Multi-Dimensional Benchmarking

Columbia Generating Station

Nuclear Plant Cost and Production

Prepared for the
Bonneville Power Administration

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Executive Summary

This report contains the results of our analysis of Columbia Generating Station's costs and performance. Benchmarks based on *Multi-Dimensional Benchmarking (MDB)* are provided for the period 1995 to 2001. Actual costs and performance for the period 1995 to 2002 and budgeted costs and performance for 2003 are included in the Utility Charts and discussion. There are seven cost models, a staffing model, and a capacity factor model included in this report. The benchmarks were developed based on data from all commercial operating nuclear plants in the US from 1995 through 2001.

The essence of MDB is that it allows Columbia Generating Station to be compared on an apples-to-apples basis with all 104 nuclear reactors in the database regardless of their size and other physical characteristics. The ability to compare Columbia Generating Station with all the other plants over a seven-year period gives far higher validity to the findings than using small peer groups. Although data is not complete for all plants, we still had between 350 and 500 data points (depending on the model) with which to update the industry benchmarks.

Multi-dimensional analysis also provides insights into the industry as a whole. Columbia Generating Station's performance needs to be viewed in the context of these industry findings.

This is the third time Multi-Dimensional Benchmarking (based on the performance of all US operating nuclear plants) has been used to assess Columbia Generating Station's costs and performance.

The first report in 1994 and 1995 showed costs could be reduced by over 30% and the capacity factor could be increased by almost 20% for Columbia Generating Station to perform at the average level of a plant with its characteristics.

The second report was for the period up through 1998. This report found the plant had become one of the top 10% most cost efficient plants in the industry. Further, its capacity factor had increased dramatically from earlier levels.

Industry Findings

US nuclear power plants' actual Total Plant Costs in mills/kWh declined by 10% between 1997 and 2001. When adjustment is made for general inflation, costs were reduced by about 20% over this period.

The average capacity factor for the industry increased from 82% in 1997 to 90% in 2001 (based on a plant's original Design Electrical Rating).

Nuclear Plant Time Costs Indices (Appendix III) show O&M Costs have increased at 2.1% per year since 1995, Capital and Fuel Costs are lower now than in 1995, and Indirects Costs have only increased by a total of 2% over the entire period of 1995 to 2001. Use of escalation factors inconsistent with industry behavior will result in budget forecasts that are out of line with the rest of the industry.

The improvement in BWRs over this period was approximately 1% per annum better than the improvement at PWRs. Even with this improvement, BWRs are still 12% more costly than PWRs on a mills/kWh basis due to higher operations, capital, and fuel costs. Maintenance and capacity factors are now equal for BWRs and PWRs (all other factors being equal).

Since 1997 cost data for nuclear plants have become appreciably more consistent, and there are far fewer plants that have abnormally high outlying years.

The differential regional cost behavior that was very apparent ten years ago is far less marked today.

- There are no additional costs industry-wide associated with increased capacity factors (fuel costs in our models are on a mills/kWh basis). In fact, over the past 20 years, higher capacity factors have been strongly correlated with lower O&M costs at individual plans.

Columbia Generating Station's Performance

From 1997 through 2000, Columbia Generating Station's Total Plant Costs (Less Indirects) in mills/kWh were among the best in the industry.

In 2001 the plants' mills/kWh were nearly 20% above the benchmark. Overall, the plant is an industry outlier on the high side in four of the nine models in 2001.

- The actual 2002 mills/kWh level will be about 10% below the benchmark due to costs modestly higher than where the cost benchmarks are likely to be, combined with a 95.7% capacity factor (in the best 10% of the industry). Only Capital Costs will be a high industry outlier in 2002.

The 2003 budgeted costs are much higher than the high level in 2001 and the projected capacity factor of 88.6% is lower than 2002's 95.7% due to 2003 being a refueling year. Thus, the Total Plant Costs in 2003 are projected to be 22.9 mills/kWh, which will be more than 25% higher than the average benchmark. Overall, the plant will be an industry outlier on the high side for six of the nine models in 2003 if the Long Range Forecast of Operating Costs and Capital budget is followed.

- Maintenance Costs increased dramatically in 2001, declined in 2002, but are budgeted to increase to the highest levels since the early nineties in 2003.

  In the past five years, Columbia Generating Station is the only US nuclear plant with two out of three years of Maintenance Costs almost double their average benchmark (2001 and projected 2003).

- Capital Costs for the period 1998 to 2001 averaged 17% lower than its benchmark. Capital remained below the benchmark from 1997 to 2000 until rising just slightly above the benchmark in 2001.

  Fuel Costs were lower than the benchmark from 1995 to 1999, but were higher than the benchmark in 2000 and 2001. This was at least partially caused by the transition to a two-year fuel cycle. Fuel Costs in 2002 declined to the likely benchmark level.

  Average Total Costs (including Indirect Costs) for the period 2001 – 2003 are 33% higher than for the period 1997 to 2000. On a mills/kWh basis this is partially masked by a 15% increase in average capacity factor between the earlier and later period.

  Columbia Generating Station's Capacity Factor for the period 1998 to 2001 averaged 3% lower than its benchmark. However, 2002's 95.7% capacity factor was substantially above where the benchmark will be. The Capacity Factor for 2003 is off to a good start and the budgeted capacity factor of 88.6% if attained will also be above the benchmark.

  In 2001, Columbia Generating Station utility employees were 5% (40) above the benchmark, and calculated contractors were double the benchmark (168 too many) for average performance for a plant with Columbia Generating Station's characteristics.

- In 2001, Bonneville agreed with Energy Northwest's proposal to increase spending on reliability as a result of the California power crisis. The power supply situation has subsequently changed dramatically and cost of power is again a very important issue.

2001 Performance Benchmarks and Actual Costs

Model #	Model Description	2001 Benchmark Average	2001 Benchmark Top 25%	2001 Benchmark Top 10%	Actual 2001	Actual 2002	Budget 2003
1	Total Plant Costs (mills/kWh) Less Indirects	18.3	17.8	17.4	21.8	16.	22.9
2	O&M Costs ($M)	95.0	92.2	90.3	117.0	89.4	143.7
3	Operations Costs ($M)	59.7	57.3	56.1	58.4	59.9	75.5
4	Maintenance Costs ($M)	34.0	32.6	32.0	58.6	29.5	68.2
5	Capital Costs ($M)	14.2	13.3	12.9	15.1	22.4	17.6
6	Fuel Costs (mills/kWh)	4.50	4.37	4.28	5.25	4.28	4.12
7	Indirect Costs ($M)	30.2	28.4	27.2	45.1	36.0	37.1
8	Capacity Factor (%)	84.2	85.6	87.6	82.6	95.7	88.6
9	Utility Staff Plus Contractors (less indirects)	988	948	929	1,195	1,093	N/A

Note: Benchmarks do not sum exactly as benchmarks for each model are derived independently.

General Discussion

For the first time since significant regulatory changes began impacting nuclear power plants in 1972, the industry has again stabilized in an economic sense. This can be seen in individual plant data becoming far more consistent, i.e. less year-to-year variability and smaller differences between plants. There are still occasional data points where utilities have not followed the FERC Uniform System of Accounts guidance. However, with the improvement in the vast majority of data points it is relatively easy to isolate these bad data points and treat them appropriately.

There are at least two main factors that have contributed to the improvement in the quality and consistency of the data:

- All the plants (with the exception of Watts Bar) have passed their initial five-year start-up period. Start-up periods strongly distort costs, and

- Economic competition in electrical generation has resulted in significantly reduced costs and improved availability for all types of generating plants. As overall costs have decreased, regional differences in nuclear plant costs have also decreased dramatically.

As a result of the improved data quality and consistency, the impact of the individual physical aspects of a plant that drive costs can now be determined and isolated even more precisely than in the past. This is especially true for regional behavior which previously was partially obscured by what appeared to be "regional group think." Regional group think is where utilities in a region have costs higher (or very rarely lower) as a group than their physical aspects would predict. This appears to be the result of the "group" comparing themselves only or predominantly with the other utilities in the region. The current higher cost regions are now strongly correlated with the major metropolitan areas in the US.

In addition the savings that are available to utilities that operate more than one plant are more quantifiable. There are also far fewer plants that have individual outlying years which makes it much easier to identify plants with particularly high costs than it was ten years ago. On a total mills/kWh basis, dual unit plants are 14% cheaper than single unit plants. There is a 4% additional savings for three unit plants. Multi-plant owners (at one or more sites) have costs 5% to 15% lower, depending on the number and size of plants. All these considerations have been taken into account in determining the benchmarks for Columbia Generating Station, which does not have these economies.

We can also see the steady improvement of BWRs in relation to PWRs. However, BWRs are still 12% more expensive on a mills/kWh basis although maintenance costs and capacity factors are now essentially the same.

On the other hand, the significant impact of plant vintage on cost and performance remains unchanged and appears to be more related to physical aspects of those plants than management control. The plants that received their licenses between 1975 and 1982 are far more expensive to operate than earlier or later plants (all other things being equal).

The industry data for the plants used in the development of the nine analytical models comes predominantly from two sources. The O&M, Fuel Costs, and Capacity Factor data comes from the Nucleonics Week's annual table entitled "US Utility Costs" which come from the individual utility's FERC Form 1 and EIA 412 submittals. The Capital Costs, staffing data, and Indirect Costs come from the EUCG Nuclear Group database.

Multi-Dimensional Benchmarking Methodology

Multi-Dimensional Benchmarking uses historic data to test for and quantify the relationships that exist between the physical aspects of a business (i.e. size, age, location, etc.) and the operating costs and performance of that business. We identified the specific physical aspects (the cost drivers) that impact nuclear generation costs, staffing levels, and capacity factors. Using commonly used analytical techniques including a combination of iterative variance analysis and complex non-linear multiple regression, we isolated and quantified the mathematical relationships that exist between these cost drivers and the parameters studied. These mathematical relationships are subsequently used as normalizing factors (hereafter referred to simply as "factors") in models to normalize (i.e., equalize) all the nuclear plants being analyzed. Applying these factors puts dissimilar plants on the same basis; in other words, turns apples and oranges into just apples—rather like setting handicaps in golf which allows golfers of differing skills to play competitively.

By using our models, all plants can now be compared directly on a common basis. As a result, benchmarks for cost and performance for each individual plant can be determined far more precisely than with traditional benchmarking.

Multi-Dimensional Benchmarking is a significant advancement compared to conventional nuclear plant benchmarking methods. With conventional benchmarking, utilities generally try to compare their plants with a small peer group. However, with nuclear power plants, because there is such a wide variation in size, vintage, and other cost drivers, conventional benchmarking often results in confusing or misleading conclusions. As an example, forecasting the miles per gallon for a car is much more accurate if multiple dimensions (weight, number of cylinders, year of manufacture, etc.) are all used as opposed to just one or two dimensions such as year or engine displacement of the car.

In the case of nuclear power plants the key cost and performance drivers are size, vintage, number of plants operated by the utility, number of units at a site, PWR or BWR, and region where the plant is located.

Mult-Dimensional Benchmarking has also been successfully applied by J Lewis and Associates to benchmark distribution system costs and performance, transmission system costs, hydroelectric costs, and transmission line construction costs for utilities across the US.

The basic analytical approach of using linear and non-linear multiple-regression analysis for determining the relationships of costs, performance, expected power consumption, weather forecasting, etc. is widely used throughout industry and government.

Appendices

Appendix I — Table – Data Used for Columbia Generating Station's Analysis

Appendix II — Table - Columbia Generating Station 1995 - 2001 Performance

Performance information is summarized for all 9 models in this table. The table shows Columbia Generating Station's overall results, annual and average deviation along with the required deviation for Columbia Generating Station to attain the top 25% and top 10% performance levels in the industry.

Appendix III — Industry Time Cost Indices for the 33 single unit plants.

Time cost indices for Models 1 through 9 are used in the calculation of all Columbia Generating Station's benchmarks and represent industry-wide changes over time. These indices are different for each model and represent the average industry behavior of all the single unit plants in our database. We used the time indices for single unit plants instead of for all plants because multi-unit plants have slightly outperformed single unit plants over the past few years. Thus, it would be unfair to compare Columbia Generating Station (a single unit plant) to their behavior.

Model Utility Charts

Two lines are shown on each Utility Chart as follows:

1. The dark line represents Columbia Generating Station's average performance benchmark (expected performance of an average utility) with normalization for all its physical characteristics along with region and time.

2. The dotted line represents Columbia Generating Station's actual performance.

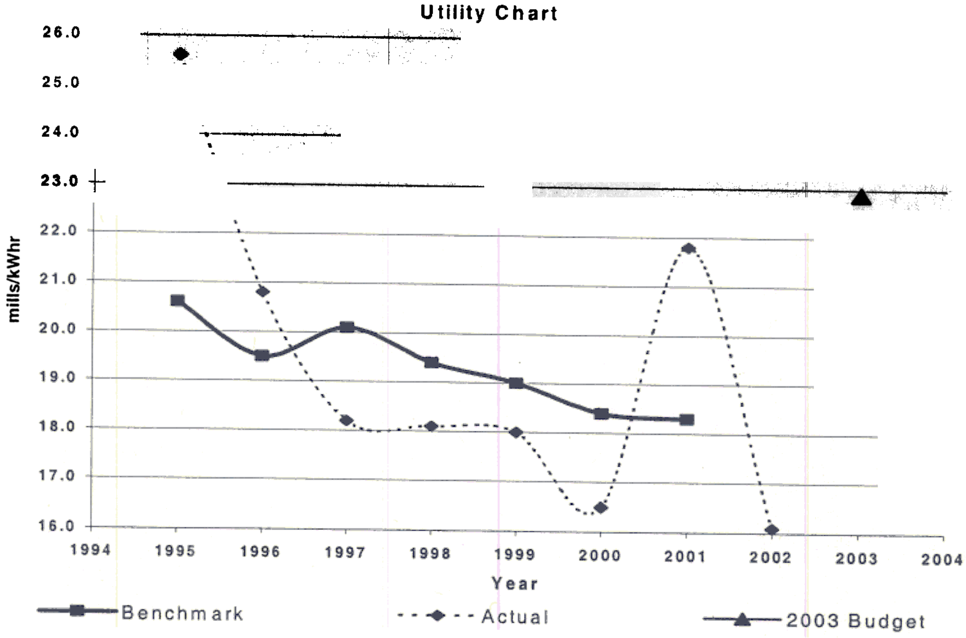
3. The single larger black triangle shows the budgeted level for 2003.

These charts show how Columbia Generating Station has performed annually over the past seven years (1995-2001). These charts include the impact on performance due to Columbia Generating Station's physical characteristics described in Appendix 1.

The utility charts are followed by a general discussion of Columbia Generating Station's performance. A small table is provided showing Columbia Generating Station's benchmark cost in 2001 for average, top 25%, and top 10% performance levels of the industry.

The upper quartile and upper decile level performance indicators are based on the sustainable rate over a five-year period for the industry excluding time changes. This provides a more consistent and precise benchmark. A plant's single year's performance can vary significantly from the average performance benchmark due to refueling, outages, major maintenance, etc,

Model 1 - Total Plant Costs (mills/kWh) Less Indirects



The above utility chart shows Columbia Generating Station's actual Total Plant Costs in mills/kWh for the period 1995-2002, its average benchmarks for 1995-2001, and its budgeted level for 2003. Total Plant Costs includes O&M, Capital, and Fuel but excludes Indirects. These benchmarks include adjustments for industry average performance changes over time and Columbia Generating Station's physical characteristics.

Columbia Generating Station's Total Plant Costs for the period 1998 to 2001 averaged 1% lower than its benchmark at 18.8mills/kWh. After falling dramatically from very high levels in 1994-1995 (1994's level of 27.1mills/kWh is not shown on the utility chart above) Columbia Generating Station remained as one of the top 10% plants in the industry from 1997 until 2000. However, the high costs in 2001 and budgeted 2003 now make the plant one of the 10% highest cost performers in the country. The long-range budget forecast shows very high costs in every refueling year through 2011.

Columbia Generating Station's 2002 actual performance will be substantially below (better than) the benchmark mainly due to the very high capacity factor in 2002. However, the budget for 2003 is very high, an industry outlier on the high side. This high budget cost is predominantly due to high maintenance and indirect costs.

An Industry Total Plant Costs Index is included in Appendix III. The index for Total Plant Costs fell from 1995 to 2001 at an average rate of 2.3% per annum (this decline includes the effects of inflation).

2001 Columbia Generating Station Performance Benchmarks
Total Plant Costs (mills/kWh)

Average Performance	Upper 25% Cutoff	Upper 10% Cutoff
18.3	17.8	17.4

Columbia Generating Station's 2001 and 2002 actual costs were 21.8m/ kWh and 16.1 mills/kWh respectively.

From the table above, it can be seen that Columbia Generating Station's 2001 Total Plant Costs benchmark is 18.3 mills/kWh. Further, changing from average to the upper 25% performance level changes the benchmark from 18.3 mills/kWh to 17.8 mills/kWh. Columbia Generating Station's 2001 actual performance of 21.8 mills/kWh was 19% above (worse than) the average performance benchmark of 18.3 mills/kWh. Budgeted 2003 performance is around 25% higher than where the 2003 benchmark will likely be, again an industry outlier.

The benchmark is really the average of refueling and non-refueling years. Columbia Generating Station's very high actual performance in 2001 and budgeted performance in each subsequent refueling year included in the long range forecast will make it an industry high side outlier every other year, and well above average on a multi-year basis period.

Methodology to extrapolate benchmarks into the future:

An equivalent performance benchmark for 2002 can be estimated by calculating as shown below. To calculate an estimated 2002 average benchmark, an assumption for the Industry Cost Index (Appendix III) is required. For example, assuming an Industry Index decrease of 1% per annum, the calculation would modify the 2001 average benchmark of 18.3 mills/kWh as follows:

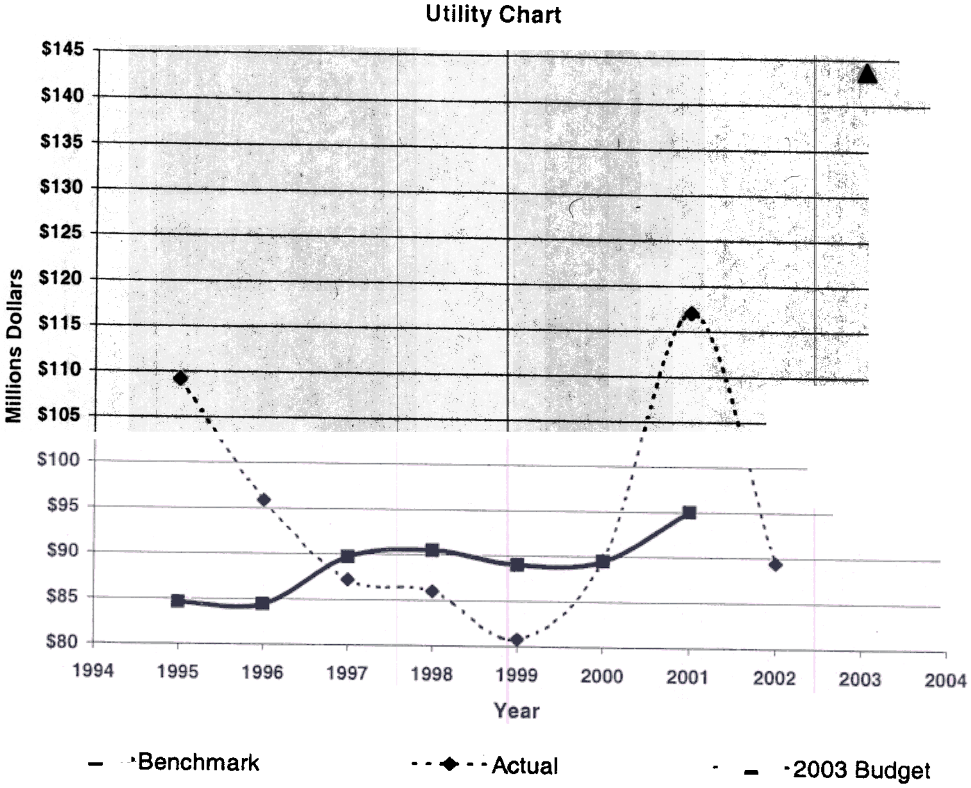
18.3 mills/kWh x (1.00-0.01) = 18.1 mills/kWh.

The corresponding upper 25% and 10% cutoff benchmarks for 2001 would be calculated using the appropriate percentages shown in Appendix II. For example, the calculation for Columbia Generating Station's 2001 top 25% benchmark would be as follows:

18.1 mills/kWh x 0.97 = 17.6 mills/kWh

In the example calculation above, we estimated a future index change for this model based on the 2000-2001 period. The annual decrease was actually 2 percent per year over the 1995-2001 period. Generally, we believe the average trend over a few years is more indicative than individual year indices. However, predicting the future is beyond the scope of this contract. We show this industry index prediction for illustrative purposes only. The reader can make their own estimate of this cost index based on the indices provided along with their individual management judgment.

Model 2 Operations and Maintenance Costs



The above utility chart shows Columbia Generating Station's actual O&M Costs for the period 1995-2002, its average benchmarks for 1995-2001, and its budgeted level for 2003. These benchmarks include adjustments for time and Columbia Generating Station's physical characteristics.

Columbia Generating Station's O&M costs for the period 1998 to 2001 averaged 2% higher than its benchmark. Costs declined significantly from 1995 to 1999 before rising rapidly in 2000 and 2001 while the benchmark increased from about $85M to $95M over the same period.

Columbia Generating Station's 2002 actual O&M Costs will be significantly below the benchmark. The budget for 2003 is approximately 35% above where the benchmark will likely be. As a result, 2003 O&M will be an industry outlier. This high budget cost is predominantly due to very high maintenance costs, but operations costs are also significantly higher than where their expected benchmark will be.

An Industry O&M Costs Index is included in Appendix III. The O&M Costs Index has increased at 2.1% per annum since 1995. This is about the same as general inflation for the period 1995 through 2001.

2001 Columbia Generating Station Performance Benchmarks
O&M Costs

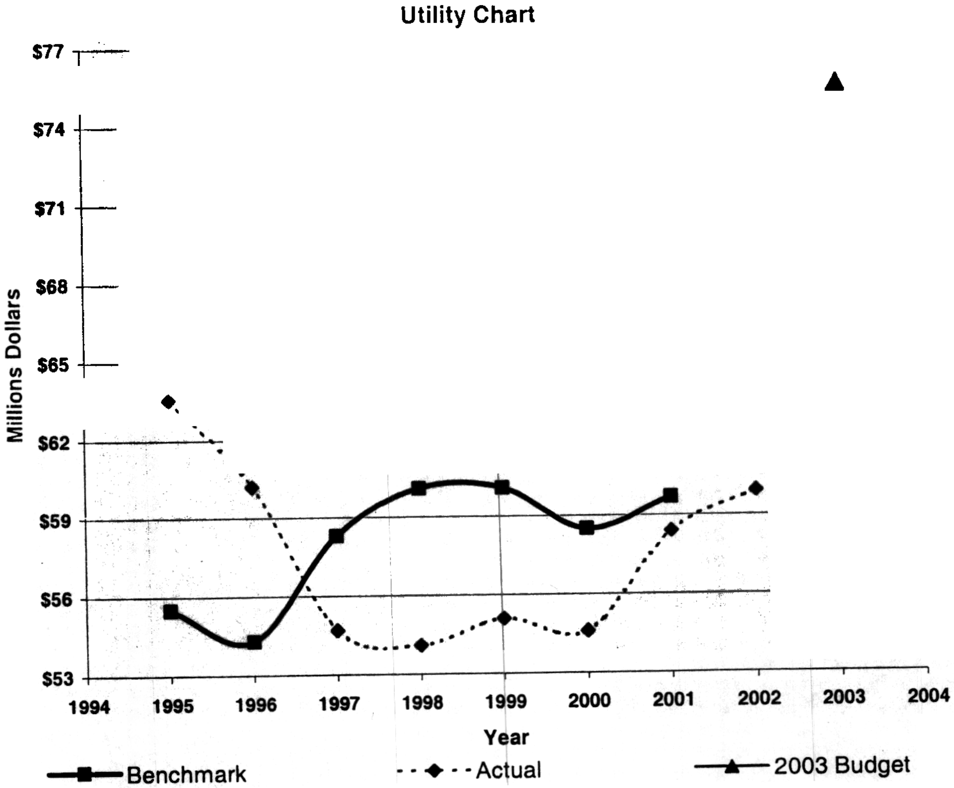
Average Performance	Upper 25% Cutoff	Upper 10% Cutoff
$95.0M	$92.2M	$90.3M

Columbia Generating Station's 2001 and 2002 actual costs were $117.0M and $89.4M respectively.

From the table above, it can be seen that Columbia Generating Station's 2001 O&M benchmark is $95.0M. Further, changing from average to the upper 25% performance level changes the benchmark from $95.0M to $92.2M. Columbia Generating Station's 2001 actual costs of $117.0M are 23% above the average performance benchmark of $95.0M.

The benchmark is really the average of refueling and non-refueling years. Columbia Generating Station's very high actual performance in 2001 and budgeted performance in each subsequent refueling year included in the long range forecast will make it an industry high side outlier every other year.

Model 3 - Operations Costs



The above utility chart shows Columbia Generating Station's actual Operations Costs for the period 1995-2002, its average benchmarks for 1995-2001, and its budgeted level for 2003. These benchmarks include adjustments for time and Columbia Generating Station's physical characteristics.

Columbia Generating Station's Operations Costs for the period 1998 to 2001 averaged 7% lower than its benchmark. Costs were significantly above the benchmark until 1997 at which time they declined to a level below the benchmark.

Columbia Generating Station's 2002 actual Operations Costs will be near or below the benchmark. However the 2003 budgeted costs will be about 25% higher than the likely benchmark and will be an industry outlier.

An Industry Operations Costs Index is included in Appendix III. The Operations Costs Index has risen at 1.3% per annum over the period 1995 through 2001 which is significantly less than general inflation over the same period.

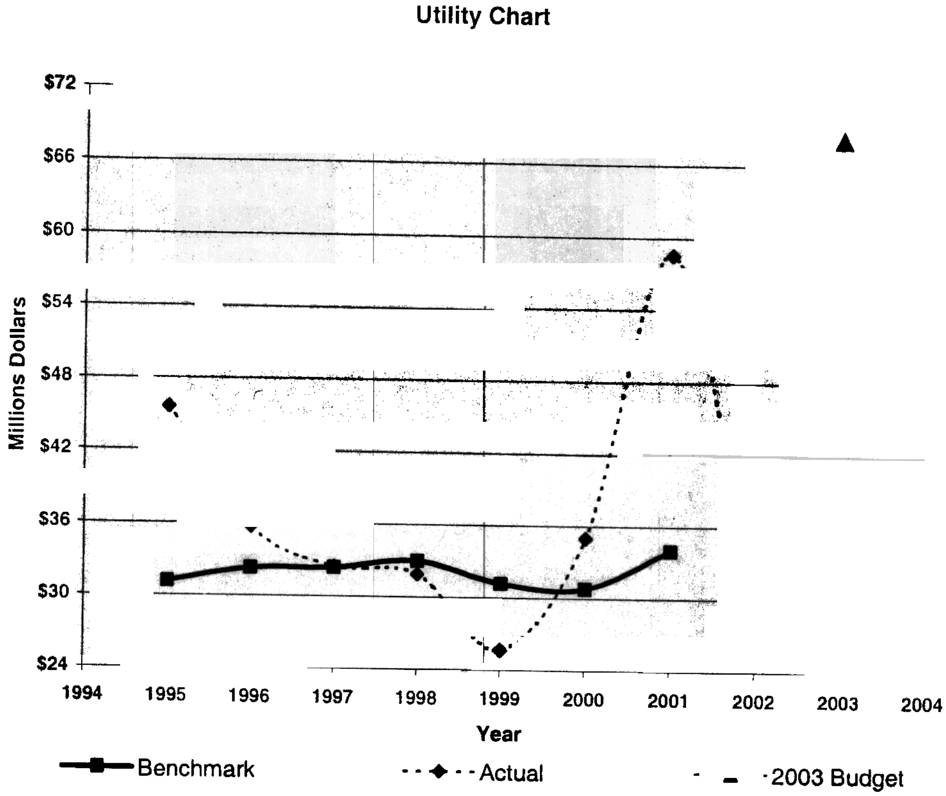
2001 Columbia Generating Station Performance Benchmarks
Operations Costs

Average Performance	Upper 25% Cutoff	Upper 10% Cutoff
$59.7M	$57.3M	$56.1M

Columbia Generating Station's 2001 and 2002 actual costs were $58.4M and $59.9M respectively.

From the table above, it can be seen that Columbia Generating Station's 2001 Operations Cost benchmark is $59.7M. Further, changing from average to the upper 25% performance level changes the benchmark from $59.7M to $57.3M. Columbia Generating Station's 2001 actual costs of $58.4 are 2% below the average performance benchmark of $59.7M.

Model 4 – Maintenance Costs



The above utility chart shows Columbia Generating Station's actual Maintenance Costs for the period 1995-2002, its average benchmarks for 1995-2001, and its budgeted level for 2003. These benchmarks include adjustments for time and Columbia Generating Station's characteristics.

Columbia Generating Station's Maintenance Costs for the period 1998 to 2001 averaged 16% higher than its benchmark. Costs were significantly above the benchmarks until 1997, at which time they dropped below the benchmark. Maintenance Costs increased somewhat in 2000 and increased dramatically in 2001 to almost twice the 1997 to 2000 average. This type of massive price spike does occur at other plants in the industry but normally no more often than once in ten years and then only for a single year.

Columbia Generating Station's 2002 actual Maintenance Costs dropped to a level that will be below the benchmark. However, the 2003 budgeted costs of $68.2M will again be nearly twice the benchmark. This second budget excursion in such a short period of time is unprecedented in the nuclear industry since the mid-nineties. The out-year budgets through 2011 show "Subtotal Outage and Major Maintenance" oscillating by about $40M or more between refueling and non-refueling years. If this budget performance takes place, Columbia Generating Station will be a major industry outlier every other year.

The wide oscillations in maintenance costs that used to coincide with refueling outages are becoming less marked throughout the industry. This appears to be the result of more on-line maintenance and the resultant shorter refueling outages. The Table below shows the maintenance costs at Columbia Generating Station and five plants that Energy Northwest is using as peer plants for the period 1997 to 2001.

Maintenance Costs (raw data)

Plant	1997	1998	1999	2000	2001	Average
	$M					
Grand Gulf (1250MW)	33.9	30.4	32.4	29.5	28.4	30.9
Wolf Creek (1170MW)	43.5	**22.4**	36.8	41.7	35.0	35.6
Callaway (1170MW)	25.2	40.6	38.0	27.8	**56.1**	37.5
Waterford (1105MW)	50.7	46.7	39.4	35.6	35.7	41.6
Perry (1190MW)	41.0	22.2	47.0	23.6	34.0	33.6
Columbia Generating Station (1105MW)	32.5	31.9	25.7	35.0	**58.6**	36.7

1. Bold numbers indicate outlier data.
2. The plant size in MWs is the original plant license "Design Electrical Rating."

Note there are only three outlier years out of 30 plant years of data, i.e. one outlier year per ten plant years. Columbia Generating Station had an outlier year in 2001 and is presently budgeting for another in 2003 and every refueling year through 2011.

Further, we have compiled the raw maintenance costs from 1989 to 2001 for the 11 largest single-unit plants in the US (Watts Bar, Seabrook, Millstone 3, Wolf Creek, Callaway, Hope Creek, Nine Mile 2, Fermi, Columbia Generating Station, Perry, and Grand Gulf).

What we found was that these costs were very similar at each of the plants and surprisingly consistent over the years. Time adjusted annual costs varied by no more than +/- 30% from their 13-year average, 89% of the time. In other words, one year in ten costs will fall below 70% of the 13-year average, and one year in ten will increase by more than 30% above the average.

Columbia Generating Station followed this pattern from 1989 to 2000 with a high of 43% above average in 1994 and a low of 32% below average in 1999. However, the costs in 2001 were 55% above average, and are budgeted to be about 60% above average in 2003 and 2005 (and high every refueling year thereafter).

There is no precedent for this behavior in the industry for this type of plant over the past 13 years with the exception of Millstone 3. Millstone 3 was on the NRC problem plant list from 1996 to 1999.

An Industry Maintenance Costs Index is included in Appendix III. The Maintenance Cost Index has fluctuated significantly over the period. Its level in 2001 was 9.4% higher than its level in 1995. Thus, on average it has increased at 1.6% per annum which is a little less than the general rate of inflation over the entire period. The index has not behaved in a smooth manner, it increased over 10% from 2000's level (which was the lowest in the entire period). However, dual unit plants escalated at the much lower rate of 2% between 2000 and 2001.

2001 Columbia Generating Station Performance Benchmarks
Maintenance Costs

Average Performance	Upper 25% Cutoff	Upper 10% Cutoff
$34.0M	$32.6M	$32.0M

Columbia Generating Station's 2001 and 2002 actual costs were $58.6M and $29.5M respectively.

From the table above, it can be seen that Columbia Generating Station's 2001 Maintenance Costs benchmark is $34.0M. Further, changing from average to the upper 25% performance level changes the benchmark from $34.0M to $32.6M. Columbia Generating Station's 2001 actual costs of $58.6M are 72% above the average performance benchmark of $34.0M which makes it an outlier in the industry for this year.

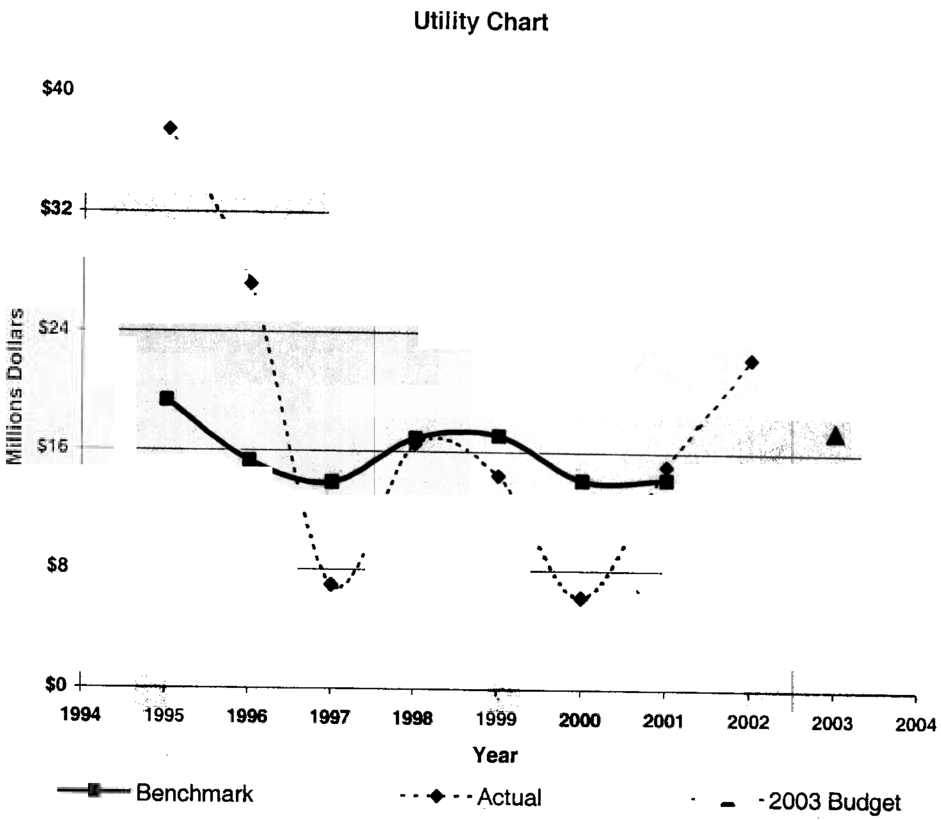
There has been some discussion that the extraordinary increases in maintenance costs may be the result of work originally deferred during the 1998 to 2000 time period. Maintenance costs during this period averaged 98% of the average performance benchmark. Examples of deferred projects include:

ISI	$2.6 M
RFW-1 A rebuild	$0.856M
Main gen. inspect	$1.5M
Preventive maintenance Optimization	$0.365M
Kaman Rad monitor replacement	$0.633M
Upgrade security systems (non 9/11)	$3.227M

HWC/Noble metals	$4.9M
Minor modifications	
Plant HVAC	$0.105M
Turbine lube oil	$0.173M
RW roof repair	$0.173M
TS amendment DG	$0.313M

These projects total less than $15M and only partially explain the massive increases in actual 2001 costs or the increases every refueling year in the Long Range Forecast of Operating Costs and Capital budget.

Model 5 Capital Costs



The above utility chart shows Columbia Generating Station's actual Capital Costs for the period 1995-2002, its average benchmarks for 1995-2001, and its budgeted level for 2003. These benchmarks include adjustments for time, and Columbia Generating Station's physical characteristics.

Columbia Generating Station's Capital Costs for the period 1998 to 2001 averaged 17% lower than its benchmark. Costs were above the benchmark until 1997. Capital remained below the benchmark from 1997 to 2000 until rising just slightly above the benchmark in 2001. Columbia Generating Station's 2002 actual costs were substantially above where the benchmark will likely be. Capital Costs for 2003 are budgeted to return to benchmark levels.

An Industry Capital Costs Index is included in Appendix III. The Capital Costs Index fluctuated significantly during the period 1995 to 2001 with a general down trend. The index ended the period at only 90% of the seven-year average and 27% below the 1995 level. If this index were expanded to show earlier years it would clearly show that capital costs have decreased at about 5% per annum since peaking in 1993. This decrease in capital costs has been a major component of the overall reduction in nuclear generation costs.

2001 Columbia Generating Station Performance Benchmarks
Capital Costs

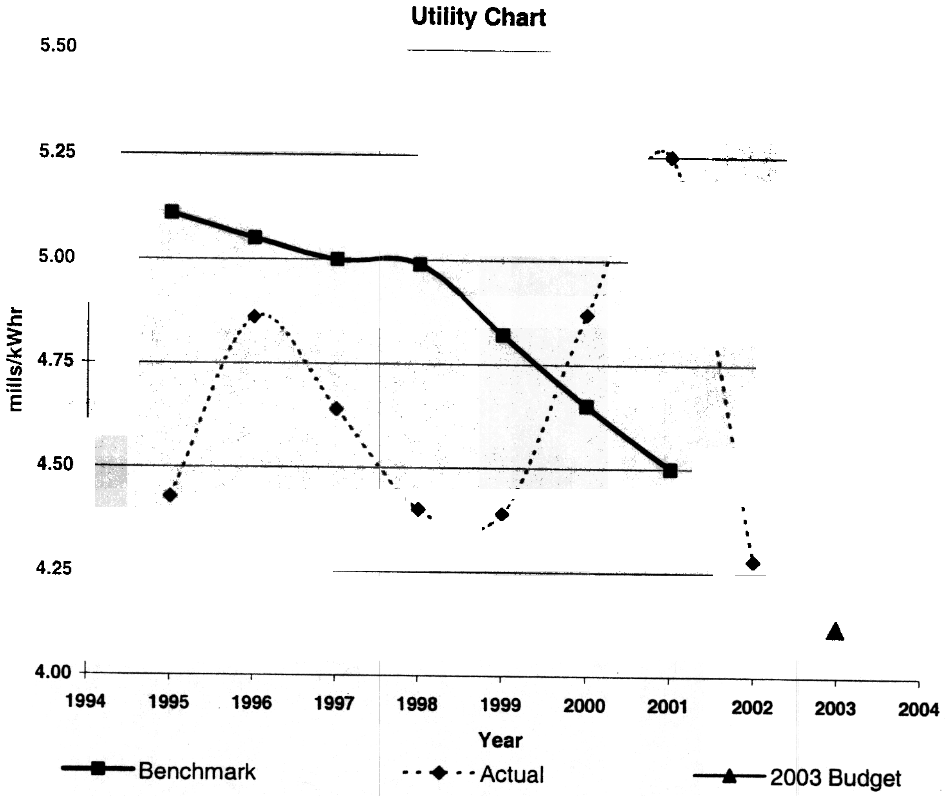
Average Performance	Upper 25% Cutoff	Upper 10% Cutoff
$14.2M	$13.3M	$12.9M

Columbia Generating Station's 2001 and 2002 actual costs were $15.1M and $22.4M respectively.

From the table above, it can be seen that Columbia Generating Station's 2001 Capital Costs benchmark is $14.2M. Further, changing from average to the upper 25% performance level changes the benchmark from $14.2M to $13.3M. Columbia Generating Station's 2001 actual costs of $15.1M are 6% above the average performance benchmark of $14.2M.

A single year of very high capital costs such as Columbia Generating Station's 2002 cost performance is not unusual in the industry.

Model 6 Fuel Costs



The above utility chart shows Columbia Generating Station's actual Fuel Costs for the period 1995-2002, its average benchmarks for 1995-2001, and its budgeted level for 2003. These benchmarks include adjustments for time and Columbia Generating Station's physical characteristics.

Columbia Generating Station's Fuel Costs for the period 1998 to 2001 averaged the same as its benchmark. Costs have trended higher since 1999 and ended 17% higher than the benchmark in 2001. Part of this cost increase is due to the transition to a two-year fuel cycle. Historically Columbia Generating Station has had fuel cost significantly below the industry average. In recent years the industry's fuel cost performance has improved dramatically.

Columbia Generating Station's 2002 actual and 2003 budgeted Fuel Costs performance has improved substantially and will likely be at or slightly below the benchmarks.

All of the other cost models in this report are based on actual cash flows. This model is the exception based on FERC's Uniform System of Accounts definition of fuel costs. It states, "....charges to this account are distributed according to the thermal energy produced in such periods."

An Industry Fuel Costs Index is included in Appendix III. The Fuel Costs Index has been declining during the entire period with an accelerated decline after 1998. The 2001 level was almost 8% lower than the seven-year average and 12% lower than it was in 1995, which in inflation-adjusted dollars is 25% lower.

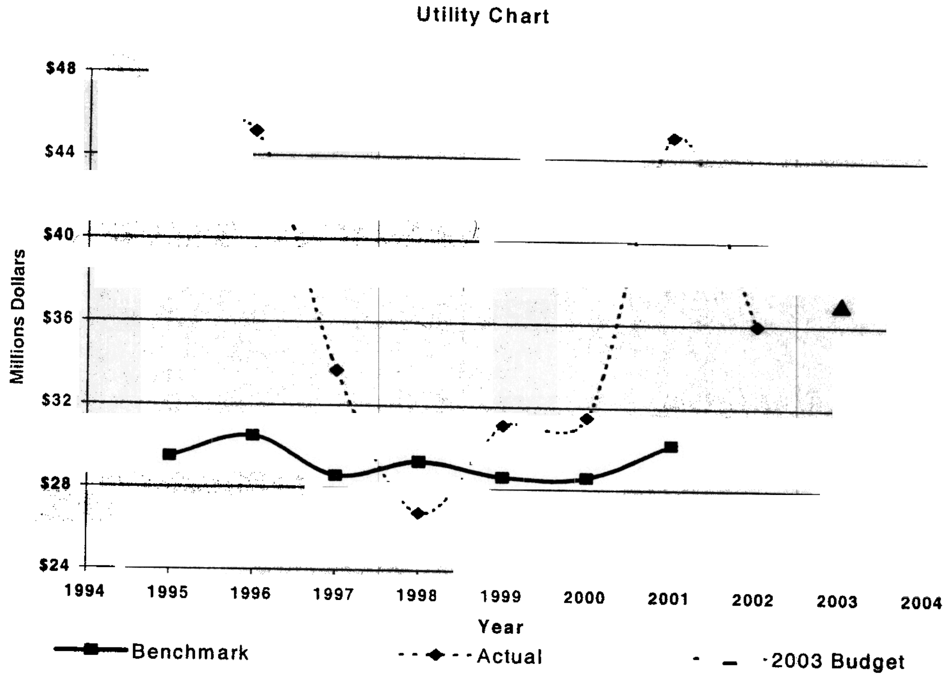
2001 Columbia Generating Station Performance Benchmarks
Fuel Costs

Average Performance	Upper 25% Cutoff	Upper 10% Cutoff
4.50 mills/kWh	4.37 mills/kWh	4.28 mills/kWh

Columbia Generating Station's 2001 and 2002 actual costs were 5.25 mills/kWh and 4.28 mills/kWh respectively.

From the table above, it can be seen that Columbia Generating Station's 2001 Fuel Costs benchmark is 4.50 mills/kWh. Further, the benchmark changes from 4.50 mills/kWh to 4.37 mills/kWh when moving from the average performance level to the upper 25% performance level. Columbia Generating Station's 2001 actual costs of 5.25 mills/kWh are 17% above the average performance benchmark of 4.50 mills/kWh, but in 2002 the costs will be essentially in line with the benchmarks.

Model 7 – Indirect Costs



The above utility chart shows Columbia Generating Station's actual Indirect Costs for the period 1995-2002, its average benchmarks for 1995-2001, and its budgeted level for 2003. These benchmarks include adjustments for inflation and Columbia Generating Station's physical characteristics.

Columbia Generating Station's Indirect costs for the period 1998 to 2001 averaged 15% higher than the benchmarks. The difference between actual and benchmark cost fluctuated significantly over the period and was close to the benchmark for the period 1997 to 2000 before increasing by about 50% in 2001. These costs are similar to the level in 1995 and 1996 when there were very large severance payments. This high level makes Columbia Generating Station an industry outlier. We have not been able to determine the reason for these significant increases in indirect costs.

In our 1998 report we pointed out that Indirect Costs on the West Coast were higher than in the rest of the country (all other things being the same). By 2001 this regional disparity had gone away and the entire country is in the same region with the exception of the Northeast States where costs are 15% higher than the rest of the country.

Although 2002 actual Indirect Costs were substantially below 2001's, they will still be substantially above the 2002 benchmark.

The budgeted 2003 performance will also be substantially higher than the likely benchmark.

An Industry Indirect Costs Index is included in Appendix III. The Indirect Costs Index has fluctuated over the period 1995 to 2001 and ended only 2% higher in 2001 than the 1995 level.

2000 Columbia Generating Station Performance Benchmarks
Indirect Costs

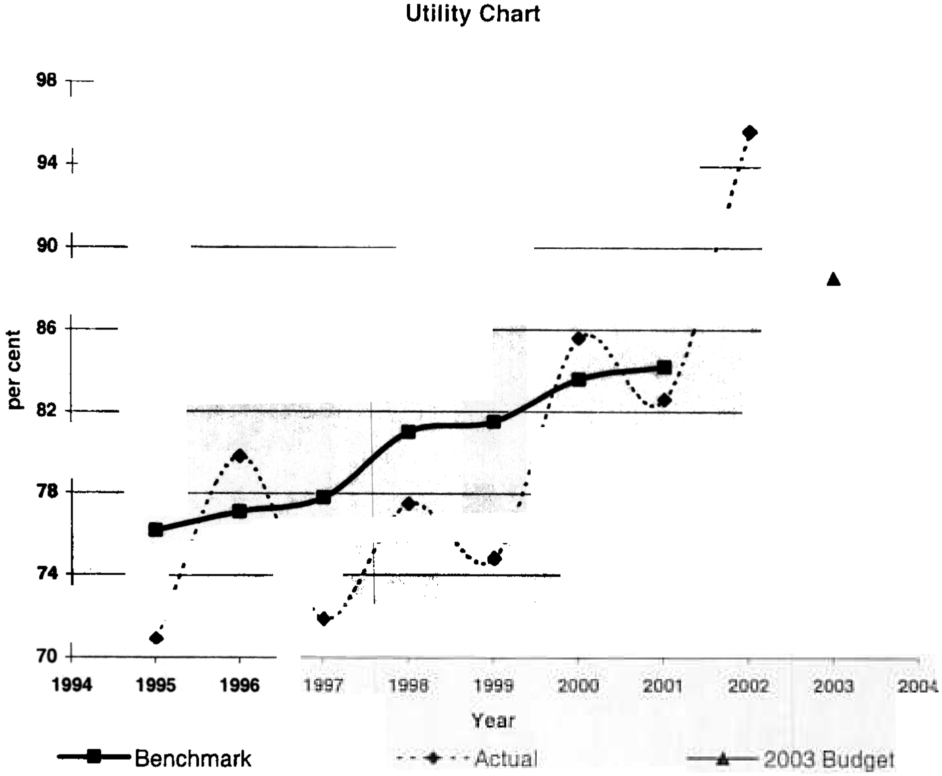
Average Performance	Upper 25% Cutoff	Upper 10% Cutoff
$30.2M	$28.4M	$27.2M

Columbia Generating Station's 2001 and 2002 actual costs were $45.1M and $36.0M respectively.

From the table above, it can be seen that Columbia Generating Station's 2001 Indirect Costs benchmark is $30.2M. Further, changing from average to the upper 25% performance level changes the benchmark from $30.2M to $28.4M. Columbia Generating Station's 2001 actual costs of $45.1M are 49% above the average performance benchmark of $30.2M.

The 2002 actual and budgeted 2003 Indirect Costs will make Columbia Generating Station close to or actually an industry outlier.

Model 8 – Capacity Factor (Original Design Electrical Rating)



The above utility chart shows Columbia Generating Station's actual Capacity Factor for the period 1995-2002, its average benchmarks for 1995-2001, and its budgeted level for 2003. These benchmarks include adjustments for time and Columbia Generating Station's physical characteristics. The actual capacity factors used in this utility chart and throughout the report include the credit for economic dispatch.

Columbia Generating Station's Capacity Factor for the period 1998 to 2001 averaged 3% lower than its benchmark. However, 2002's 95.7% capacity factor was substantially above where the benchmark will be. The Capacity Factor for 2003 is off to a good start and the budgeted capacity factor of 88.6% if attained will also be above the benchmark. Columbia Generating Station's actual Capacity Factor has risen faster than the benchmark, so there has been a steady improvement in the plant's performance.

Power magazine's August 2002 issue reported the average capacity factor for all US plants averaged 87% and 88% for 2000 and 2001 respectively. They attribute these high capacity factors to greatly reduced unplanned outages and reducing the length of refueling outages. "In 1990, the US average for refueling outages was 105 days, and the median outage was 76, according to INPO. By 2000, these numbers had dropped to 39.9 and 35 days respectively." They report that Exelon, with a fleet of 20 nuclear units average only 22 days per refueling outage. For the first half of 2001, Excelon's average was only 16 days.

The best BWR's are finishing refueling outages in as little as 14 days, 16 hours (Browns Ferry-3).

Capacity Factors for Large Single Unit Post TMI Plants
(Based on Original Design Electrical Rating)

Plant	1997	1998	1999	2000	2001	Average
	%					
Grand Gulf	99	84	77	98	91	90
Wolf Creek	82	101	89	89	101	92
Callaway)	87	83	84	98	82	87
Waterford	69	89	77	88	99	84
Perry	78	99	88	97	75	87
Hope Creek	68	93	83	78	86	82
Nine Mile 2	92	76	92	84	96	88
Fermi	58	74	99	86	89	81
Columbia Generating Station)	72	78	75	86	83	79

Note: The capacity factors in this table are raw numbers except that Columbia Generating Station's capacity factors were credited with economic dispatch.

Columbia Generating Station had a 95.7% capacity factor in 2002 and forecasts an 87% capacity factor in 2003. It's Capacity Factor performance since 2000 has been particularly good.

An Industry Capacity Factor Index is included in Appendix III. The time index for Capacity Factors rose at 1.8% per year over the entire period.

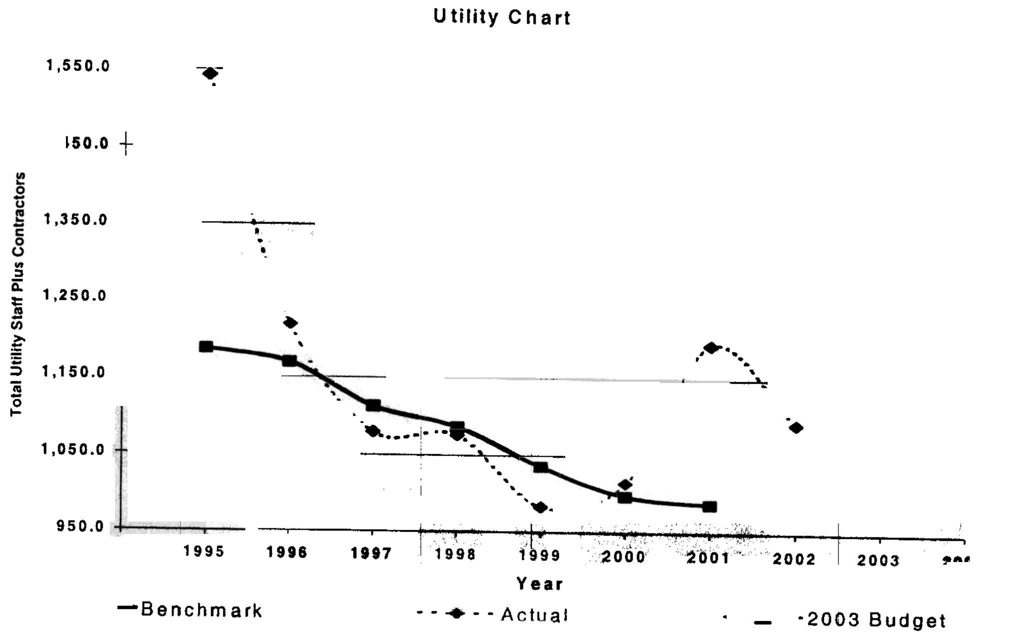
2001 Columbia Generating Station Performance Benchmarks
Capacity Factor

Average Performance	Upper 25% Cutoff	Upper 10% Cutoff
84.2%	85.6%	87.6%

Columbia Generating Station's 2001 and 2002 actual capacity factors were 82.6% and 95.7% respectively.

From the table above, it can be seen that Columbia Generating Station's 2001 Capacity Factor benchmark is 84.2%. Further, changing from average to the upper 25% performance level changes the benchmark from 84.2% to 85.6%. Columbia Generating Station's 2001 actual capacity factor of 82.6% was 2% below the average performance benchmark of 84.2%. The 2002 capacity factor of 95.7% will be substantially higher than the 2002 benchmark and the two-year average of 89.2% puts Columbia Generating Station in the top 10% of the industry for a plant with its characteristics.

Model 9 – Utility Staff Plus Contractors (Less Indirects)



The above utility chart shows Columbia Generating Station's actual Utility Staff Plus Contractors for the period 1995-2002, its average benchmarks for 1995-2001, and its budgeted level for 2003. These benchmarks include adjustments for the time behavior of the industry and Columbia Generating Station's physical characteristics. Columbia Generating Station is in a region where Total Utility Plus Contractor Staffing is 7% lower than industry average. More than 60% of all plants fall into this region.

Columbia Generating Station's Utility Staff plus Contactors performance for the period 1998 to 2001 averaged more than 4% above its benchmark. From 1996 to 2000 the labor force was at or below its benchmark with contractors on average representing 16% of the total labor force. However, this changed dramatically in 2001 with a 20% increase in total labor requirements. There was some reduction in 2002, but the 2003 budget calls for a labor force even greater than the 2001 level. The increase is predominantly in the "outside services" category which funds contractors.

In 2001 the Utility Staff Plus Contractors (not including indirects) benchmark was 988 (830 utility employees plus 158 contractors). Columbia Generating Station's actual labor force that year was 1,195 (869 utility employees plus 326 contractors). Columbia Generating Station does not submit contractor numbers to the EUCG. However, between 2000 and 2001, its outsides service cost rose from $24 million to $47 million; and at the average industry contractor rate of $144,000 per annum this represents a 160 contractor increase. Even using traditional benchmarking methods, Columbia Generating Station's labor requirements in 2001 of 1,195 are significantly higher than its peers. There are five other large, post-TMI, single unit BWR plants in the country. These are Hope Creek, Nine-Mile 2, Fermi, Perry, and Grand Gulf. The respective labor forces (including contractors) for these plants in 2001 were 995, 850, 964, 901, and 900. Furthermore, the best performing large dual-unit BWRs at Limerick and LaSalle in 2001 were 1046 and 1018 respectively (total for two reactors, not per unit).

In 2001 Columbia Generating Station had 5% (40) too many utility employees and twice the number of contractors (168) too many for average performance. The 2003 budget equates to even higher labor requirements than in 2001.

This Utility Staff Plus Contractors Model includes utility employees (excluding indirects) plus all contractors (both short term and long term). To fairly compare all plants on an equal basis it is necessary to include both utility staff and contractors. In 1997, on average, utility employees (at single-unit plants) represented 68% of all labor requirements; by 2001 this had increased to 76%. This has been due to utility employees remaining static over this period, while contractors have been reduced by 1/3. The reduction in contractors is likely largely influenced by the significantly reduced outage times at plants.

The labor numbers used in this analysis come from the nuclear Electric Utility Cost Group (EUCG) database. Since 1996 EUCG has asked its members to submit only their own employees plus long term contractors. Prior to that time data for both long term and short-term contract labor was required. However, it is still possible to estimate total contractors reasonably accurately by analyzing "Outside Services Costs." In addition, short-term contractors on average represent less than 10% of the labor force and therefore their impact on the total is limited.

The data submitted for utility employees is both accurate and consistent from year to year at individual utilities. This can be checked against each utility's annual direct cost labor rate. In 2001 this rate averaged $72,000 per employee for the industry as a whole after having escalated somewhat higher than inflation at 3% per annum over the past four years. This rate varies considerably across the country (+/- 20%) with the rate around major urban areas being significantly higher than in more rural areas.

During this same period labor requirements at utilities across the country have been falling at a steady rate of 3% per annum. The combination of costs per employee increasing at 3% per annum, and numbers of employees decreasing at the same rate has resulted in static O&M costs for nuclear utilities over the past four years.

There have been significant changes in the regional impact of Utility Staff Plus Contractors. Prior to 1997 regional impacts ranged +/- 20% across the US. In 2001 the range was down to +/- 7% with major urban areas requiring 14% more people than the rest of the country (all other factors being equal).

An Industry Utility Staff Plus Contractors Index is included in Appendix III. The time index for Utility Staff Plus Contractors has been decreasing at a rate of 2.7% per year over the period.

2001 Columbia Generating Station Performance Benchmarks
Utility Staff Plus Contractors

Average Performance	Upper 25% Cutoff	Upper 10% Cutoff
988	948	929

Columbia Generating Station's 2001 and 2002 actual Utility Staff Plus Contractors were 1195 and 1093 respectively.

From the table above, it can be seen that Columbia Generating Station's 2001 Utility Staff Plus Contractors benchmark is 988. Further, changing from average to the upper 25% performance level changes the benchmark from 988 to 948. Columbia Generating Station's 2001 actual of 1195 was 21% higher than the average performance benchmark of 988.

The Utility Staff Plus Contractors level in 2002 and the budgeted level for 2003 are significantly above where the benchmark will be.

APPENDIX I Data Used for Columbia Generating Station Analysis

The industry data for the plants used in the development of the nine analytical models comes predominantly from two sources. The O&M, Fuel Costs, and Capacity Factor data comes from the Nucleonics Week's annual table entitled "US Utility Costs" which come from the individual utility's FERC Form 1 and EIA 412 submittals. The Capital Costs, staffing data, and Indirect Costs come from the EUCG Nuclear Group.

The attached Table shows this data for Columbia Generating Station for each of the seven years 1995-2003. The data for 2002 and the 2003 budget have been supplied in the same format by Energy Northwest and BPA.

Appendix I - Table
Columbia Generating Station
Data Used

Model #	Model Description	1995	1996	1997	1998		2000			2003 (Budget)
1	Total Plant Costs (mills/kWh)	25.6	20.8	18.2	18.1	18.0	16.5	21.8	16.1	22.9
2	O&M Costs ($M)	109.2	95.9	87.2	86.0	80.8	89.6	117.0	89.4	143.7
3	Operations Costs ($M)	63.6	60.2	54.7	54.1	55.1	54.6	58.4	59.9	75.5
4	Maintenance Costs ($M)	45.6	35.7	32.5	31.9	25.7	35.0	58.6	29.5	68.2
5	Capital ($M)	37.5	27.2	7.0	16.5	14.4	6.2	15.1	22.4	17.6
6	Fuel (mills/kWh)	4.43	4.86	4.64	4.40	4.39	4.87	5.25	4.28	4.12
7	Indirect Costs ($M)	43.7	45.2	33.7	26.8	31.1	31.5	45.1	36.0	37.1
8	Capacity Factor (%)	70.9	79.8	71.9	77.5	74.8	85.6	82.6	95.7	88.6
9	Utility Staff + Contractors	1,543	1,219	1,080	1,076	984	1,015	1,195	1,093	N/A
Total $s	Total Costs (O&M + Cap + Fuel + Indirects in $M)	220.8	205.7	160.2	162.3	158.	167.5	219.2	188.4	233.8
mills/kWh	Total Costs (O&M + Cap + Fuel + Indirects in $M)	32.2	26.7	23.0	21.6	21.8	20.3	27.4	19.9	27.3

Plant Characteristics: Single Unit, 1105MW (DER), BWR, and with full power operating license on 4-84.

APPENDIX II Columbia Generating Station Deviation From Average Performance 1995-2001

This table shows Columbia Generating Station performance in relation to its benchmarks for each of the seven years 1995-2001. It also shows Columbia Generating Station's average performance for the four year period 1998-2001 and the level of performance required for Columbia Generating Station to join those in the top 25% and top 10% performance levels.

The numbers in this table represent Columbia Generating Station's actual costs shown as a percentage of their benchmark. Numbers greater than 100 indicate actual costs higher than the benchmark. Conversely, numbers below 100 show actual costs lower than the benchmark.

Actual annual costs can range quite considerably about the benchmarks which are based on an average five year performance. This ranges from as low as +/- 15% for capacity factor and fuel to +/- 60% for capital. Where Columbia Generating Station data falls outside these model ranges this is shown in bold type in the following table. For the industry as a whole these outliers are expected to occur at a plant no more than once every ten years.

In this table, Columbia Generating Station has been normalized for its specific physical characteristics, time indices, and regional impacts in every model.

Appendix II - Table
Columbia Generating Station
Percent of Average Performance

Model #	Model Description	1995	1996	1997	1998	1999			1998-2001 Avg	Upper 25% Cutoff	Upper 10% Cutoff
1	Total Plant Costs (mills/kWh)	124	107	91	93	95	90	119	99	97	95
2	O&M Costs ($M)	129	114	97	95	91	100	123	102	97	95
3	Operations Costs ($M)	115	111	94	90	92	93	98	93	96	94
4	Maintenance Costs ($M)	**146**	111	100	97	82	114	**172**	116	96	94
5	Capital Costs ($M)	**193**	**178**	50	98	84	44	106	83	94	91
6	Fuel Costs (mills/kWh)	87	96	93	88	91	105	**117**	100	97	95
7	Indirect Costs ($M)	**148**	**148**	118	91	109	110	**149**	115	94	90
8	Capacity Factor (%)	93	104	92	96	92	102	98	97	102	104
9	Utility Staff + Contractors	**130**	104	97	99	95	102	**121**	104	96	94

Bolded numbers represent industry outliers that would be expected to occur at an average plant no more often than every ten years.

APPENDIX III Industry Time Cost Indices

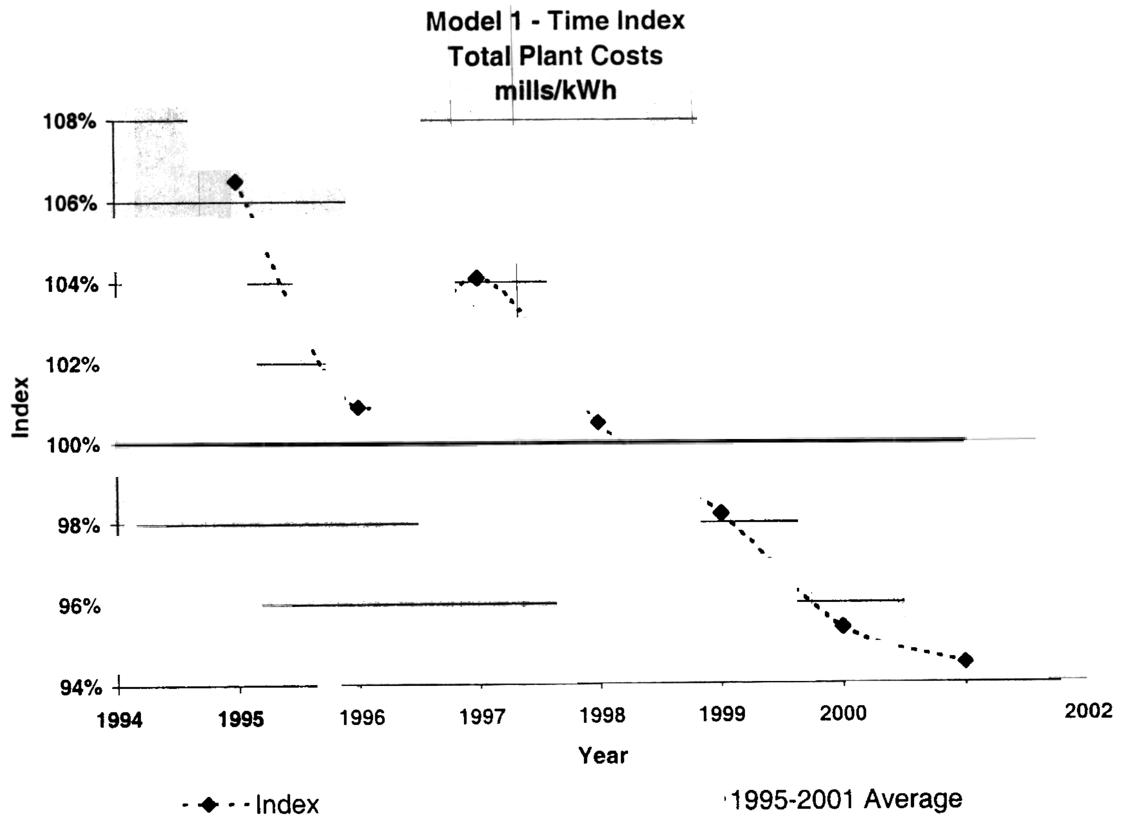
The following charts for Models 1-9 show the average behavior of Columbia Generating Station and the other 32 single unit plants in our database. These indices are based on non-weighted averages, i.e., each plant has the same weight in the index regardless of total dollars spent or MWs of capacity. This stops the index from being dominated by the performance of the larger plants. It is therefore truly representative of the behavior of the US nuclear industry as a whole.

The industry index is the average of the annual percentage changes of all the plants in relation to their own average performance for the seven-year period 1995 to 2001. Thus an index reading of 100% represents the average performance of the industry over the seven-year period. A reading of 105% indicates that the industry was 5% more expensive that year; conversely, for 95% it was 5% less expensive.

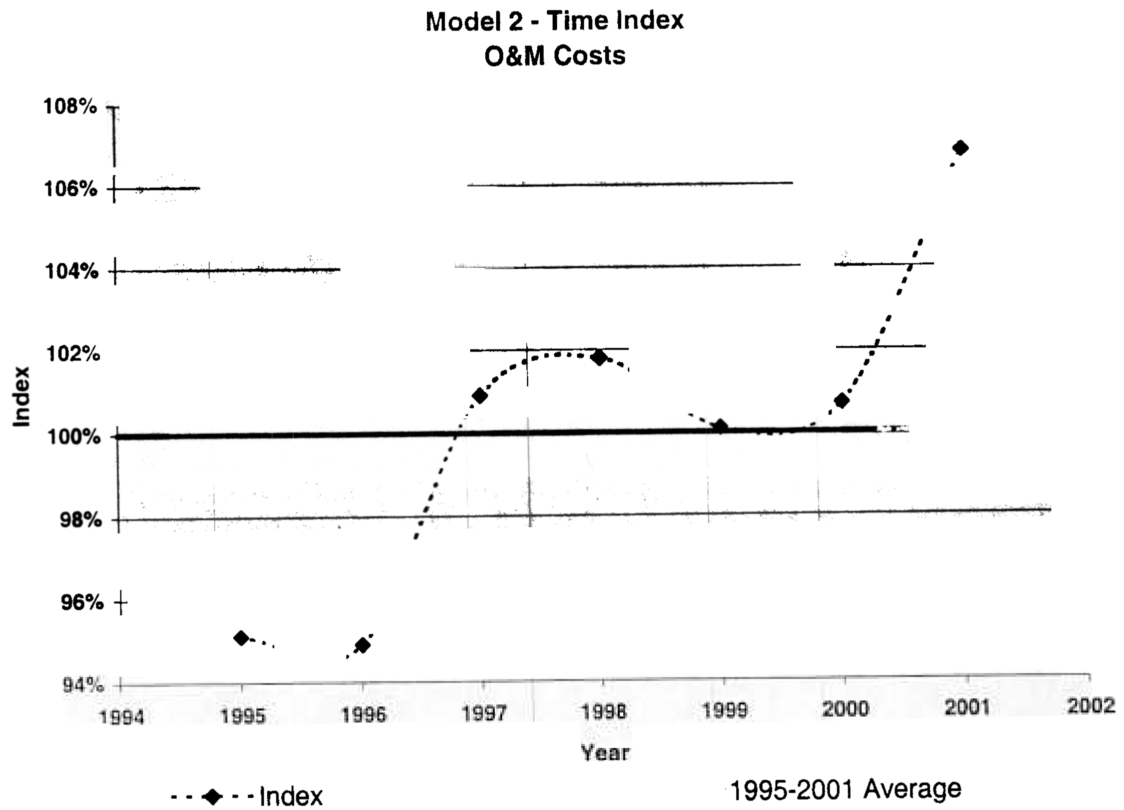
In other words, the index measures (for the cost models) the effective dollar escalation rate for the US nuclear plant industry as a whole. It represents a combination of general monetary inflation and changes in management practices (the more or less efficient use of labor and materials). In the few cases where a utility had a major aberrant annual data point this was removed as being unrepresentative of the industry as a whole.

These charts are useful for showing the general trend of the industry so that Bonneville can see how the Columbia Generating Station is performing relative to its contemporaries. These industry indices are shown separately for each model. They are also useful for projecting plant escalation trends for a few years into the future unless the industry begins to change dramatically. These indices are incorporated in all benchmark calculations.

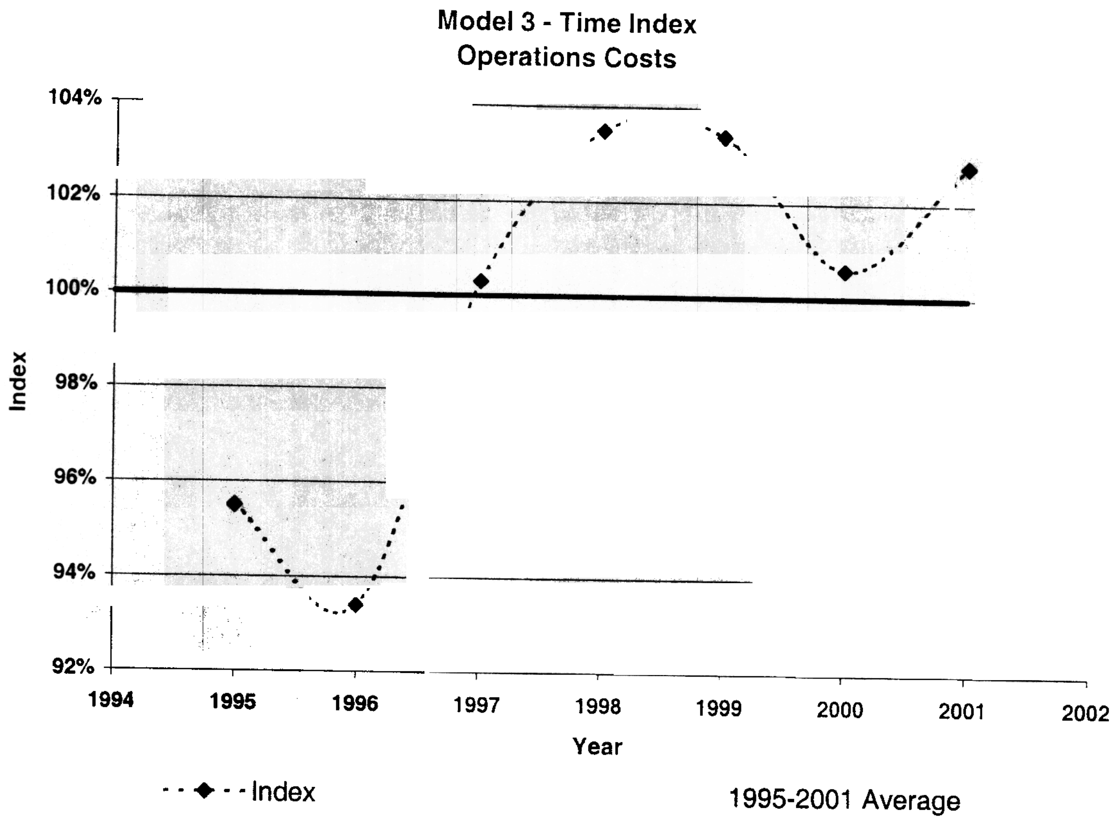
The 35 multi-unit plants in our database also follow these time indices very closely. However, multi-unit plants have slightly out performed single unit plants over the past few years, and thus it would be unfair to compare Columbia Generating Station (a single unit plant) to their behavior. The time indices are the only aspect of this report where Columbia Generating Station is not being compared with all plants in our database.



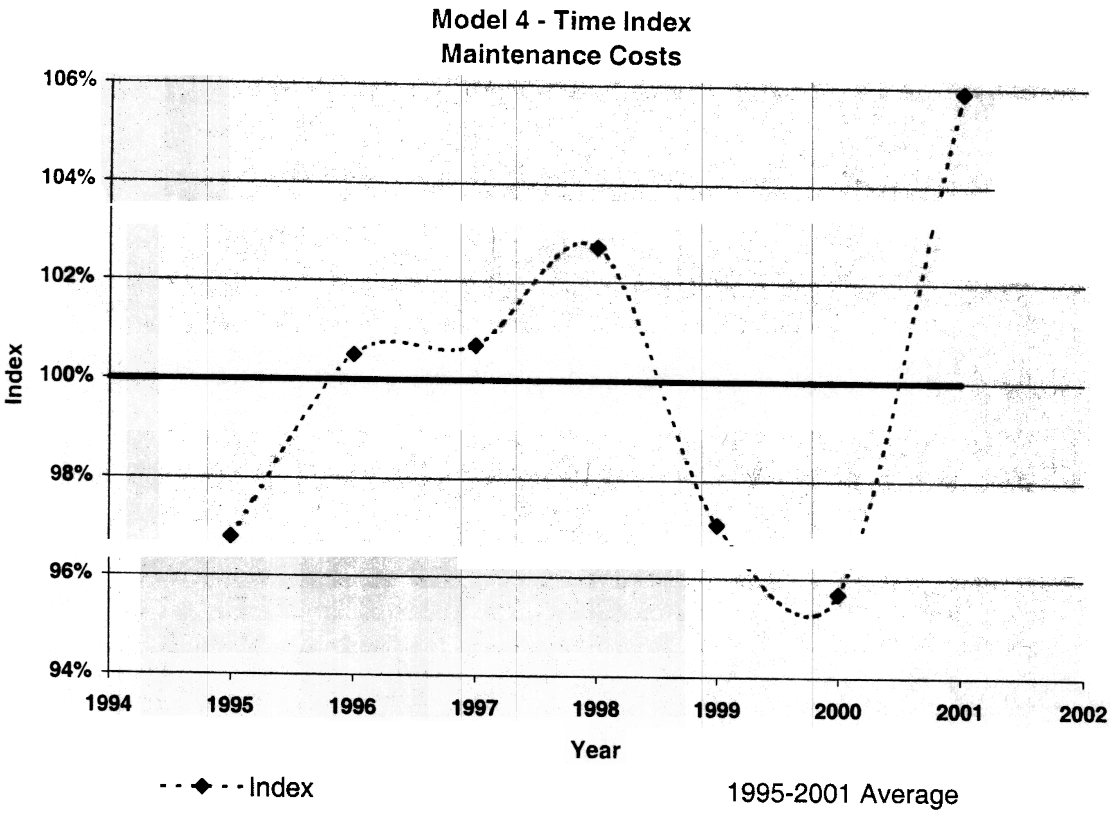
Model 1 - Time Index
Total Plant Costs
mills/kWh
108%
106%
104%
102%
100%
98%
96%
94%
Index
1994
1995
1996
1997
1998
1999
2000
2002
Year
Index
1995-2001 Average



Model 2 - Time Index
O&M Costs
108%
106%
104%
102%
100%
98%
96%
94%
Index
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
Index
1995-2001 Average

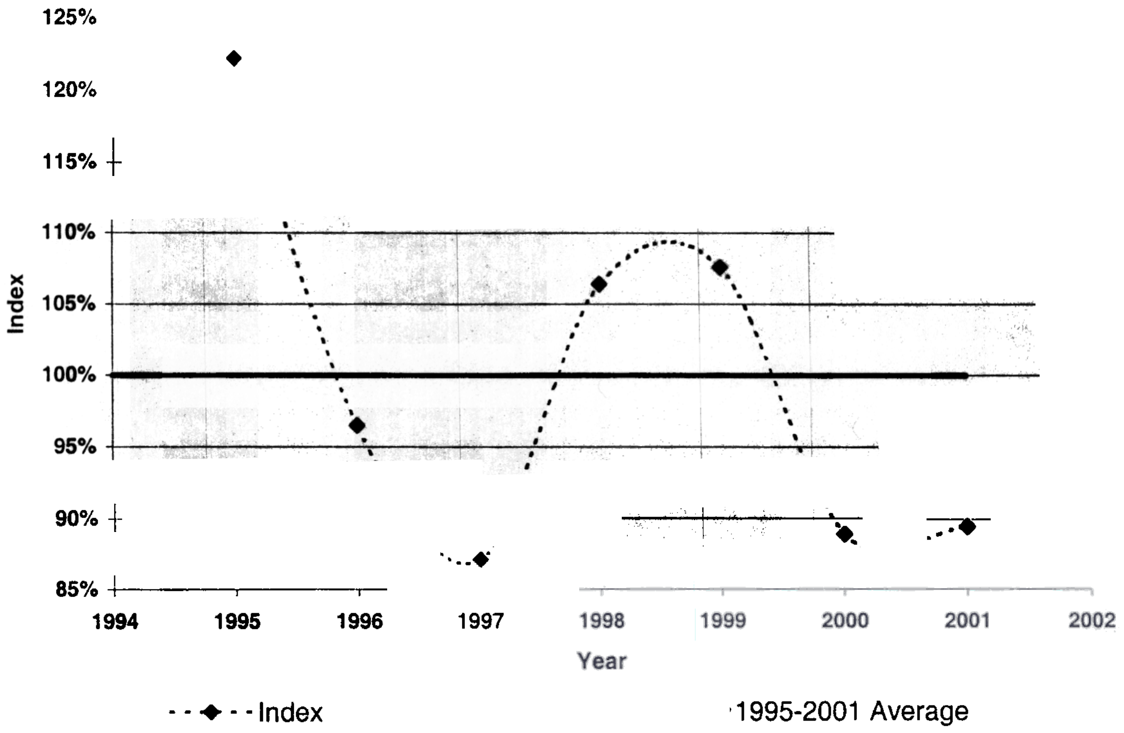


Model 3 - Time Index
Operations Costs
104%
102%
100%
98%
96%
94%
92%
Index
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
Index
1995-2001 Average

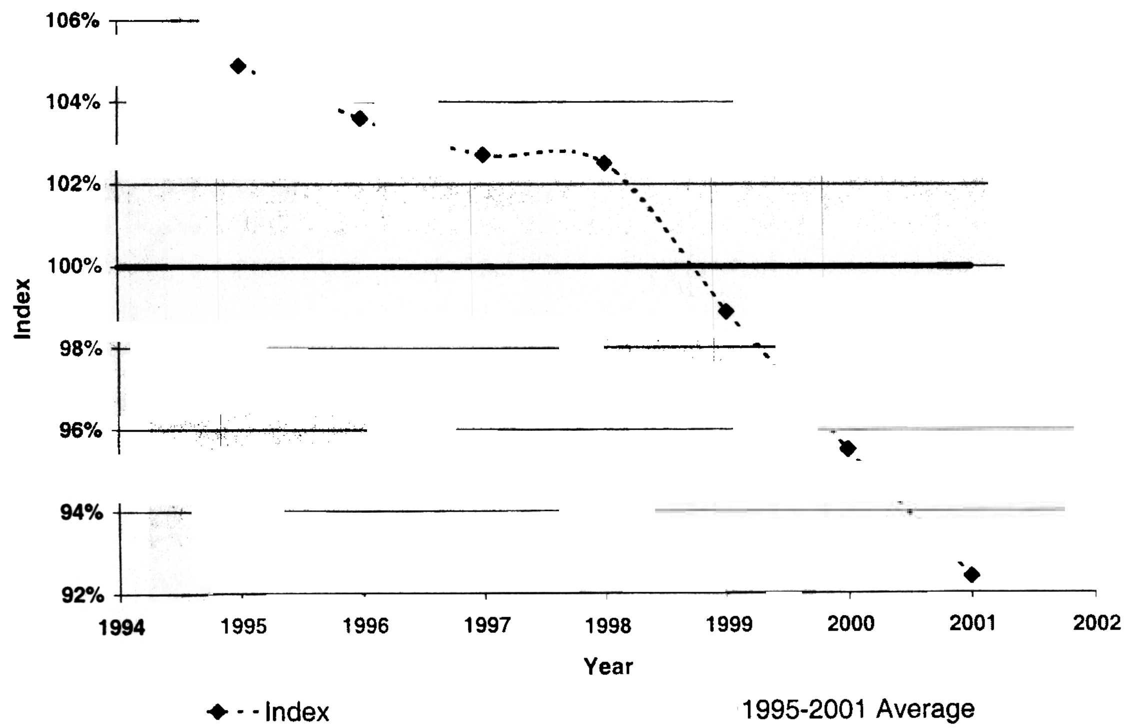


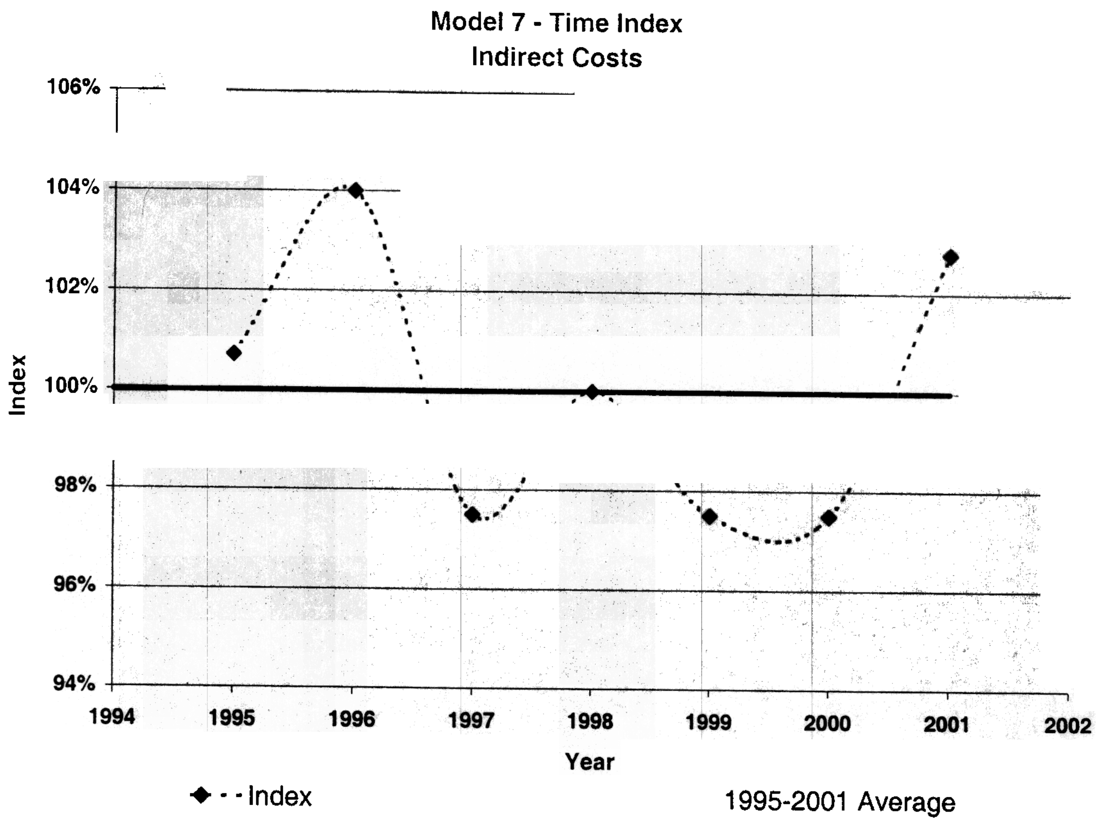
Model 4 - Time Index
Maintenance Costs
106%
104%
102%
100%
98%
96%
94%
Index
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
Index
1995-2001 Average

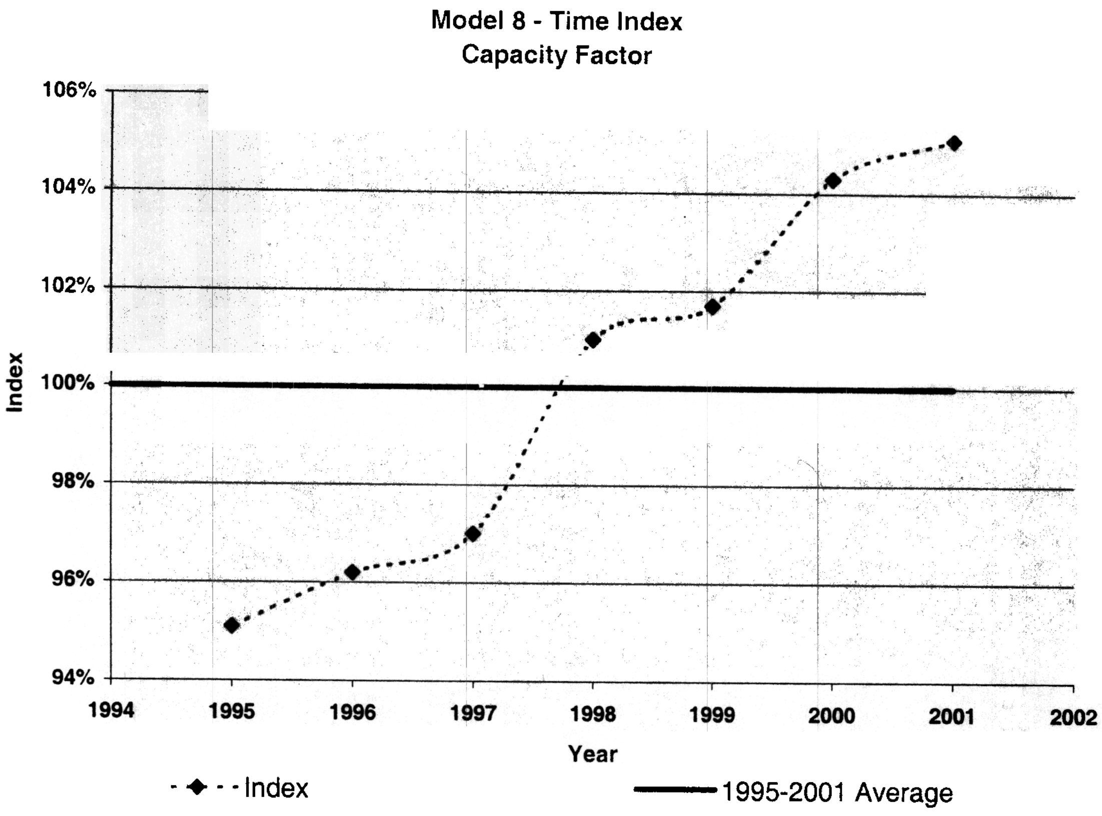
Model 5 - Time Index
Capital Costs

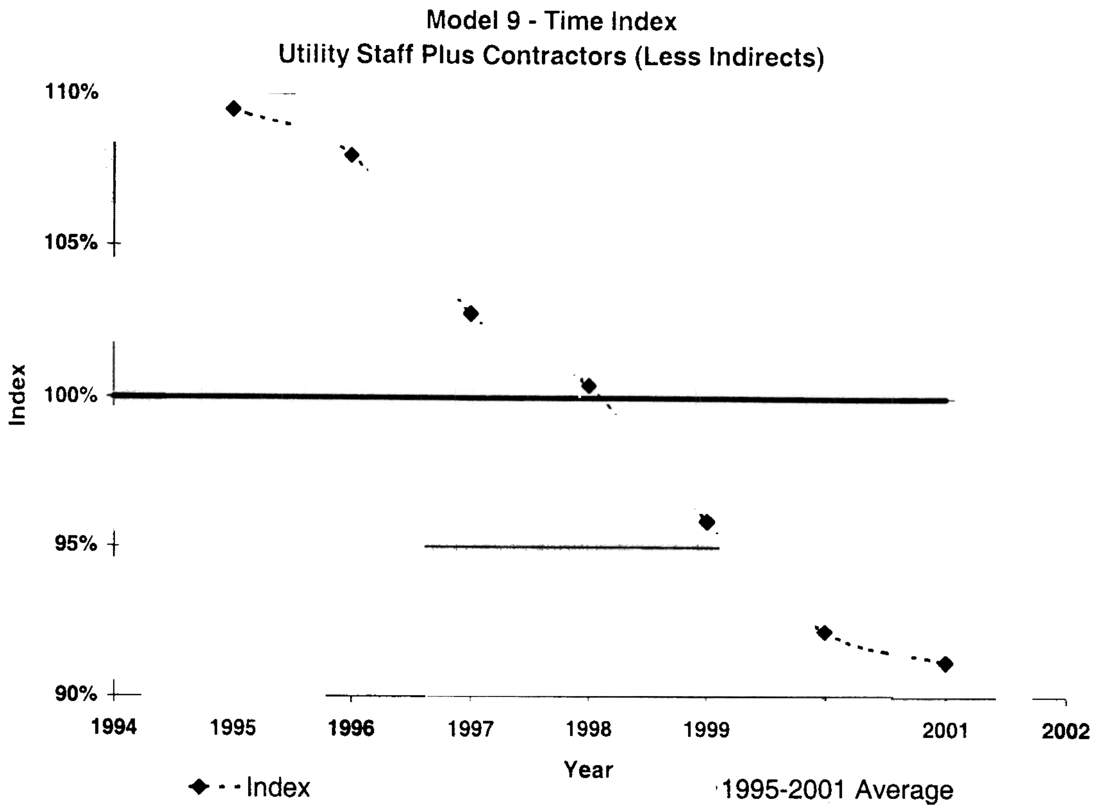


Model 6 - Time Index
Fuel Costs (mills/kWh)




Model 7 - Time Index
Indirect Costs
106%
104%
102%
100%
98%
96%
94%
Index
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
Index
1995-2001 Average


Model 8 - Time Index
Capacity Factor
106%
104%
102%
100%
98%
96%
94%
Index
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
Index
1995-2001 Average


Model 9 - Time Index
Utility Staff Plus Contractors (Less Indirects)
110%
105%
100%
95%
90%
Index
1994
1995
1996
1997
1998
1999
2001
2002
Year
Index
1995-2001 Average