



Nuclear Enterprise Portfolio Example

*A PowerShift LLC
Simulation Analysis
March 2002*



Nuclear Enterprise Agenda

from “Nuclear Enterprise: Managing the Nuclear Generation Business in the 21st Century,” January 2002

- Sustain a high performance culture; balance safety, business performance and personal values
- Maximize total portfolio value
- Apply value hierarchy based on scalable value proposition
- Allocate resources at all asset levels based on value contribution
- Achieve and maintain consistent performance
- Manage safety and business risks

The following Portfolio Example illustrates the business dynamics of a small nuclear portfolio including most of the agenda items.



Nuclear Enterprise Strategic Situation

- Nuclear Enterprise (NE) owns portfolio of four units
- NE is evaluating whether, where and how it should spend additional O&M dollars to improve material condition (MC) at each unit
 - Better MC leads to higher capacity factors and increased revenues
- Key decision criteria will be net present value (NPV) of net income and absolute O&M dollars spent over a 5-year planning horizon
- Performance of each unit, and the portfolio is variable in multiple dimensions



Portfolio Description

Unit 1

- One 600 MW unit
- Fair Material Condition (MC)
- Effective management
- Higher electricity price

Unit 4

- One 1250 MW unit
- Fair MC
- Less effective management
- Lower electricity price

Units 2/3

- Two 1000 MW units
- Very Good MC
- Effective management
- Average electricity price



This portfolio could represent an NE that owns three original, well managed units and has recently acquired a fourth unit that could benefit from improved management and material condition.



Four Portfolio Management Strategy Alternatives

- **Baseline:** Maintain current MC at each unit, do not spend additional O&M to raise MC
or spend additional O&M to raise MC to “Excellent”
- **MDC Ratio:** Limit incremental O&M expenditures, ratio based on (unit MDC/portfolio MDC).
- **Low MC:** Limit incremental expenditures, spend on lowest MC unit first
- **Target MC:** No constraint on incremental O&M, improve MC at all units

These are examples of policies that could be implemented by the Nuclear Enterprise. The Baseline or “maintain” strategy serves as both a reference and as a benchmark of risk - the three active strategies all entail risking additional resources to realize higher returns.

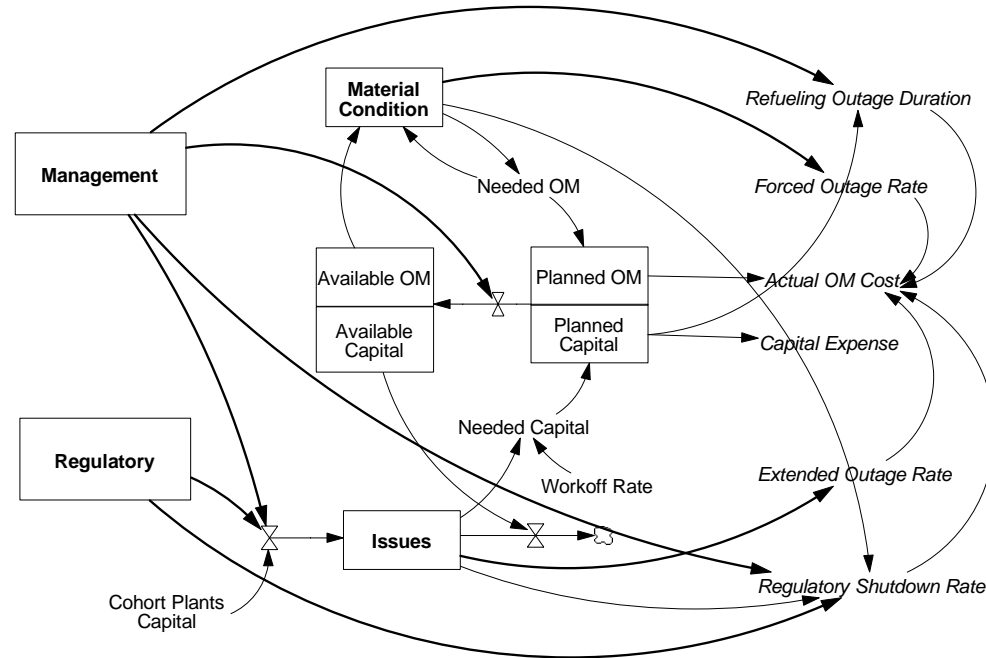


Analysis Performed Using POWERGEN Simulation Model

- PowerShift LLC's proprietary model of a portfolio of nuclear units
- Simulates day-by-day generation for each unit
- Accounts for all ways generation can be lost including refuelings, outages, derates and shutdowns
- Incorporates key performance drivers
 - management
 - regulatory environment
 - material condition
 - technical and safety issues

The POWERGEN model also allows various management policies or strategies to be integrated with fundamental operating dynamics - the ability to integrate across numerous variables as well as the portfolio units, provides unique insight into overall performance.

POWERGEN Linkage Diagram

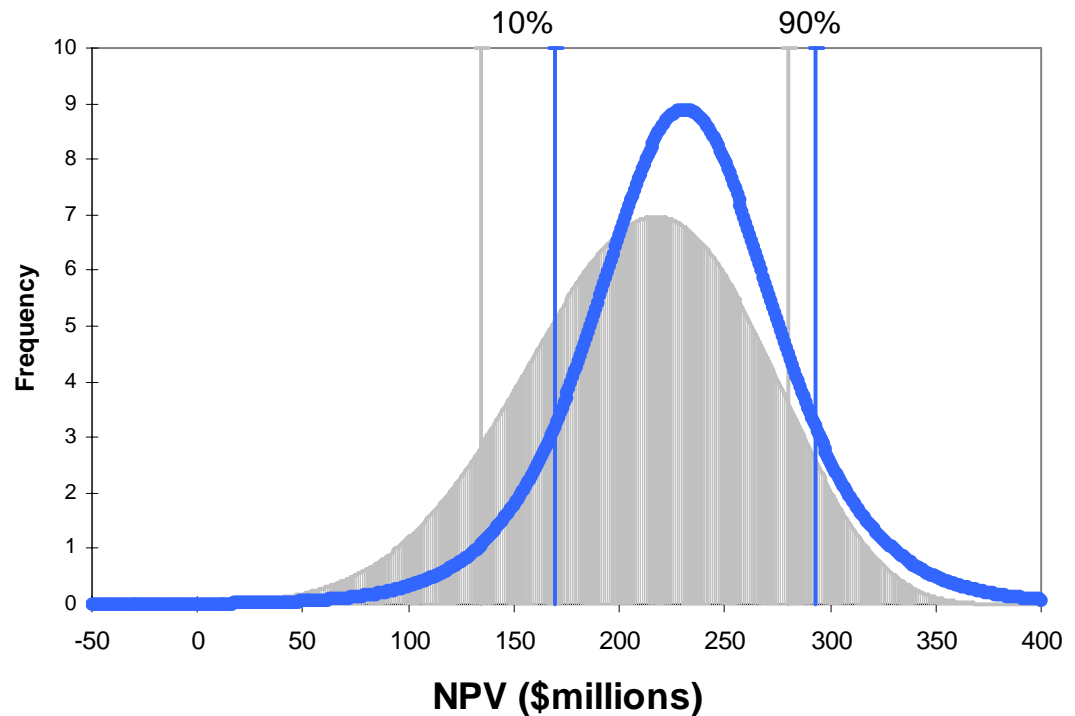


The linkage diagram shows the functional relationships that are established for each unit in the portfolio.



5 Year NPV of Net Income - Unit 4

○ Baseline
— Target MC



The POWERGEN simulation outputs reflect a range of possible outcomes and can be fit to probability distributions; for example this chart compares the NPV distributions for Unit 4 for two strategies. This approach allows quantification of variability and risks across multiple dimensions of the portfolio's performance. As shown in the following slides, overall results are built up from detailed performance analysis for each strategy and unit.

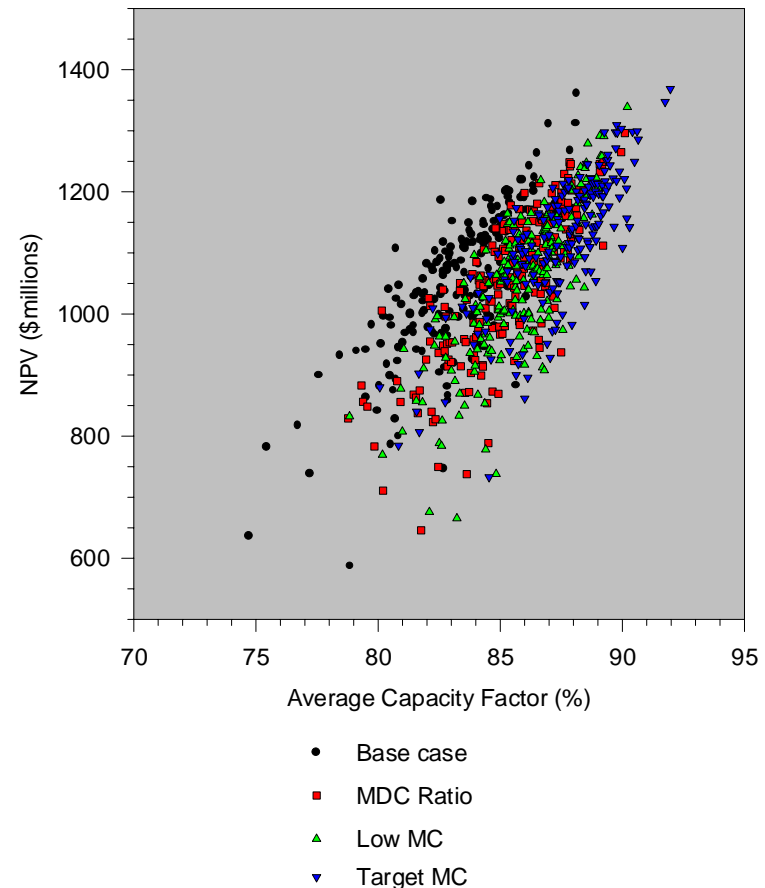


The chart provides the results of multiple simulations of the portfolio's performance for each of the four business strategies. Each data point corresponds to the portfolio average capacity factor and net present value of income for a five year operating period.

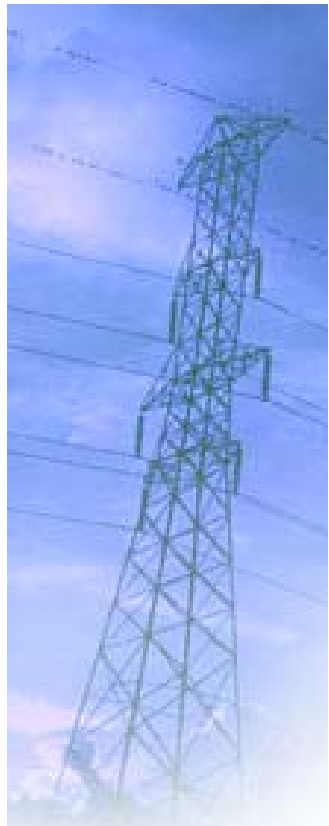
The dispersed nature of the outcomes for each strategy corresponds to the reality of business performance - it is variable, significant extremes are possible, and results overlap.

The raw performance data demonstrate the dilemma in asset management. Because reality is so fuzzy, intuition and judgment may not be reliable in reaching an informed decision as to the best strategy.

5-year Portfolio Results Portfolio CF vs NPV



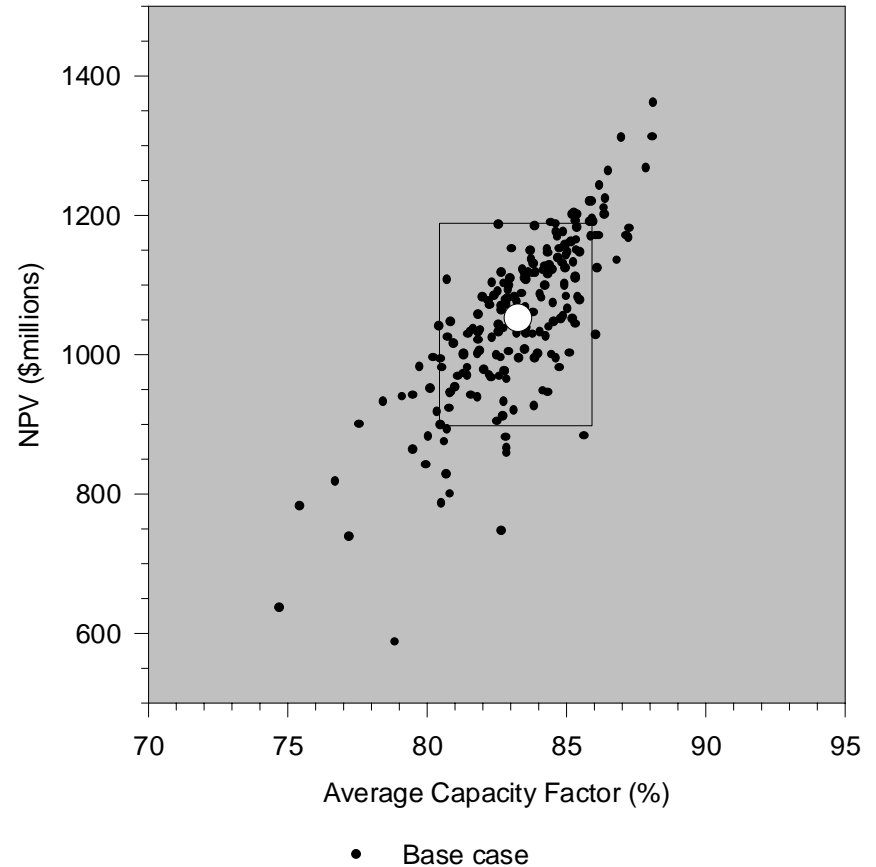
Simulation provides a very powerful starting point by quantifying the the values and frequency of each potential outcome, setting the stage for meaningful, risk based comparisons.



Starting with the simulation results from the Baseline case, it is possible to quantify the risk/return characteristics of the status quo situation of the portfolio.

- The large white symbol on the chart indicates the average values of NPV and CF for the Baseline.
- The box encompasses a subset of the data points corresponding to the 10% and 90% confidence limits. In other words, within the box are 80% of the total simulated outcomes. The larger the box the more variable the results.
- The scatter of the data points indicates that generally NPV increases with CF, however it also illustrates that there can be significant variation in NPV at a given CF, particularly at lower CFs.

5-year Portfolio Results Portfolio CF vs NPV



Statistical analysis of the simulation results begins to establish useful metrics for comparison of various improvement strategies.

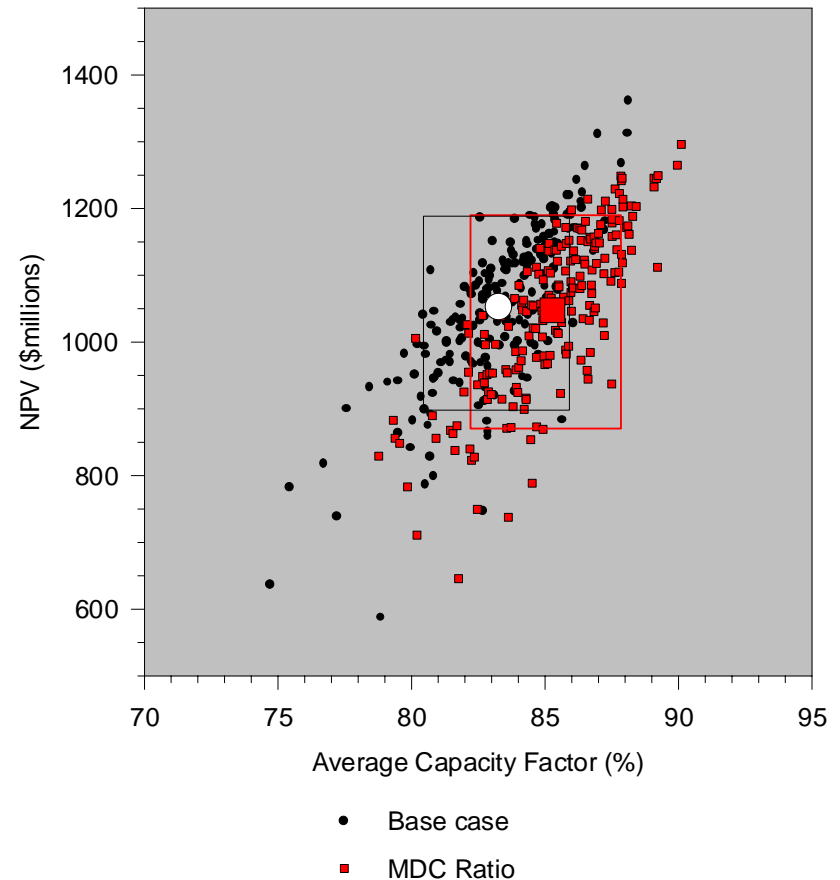


This plot compares the Baseline case results to the MDC Ratio strategy that allocates additional O&M investment based on relative size of each unit.

- The average value of portfolio NPV for the MDC Ratio strategy is essentially the same as the Baseline case .
- Clearly, the MDC Ratio strategy does result in improved capacity factor performance. If the only focus was on CF, then this strategy might be viewed as improving performance.
- The confidence box for the MDC Ratio strategy extends somewhat lower than for the Baseline case. This indicates that there is some greater downside risk for this strategy.

Statistical analysis of the simulation data leads to valid comparisons of competing portfolio strategies. Simulation also allows the integration of many contributing variables to compute a top level measure, such as portfolio value, as the basis for judging superior performance.

5-year Portfolio Results Portfolio CF vs NPV

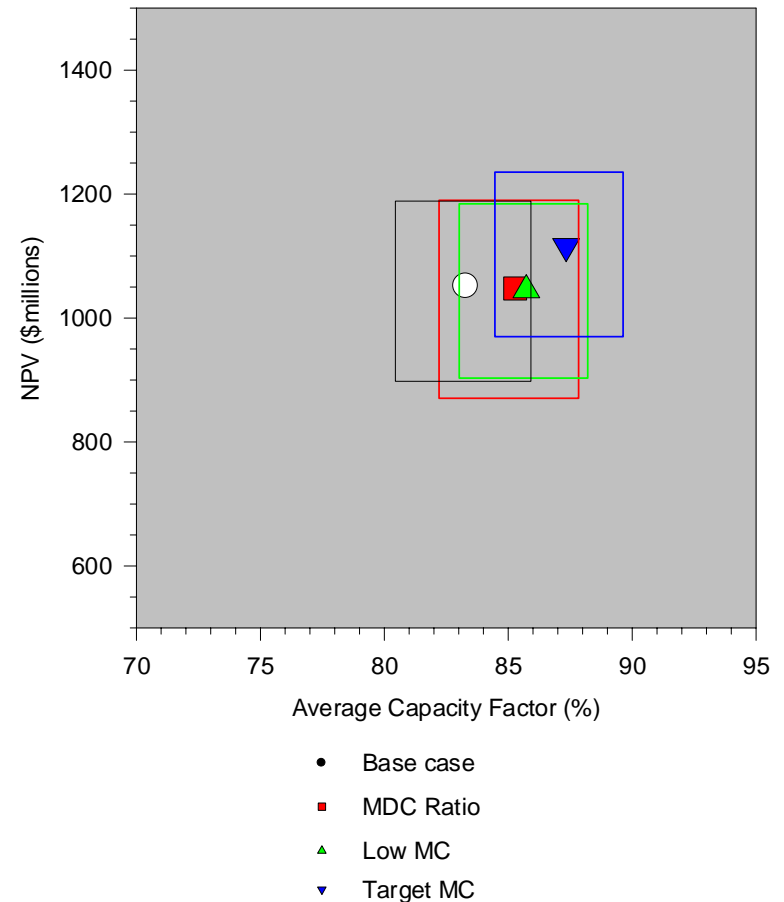




This chart takes the initial raw data presented in Slide 9 and presents just the processed statistics - averages and 10/90 percentile boxes - for each strategy.

- Each improvement strategy does result in higher CFs than the Baseline case - a result of increased O&M investment in the units material condition.
- In terms of average NPV, the chart indicates that two of the improvement strategies offer no real gain over the Baseline case. As noted previously the MDC Ratio strategy also entails somewhat greater downside risk.
- The Target MC strategy alone offers a significant gain in NPV of the portfolio, a fundamental decision criterion. In addition this strategy offers a better risk profile (less downside, more upside) and a smaller footprint meaning lower variability.

5-year Portfolio Results Portfolio CF vs NPV

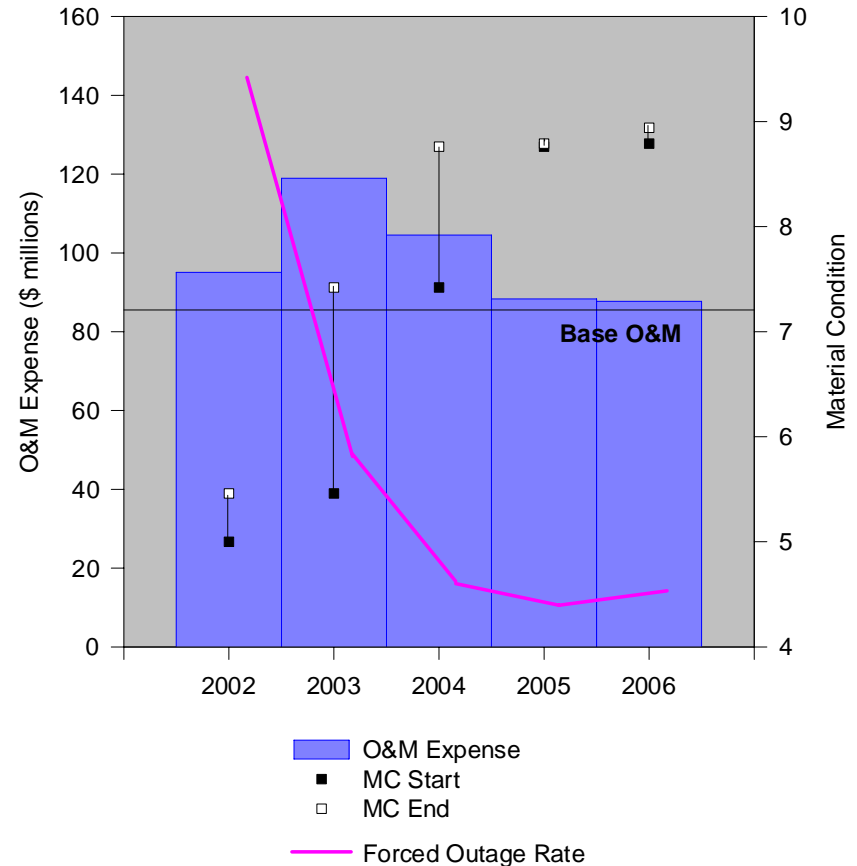




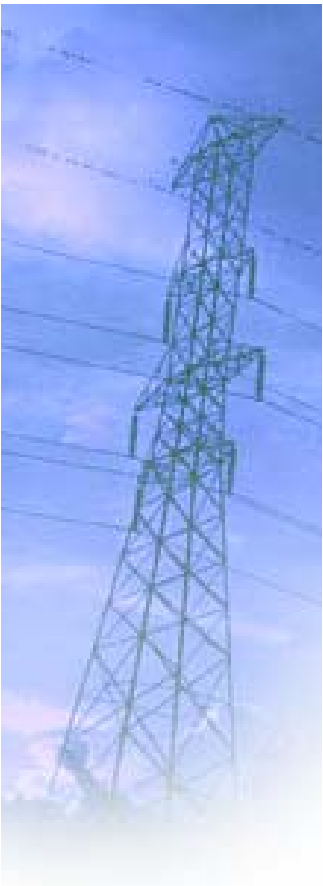
Results for each unit can be examined in detail. For example, this chart compares the Baseline case and Low MC strategy for Unit 4.

- The blue bars indicate the level of O&M expense by year. The horizontal line is the Baseline case level of O&M, with amounts above the line corresponding to the investment associated with this strategy.
- The vertical black line segments track the changes in unit material condition year to year. MC responds to the investment up to the goal of about MC = 9.
- The bright pink line represents the lost generation due to forced outages. As MC improves, the FO rate decreases.

**Unit 4 (1250 MW)
Average Material Condition
Base O&M + Incremental Improvement O&M**



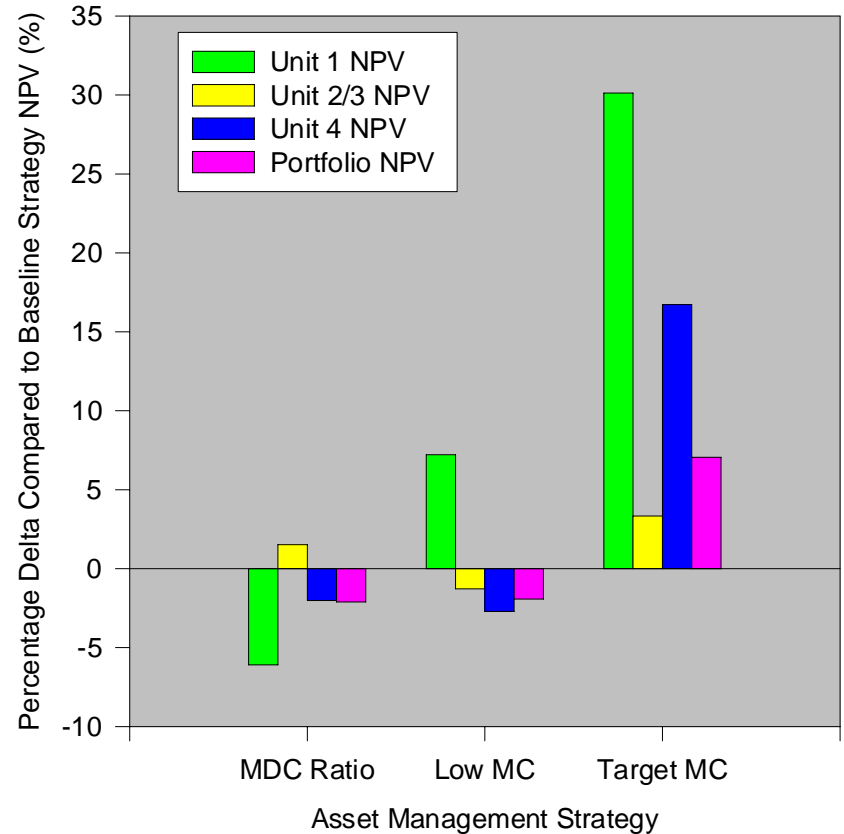
The results for each unit vary based on starting conditions, strategy, timing of investment, effectiveness of incremental O&M in improving performance, etc.



We can also examine how each strategy impacts each unit including its incremental value contribution. This chart compares each improvement strategy to the Baseline case reference.

- The pink bars show again that only one strategy (Target MC) results in increased portfolio value (approx 7%) relative to the Baseline case.
- The other two strategies yield increased value for one or two units, but not for the portfolio.

**Asset Management Strategy Comparison
Units vs Portfolio (5 Year NPV)**
80% Confidence Level



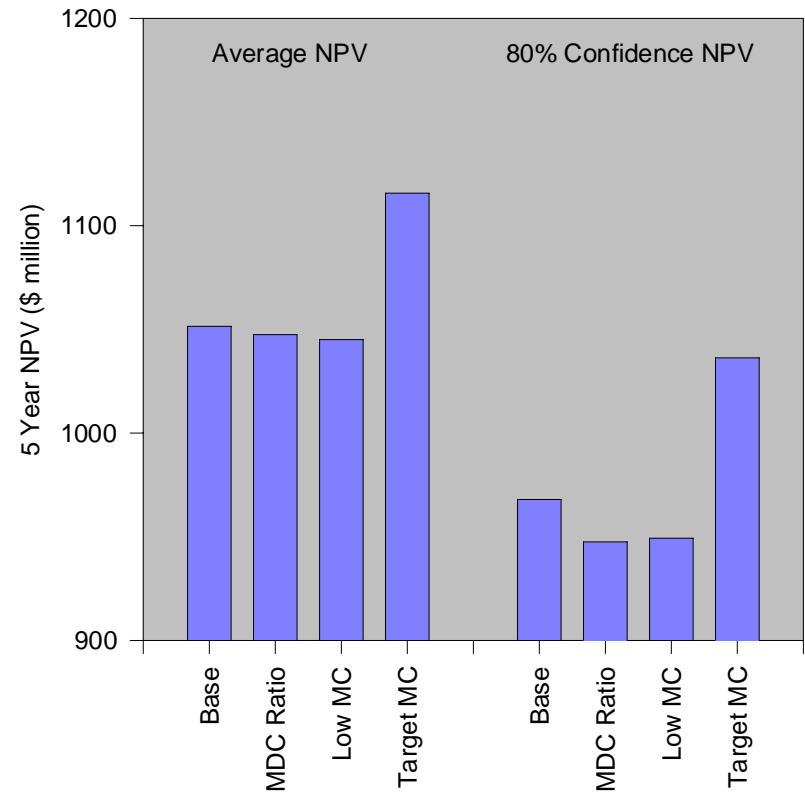
The chart uses 80% confidence level values for the comparisons of NPV. For the MDC Ratio and Low MC strategies, comparisons of NPV average values are much closer, as shown in the next slide.



This chart compares average values to 80% confidence level values of Portfolio NPV for the four portfolio strategies.

- Note that the average NPVs for the MDC Ratio and Low MC strategies are very close to the Baseline case - perhaps not sufficiently different to be considered significant.
- The comparison of 80% confidence NPVs shows a much more dramatic difference in strategies. It suggests that the MDC Ratio and Low MC strategies carry more risk and offer little in the way of greater return.

Portfolio Performance Improvement Strategies 5 Year Portfolio NPV



Investments in plant assets to improve performance entail a variety of risks. In general the investment occurs up front while potential benefits occur later in time, and thus are discounted in present value terms. In addition, the investment cost is essentially certain (with some risk of overrun), while the probability of realizing benefits is less certain, and may vary considerably based on the type of project.



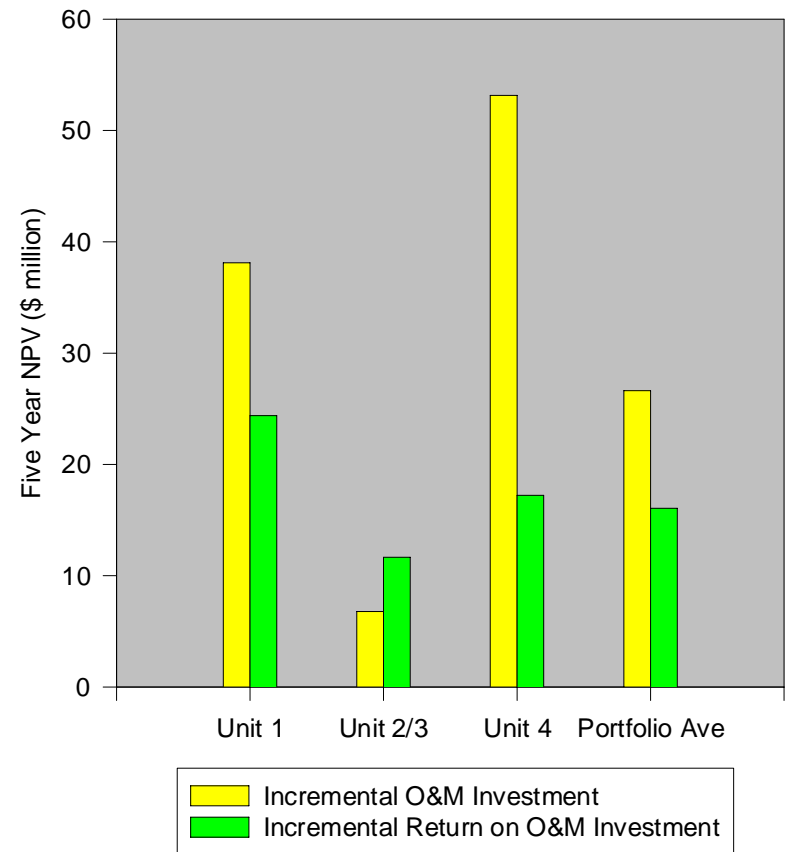
The Target MC strategy results in improved NPV for the portfolio and each unit. This chart shows the incremental O&M investment and increased net income for each unit and the portfolio. For example, Unit 1 had \$38 million (NPV) of investment over five years which yielded \$24 million (NPV) of additional income.

- All units realize positive ROI but required investment is lowest for Units 2/3 due to very good initial material condition. Required investment is highest for Unit 4 since it has lower mgmt effectiveness in addition to below average MC.
- ROI is best for Units 2/3 suggesting that small investments in plants in good condition may yield higher returns. Unit 4 ROI impacted by low electricity prices.

Five Year ROI Summary

Unit 1	64%
Unit 2/3	125%
Unit 4	32%
Portfolio	60%

Incremental O&M Investment and Return on Investment Target MC Strategy vs Baseline

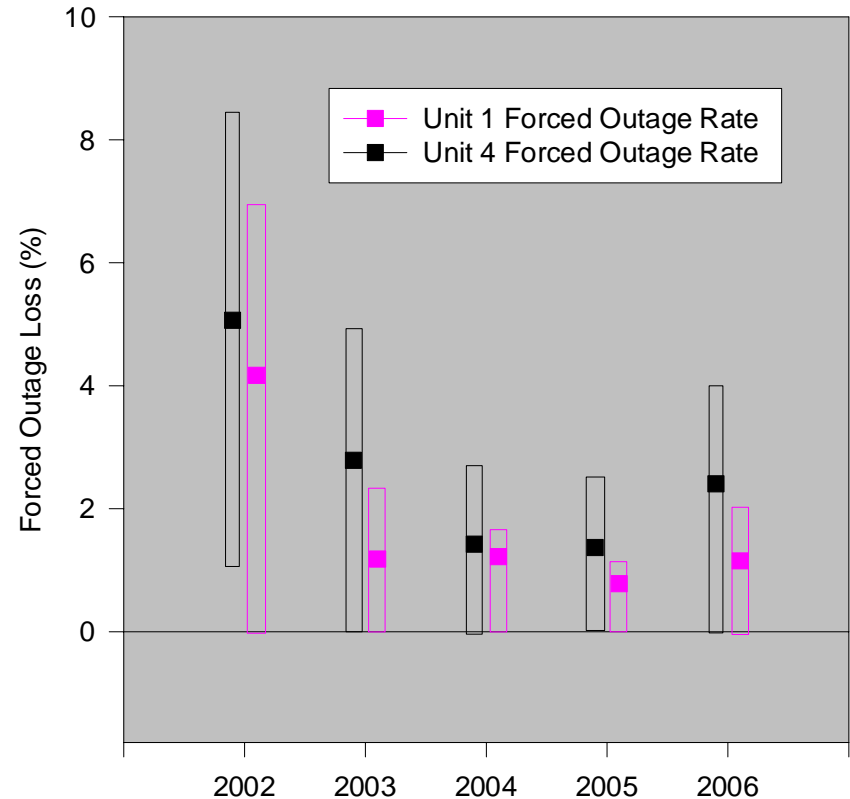


While overall portfolio ROI for this strategy is good, ROI of each plant would need to be compared against investment criteria and other alternatives.

This review has included both portfolio and unit-level financial results. We can also examine the impact of a specific strategy on operating parameter, e.g., forced outage loss.

- The chart shows forced outage loss for Unit 1 and Unit 4 by year. Both units show improved forced outage performance, responding to the incremental investment of O&M. The solid data points are the average losses while the bars indicate the 20%/80% confidence values.
- Unit 1's performance is better than Unit 4's. Recall that Unit 1 had better management effectiveness, thus it is able to better utilize the additional resources.

**Forced Outage Rate
Target MC Strategy
Average and 80% Confidence Limits**



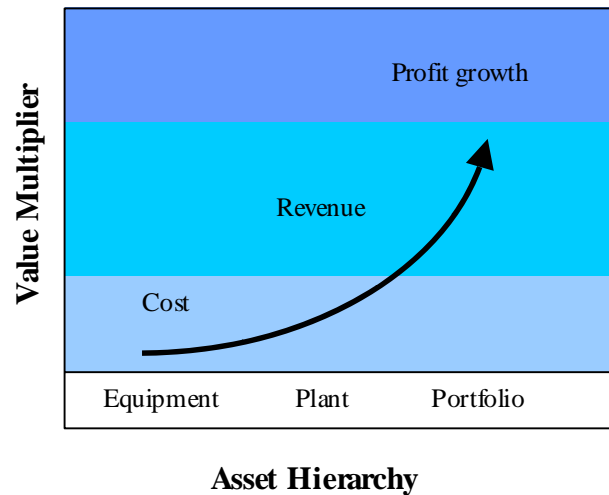
Not all nuclear plants are equal, and their individual characteristics can interact strongly with portfolio performance and strategy effectiveness.



Scalable Value Proposition

Average Additional Value per Unit per Year

Target MC Strategy vs Base Case



	New Value
Enterprise Value	<ul style="list-style-type: none"> •\$5.4M net income •\$65.5M market value
Asset Utilization	<ul style="list-style-type: none"> •\$9.9M revenue
Resource Utilization	<ul style="list-style-type: none"> •(\$2.7M) forced outage costs

	Revenue	FOadder	Net Income
Base Case	206,359,702	3,855,113	69,874,195
Target MC	216,308,989	1,168,277	75,318,650
Delta	9,949,287	-2,686,836	5,444,455
After Taxes			3,538,896
Market value			65,469,569
\$ are per unit per year			

Strategies to improve performance can create different types and quantities of business value. This is illustrated for the Target MC strategy which results in reduced forced outage losses, improved capacity factor and higher net income. The value associated with each mechanism is tabulated in the table and summarized above. Fewer FOs save costs, improved CF produces more revenue and net income; increasing income is reflected ultimately in market value of the enterprise.



Conclusions

- The Portfolio Example illuminates the complex ways business strategy, portfolio characteristics and risk interact, and illustrates the challenge in identifying optimal strategies for nuclear asset management.
- Business simulation is an effective tool for analyzing nuclear plant and portfolio performance and capturing the operational and financial dynamics that determine value, risk and uncertainty.



PowerShift LLC

- Senior level consulting services with emphasis on enterprise asset management and business simulation.
- Leader and innovator in nuclear asset management
 - early genco work
 - third party management concept
 - nuclear plant valuation and sale transactions; alternative business structures
 - nuclear enterprise management
 - POWERGEN simulation tools