

TEST REPORT

PLANT EFFICIENCY LOSS RECOVERY CYCLE ISOLATION TESTING SERVICES

**[POWER GENERATION CLIENT]
600 MW NATURAL GAS COMBINED CYCLE**

**THIS IS A SAMPLE REPORT
BASED ON ACTUAL TEST RESULTS**



ABSOLUTE ZERO LEAKAGE

**PLANT EFFICIENCY IMPROVEMENT AND REDUCED MAINTENANCE COSTS
VIA
SUPERIOR CYCLE ISOLATION
IN POWER GENERATION APPLICATIONS**

1 INTRODUCTION

The following report details the testing methods employed and results obtained during Cycle Isolation Testing at [Client Name, Location and Unit] on [Date of Testing].

The plant/unit is Natural Gas Fired Combined Cycle generator with an approximate capacity of 600 MW.

Testing was executed by Valvtechnologies, Inc. and [Distributor Name] in cooperation with [Client] operations and engineering personnel.

2 SUMMARY OF RESULTS

184 valves were tested for leakage during a two day survey. The summary results are as follows:

- Total Annual Energy Costs attributable to Cycle Energy Losses of **\$2,673,862** were identified;
- Total Energy Losses equate to roughly **1.0% of Plant Heat Rate** (efficiency) based on energy in costs only;
- A total of 41 valves were determined as having a positive 4 Year Internal Rate of Return (IRR) on replacement with Absolute Zero Leakage Valves;
- 17 valves have been classified as High Priority Action Items (Critical Losses) or as having a calculated payback off less than one year on replacement costs;
- The 17 high priority valves represent \$2,608,856 in Cycle Energy Losses or 97.6% of the total losses identified; and
- 9 valves have been classified as Moderate Priority Action Items or as having a calculated payback of one to two years on replacement costs.

Additionally, many high energy valves which were suspected to be "leakers" were actually identified as seating tightly. This verifies [CLIENTNAME]'s maintenance processes and also assists in avoiding unnecessary and costly repairs and replacements.

Further details on the above follow.

3 TESTING METHODOLOGY

Valvtechnologies employs knowledge-based software, an extensive database of laboratory verified valve leakages, and specialized equipment which together utilize Ultrasonic Energy Emission (sound energy) measurement to accurately identify and quantify energy losses across isolation valves.

The process is briefly described as follows:

As fluid leaks through a constriction from high to low pressure, it produces turbulence. The degree of turbulence is mathematically or scientifically related the rate of fluid flow through the constriction.

In the field, the degree of turbulence is recorded indirectly via an acoustical signal (or ultrasonic emission). Knowledge-based software is used to correlate the recording to

an extensive database containing all relevant properties for an array of valve types and conditions of service with laboratory verified leakage rates. The program returns a leakage rate for the subject valve.

Testing services are intrinsically safe and non-intrusive to normal plant operations.

4 TEST PREPARATION AND DATA COLLECTION

Better information improves the quality of the survey and number of valves that can be tested in given time frame.

[The Client's] engineering and operations personnel did an exceptional job in preparing the valves for testing and in providing safe access to the subject valves.

Operational and physical data was compiled and made available by [the Client] prior to the tests which enabled testing on a substantial number of valves in a single day. Only a very limited quantity of valves required post-test data collection.

The results reflect a good cross-section of valve conditions in the higher energy systems.

5 ECONOMIC IMPACT OF CYCLE LOSSES

A complete table of results is presented in Attachment 1. For each valve tested, this table displays the calculated leakage rates in pounds per hour and the economic impact of the leakage.

In the economic calculations, the following information/assumptions were used:

- A cycle energy cost of \$7.50 per MMBTU.
- Average annual unit operation of 8000 hrs/yr representing roughly 90% availability.
- Install Costs are approximated at \$1500 per valve for nominal valve sizes of 4" or less and \$2500 per valve for 6" valves; all valves tested were 6" or less.
- A average plant Heat Rate of 7,500 BTU/kwhr was assumed in determining the losses as a percentage of total efficiency;
- Valve replacement costs are budget estimates;
- All financial calculations are based on replacements with Absolute Zero Leakage products with 4 year minimum lifecycles.

The following table summarizes ALL valves for which the economic calculations yielded a positive Internal Rate of Return (IRR) on replacement over 4 years of operation.

**TABLE 1
4 YEAR INTERNAL RATES OF RETURN ON REPLACEMENT**

VTI TEST #	LEAKAGE RATE (lbs/hr)	ENERGY LOSS (MMBtu/hr)	ANNUAL COST OF ENERGY LOSS @ \$7.50/MMBTU	REPLACEMENT VALVE COSTS			PAYBACK ON REPLACEMENT		4 YEAR INTERNAL RATE OF RETURN (IRR)
				VALVE COST	INSTALL COST	TOTAL	YRS	MNTHS	
1	24.80	0.0153	\$ 919	\$ 1,260	\$ 1,500	\$ 2,760	3.0	36.1	13%
2	20.82	0.0129	\$ 771	\$ 1,260	\$ 1,500	\$ 2,760	3.6	43.0	5%
3	22.73	0.0140	\$ 842	\$ 1,260	\$ 1,500	\$ 2,760	3.3	39.4	8%
8	26.29	0.0162	\$ 974	\$ 1,809	\$ 1,500	\$ 3,309	3.4	40.8	7%
19	8.55	0.0119	\$ 713	\$ 1,260	\$ 1,500	\$ 2,760	3.9	46.4	1%
23	281.87	0.4219	\$ 25,313	\$ 1,809	\$ 1,500	\$ 3,309	0.1	1.6	765%
24	18.72	0.0280	\$ 1,681	\$ 1,809	\$ 1,500	\$ 3,309	2.0	23.6	36%
25	281.87	0.4219	\$ 25,313	\$ 1,809	\$ 1,500	\$ 3,309	0.1	1.6	765%
26	53.12	0.0795	\$ 4,770	\$ 1,809	\$ 1,500	\$ 3,309	0.7	8.3	140%
30	25.59	0.0383	\$ 2,298	\$ 1,809	\$ 1,500	\$ 3,309	1.4	17.3	58%
137	65.86	0.0986	\$ 5,915	\$ 1,809	\$ 1,500	\$ 3,309	0.6	6.7	176%
139	11.18	0.0167	\$ 1,004	\$ 1,809	\$ 1,500	\$ 3,309	3.3	39.5	8%
140	8.28	0.0123	\$ 739	\$ 1,260	\$ 1,500	\$ 2,760	3.7	44.8	3%
149	17.65	0.0216	\$ 1,295	\$ 1,260	\$ 1,500	\$ 2,760	2.1	25.6	31%
150	142.15	0.1739	\$ 10,433	\$ 1,260	\$ 1,500	\$ 2,760	0.3	3.2	377%
158	26.37	0.0264	\$ 1,584	\$ 4,807	\$ 1,500	\$ 6,307	4.0	47.8	0%
179	3273.31	4.8025	\$ 288,152	\$10,160	\$ 2,500	\$12,660	0.0	0.5	2276%
180	2393.80	3.5121	\$ 210,728	\$10,160	\$ 2,500	\$12,660	0.1	0.7	1665%
32	20.82	0.0129	\$ 771	\$ 1,260	\$ 1,500	\$ 2,760	3.6	43.0	5%
33	31.33	0.0193	\$ 1,160	\$ 1,260	\$ 1,500	\$ 2,760	2.4	28.6	25%
36	31.33	0.0193	\$ 1,160	\$ 1,260	\$ 1,500	\$ 2,760	2.4	28.6	25%
37	24.09	0.0149	\$ 892	\$ 1,260	\$ 1,500	\$ 2,760	3.1	37.1	11%
38	20.82	0.0129	\$ 771	\$ 1,260	\$ 1,500	\$ 2,760	3.6	43.0	5%
39	23.40	0.0144	\$ 866	\$ 1,809	\$ 1,500	\$ 3,309	3.8	45.8	2%
50	19.70	0.0274	\$ 1,643	\$ 1,260	\$ 1,500	\$ 2,760	1.7	20.2	47%
56	122.36	0.1831	\$ 10,989	\$ 1,809	\$ 1,500	\$ 3,309	0.3	3.6	331%
57	31.53	0.0472	\$ 2,832	\$ 1,809	\$ 1,500	\$ 3,309	1.2	14.0	77%
60	18.02	0.0270	\$ 1,619	\$ 4,422	\$ 1,500	\$ 5,922	3.7	43.9	4%
61	110.24	0.1650	\$ 9,900	\$ 1,809	\$ 1,500	\$ 3,309	0.3	4.0	298%
62	150.75	0.2256	\$ 13,538	\$ 1,809	\$ 1,500	\$ 3,309	0.2	2.9	409%
117	162.37	0.2382	\$ 14,293	\$ 1,809	\$ 1,500	\$ 3,309	0.2	2.8	431%
125	29.33	0.0412	\$ 2,472	\$ 1,260	\$ 1,500	\$ 2,760	1.1	13.4	81%
168	9.80	0.0120	\$ 719	\$ 1,067	\$ 1,500	\$ 2,567	3.6	42.8	5%
176	14098.96	20.6857	\$ 1,241,144	\$11,220	\$ 2,500	\$13,720	0.0	0.1	9046%
177	7540.28	11.0629	\$ 663,777	\$11,220	\$ 2,500	\$13,720	0.0	0.2	4838%
65	11.04	0.0145	\$ 871	\$ 1,260	\$ 1,500	\$ 2,760	3.2	38.0	10%
78	511.45	0.7504	\$ 45,023	\$ 1,809	\$ 1,500	\$ 3,309	0.1	0.9	1361%
79	118.74	0.1742	\$ 10,453	\$ 1,809	\$ 1,500	\$ 3,309	0.3	3.8	315%
80	57.21	0.0839	\$ 5,037	\$ 1,809	\$ 1,500	\$ 3,309	0.7	7.9	148%
82	22.38	0.0328	\$ 1,970	\$ 1,809	\$ 1,500	\$ 3,309	1.7	20.2	47%
83	273.53	0.4013	\$ 24,079	\$ 1,809	\$ 1,500	\$ 3,309	0.1	1.6	728%
TOTAL:			\$ 2,639,424						

High Priority Action Items are defined as valves for which the energy losses justify remedial action based on a positive economic payback of 1 year or less. These are considered 'CRITICAL LOSSES.' A total of 17 Critical Loss valves were identified. [CLIENT] will recover 97.6% of the total energy losses identified by eliminating these leaks. Monetarily this equates to \$2,608,856 annually or 43.5 MMBTU PER HOUR in energy cost.

Critical Loss valves are listed in the following tables:

**TABLE 2
CRITICAL LOSSES : HIGH PRIORITY REPAIRS/REPLACEMENTS**

VTI TEST #	LEAKAGE RATE (lbs/hr)	ENERGY LOSS (MMBtu/hr)	ANNUAL COST OF ENERGY LOSS @ \$7.50/MMBTU	REPLACEMENT VALVE COSTS			PAYBACK ON REPLACEMENT		4 YEAR INTERNAL RATE OF RETURN (IRR)
				VALVE COST	INSTALL COST	TOTAL	YRS	MNTHS	
23	281.87	0.4219	\$ 25,313	\$ 1,809	\$ 1,500	\$ 3,309	0.1	1.6	765%
25	281.87	0.4219	\$ 25,313	\$ 1,809	\$ 1,500	\$ 3,309	0.1	1.6	765%
26	53.12	0.0795	\$ 4,770	\$ 1,809	\$ 1,500	\$ 3,309	0.7	8.3	140%
137	65.86	0.0986	\$ 5,915	\$ 1,809	\$ 1,500	\$ 3,309	0.6	6.7	176%
150	142.15	0.1739	\$ 10,433	\$ 1,260	\$ 1,500	\$ 2,760	0.3	3.2	377%
179	3273.31	4.8025	\$ 288,152	\$10,160	\$ 2,500	\$12,660	0.0	0.5	2276%
180	2393.80	3.5121	\$ 210,728	\$10,160	\$ 2,500	\$12,660	0.1	0.7	1665%
56	122.36	0.1831	\$ 10,989	\$ 1,809	\$ 1,500	\$ 3,309	0.3	3.6	331%
61	110.24	0.1650	\$ 9,900	\$ 1,809	\$ 1,500	\$ 3,309	0.3	4.0	298%
62	150.75	0.2256	\$ 13,538	\$ 1,809	\$ 1,500	\$ 3,309	0.2	2.9	409%
117	162.37	0.2382	\$ 14,293	\$ 1,809	\$ 1,500	\$ 3,309	0.2	2.8	431%
176	14098.96	20.6857	\$ 1,241,144	\$11,220	\$ 2,500	\$13,720	0.0	0.1	9046%
177	7540.28	11.0629	\$ 663,777	\$11,220	\$ 2,500	\$13,720	0.0	0.2	4838%
78	511.45	0.7504	\$ 45,023	\$ 1,809	\$ 1,500	\$ 3,309	0.1	0.9	1361%
79	118.74	0.1742	\$ 10,453	\$ 1,809	\$ 1,500	\$ 3,309	0.3	3.8	315%
80	57.21	0.0839	\$ 5,037	\$ 1,809	\$ 1,500	\$ 3,309	0.7	7.9	148%
83	273.53	0.4013	\$ 24,079	\$ 1,809	\$ 1,500	\$ 3,309	0.1	1.6	728%
TOTAL:			\$ 2,608,856						

Moderate Priority Action Items are defined as valves with a nominal payback period between 1 and 2.5 years. These valves are listed in the following table:

**TABLE 3
MODERATE PRIORITY ACTION ITEMS**

VTI TEST #	LEAKAGE RATE (lbs/hr)	ENERGY LOSS (MMBtu/hr)	ANNUAL COST OF ENERGY LOSS @ \$7.50/MMBTU	REPLACEMENT VALVE COSTS			PAYBACK ON REPLACEMENT		4 YEAR INTERNAL RATE OF RETURN (IRR)
				VALVE COST	INSTALL COST	TOTAL	YRS	MNTHS	
24	18.72	0.0280	\$ 1,681	\$ 1,809	\$ 1,500	\$ 3,309	2.0	23.6	36%
30	25.59	0.0383	\$ 2,298	\$ 1,809	\$ 1,500	\$ 3,309	1.4	17.3	58%
149	17.65	0.0216	\$ 1,295	\$ 1,260	\$ 1,500	\$ 2,760	2.1	25.6	31%
33	31.33	0.0193	\$ 1,160	\$ 1,260	\$ 1,500	\$ 2,760	2.4	28.6	25%
36	31.33	0.0193	\$ 1,160	\$ 1,260	\$ 1,500	\$ 2,760	2.4	28.6	25%
50	19.70	0.0274	\$ 1,643	\$ 1,260	\$ 1,500	\$ 2,760	1.7	20.2	47%
57	31.53	0.0472	\$ 2,832	\$ 1,809	\$ 1,500	\$ 3,309	1.2	14.0	77%
125	29.33	0.0412	\$ 2,472	\$ 1,260	\$ 1,500	\$ 2,760	1.1	13.4	81%
82	22.38	0.0328	\$ 1,970	\$ 1,809	\$ 1,500	\$ 3,309	1.7	20.2	47%
TOTAL:			\$ 16,512						

6 CONSERVATIVE NATURE OF RESULTS

Valvtechnologies' Testing Results are conservative in nature and should be considered the MINIMUM EXPECTED BENEFIT in terms of heat rate recovery. Valvtechnologies measures the fluid loss across a given valve and equates it to the fuel cost required to make up that energy loss. However, depending upon the location and function of the subject valve, the effect on heat rate and plant generation output can be far greater. Consider the following simple examples:

- If the plant output is limited by the turbine (and the boiler has some available margin), then the above method will be very accurate for calculating total heat rate loss (fuel and generation) on the MAIN STEAM LINES ONLY. In this case, the main steam flow to the turbine will be generally regulated at the turbine inlet control valve. If there are losses in the main steam lines, the boiler can simply burn additional fuel to make up those losses and maintain the steam turbine at peak output.
- If the plant output is limited by the boiler (e.g. the boilers have been derated and there is available margin in the turbine), the energy losses across a valve will equate to Kilowatt Generation output losses as opposed to Heat input losses. In this case, the total heat rate loss will be much higher than the Valvtechnologies calculations (depending on plant unit efficiency).
- Finally, since there are no controls on the Intermediate and Low Pressure turbine inlets, energy losses in the reheat lines will result in BOTH input (fuel) and output (generation) losses.

There are other systems and factors as well but our experience has shown that most plants realize unit heat rate improvements in excess of the heat losses across the valve; oftentimes more than double.

7 CONCLUSIONS AND RECOMMENDATIONS

It is highly recommended that [CLIENTNAME] take immediate action on the High Priority or Critical Loss valves presented in Table 2. These 17 valves account for \$2,608,856 out of a total of \$2,673,862 in identified energy cost losses (or 97.6% of the total losses identified). Achieving Absolute Zero Leakage on these valves will result in an economic payback of 1 year or less.

Valve leakages increase over time. It is therefore recommended that [CLIENTNAME] budget for the repair/replacement of valves listed in Table 3 (Moderate Priority Action Items) valves within one or two outages. At the current leakage rates, achieving Absolute Zero Leakage on these valves will result in an economic payback of 1 to 2.5 years.

The losses on all other valves tested would be considered at this stage to be 'manageable.' Again keeping in mind that leakage rates increase over time, the data presented in Table 1 and Attachment 1 provides an effective managerial tool for balancing future valve repairs and replacements against available budgets.

Additionally, the value of Cycle Isolation Testing is not limited to recovery of losses. Secondary benefits include:

- Recovery of lost plant output or generation (revenue) due to non-fuel efficiency degradation as a result of poor cycle isolation;
- Cost avoidance of unnecessary repairs by identifying 'tight' valves;
- Protection of other plant equipment from unnecessary heat loads or water induction problems;
- Verification of warranties and guarantees of valves in place;
- Confirmation that plant equipment can be isolated for repairs; and
- The general transparency necessary to make more informed decisions on far more expensive repairs.

A program approach to cycle isolation will not only help maintain peak efficiency but will decrease overall valve operations and maintenance costs.

8 ENVIRONMENTAL IMPACT

It further merits noting that the majority of today's environmental regulations relate emissions levels to the heat or energy content of the fuel burned (as opposed to the generation output). Eliminating cycle energy losses on the Critical Loss or High Priority Replacements alone will result in a **1.0% reduction in emissions levels**.

9 GOING FORWARD

The testing services and the report provide Plant Managers and Operations Personnel with valuable intelligence to help mitigate cycle losses and reduce valve maintenance and repair costs overall.

Although it is initially recommended that testing focuses on high energy valves which will generate the highest rates of return on investments in plant unit heat rate, achieving and maintaining peak cycle efficiency will require regular testing on larger populations of valves.

ATTACHMENT 1 : COMPLETE TEST RESULTS

VTI TEST #	VALVE DESCRIPTION						SERVICE CONDITIONS			LEAKAGE RATE (lbs/hr)	ENERGY LOSS (MMBtu/hr)	ANNUAL COST OF ENERGY LOSS @ \$7.50/MMBTU	REPLACEMENT VALVE COSTS			PAYBACK ON REPLACEMENT		4 YEAR INTERNAL RATE OF RETURN (IRR)
	PLANT TAG #	MFG	SIZE	CLASS	TYPE	ACTUATOR	FLUID	PRESS (PSIG)	TEMP (F)				VALVE COST	INSTALL COST	TOTAL	YRS	MNTHS	
1			2	1690	Globe	Manual	Water	3500	600	24.80	0.0153	\$ 919	\$ 1,260	\$ 1,500	\$ 2,760	3.0	36.1	13%
2			2	1690	Globe	Manual	Water	3500	600	20.82	0.0129	\$ 771	\$ 1,260	\$ 1,500	\$ 2,760	3.6	43.0	5%
3			2	1690	Globe	Manual	Water	3500	600	22.73	0.0140	\$ 842	\$ 1,260	\$ 1,500	\$ 2,760	3.3	39.4	8%
4			2	1690	Globe	Manual	Water	3500	600	18.00	0.0111	\$ 666	\$ 1,260	\$ 1,500	\$ 2,760	4.1	49.7	
5			2	1690	Globe	Manual	Water	3500	600	13.84	0.0085	\$ 512	\$ 1,260	\$ 1,500	\$ 2,760	5.4	64.6	
6			2	1690	Globe	Manual	Water	3500	600	15.55	0.0096	\$ 576	\$ 1,260	\$ 1,500	\$ 2,760	4.8	57.5	
7			2	1690	Globe	Manual	Water	3500	600	13.84	0.0085	\$ 512	\$ 1,260	\$ 1,500	\$ 2,760	5.4	64.6	
8			2	2500	Globe	Manual	Water	3500	600	26.29	0.0162	\$ 974	\$ 1,809	\$ 1,500	\$ 3,309	3.4	40.8	7%
9			2	2500	Globe	Manual	Water	3500	600	14.25	0.0088	\$ 528	\$ 1,809	\$ 1,500	\$ 3,309	6.3	75.3	
10			2	2500	Globe	Manual	Water	3500	600	15.55	0.0096	\$ 576	\$ 1,809	\$ 1,500	\$ 3,309	5.7	68.9	
11			2	2500	Globe	Manual	Water	3500	600	15.11	0.0093	\$ 559	\$ 1,809	\$ 1,500	\$ 3,309	5.9	71.0	
12			2	2500	Globe	Manual	Water	3500	600	11.96	0.0074	\$ 443	\$ 1,809	\$ 1,500	\$ 3,309	7.5	89.6	
13			2	2500	Globe	Manual	Water	3500	600	12.68	0.0078	\$ 470	\$ 1,809	\$ 1,500	\$ 3,309	7.0	84.6	
14			2	2500	Globe	Manual	Water	3500	600	8.43	0.0052	\$ 312	\$ 1,809	\$ 1,500	\$ 3,309	10.6	127.2	
15			2	2500	Globe	Manual	Water	3500	600	8.93	0.0055	\$ 331	\$ 1,809	\$ 1,500	\$ 3,309	10.0	120.0	
16			2	2500	Globe	Manual	Water	3500	600	9.75	0.0060	\$ 361	\$ 1,809	\$ 1,500	\$ 3,309	9.2	110.0	
17			2	2500	Globe	Manual	Water	3500	600	7.28	0.0045	\$ 270	\$ 1,809	\$ 1,500	\$ 3,309	12.3	147.2	
18			2	2500	Globe	Manual	Water	3500	600	13.44	0.0083	\$ 498	\$ 1,809	\$ 1,500	\$ 3,309	6.6	79.8	
19			2	1690	-	Limiterque	Steam	660	775	8.55	0.0119	\$ 713	\$ 1,260	\$ 1,500	\$ 2,760	3.9	46.4	1%
20			2	1690	-	Limiterque	Steam	660	775	1.99	0.0028	\$ 166	\$ 1,260	\$ 1,500	\$ 2,760	16.7	200.0	
21			2	800	Globe	Limiterque	Steam	150	715	0.90	0.0012	\$ 74	\$ 1,260	\$ 1,500	\$ 2,760	37.1	444.8	
22			2	1690	Globe	Limiterque	Steam	610	1062	0.78	0.0012	\$ 73	\$ 1,260	\$ 1,500	\$ 2,760	37.8	453.5	
23			2	2680	Globe	Limiterque	Steam	2530	1062	281.87	0.4219	\$ 25,313	\$ 1,809	\$ 1,500	\$ 3,309	0.1	1.6	765%
24			2	2680	Globe	Limiterque	Steam	2530	1062	18.72	0.0280	\$ 1,681	\$ 1,809	\$ 1,500	\$ 3,309	2.0	23.6	36%
25			2	2680	Globe	Limiterque	Steam	2530	1062	281.87	0.4219	\$ 25,313	\$ 1,809	\$ 1,500	\$ 3,309	0.1	1.6	765%
26			2	2680	Globe	Limiterque	Steam	2530	1062	53.12	0.0795	\$ 4,770	\$ 1,809	\$ 1,500	\$ 3,309	0.7	8.3	140%
27			2	1690	Globe	Limiterque	Steam	610	1062	1.32	0.0021	\$ 123	\$ 1,260	\$ 1,500	\$ 2,760	22.4	269.2	
28			3	2500	Globe	Gearbox	Steam	2530	1062	3.77	0.0056	\$ 339	\$ 4,422	\$ 1,500	\$ 5,922	17.5	209.9	
29			3	2500	Globe	Gearbox	Steam	2530	1062	7.05	0.0106	\$ 633	\$ 4,422	\$ 1,500	\$ 5,922	9.4	112.2	
30			2	2500	Globe	Gearbox	Steam	2530	1062	25.59	0.0383	\$ 2,298	\$ 1,809	\$ 1,500	\$ 3,309	1.4	17.3	58%
31			2	2500	Globe	Gearbox	Steam	2530	1062	0.36	0.0005	\$ 32	\$ 1,809	\$ 1,500	\$ 3,309	103.6	1243.8	
128			2	2500	Ball	Rotork	Steam	2530	1062	1.39	0.0021	\$ 125	\$ 1,809	\$ 1,500	\$ 3,309	26.5	318.4	
129			2	600	Ball	Rotork	Steam	2530	1050	1.56	0.0023	\$ 139	\$ 1,260	\$ 1,500	\$ 2,760	19.8	237.7	
130			2	300	Ball	Rotork	Water	3500	600	4.99	0.0031	\$ 185	\$ 1,260	\$ 1,500	\$ 2,760	15.0	179.4	
131			2	300	Ball	Manual	Water	3500	600	5.13	0.0032	\$ 190	\$ 1,260	\$ 1,500	\$ 2,760	14.5	174.3	
132			2	300	Ball	Manual	Water	3500	600	4.99	0.0031	\$ 185	\$ 1,260	\$ 1,500	\$ 2,760	15.0	179.4	
133			2	300	Ball	Rotork	Water	3500	600	4.99	0.0031	\$ 185	\$ 1,260	\$ 1,500	\$ 2,760	15.0	179.4	
134			2	600	Ball	Rotork	Steam	3500	800	3.69	0.0045	\$ 271	\$ 1,260	\$ 1,500	\$ 2,760	10.2	122.2	
135			2	600	Ball	Manual	Steam	3500	800	4.10	0.0050	\$ 301	\$ 1,260	\$ 1,500	\$ 2,760	9.2	110.1	
136			2	600	Ball	Manual	Steam	3500	800	5.60	0.0069	\$ 411	\$ 1,260	\$ 1,500	\$ 2,760	6.7	80.5	
137			2	2500	Ball	Rotork	Steam	2530	1062	65.86	0.0986	\$ 5,915	\$ 1,809	\$ 1,500	\$ 3,309	0.6	6.7	176%
138			2	2500	Ball	Manual	Steam	2530	1062	0.19	0.0003	\$ 17	\$ 1,809	\$ 1,500	\$ 3,309	192.6	2310.6	
139			2	2500	Ball	Manual	Steam	2530	1062	11.18	0.0167	\$ 1,004	\$ 1,809	\$ 1,500	\$ 3,309	3.3	39.5	8%
140			2	600	Ball	Rotork	Steam	2530	1050	8.28	0.0123	\$ 739	\$ 1,260	\$ 1,500	\$ 2,760	3.7	44.8	3%
141			2	600	Ball	Manual	Steam	2530	1050	1.73	0.0026	\$ 155	\$ 1,260	\$ 1,500	\$ 2,760	17.8	214.2	
142			2	600	Ball	Manual	Steam	2530	1050	3.24	0.0048	\$ 289	\$ 1,260	\$ 1,500	\$ 2,760	9.5	114.5	
143			2	2500	Ball	Rotork	Water	660	400	7.64	0.0029	\$ 172	\$ 1,809	\$ 1,500	\$ 3,309	19.3	231.1	
144			2	600	Ball	Rotork	Water	660	400	8.58	0.0032	\$ 193	\$ 1,260	\$ 1,500	\$ 2,760	14.3	171.5	
145			2	600	Ball	Rotork	Steam	3500	800	8.50	0.0104	\$ 624	\$ 1,260	\$ 1,500	\$ 2,760	4.4	53.1	

ATTACHMENT 1 : COMPLETE TEST RESULTS

VTI TEST #	VALVE DESCRIPTION						SERVICE CONDITIONS			LEAKAGE RATE (lbs/hr)	ENERGY LOSS (MMBtu/hr)	ANNUAL COST OF ENERGY LOSS @ \$7.50/MMBTU	REPLACEMENT VALVE COSTS			PAYBACK ON REPLACEMENT		4 YEAR INTERNAL RATE OF RETURN (IRR)
	PLANT TAG #	MFG	SIZE	CLASS	TYPE	ACTUATOR	FLUID	PRESS (PSIG)	TEMP (F)				VALVE COST	INSTALL COST	TOTAL	YRS	MNTHS	
146			2	600	Ball	Manual	Steam	3500	800	6.22	0.0076	\$ 456	\$ 1,260	\$ 1,500	\$ 2,760	6.0	72.6	
147			2	600	Ball	Manual	Steam	3500	800	3.69	0.0045	\$ 271	\$ 1,260	\$ 1,500	\$ 2,760	10.2	122.2	
148			2	600	Globe	Gearbox	Water	660	400	14.09	0.0053	\$ 317	\$ 1,260	\$ 1,500	\$ 2,760	8.7	104.4	
149			2	600	Ball	Rotork	Steam	3500	800	17.65	0.0216	\$ 1,295	\$ 1,260	\$ 1,500	\$ 2,760	2.1	25.6	31%
150			2	600	Ball	Manual	Steam	3500	800	142.15	0.1739	\$ 10,433	\$ 1,260	\$ 1,500	\$ 2,760	0.3	3.2	377%
151			2.5	600	Ball	Manual	Steam	3500	800	4.55	0.0056	\$ 334	\$ 3,773	\$ 1,500	\$ 5,273	15.8	189.5	
152			2.5	600	Globe	Limitorque	Steam	660	500	0.29	0.0004	\$ 21	\$ 3,773	\$ 1,500	\$ 5,273	246.6	2959.6	
153			2.5	300	Globe	Limitorque	Water	150	350	11.16	0.0036	\$ 215	\$ 3,773	\$ 1,500	\$ 5,273	24.5	293.7	
154			2.5	300	Globe	Limitorque	Water	150	350	8.84	0.0028	\$ 171	\$ 3,773	\$ 1,500	\$ 5,273	30.9	370.9	
155			2.5	600	Globe	Limitorque	Steam	660	500	0.29	0.0004	\$ 21	\$ 3,773	\$ 1,500	\$ 5,273	246.6	2959.6	
156			1.5	1690	Globe	Limitorque	Steam	3500	800	7.95	0.0097	\$ 584	\$ 1,067	\$ 1,500	\$ 2,567	4.4	52.8	
157			1.5	1690	Globe	Limitorque	Steam	3500	800	7.16	0.0088	\$ 526	\$ 1,067	\$ 1,500	\$ 2,567	4.9	58.6	
158			4	1690	Globe	Limitorque	Steam	3500	750	26.37	0.0264	\$ 1,584	\$ 4,807	\$ 1,500	\$ 6,307	4.0	47.8	0%
159			1.5	2250	Ball	Rotork	Water	660	400	8.84	0.0033	\$ 199	\$ 1,067	\$ 1,500	\$ 2,567	12.9	154.9	
160			1.5	2250	Ball	Rotork	Water	660	400	9.37	0.0035	\$ 211	\$ 1,067	\$ 1,500	\$ 2,567	12.2	146.1	
161			1.5	2250	Ball	Rotork	Water	660	400	7.42	0.0028	\$ 167	\$ 1,067	\$ 1,500	\$ 2,567	15.4	184.6	
162			3	900	Globe	Manual	Water	660	400	14.51	0.0054	\$ 327	\$ 4,244	\$ 1,500	\$ 5,744	17.6	211.1	
163			6	300	Globe	Manual	Water	150	120	30.81	0.0027	\$ 163	\$ 6,879	\$ 2,500	\$ 9,379	57.7	692.2	
179			6	2250	Control	Fisher	Steam	3500	1062	3273.31	4.8025	\$ 288,152	\$ 10,160	\$ 2,500	\$ 12,660	0.0	0.5	2276%
180			6	2250	Control	Fisher	Steam	3500	1062	2393.80	3.5121	\$ 210,728	\$ 10,160	\$ 2,500	\$ 12,660	0.1	0.7	1665%
181			3	600	Globe	Manual	Water	660	400	58.86	0.0221	\$ 1,325	\$ 4,244	\$ 1,500	\$ 5,744	4.3	52.0	
32			2	1690	Globe	Manual	Water	3500	600	20.82	0.0129	\$ 771	\$ 1,260	\$ 1,500	\$ 2,760	3.6	43.0	5%
33			2	1690	Globe	Manual	Water	3500	600	31.33	0.0193	\$ 1,160	\$ 1,260	\$ 1,500	\$ 2,760	2.4	28.6	25%
34			2	1690	Globe	Manual	Water	3500	600	18.00	0.0111	\$ 666	\$ 1,260	\$ 1,500	\$ 2,760	4.1	49.7	
35			2	1690	Globe	Manual	Water	3500	600	16.01	0.0099	\$ 593	\$ 1,260	\$ 1,500	\$ 2,760	4.7	55.9	
36			2	1690	Globe	Manual	Water	3500	600	31.33	0.0193	\$ 1,160	\$ 1,260	\$ 1,500	\$ 2,760	2.4	28.6	25%
37			2	1690	Globe	Manual	Water	3500	600	24.09	0.0149	\$ 892	\$ 1,260	\$ 1,500	\$ 2,760	3.1	37.1	11%
38			2	1690	Globe	Manual	Water	3500	600	20.82	0.0129	\$ 771	\$ 1,260	\$ 1,500	\$ 2,760	3.6	43.0	5%
39			2	2500	Globe	Manual	Water	3500	600	23.40	0.0144	\$ 866	\$ 1,809	\$ 1,500	\$ 3,309	3.8	45.8	2%
40			2	2500	Globe	Manual	Water	3500	600	13.84	0.0085	\$ 512	\$ 1,809	\$ 1,500	\$ 3,309	6.5	77.5	
41			2	2500	Globe	Manual	Water	3500	600	13.44	0.0083	\$ 498	\$ 1,809	\$ 1,500	\$ 3,309	6.6	79.8	
42			2	2500	Globe	Manual	Water	3500	600	12.32	0.0076	\$ 456	\$ 1,809	\$ 1,500	\$ 3,309	7.3	87.1	
43			2	2500	Globe	Manual	Water	3500	600	14.25	0.0088	\$ 528	\$ 1,809	\$ 1,500	\$ 3,309	6.3	75.3	
44			2	2500	Globe	Manual	Water	3500	600	14.67	0.0091	\$ 543	\$ 1,809	\$ 1,500	\$ 3,309	6.1	73.1	
45			2	2500	Globe	Manual	Water	3500	600	9.75	0.0060	\$ 361	\$ 1,809	\$ 1,500	\$ 3,309	9.2	110.0	
46			2	2500	Globe	Manual	Water	3500	600	7.95	0.0049	\$ 294	\$ 1,809	\$ 1,500	\$ 3,309	11.2	134.9	
47			2	2500	Globe	Manual	Water	3500	600	8.43	0.0052	\$ 312	\$ 1,809	\$ 1,500	\$ 3,309	10.6	127.2	
48			2	2500	Globe	Manual	Water	3500	600	8.68	0.0054	\$ 321	\$ 1,809	\$ 1,500	\$ 3,309	10.3	123.6	
49			2	2500	Globe	Manual	Water	3500	600	10.34	0.0064	\$ 383	\$ 1,809	\$ 1,500	\$ 3,309	8.6	103.7	
50			2	800	-	Limitorque	Steam	660	775	19.70	0.0274	\$ 1,643	\$ 1,260	\$ 1,500	\$ 2,760	1.7	20.2	47%
51			2	800	-	Limitorque	Steam	660	775	1.06	0.0015	\$ 89	\$ 1,260	\$ 1,500	\$ 2,760	31.2	373.9	
52			2	800	Globe	Limitorque	Steam	150	715	0.59	0.0008	\$ 49	\$ 1,260	\$ 1,500	\$ 2,760	56.3	675.1	
53			2	1690	Globe	Limitorque	Steam	610	1062	0.97	0.0015	\$ 90	\$ 1,260	\$ 1,500	\$ 2,760	30.7	368.1	
54			2	2680	Globe	Limitorque	Steam	2530	1062	1.24	0.0019	\$ 112	\$ 1,809	\$ 1,500	\$ 3,309	29.6	355.7	
55			2	2680	Globe	Limitorque	Steam	2530	1062	1.53	0.0023	\$ 138	\$ 1,809	\$ 1,500	\$ 3,309	24.1	288.8	
56			2	2680	Globe	Limitorque	Steam	2530	1062	122.36	0.1831	\$ 10,989	\$ 1,809	\$ 1,500	\$ 3,309	0.3	3.6	331%
57			2	2680	Globe	Limitorque	Steam	2530	1062	31.53	0.0472	\$ 2,832	\$ 1,809	\$ 1,500	\$ 3,309	1.2	14.0	77%
58			2	2500	-	Limitorque	Steam	610	1062	0.57	0.0009	\$ 53	\$ 1,809	\$ 1,500	\$ 3,309	62.0	743.5	
59			3	2500	Globe	Gearbox	Steam	2530	1062	4.64	0.0070	\$ 417	\$ 4,422	\$ 1,500	\$ 5,922	14.2	170.4	

ATTACHMENT 1 : COMPLETE TEST RESULTS

VTI TEST #	VALVE DESCRIPTION						SERVICE CONDITIONS			LEAKAGE RATE (lbs/hr)	ENERGY LOSS (MMBtu/hr)	ANNUAL COST OF ENERGY LOSS @ \$7.50/MMBTU	REPLACEMENT VALVE COSTS			PAYBACK ON REPLACEMENT		4 YEAR INTERNAL RATE OF RETURN (IRR)
	PLANT TAG #	MFG	SIZE	CLASS	TYPE	ACTUATOR	FLUID	PRESS (PSIG)	TEMP (F)				VALVE COST	INSTALL COST	TOTAL	YRS	MNTHS	
60			3	2500	Globe	Gearbox	Steam	2530	1062	18.02	0.0270	\$ 1,619	\$ 4,422	\$ 1,500	\$ 5,922	3.7	43.9	4%
61			2	2500	Globe	Gearbox	Steam	2530	1062	110.24	0.1650	\$ 9,900	\$ 1,809	\$ 1,500	\$ 3,309	0.3	4.0	298%
62			2	2500	Globe	Gearbox	Steam	2530	1062	150.75	0.2256	\$ 13,538	\$ 1,809	\$ 1,500	\$ 3,309	0.2	2.9	409%
107			2	2500	Ball	Rotork	Steam	2530	1062	2.60	0.0039	\$ 233	\$ 1,809	\$ 1,500	\$ 3,309	14.2	170.3	
108			2	600	Ball	Rotork	Steam	660	800	1.16	0.0016	\$ 97	\$ 1,260	\$ 1,500	\$ 2,760	28.3	339.8	
109			2	300	Ball	Rotork	Steam	150	600	0.32	0.0004	\$ 25	\$ 1,260	\$ 1,500	\$ 2,760	108.4	1300.5	
110			2	300	Ball	Manual	Steam	150	600	0.23	0.0003	\$ 19	\$ 1,260	\$ 1,500	\$ 2,760	148.2	1778.3	
111			2	300	Ball	Manual	Steam	150	600	0.23	0.0003	\$ 19	\$ 1,260	\$ 1,500	\$ 2,760	148.2	1778.3	
112			2	300	Ball	Rotork	Steam	150	600	0.26	0.0003	\$ 21	\$ 1,260	\$ 1,500	\$ 2,760	133.5	1602.2	
113			2	600	Ball	Rotork	Steam	660	800	0.69	0.0010	\$ 58	\$ 1,260	\$ 1,500	\$ 2,760	47.7	572.5	
114			2	600	Ball	Manual	Steam	660	800	0.62	0.0009	\$ 52	\$ 1,260	\$ 1,500	\$ 2,760	53.0	635.4	
115			2	600	Ball	Manual	Steam	660	800	0.62	0.0009	\$ 52	\$ 1,260	\$ 1,500	\$ 2,760	53.0	635.4	
116			2	2500	Ball	Rotork	Steam	3500	1062	3.42	0.0050	\$ 301	\$ 1,809	\$ 1,500	\$ 3,309	11.0	131.8	
117			2	2500	Ball	Manual	Steam	3500	1062	162.37	0.2382	\$ 14,293	\$ 1,809	\$ 1,500	\$ 3,309	0.2	2.8	431%
118			2	2500	Ball	Manual	Steam	3500	1062	2.26	0.0033	\$ 199	\$ 1,809	\$ 1,500	\$ 3,309	16.7	200.0	
119			2	600	Ball	Rotork	Steam	660	1050	0.24	0.0004	\$ 22	\$ 1,260	\$ 1,500	\$ 2,760	123.5	1482.4	
120			2	600	Ball	Manual	Steam	660	1050	0.69	0.0011	\$ 63	\$ 1,260	\$ 1,500	\$ 2,760	43.5	522.4	
121			2	600	Ball	Manual	Steam	660	1050	0.56	0.0009	\$ 51	\$ 1,260	\$ 1,500	\$ 2,760	53.6	643.5	
122			2	2500	Ball	Rotork	Water	3500	400	8.84	0.0033	\$ 199	\$ 1,809	\$ 1,500	\$ 3,309	16.6	199.7	
123			2	600	Ball	Rotork	Water	660	400	8.10	0.0030	\$ 182	\$ 1,260	\$ 1,500	\$ 2,760	15.1	181.8	
124			2	600	Ball	Rotork	Steam	660	800	0.62	0.0009	\$ 52	\$ 1,260	\$ 1,500	\$ 2,760	53.0	635.4	
125			2	600	Ball	Manual	Steam	660	800	29.33	0.0412	\$ 2,472	\$ 1,260	\$ 1,500	\$ 2,760	1.1	13.4	81%
126			2	600	Ball	Manual	Steam	660	800	0.37	0.0005	\$ 31	\$ 1,260	\$ 1,500	\$ 2,760	89.2	1070.4	
127			6	1500	Globe	Gearbox	Water	3500	400	18.87	0.0071	\$ 425	\$ 10,160	\$ 2,500	\$ 12,660	29.8	357.8	
164			2.5	600	Globe	Limitorque	Steam	660	500	0.29	0.0004	\$ 21	\$ 3,773	\$ 1,500	\$ 5,273	246.6	2959.6	
165			2.5	300	Globe	Limitorque	Water	150	350	9.10	0.0029	\$ 176	\$ 3,773	\$ 1,500	\$ 5,273	30.0	360.2	
166			2.5	300	Globe	Limitorque	Water	150	350	9.93	0.0032	\$ 192	\$ 3,773	\$ 1,500	\$ 5,273	27.5	330.0	
167			2.5	600	Globe	Limitorque	Steam	660	500	0.29	0.0004	\$ 21	\$ 3,773	\$ 1,500	\$ 5,273	246.6	2959.6	
168			1.5	1690	Globe	Limitorque	Steam	3500	800	9.80	0.0120	\$ 719	\$ 1,067	\$ 1,500	\$ 2,567	3.6	42.8	5%
169			1.5	1690	Globe	Limitorque	Steam	3500	800	4.25	0.0052	\$ 312	\$ 1,067	\$ 1,500	\$ 2,567	8.2	98.7	
170			4	1690	Globe	Limitorque	Steam	3500	750	17.37	0.0174	\$ 1,043	\$ 4,807	\$ 1,500	\$ 6,307	6.0	72.5	
171			1.5	2250	Ball	Rotork	Water	3500	400	7.64	0.0029	\$ 172	\$ 1,067	\$ 1,500	\$ 2,567	14.9	179.2	
172			1.5	2250	Ball	Rotork	Water	3500	400	7.42	0.0028	\$ 167	\$ 1,067	\$ 1,500	\$ 2,567	15.4	184.6	
173			1.5	2250	Ball	Rotork	Water	3500	400	7.20	0.0027	\$ 162	\$ 1,067	\$ 1,500	\$ 2,567	15.8	190.0	
174			3	900	Globe	Manual	Water	660	400	12.18	0.0046	\$ 274	\$ 4,244	\$ 1,500	\$ 5,744	21.0	251.5	
175			6	300	Globe	Manual	Water	150	120	35.65	0.0031	\$ 188	\$ 6,879	\$ 2,500	\$ 9,379	49.9	598.2	
176			6	2500	Control	Fisher	Steam	3500	1062	14098.96	20.6857	\$ 1,241,144	\$ 11,220	\$ 2,500	\$ 13,720	0.0	0.1	9046%
177			6	2500	Control	Fisher	Steam	3500	1062	7540.28	11.0629	\$ 663,777	\$ 11,220	\$ 2,500	\$ 13,720	0.0	0.2	4838%
178			3	600	Globe	Manual	Water	660	400	27.57	0.0103	\$ 620	\$ 4,244	\$ 1,500	\$ 5,744	9.3	111.1	
63			1	600	Ball	Manual	Steam	660	650	2.51	0.0033	\$ 198	\$ 783	\$ 1,500	\$ 2,283	11.5	138.6	
64			1	600	Ball	Manual	Steam	660	650	0.88	0.0012	\$ 70	\$ 783	\$ 1,500	\$ 2,283	32.8	393.2	
65			2	600	Ball	Manual	Steam	660	650	11.04	0.0145	\$ 871	\$ 1,260	\$ 1,500	\$ 2,760	3.2	38.0	10%
66			2	600	Ball	Manual	Steam	660	800	2.16	0.0030	\$ 182	\$ 1,260	\$ 1,500	\$ 2,760	15.1	181.7	
67			2	600	Ball	Rotork	Steam	660	800	4.98	0.0070	\$ 420	\$ 1,260	\$ 1,500	\$ 2,760	6.6	78.9	
68			2	600	Ball	Manual	Steam	660	800	0.76	0.0011	\$ 64	\$ 1,260	\$ 1,500	\$ 2,760	43.0	515.8	
69			2	2500	Ball	Rotork	Steam	3500	1062	2.03	0.0030	\$ 179	\$ 1,809	\$ 1,500	\$ 3,309	18.5	222.0	
70			2	2500	Ball	Manual	Steam	3500	1062	1.83	0.0027	\$ 161	\$ 1,809	\$ 1,500	\$ 3,309	20.5	246.4	
71			2	2500	Ball	Rotork	Steam	3500	1062	1.83	0.0027	\$ 161	\$ 1,809	\$ 1,500	\$ 3,309	20.5	246.4	

ATTACHMENT 1 : COMPLETE TEST RESULTS

VTI TEST #	VALVE DESCRIPTION						SERVICE CONDITIONS			LEAKAGE RATE (lbs/hr)	ENERGY LOSS (MMBtu/hr)	ANNUAL COST OF ENERGY LOSS @ \$7.50/MMBTU	REPLACEMENT VALVE COSTS			PAYBACK ON REPLACEMENT		4 YEAR INTERNAL RATE OF RETURN (IRR)		
	PLANT TAG #	MFG	SIZE	CLASS	TYPE	ACTUATOR	FLUID	PRESS (PSIG)	TEMP (F)				VALVE COST	INSTALL COST	TOTAL	YRS	MNTHS			
72			2	600	Ball	Manual	Steam	660	1050	0.50	0.0008	\$ 46	\$ 1,260	\$ 1,500	\$ 2,760	59.5	714.3			
73			2	600	Ball	Manual	Steam	660	1050	0.56	0.0009	\$ 51	\$ 1,260	\$ 1,500	\$ 2,760	53.6	643.5			
74			2	600	Ball	Manual	Steam	660	1050	0.69	0.0011	\$ 63	\$ 1,260	\$ 1,500	\$ 2,760	43.5	522.4			
75			2	300	Ball	Rotork	Steam	150	650	1.79	0.0024	\$ 145	\$ 1,260	\$ 1,500	\$ 2,760	19.0	227.7			
76			2	300	Ball	Manual	Steam	150	650	0.38	0.0005	\$ 30	\$ 1,260	\$ 1,500	\$ 2,760	90.7	1088.8			
77			2	300	Ball	Manual	Steam	150	650	1.18	0.0016	\$ 96	\$ 1,260	\$ 1,500	\$ 2,760	28.8	345.7			
78			2	2500	Ball	Rotork	Steam	3500	1062	511.45	0.7504	\$ 45,023	\$ 1,809	\$ 1,500	\$ 3,309	0.1	0.9	1361%		
79			2	2500	Ball	Manual	Steam	3500	1062	118.74	0.1742	\$ 10,453	\$ 1,809	\$ 1,500	\$ 3,309	0.3	3.8	315%		
80			2	2500	Ball	Manual	Steam	3500	1062	57.21	0.0839	\$ 5,037	\$ 1,809	\$ 1,500	\$ 3,309	0.7	7.9	148%		
81			2	2500	Ball	Manual	Steam	3500	1062	4.22	0.0062	\$ 371	\$ 1,809	\$ 1,500	\$ 3,309	8.9	107.0			
82			2	2500	Ball	Manual	Steam	3500	1062	22.38	0.0328	\$ 1,970	\$ 1,809	\$ 1,500	\$ 3,309	1.7	20.2	47%		
83			2	2500	Ball	Rotork	Steam	3500	1062	273.53	0.4013	\$ 24,079	\$ 1,809	\$ 1,500	\$ 3,309	0.1	1.6	728%		
84			2	300	Ball	Rotork	Steam	150	600	3.53	0.0047	\$ 280	\$ 1,260	\$ 1,500	\$ 2,760	9.8	118.1			
85			2	300	Ball	Rotork	Steam	150	600	0.32	0.0004	\$ 25	\$ 1,260	\$ 1,500	\$ 2,760	108.4	1300.5			
86			2	1500	Ball	Rotork	Water	2530	600	6.48	0.0040	\$ 240	\$ 1,260	\$ 1,500	\$ 2,760	11.5	138.0			
87			2	300	Ball	Rotork	Steam	150	400	0.05	0.0001	\$ 3	\$ 1,260	\$ 1,500	\$ 2,760	823.3	9879.2			
88			2	300	Ball	Rotork	Steam	150	650	5.65	0.0076	\$ 458	\$ 1,260	\$ 1,500	\$ 2,760	6.0	72.3			
89			2	300	Ball	Manual	Steam	150	650	0.86	0.0012	\$ 70	\$ 1,260	\$ 1,500	\$ 2,760	39.4	472.7			
90			2	1500	Ball	Manual	Water	2530	650	6.62	0.0046	\$ 277	\$ 1,260	\$ 1,500	\$ 2,760	10.0	119.7			
91			2	300	Ball	Rotork	Steam	150	400	0.05	0.0001	\$ 3	\$ 1,260	\$ 1,500	\$ 2,760	823.3	9879.2			
92			2	300	Ball	Rotork	Steam	150	650	1.99	0.0027	\$ 161	\$ 1,260	\$ 1,500	\$ 2,760	17.1	205.2			
93			2	300	Ball	Manual	Steam	150	650	0.25	0.0003	\$ 20	\$ 1,260	\$ 1,500	\$ 2,760	137.7	1652.5			
94			2	600	Ball	Manual	Steam	660	650	3.16	0.0042	\$ 249	\$ 1,260	\$ 1,500	\$ 2,760	11.1	132.9			
95			2	600	Ball	Manual	Steam	660	800	1.95	0.0027	\$ 164	\$ 1,260	\$ 1,500	\$ 2,760	16.8	201.7			
96			2	600	Ball	Rotork	Steam	660	800	0.69	0.0010	\$ 58	\$ 1,260	\$ 1,500	\$ 2,760	47.7	572.5			
97			2	600	-	Sisco	Steam	660	800	6.10	0.0086	\$ 514	\$ 1,260	\$ 1,500	\$ 2,760	5.4	64.5			
98			2	600	Ball	Rotork	Steam	660	1050	0.27	0.0004	\$ 25	\$ 1,260	\$ 1,500	\$ 2,760	111.3	1335.6			
99			2	600	Ball	Manual	Steam	660	1050	3.28	0.0051	\$ 303	\$ 1,260	\$ 1,500	\$ 2,760	9.1	109.3			
100			2	600	Ball	Manual	Steam	660	1050	1.04	0.0016	\$ 96	\$ 1,260	\$ 1,500	\$ 2,760	28.7	344.2			
101			2	600	Ball	Rotork	Steam	660	1050	0.50	0.0008	\$ 46	\$ 1,260	\$ 1,500	\$ 2,760	59.5	714.3			
102			2	600	Ball	Manual	Steam	660	1050	1.28	0.0020	\$ 119	\$ 1,260	\$ 1,500	\$ 2,760	23.3	279.4			
103			2	600	Ball	Manual	Steam	660	1050	0.76	0.0012	\$ 70	\$ 1,260	\$ 1,500	\$ 2,760	39.2	470.6			
104			2	300	Ball	Rotork	Steam	150	600	0.13	0.0002	\$ 10	\$ 1,260	\$ 1,500	\$ 2,760	277.1	3325.2			
105			2	300	Ball	Manual	Steam	150	600	0.04	0.0000	\$ 3	\$ 1,260	\$ 1,500	\$ 2,760	968.8	11625.5			
106			2	300	Ball	Manual	Steam	150	600	0.23	0.0003	\$ 19	\$ 1,260	\$ 1,500	\$ 2,760	148.2	1778.3			
182			2	600	Ball	Rotork	Steam	660	1050	2.40	0.0037	\$ 222	\$ 1,260	\$ 1,500	\$ 2,760	12.5	149.4			
183			2	600	Ball	Manual	Steam	660	1050	0.56	0.0009	\$ 51	\$ 1,260	\$ 1,500	\$ 2,760	53.6	643.5			
184			2	600	Ball	Manual	Steam	660	1050	0.45	0.0007	\$ 42	\$ 1,260	\$ 1,500	\$ 2,760	66.1	792.8			
TOTAL:												\$ 2,673,862								