Turbine Dynamics

Down Hole Power and EM Telemetry

"Performance beyond Expectation"

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Predictive Analysis of the Turbine Alternator.

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Introduction.

Since successfully demonstrating our first closed loop turbine alternator in July 2008, we have received a number of enquiries about its performance in flow schemes different from the 3" ID data published on our web site. We initially treated each enquiry as an opportunity to test the tool in a new flow environment to determine its characteristics, but this quickly became time consuming, costly and inefficient. We therefore needed a theoretical method to reduce the response time for enquiries, reduce our experimental costs and therefore improve our overall service efficiency. This report graphically illustrates that this objective has been successfully achieved and we are now able to accurately calculate the performance of our turbine alternator in a range of collar sizes.

This analysis has also shown that in many cases a compromise must be struck between conflicting requirements. Whereas the electrical power can be designed to match a given flow range, frequently this occurs at the expense of high flow velocities and large pressure drops across the tool. The physics of a flow environment seldom allows a happy balance of conflicting requirement to be struck, especially in low flow schemes where these conflicts are particularly troublesome. For example, it is generally accepted within the industry that mud flow velocity past exposed components, e.g. impellers, should be kept below 40ft/sec to minimise flow erosion and the pressure drop across the tool should be less that 100 psi. Our analysis demonstrates that keeping these two important variables within safe limits is sometimes impossible to achieve whilst also generating significant levels of regulated electrical power over a wide range of flow.

The data has been prepared for a number of cases from our starting point of 3" ID down to a minimum of 2.3" ID in flow sleeve increments of 0.1". Where available, actual flow loop data has been plotted with the theoretical data to allow a direct comparison to be made. In all cases, the open loop data is plotted up to the 200 Watts maximum output power of the alternator.

3” ID Data.

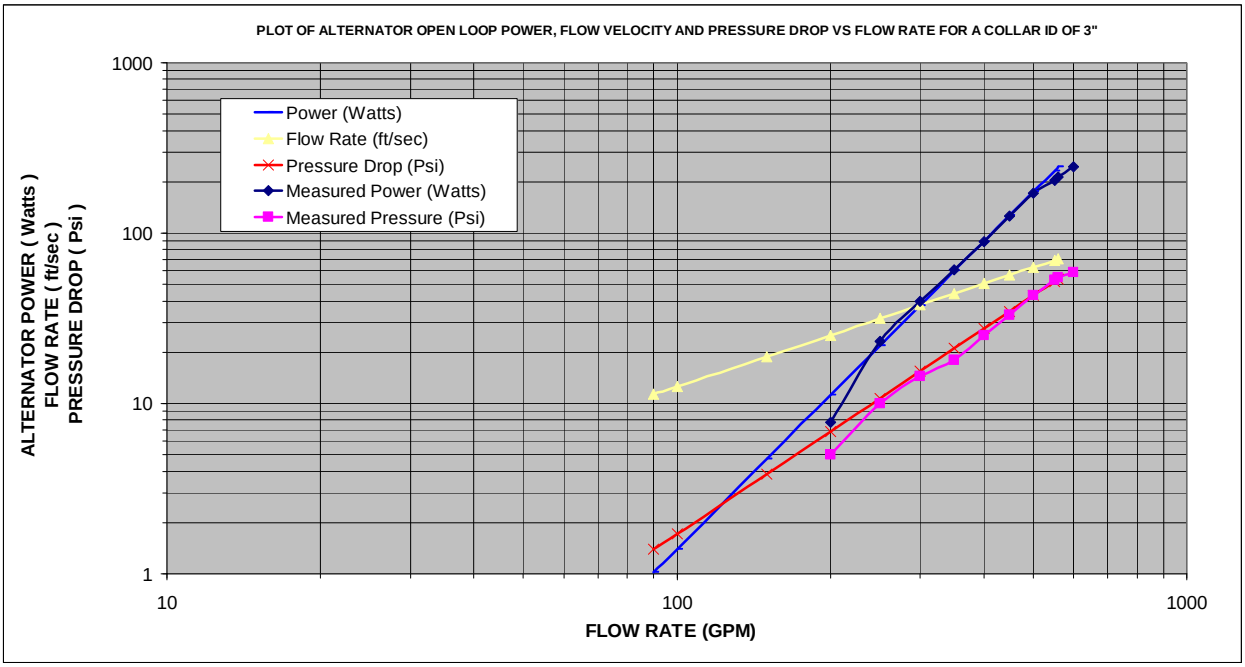

Fig 1: Plot of theoretical and actual flow loop performance in a 3” ID flow sleeve.

2.9” ID Data.

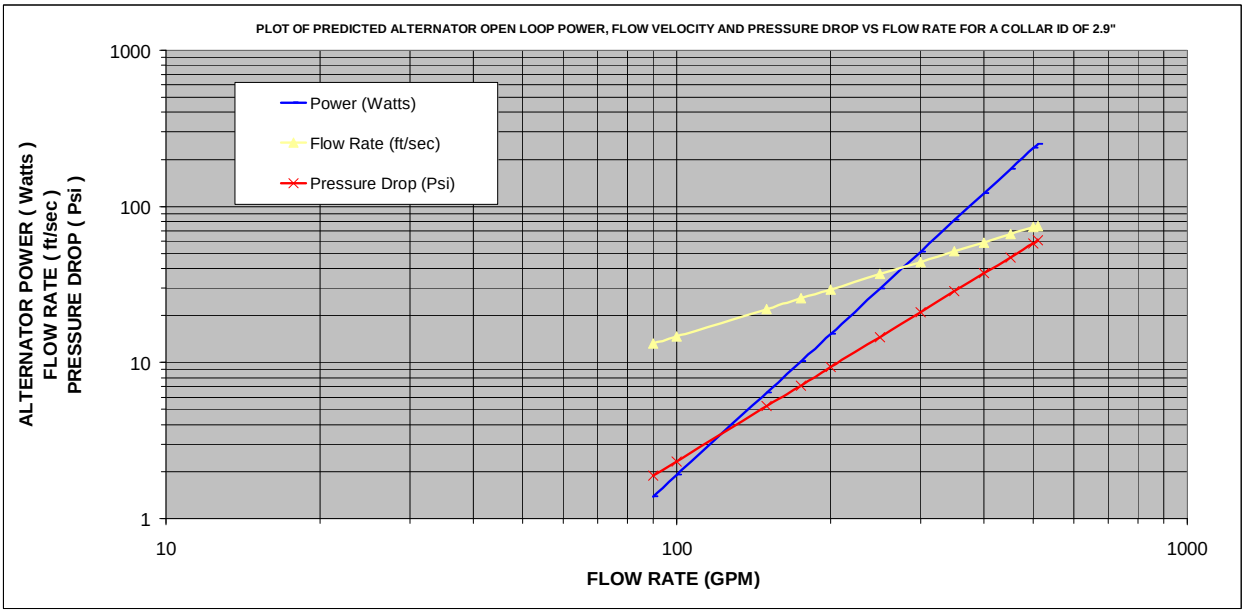

Fig 2: Plot of theoretical flow loop performance in a 2.9” ID flow sleeve.

2.8” ID Data.

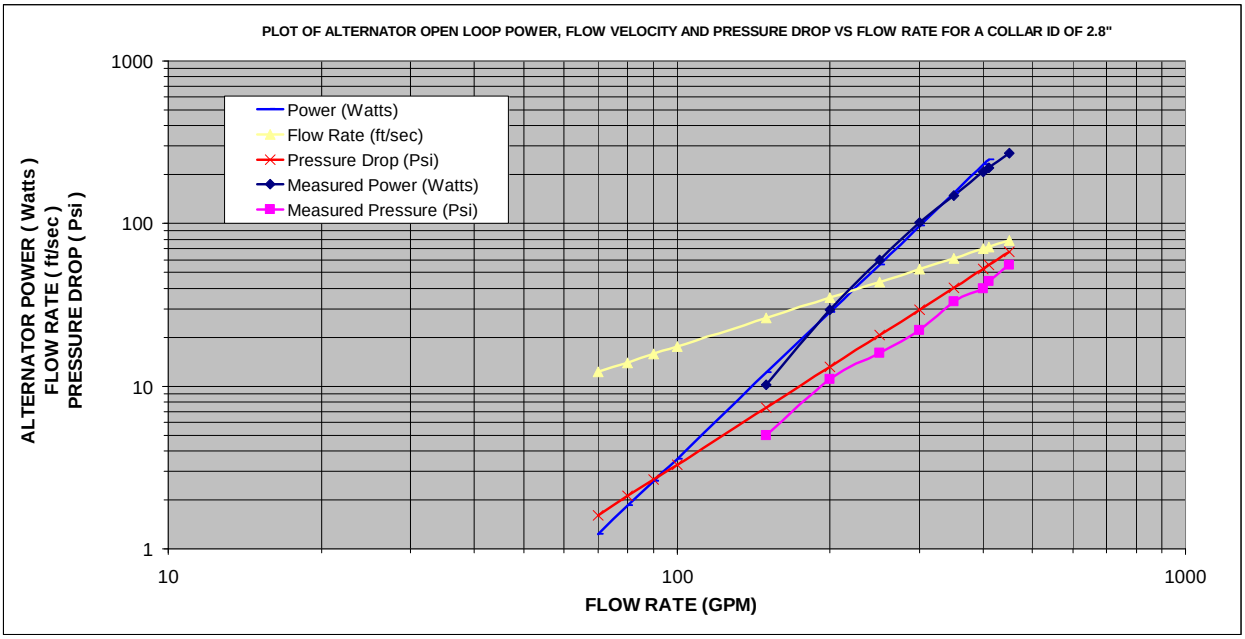

Fig 3: Plot of theoretical and actual flow loop performance in a 2.8” ID flow sleeve.

2.7” ID Data.

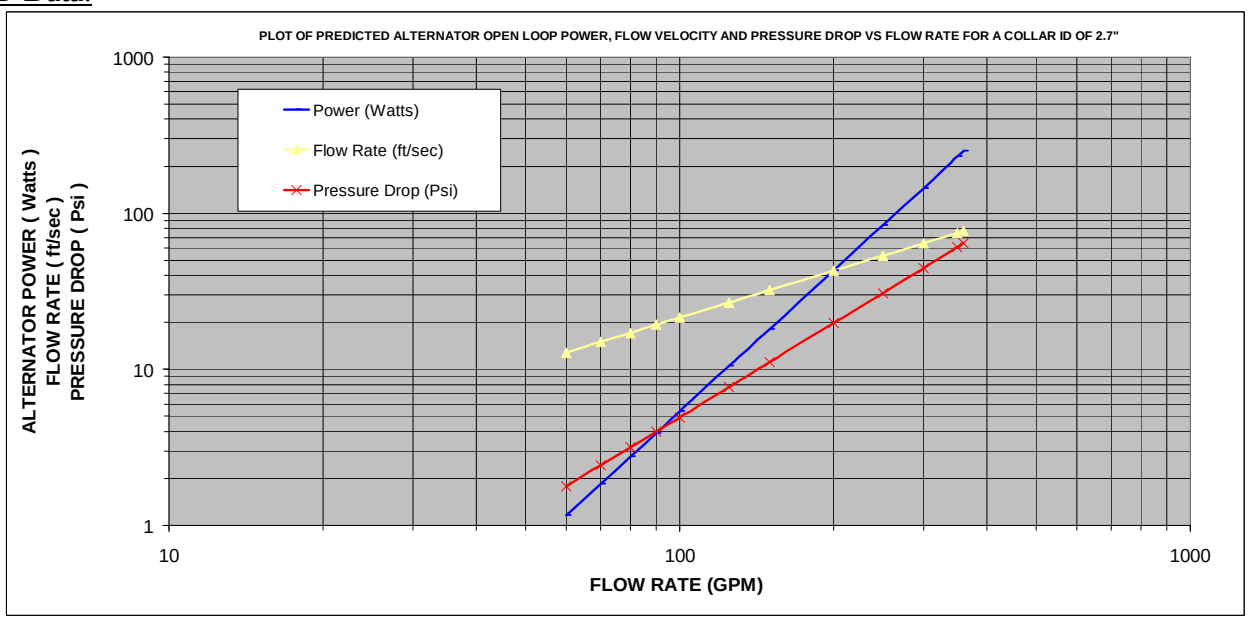

Fig 4: Plot of theoretical flow loop performance in a 2.7” ID flow sleeve.

2.6” ID Data.

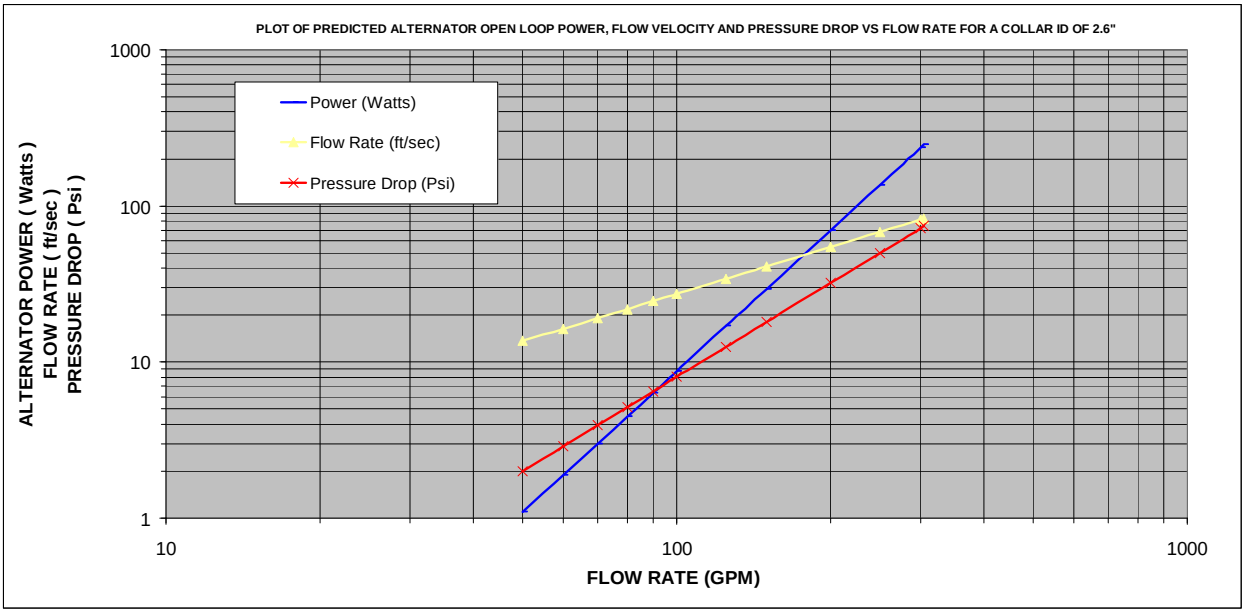

Fig 5: Plot of the theoretical flow loop performance in a 2.6” ID flow sleeve.

2.5” ID Data.

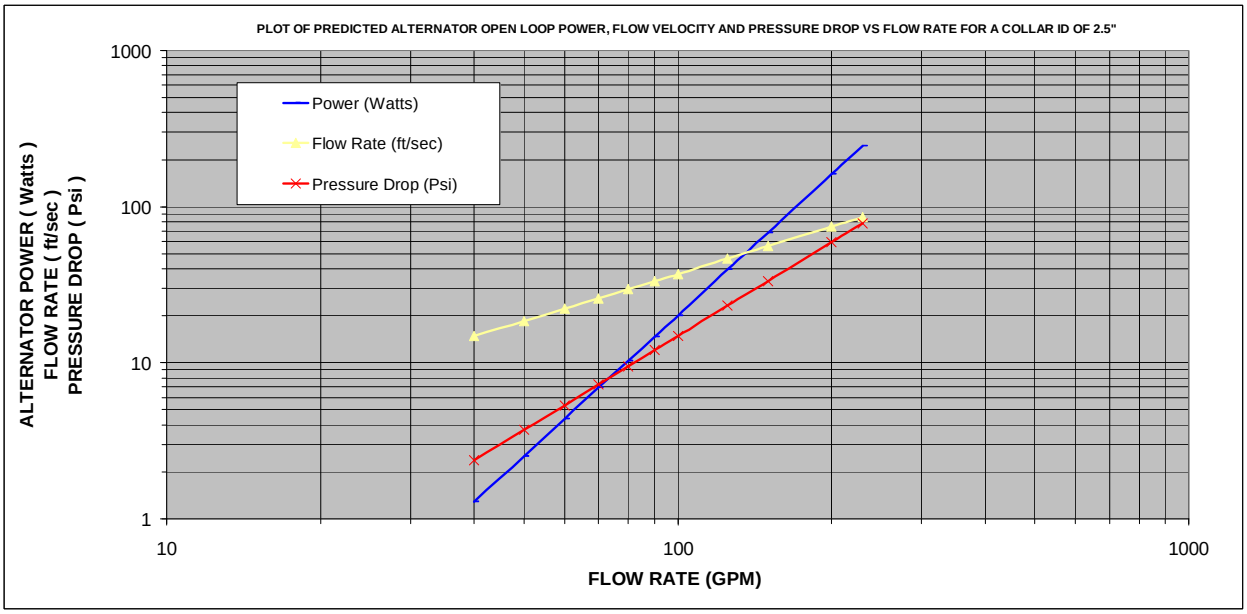

Fig 6: Plot of the theoretical flow loop performance in a 2.5” ID flow sleeve.

2.4” ID Data.

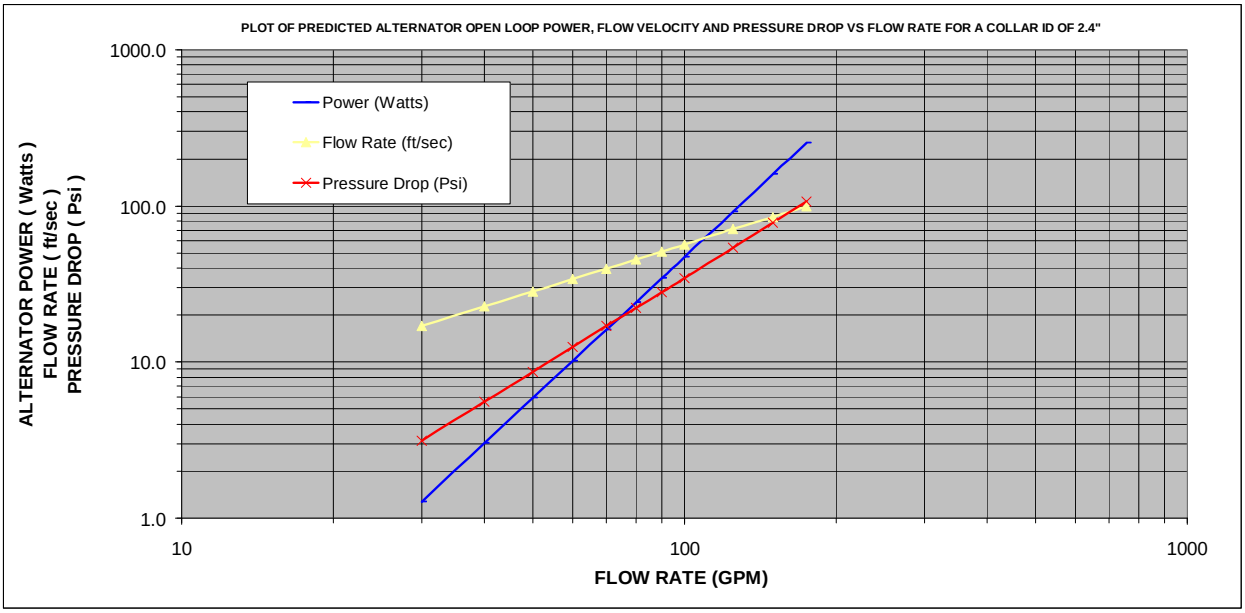

Fig 7: Plot of the theoretical flow loop performance in a 2.4” ID flow sleeve.

2.3” ID Data.

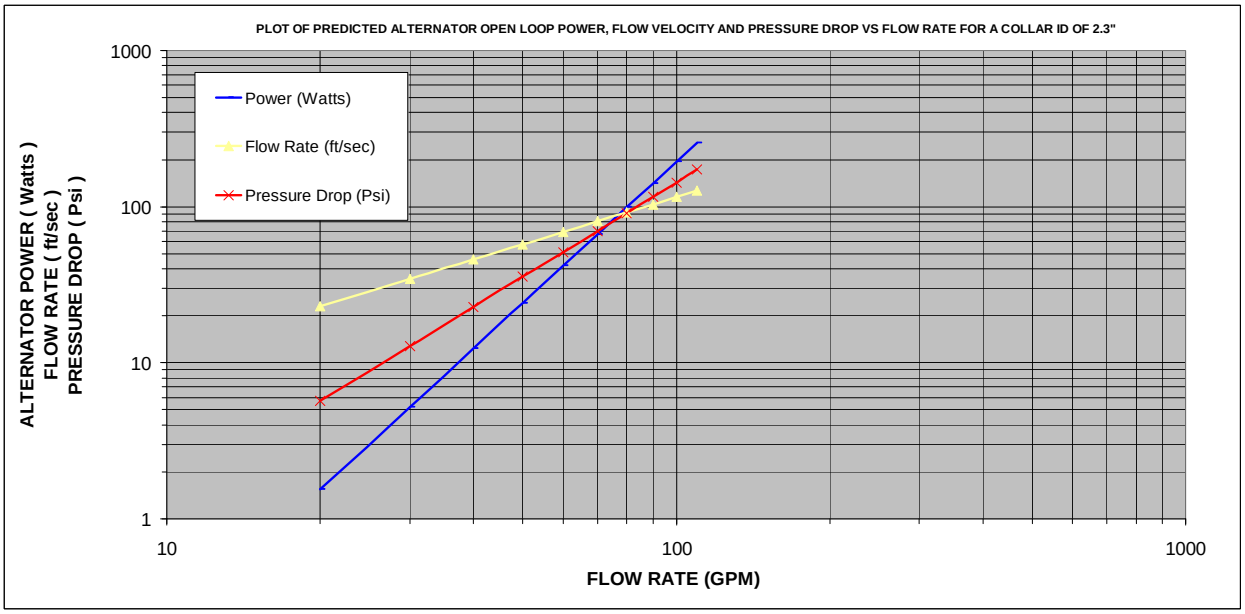

Fig 8: Plot of the theoretical flow loop performance in a 2.3” ID flow sleeve.

Conclusions.

Turbine Dynamics has developed a theoretical method for predicting the behaviour of their turbine alternator against a variety of flow conditions. These theoretical calculations show a high degree of correlation against actual flow loop data confirming their accuracy and usefulness for predictive purposes.