



Great Step 2018

Petro Case Study

Problem Statement



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An oil company is planning to drill a deep exploratory well in an area where a high pressure formation, located about 500ft above the objective oil formation, has been encountered in some wells. The normal drilling practice is to drill to total depth, run open hole logs, and completes the well if producible hydrocarbons are indicated. Normal pressure in the objective formation is expected, and the well can be controlled with relatively low mud weights. When over-pressured zone is present above the objective formation, the substantially higher mud weights are required to maintain control of the well.

High pressure with low mud weight usually results in breaking down the incompetent strata near the top of the long open-hole section and losing circulation. To protect against the lost circulation problem (and resulting loss of control) one could plan to drill to a point just above where one anticipate the over-pressured zone to be, run a string of intermediate casing to seal off the incompetent strata, increase mud weight and continue drilling..

Blowout risk is greatly reduced with this strategy, but at the expense of an extra string of intermediate casing costing \$100,000. This expense added to the estimated cost of \$300,000 to drill the well in the conventional manner, would result in a total well cost of \$400,000.

An alternative drilling program would be to eliminate any plans for running intermediate casing and gambling that the over-pressured zone is not present. This would keep the drilling costs at \$300,000 unless one encounters an over-pressured zone.

If this happens then one has to pay an additional amount to regain control of the well and set an intermediate string of casing. It is estimated that this contingency would cause well costs to climb to \$450,000 (\$300,000 base cost, \$100,000 for intermediate casing, and \$50,000 for extra rig time, mud costs, etc. needed to maintain control until the intermediate casing is set). The geologist judges that the probability of encountering over-pressured zone is 0.3.

As a third alternative, one could run a log above the possible high pressure zone and calculate geostatic pressure gradient trend as measured from the changes of the shale sections above the zone. Or, one could use a density log or both. The idea is that a geophysical technique can be used to indicate-imperfectly-whether the well is approaching an over-pressured zone.

The reliability of this interpretative technique is judged to be 0.9. That is, given either state of nature, there is a 90% chance the interpretation is correct. The cost of these logging surveys is \$20,000. If one ran the logs one would, of course, defer his decision whether to run intermediate casing until he obtained the additional (imperfect) information from the logs.

Question:

What would be the preferred strategy to drill the well with minimizing the expected drilling costs? Justify your decision with the chances and decisions in a stepwise manner.