. W. G. G.   |       |
|                |  | ALLIS-CHALMERS                |  | FORM 6715-1   |       |

the following sheets contain dynamic  
torque analysis applicable to valves #

201-16

item description: item #5

20" Suppression Chamber w/ Bettis Operator

upstream piping: straight pipe

valve shaft: horizontal

closing time: 30 seconds.

7. 4.









|                                                     |  |                               |  |                                   |  |
|-----------------------------------------------------|--|-------------------------------|--|-----------------------------------|--|
| CUSTOMER<br><b>Niagara Mohawk Power Corporation</b> |  | DATE                          |  | SHEET OF                          |  |
| SUBJECT<br><b>Emergency Close Torque Analysis</b>   |  | PRELIM.                       |  | FINAL                             |  |
| DRAWING NUMBER                                      |  | LITHO IN U.S.A.-A-C           |  | CALCULATED BY<br><i>W. J. ...</i> |  |
|                                                     |  | ENGINEERING CALCULATION SHEET |  | CHKD.<br><i>R. J. 11/4/85</i>     |  |
|                                                     |  | ALLIS-CHALMERS                |  | FORM 6715-1                       |  |

Valve # 201-16      Location: Suppression Chamber      Valve Size: 20"  
 valve seat: upstream      operator: Bellis      closes: counter clockwise  
                                                                                  closing Time: 30 seconds

Upstream piping: straight pipe  
 valve shaft horizontal      0 seconds delay

Reference: Allis Chalmers VER 0209  
 Test # 21      Figure # 9

$$T_D = 4.63 C_T \Delta P \quad T_b = 3.93 \Delta P \quad T_o = T_D + T_b$$

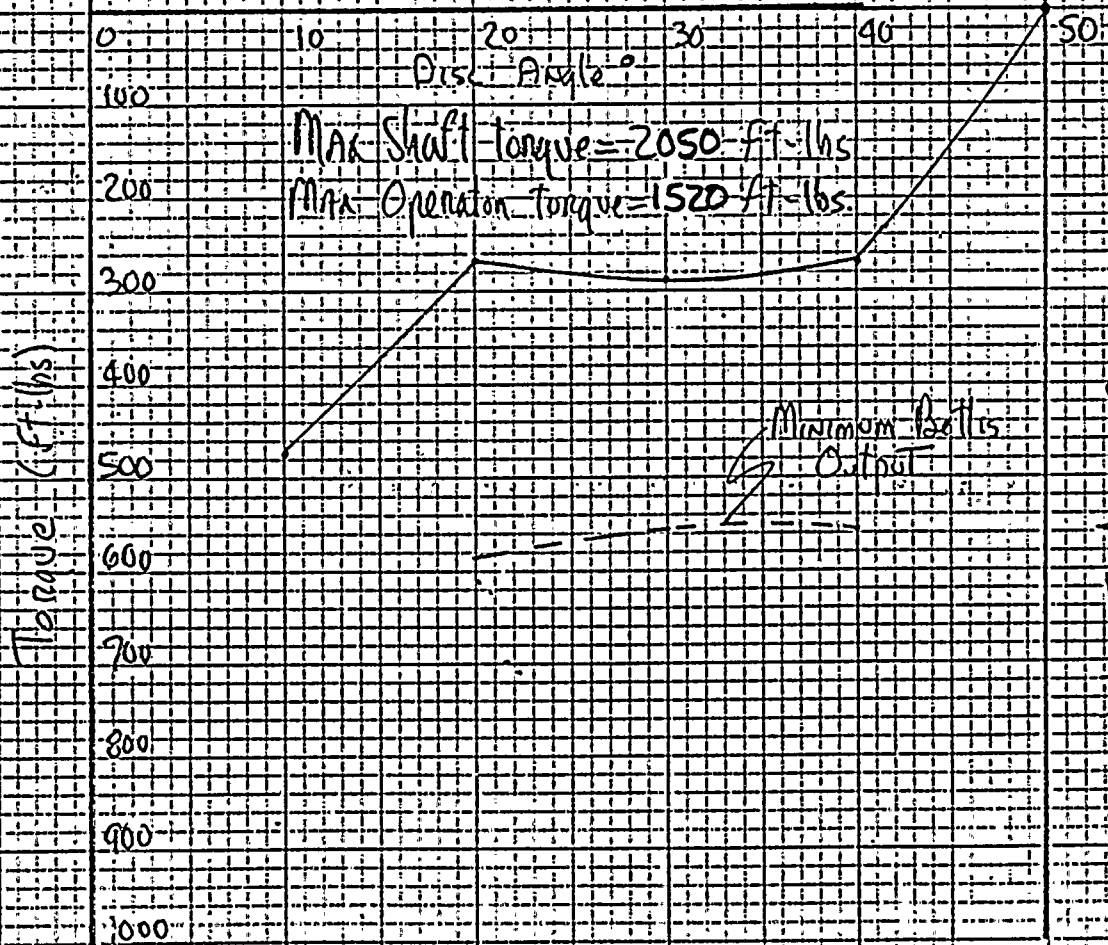
| Disc Angle | P <sub>1</sub> | ΔP   | C <sub>T</sub> | T <sub>D</sub> | T <sub>b</sub> | T <sub>o</sub> |
|------------|----------------|------|----------------|----------------|----------------|----------------|
| 50         | 0              | 0    | 0              | 0              | 0              | 0              |
| 40         | 19.7           | 12.9 | -3.6           | 21.5           | 51             | 266            |
| 30         | 20.9           | 17.3 | -2.7           | 21.6           | 68             | 284            |
| 20         | 21.1           | 20.7 | -1.9           | 18.2           | 81             | 263            |
| 10         | 21.3           | 21.3 | -4.0           | 39.4           | 84             | 478            |



Niagara Mohawk Power Corporation  
Valve 201-16 20" Suppression Chamber Valve  
with Bleeds

0 Second delay

Torque vs Disc Angle



by C.W. Anderson









|                                                     |  |                               |  |                                                           |  |
|-----------------------------------------------------|--|-------------------------------|--|-----------------------------------------------------------|--|
| CUSTOMER<br><b>Niagara Mohawk Power Corporation</b> |  | DATE                          |  | SHEET OF                                                  |  |
| SUBJECT<br><b>Emergency Close Torque Analysis</b>   |  | PRELIM.                       |  | FINAL                                                     |  |
| DRAWING NUMBER                                      |  | LITHO IN U.S.A.-A-C           |  | CALCULATED BY<br><i>R.J.</i><br>CHKD. <i>R.J.</i> 11/4/83 |  |
|                                                     |  | ENGINEERING CALCULATION SHEET |  |                                                           |  |
|                                                     |  | ALLIS-CHALMERS                |  | FORM 6715-1                                               |  |

Valve #201-16      Location: Suppressing Chamber      Valve Size: 20"  
 valve seat: upstream      operator: Betts      closes: counterclockwise  
                                                                                  closing Time: 30 sec.  
 Upstream piping: straight pipe  
                                  valve shaft horizontal      1 seconds delay  
 Reference: Allis Chalmers VER 0209  
                                  Test # 21      figure # 9

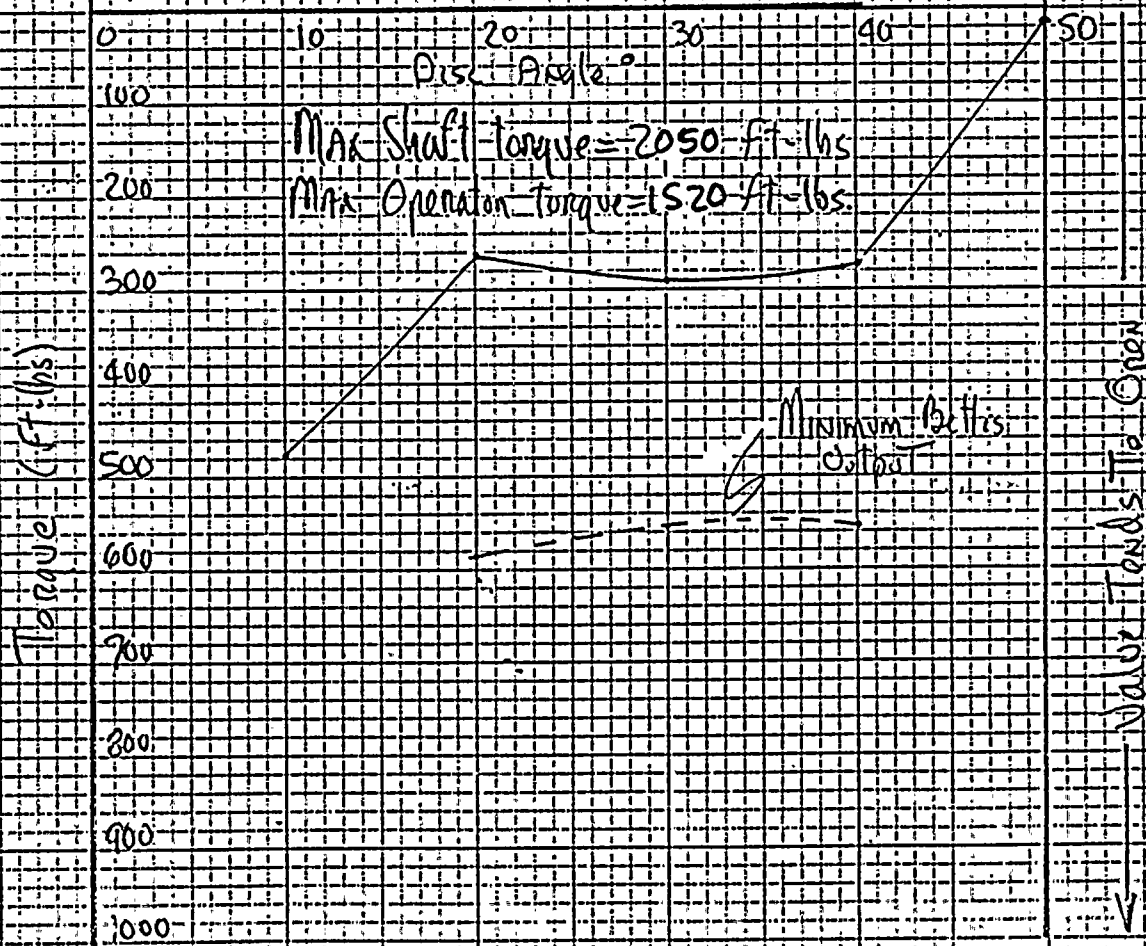
| Disc Angle | P <sub>1</sub> | ΔP   | C <sub>T</sub> | T <sub>a</sub> | T <sub>b</sub> | T <sub>0</sub> |
|------------|----------------|------|----------------|----------------|----------------|----------------|
| 50         | 9              | 4.3  | 0              | 0              | 17             | 17             |
| 40         | 20.1           | 13   | -3.6           | 217            | 51             | 268            |
| 30         | 21             | 17.4 | -2.7           | 218            | 68             | 286            |
| 20         | 21.1           | 20.7 | -1.9           | 182            | 81             | 263            |
| 10         | 21.3           | 21.3 | -4             | 394            | 84             | 470            |



Niagara Mohawk Power Corporation  
Valve 201-16 20" Suppression Chamber Valve  
With Bellis

1 Second delay

Torque vs Disc Angle



by: G.W. Ingalls





24



|                                                     |  |                               |  |                                                                 |  |
|-----------------------------------------------------|--|-------------------------------|--|-----------------------------------------------------------------|--|
| CUSTOMER<br><b>Niagara Mohawk Power Corporation</b> |  | DATE                          |  | SHEET OF                                                        |  |
| SUBJECT<br><b>Emergency Close Torque Analysis</b>   |  | PRELIM.                       |  | FINAL                                                           |  |
| DRAWING NUMBER                                      |  | LITHO IN U.S.A.-A-C           |  | CALCULATED BY<br><i>W. J. ...</i><br>CHKD. <i>R. J. 11/4/83</i> |  |
|                                                     |  | ENGINEERING CALCULATION SHEET |  |                                                                 |  |
|                                                     |  | ALLIS-CHALMERS                |  | FORM 6715-1                                                     |  |

Valve # 201-16      Location: Suppression Chamber      Valve Size: 20"  
 valve seat: upstream      operator: Bellis      closes: counter clockwise  
                                                                                          closing Time: 30 sec  
 Upstream piping: straight pipe  
 valve shaft horizontal      3 seconds delay  
 Reference: Allis Chalmers UER 0209  
 Test # 21      Figure # 9

| Disc Angle | P <sub>1</sub> | ΔP   | C <sub>T</sub> | T <sub>a</sub> | T <sub>b</sub> | T <sub>0</sub> |
|------------|----------------|------|----------------|----------------|----------------|----------------|
| 50         | 17             | 7.5  | 0              | 0              | 29             | 29             |
| 40         | 20.5           | 13.1 | -3.9           | 242            | 53             | 295            |
| 30         | 21.1           | 17.7 | -2.8           | 229            | 70             | 299            |
| 20         | 21.1           | 20.7 | -1.9           | 182            | 81             | 263            |
| 10         | 21.3           | 21.3 | -4.0           | 394            | 82             | 477            |

24

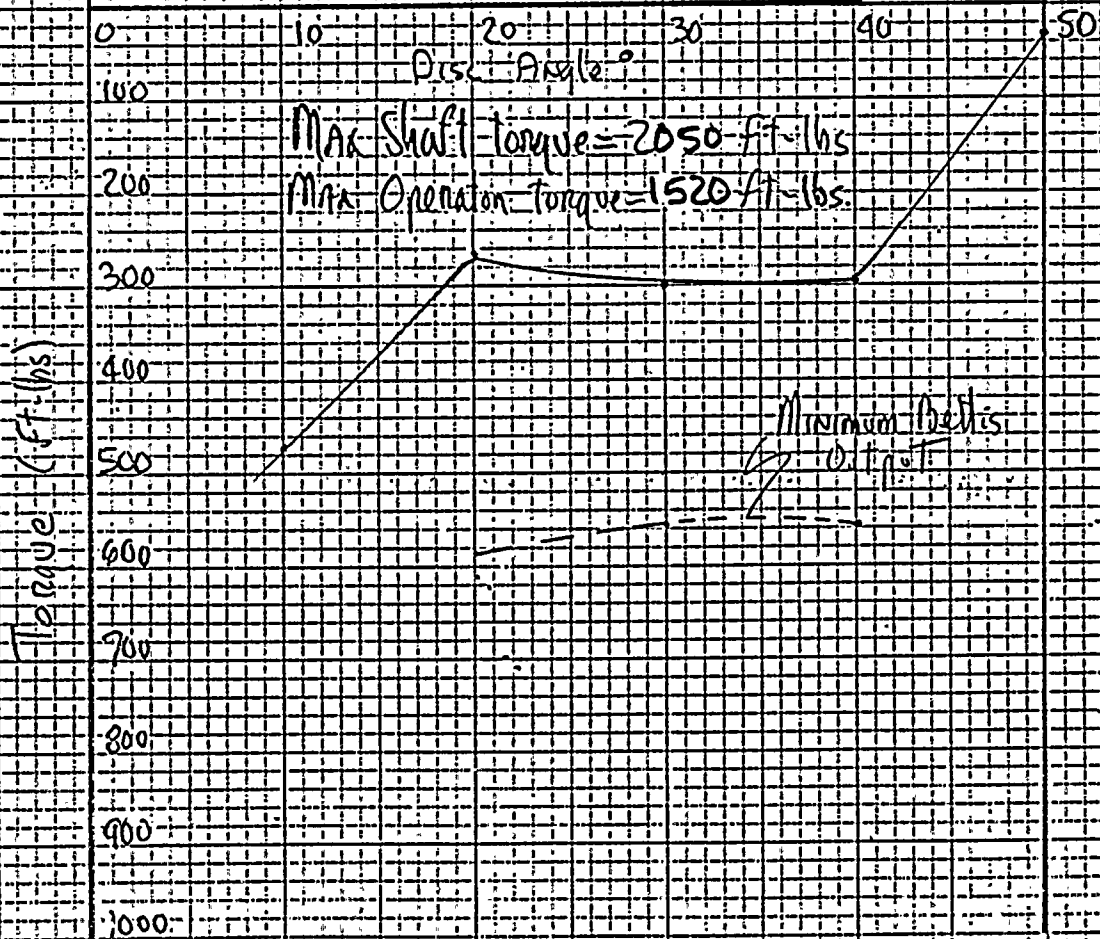




Niragana Mohawk Power Corporation  
Valve 201-16 20" Suppressed Chamber with  
Bellis

3 Second delay

Torque vs Disc Angle



By: C. W. Anderson

2000



|                |  |                                                                    |         |               |  |
|----------------|--|--------------------------------------------------------------------|---------|---------------|--|
| CUSTOMER       |  | DATE                                                               |         | SHEET OF      |  |
| SUBJECT        |  |                                                                    | PRELIM. | FINAL         |  |
| DRAWING NUMBER |  | LITHO IN U.S.A. - A-C                                              |         | CALCULATED BY |  |
|                |  | <b>ENGINEERING CALCULATION SHEET</b><br>ALLIS-CHALMERS FORM 6715-1 |         |               |  |

the following sheets contain dynamic  
torque analysis applicable to valves #

201-32

item description: item #6

24" Drywell Valve... w/ Bellis Operator

upstream piping: 90° elbow

valve shaft: vertical, in plane with upstream elbow

closing time: 30 seconds

200



CUSTOMER

Niagara Mohawk - Nine Mile Point

DATE

SHEET OF

SUBJECT

Pressure Drop Across (2) Valves in Series

PRELIM.

FINAL

DRAWING NUMBER

LITHO IN U.S.A.-A-C

CALCULATED BY

## ENGINEERING CALCULATION SHEET

ALLIS-CHALMERS

FORM 6713-1

CHKD: 12.3. 11/4/83

Two valves are in series in a pipeline. One valve is blocked at 50° open and does not move. The other valve closes from 50° open in 30 seconds.

Valve location: Druswell

Bellis Operation

Delay time: 0 sec.

 $T/d = 24$ 

| Valve Closing Time (sec.) | Disc Angle Fixed Valve | K Fixed Valve | Disc Angle Closing Valve | K Closing Valve | K <sub>T</sub> (Fixed valve + closing valve) | Car Discharge Coef. | Equivalent Disc Angle | P <sub>1</sub> | ΔP <sub>T</sub> | ΔP <sub>FV</sub> | ΔP <sub>MV</sub> |
|---------------------------|------------------------|---------------|--------------------------|-----------------|----------------------------------------------|---------------------|-----------------------|----------------|-----------------|------------------|------------------|
| 0                         | 50°                    | 12            | 50°                      | 12              | 24                                           | .2                  | 42                    | 0              | 0               | 0                | 0                |
| 1                         |                        |               | 48                       | 13.8            | 25.8                                         | .193                | 41                    | 32.6           | 28.9            | 13.4             | 15.5             |
| 2                         |                        |               | 46                       | 16.7            | 28.7                                         | .183                | 40                    | 33.3           | 29.5            | 12.3             | 17.2             |
| 3                         |                        |               | 44                       | 19.7            | 31.7                                         | .175                | 39                    | 31.5           | 28              | 10.6             | 17.4             |
| 4                         |                        |               | 42                       | 24              | 36                                           | .164                | 38                    | 29.5           | 26.9            | 9                | 17.9             |
| 5                         |                        |               | 40                       | 28.2            | 40.2                                         | .156                | 36                    | 27.6           | 25.5            | 7.5              | 18               |
| 6                         |                        |               | 38                       | 33.6            | 45.6                                         | .146                | 35                    | 26.2           | 24.3            | 6.4              | 17.9             |
| 7                         |                        |               | 36                       | 40.6            | 52.6                                         | .137                | 34                    | 25             | 23.3            | 5.3              | 18               |
| 8                         |                        |               | 34                       | 50              | 62                                           | .126                | 32                    | 24.2           | 22.5            | 4.4              | 18.1             |
| 9                         |                        |               | 32                       | 63              | 75                                           | .115                | 30                    | 23.7           | 22              | 3.5              | 18.5             |
| 10                        |                        |               | 30                       | 81.6            | 93.6                                         | .103                | 28                    | 23.1           | 21.8            | 2.8              | 19               |
| 11                        |                        |               | 28                       | 101             | 113                                          | .094                | 28                    | 22.9           | 21.7            | 2.3              | 19.4             |
| 12                        |                        |               | 26                       | 134.2           | 146.2                                        | .082                | 25                    | 22.8           | 22              | 1.8              | 20.2             |
| 14                        |                        |               | 22                       | 243             | 255                                          | .063                | 22                    | 22.6           | 22              | 1.04             | 21.0             |
| 16                        |                        |               | 20                       | 362             | 374                                          | .052                | 20                    | 22.5           | 22.1            | .71              | 21.3             |
| 18                        |                        |               | 15                       | 692             | 704                                          | .038                | 16                    | 22.4           | 22.4            | .38              | 22               |
| 20                        |                        |               | 12                       | 1735            | 1747                                         | .024                | 12                    | 22.4           | 22.4            | .15              | 22.3             |
| 22                        |                        |               | 10                       | 3085            | 3097                                         | .018                | 10                    | 22.4           | 22.4            | .09              | 22.3             |
| 24                        |                        |               | 7                        | 8263            | 8275                                         | .011                | 7                     | 22.4           | 22.4            | .03              | 22.4             |
| 26                        |                        |               | 6                        | 9999            | 10011                                        | .010                | 6                     | 22.4           | 22.4            | .03              | 22.4             |
| 28                        |                        |               |                          |                 |                                              |                     |                       | 22.3           |                 |                  |                  |
| 30                        |                        |               |                          |                 |                                              |                     |                       | 22.3           |                 |                  |                  |

200



|                                                     |  |                               |  |                                                                    |  |
|-----------------------------------------------------|--|-------------------------------|--|--------------------------------------------------------------------|--|
| CUSTOMER<br><b>Niagara Mohawk Power Corporation</b> |  | DATE                          |  | SHEET OF                                                           |  |
| SUBJECT<br><b>Emergency Close Torque Analysis</b>   |  | PRELIM.                       |  | FINAL                                                              |  |
| DRAWING NUMBER                                      |  | LITHO IN U.S.A. - A-C         |  | CALCULATED BY<br><i>W. J. ...</i><br>CHKD.<br><i>R. J. 11/4/83</i> |  |
|                                                     |  | ENGINEERING CALCULATION SHEET |  |                                                                    |  |
|                                                     |  | ALLIS-CHALMERS                |  | FORM 6715-1                                                        |  |

Valve #201-32      Location: Drywell      Valve Size: 24"  
 valve seat: upstream      operator: Bettis      closes: clockwise  
                                                                  closing Time: 30 seconds  
 Upstream piping: 90° elbow  
 valve shaft in plane with upstream elbow      0 seconds delay  
 Reference: Allis Chalmers UER 0209  
 Test # 21      figure # 9

| Disc Angle | P <sub>i</sub> | ΔP   | C <sub>T</sub> | T <sub>a</sub> | T <sub>b</sub> | T <sub>o</sub> |
|------------|----------------|------|----------------|----------------|----------------|----------------|
| 50         | 0              | 0    | 0              | 0              | 0              | 0              |
| 40         | 27.6           | 18   | -5.4           | 778            | 102            | 880            |
| 30         | 23.1           | 19   | -3.1           | 471            | 107            | 578            |
| 20         | 22.5           | 21.3 | -2.1           | 358            | 120            | 478            |
| 10         | 22.4           | 22.3 | -2.4           | 428            | 126            | 554            |

2000

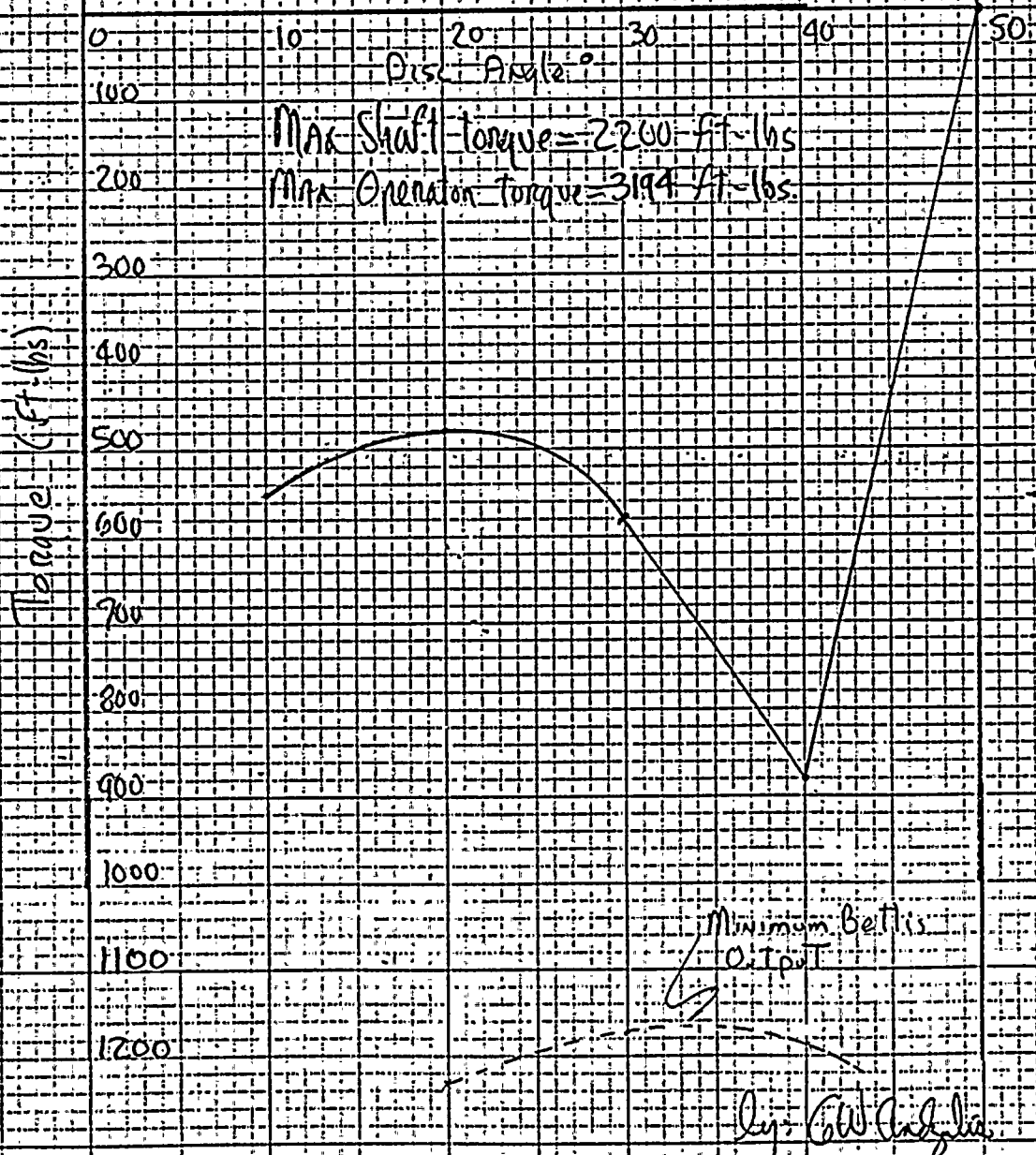




Niagara Mohawk Power Corporation  
Valve 201-32 24" Daywell Valve w/ Bellis

0 Second delay

Torque vs. Disc Angle



By: G.W. Anglin

12-1-74





200



|                                                     |  |                     |             |                                                                |  |
|-----------------------------------------------------|--|---------------------|-------------|----------------------------------------------------------------|--|
| CUSTOMER<br><b>Niagara Mohawk Power Corporation</b> |  | DATE                |             | SHEET OF                                                       |  |
| SUBJECT<br><b>Emergency Close Torque Analysis</b>   |  | PRELIM.             |             | FINAL                                                          |  |
| DRAWING NUMBER                                      |  | LITHO IN U.S.A.-A-C |             | CALCULATED BY<br><i>Chalmers</i><br>CHKD. <i>R. J. 11/4/83</i> |  |
| <b>ENGINEERING CALCULATION SHEET</b>                |  |                     |             |                                                                |  |
| ALLIS-CHALMERS                                      |  |                     | FORM 6715-1 |                                                                |  |

Valve # **261-32**      Location: **Drumwell**      Value Size: **24"**  
 valve seat: **upstream**      operator: **Bettis**      closes: **clockwise**  
                                                                                  closing Time: **30 seconds**  
 Upstream piping: **90° elbow**  
 Valve shaft in plane with upstream elbow      1 seconds delay  
 Reference: **Allis Chalmers UER 0209**  
 Test # **21**      Figure # **9**

| Disc Angle | P <sub>i</sub> | ΔP   | C <sub>T</sub> | T <sub>d</sub> | T <sub>b</sub> | T <sub>o</sub> |
|------------|----------------|------|----------------|----------------|----------------|----------------|
| 50         | 32.6           | 14.5 | -6.4           | 742            | 82             | 824            |
| 40         | 26.2           | 17   | -5.1           | 694            | 96             | 790            |
| 30         | 22.9           | 18.9 | -3.0           | 454            | 107            | 561            |
| 20         | 22.4           | 21.4 | -2.1           | 360            | 121            | 481            |
| 10         | 22.4           | 22.3 | -2.4           | 428            | 126            | 554            |

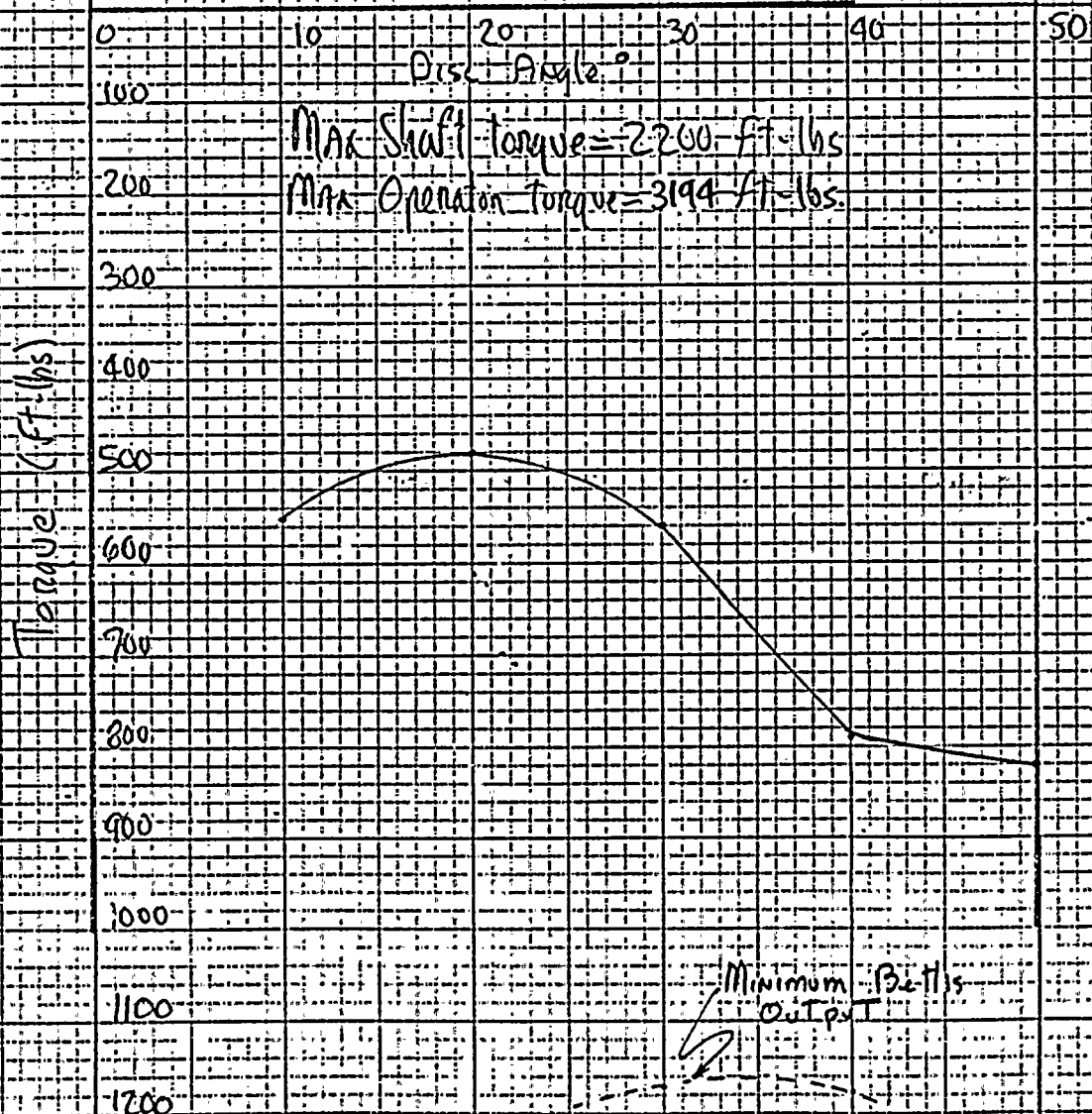
2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100



Niagara Mohawk Power Corporation  
Value 201-32 24" Danwell Valve w/ Beff's

1 Second delay

Torque vs. Disc Angle



Eq. 6.1.1.1

2, 0  
K (1.1),







0. 0  
P. 3. 1,



|                                              |  |                               |  |                        |  |
|----------------------------------------------|--|-------------------------------|--|------------------------|--|
| CUSTOMER<br>Niagara Mohawk Power Corporation |  | DATE                          |  | SHEET OF               |  |
| SUBJECT<br>Emergency Close Torque Analysis   |  | PRELIM.                       |  | FINAL                  |  |
| DRAWING NUMBER                               |  | LITHO IN U.S.A. - A-C         |  | CALCULATED BY<br>CHKD. |  |
|                                              |  | ENGINEERING CALCULATION SHEET |  | 12.3. 11/4/83          |  |
|                                              |  | ALLIS-CHALMERS                |  | FORM 6715-1            |  |

Valve # 201-32      Location: Drywell      Valve Size: 24"  
 valve seat: upstream      operator: Bellis      closes: clockwise  
                                                                  closing Time: 30 seconds  
 Upstream piping: 90° elbow  
 Valve shaft in plane with upstream elbow      3 seconds delay  
 Reference: Allis Chalmers VER 0209  
 Test # 24      Figure # 9

| Disc Angle | P <sub>1</sub> | ΔP   | C <sub>T</sub> | T <sub>d</sub> | T <sub>b</sub> | T <sub>o</sub> |
|------------|----------------|------|----------------|----------------|----------------|----------------|
| 50         | 31.5           | 14   | -6.2           | 694            | 791            | 773            |
| 40         | 24.2           | 15.8 | -4.7           | 594            | 891            | 683            |
| 30         | 22.7           | 19.2 | -3.1           | 476            | 108            | 584            |
| 20         | 22.4           | 21.4 | -2.1           | 360            | 121            | 481            |
| 10         | 22.3           | 22.2 | -4.1           | 728            | 125            | 853            |

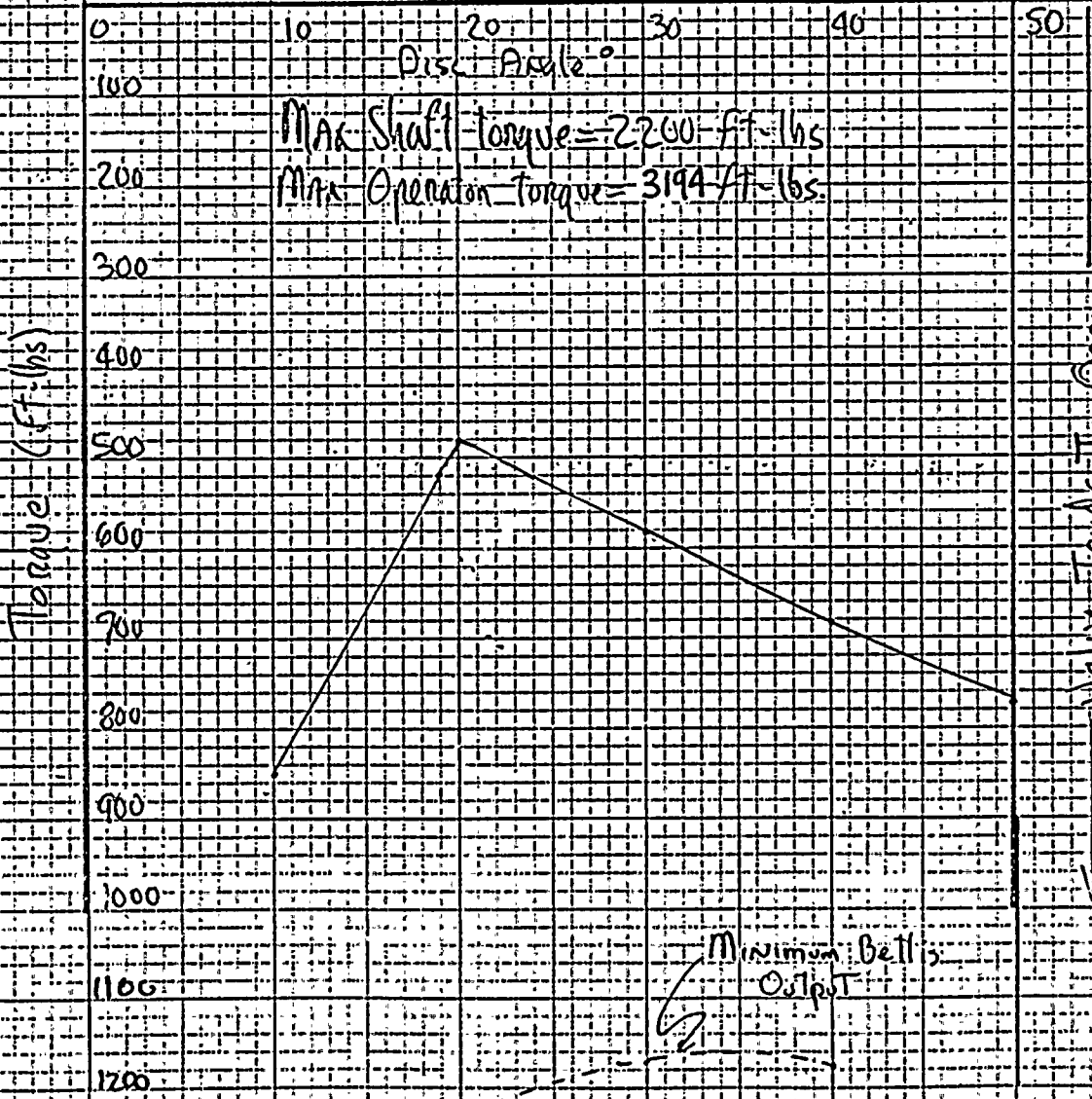
0 0 0  
0 0 0  
0 0 0



Niagara Mohawk Power Corporation  
Valve 201-32 24" Dairwell Valve w/ Bell is

3 Second delay

Torque vs Disc Angle



By G.W. Andrews

100

