AGING versus RELIABILITY

Do generating plants experience lower performance as they get older?

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This month's case study addresses a topic of great interest to many people in our industry:

"**Should we expect lower reliability of our power plants as they age?"**

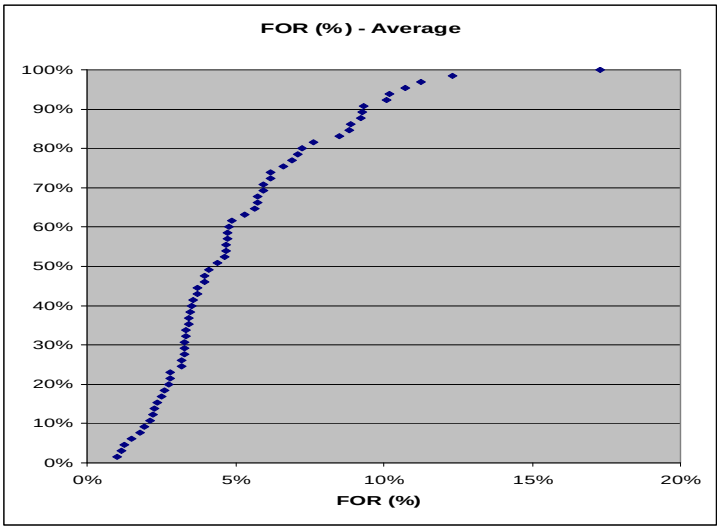
The answer to that question has significant implications to planners, regulators, investors, insurers and management as well as equipment suppliers and other service providers. *Unfortunately*, that simple question does not have a simple answer. In fact, like most problems in real life, there are a great number of complex relationships that must be understood before attempting to solve the problem. The following analysis might help us understand one piece of the puzzle.

Benchmarking Study

Recently I helped one European company perform a benchmarking study on a number of their generating plants. As a first step we had to determine the best peer group whose design and operational characteristics were most similar to their units while keeping a large enough population for statistical validity (see our case studies for August 2002 and September 2003 for more details on this technique). For one group of their fossil steam units the following criteria were selected:

1) Subcritical
2) Reserve Shutdown Hours less than 1000 Hours per Year
3) Primary fuel = Coal
4) Natural or Controlled Boiler Circulation
5) Net Output Factor greater than 80%
6) Net Capacity Factor greater than 75%
7) Size between 200-500 MW

This resulted in the selection of a peer group population of 65 units extracted from the North American Electric Reliability Council's (NERC) Generating Availability Data System (GADS) database of over 4000 units. We then compiled and rank ordered the selected units' Forced Outage Rates (FOR) over the last 5 year period to produce the frequency distribution curve shown below (this curve is sometimes referred to as an "S" curve since for normal distributions it will resemble the letter "S"). In this curve the "Y" axis represents the percentile of the units in the population ranked by FOR and the "X" axis is the FOR (a low FOR means the unit is very reliable while a high FOR means we cannot rely on it to generate when it is needed). When we superimpose our unit's FOR value on the chart we can see where in its peer population its FOR falls and get an insight as to what we might expect in the future as well as improvement potential.



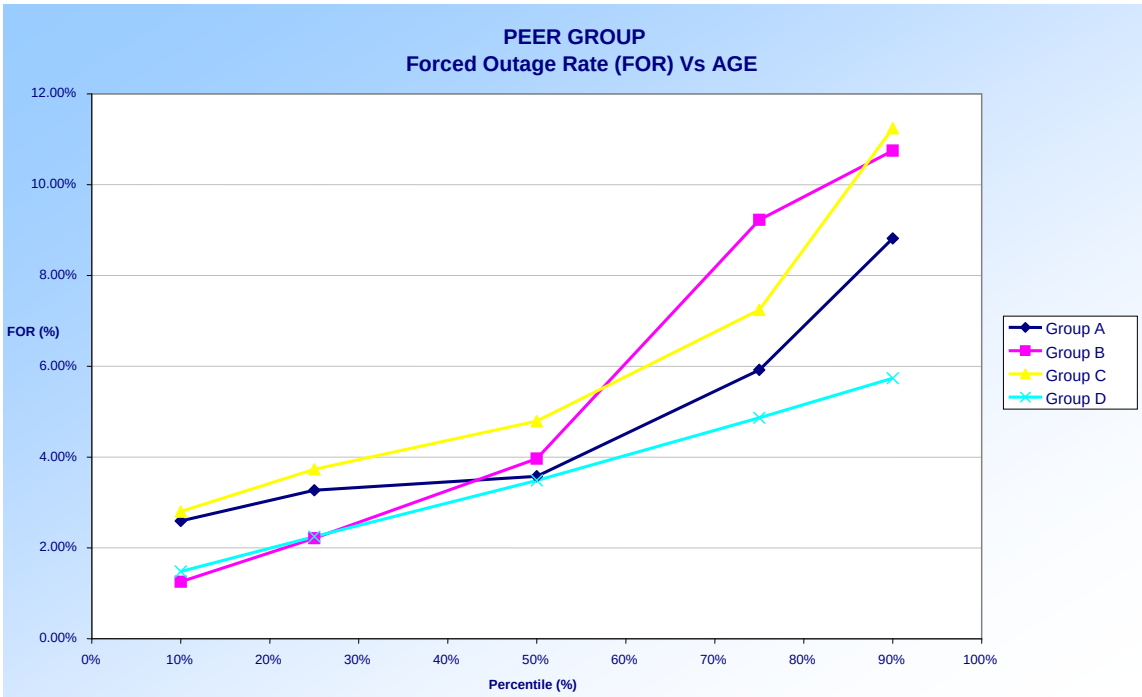
Aging

When it was noted that the select criteria did not include an age indicator, some questioned whether it was fair to compare recent units to their older sisters, even if other design or operational characteristics were the same. In order to explore this possibility we divided the total population of 65 peer units into four equal (approximately) groups with the youngest quartile being group "A", the next youngest group "B", the next group "C" and finally the oldest quartile group "D".

We then looked at the FOR distribution for each of the four groups. The following table gives these results:

	FOR (%)				
Percentile	**10th**	**25th**	**50th**	**75th**	**90th**
Group A (youngest)	2.59	3.27	3.58	5.92	8.82
Group B	1.26	2.21	3.97	9.23	10.75
Group C	2.80	3.73	4.79	7.24	11.24
Group D (oldest)	1.48	2.25	3.49	4.87	5.74

This data is plotted in the following graph with the "Y" axis representing FOR and the "X" axis the percentile:



We can draw certain conclusions from the data in the chart and graph:

1) The top performing units seem generally unaffected by age, as seen by the proximity between their FORs at the 10th and 25th percentiles.
2) At any particular percentile and moving across the age groups there is not an obvious positive correlation between FOR and age. Neither the worst performer is in the oldest group at either the 75th or 90th percentiles nor does the best performer happen to be in the youngest group at the 10th and 25th percentiles.

Unquestionably, there must be other factors influencing the FOR variability within this population. What we can conclude is that age alone is not one of them.

Other studies that have focused on this question, for different peer groups have found a correlation between age and reliability ***if the resources required to counteract the aging effects are <u>not</u> provided!!*** This should come as no surprise to those familiar with generating plants. However, it is a management issue to ensure that those additional resources are provided (and proactively is better than reactively). This can certainly be reconciled with the above data. Management must recognise that additional resources will be required as the plant ages and prepare to make them available before it becomes an emergency situation (see our case study for October 2003 for a discussion of cost

forecasting techniques and our May 2002 case study for an analysis of the relative influence of management vs., design on reliability).

Conclusions

Although the above analysis is for just one peer group and should not be generalised as applying to all types of units, it is an indication that at least one group of units does not exhibit lower reliabilities as they age. It is possible, and in this Reliability Engineer's opinion very probable, that other groups of similar units will exhibit the same trends.

Future

What is needed is to extend this type of analysis to other types of generating plants to try to detect the underlying trends regarding age versus reliability. The Performance of Generating Plant (PGP) Committee of the World Energy Council (WEC) would like to invite you to participate with us, together with the Reliability Committee of the American Society of Mechanical Engineers (ASME) and the North American Electric Reliability Council (NERC) in an effort to study the factors and their trends influencing generating plant performance. You can do that in a variety of ways:

1) Submit ideas on specific issues that you would like to see investigated
2) Help to develop specific Terms of Reference (TOR) for each approved idea
3) Participate in Task Forces that will be set up on an individual and temporary basis to study the specific issue you are interested in (this will be a self-correcting mechanism such that if no one volunteers to serve on the study task force, that study will not be done).
4) Help prepare reports describing the study and its results
5) Distribute and publicise the study results among interested parties within your country

Since we visualise "virtual" task forces for these analyses, all communication and coordination will be done by phone or email in order to minimise travel costs.

Please send your thoughts about this proposed programme along with any study ideas you may have to

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