

Reservoir depletion is another important factor. If enough oil has been extracted from the reservoir the reservoir pressure must decrease. We have been provided many estimates of this pressure reduction. They range from 550 to 2000 psi. The pressure at the BOP should reflect this reduction, but a reduction has not been observed.

Any model has to not only assume various flow paths and resistances; it has to account for potential erosion during the long flowing time. It is assumed that the kill operation where mud was forced through the various paths could have eroded the BOP. However, to this point no model has attempted to quantify this effect.

The model of the system will have a lot of parameters. Some of these are to approximate a complex process (the calculation of a two phase flow rate through an orifice, the difference between the gas and liquid velocities in a rising two phase flow, etc.). Some of these are to approximate the unknown geometry (the ratio of the deep and shallow flow resistances, the amount of flow flowing through the annulus of the BOP, etc.).

Once the model is complete, the model will calculate the BOP pressure during well shut in with and without a leak. The goal is to determine if a leak exists by comparing the measured BOP pressure to the calculated values. Unfortunately, if this difference between the leak and no-leak BOP pressure is small compared to the accuracy of the prediction of the no-leak pressure, we will not be able to determine the integrity of the well.

At this point, no model has been able to predict why the kill operation. Many have predicted it would succeed. Ones that predict kill failure do not allow prediction of the steady flowing condition. Thus, one might conclude that the models have yet to be correct.

Let me pose a simple analogy. We are able to observe the rate of riders exiting the Metro at National Airport in Washington, DC. We know that the rate is sensitive to the operating condition of the red line (which does not go to National Airport). If the red line is not running, we know that the number of passengers exiting at National Airport will decrease. We can create the model, and determine the effect of shutting down the red line. Even if our model reduction is accurate, if we do not know the baseline condition, we cannot determine if the red line is running or not. The only control we have is to reduce the number of exit styles. That still will not allow us to determine if the red line is running. This is why one cannot use an inaccurate model to determine if the well is sound. It is not that the sensitivity is low; it is that our uncertainties are high.