NOTICE CONCERNING COPYRIGHT RESTRICTIONS

This document may contain copyrighted materials. These materials have been made available for use in research, teaching, and private study, but may not be used for any commercial purpose. Users may not otherwise copy, reproduce, retransmit, distribute, publish, commercially exploit or otherwise transfer any material.

The copyright law of the United States (Title 17, United States Code) governs the making of photocopies or other reproductions of copyrighted material.

Under certain conditions specified in the law, libraries and archives are authorized to furnish a photocopy or other reproduction. One of these specific conditions is that the photocopy or reproduction is not to be "used for any purpose other than private study, scholarship, or research." If a user makes a request for, or later uses, a photocopy or reproduction for purposes in excess of "fair use," that user may be liable for copyright infringement.

This institution reserves the right to refuse to accept a copying order if, in its judgment, fulfillment of the order would involve violation of copyright law.
Geothermal Well Cost Update 2009

A. J. Mansure¹ and D. A. Blankenship²

¹Consultant to Sandia National Laboratories
²Sandia National Laboratories

Keywords
Well costs, drilling, well construction, well cost analysis

ABSTRACT

Geothermal well construction costs are critical to future geothermal development including both hydrothermal and Engineered Geothermal Systems (EGS). Cost analyses presented at last year’s Geothermal Resources Council were made before the financial crises of 2008 impacted energy prices and the drilling industry. As such, here we present an update to last year’s well cost analyses. Because the drilling industry is currently in flux, no attempt has been made to forecast future well construction costs, rather information is provided on changes in the drilling industry.

Introduction

In the last year there have been changes in the drilling industry that affect one’s understanding of the fundamental question: “How do we make sense of what has happened in the last five years and are well construction costs comparisons based on year 2004 dollars still valid?” 2004 was the end of the last period during which well construction costs were relatively stable. It was also the cost basis year for several significant evaluations of the geothermal energy. A year ago, it appeared well construction costs had stopped increasing and were beginning to stabilize. However, since that time the global economy has faltered, oil & gas prices have crashed, and rig counts have fallen significantly. The result is that well construction costs are declining. The drilling industry is again in a state of flux.

Past geothermal well construction cost analyses (Mansure et al. 2005, Mansure et al. 2006, and Mansure and Blankenship 2008) have been performed to support a number of Department of Energy (DOE) Geothermal Technologies Program (GTP) activities, including the GTP Multi-Year Research, Development and Demonstration Plan (DOE 2009), The Future of Geothermal Energy (MIT 2006), and Geothermal Electric Technologies Evaluation Model (GETEM) (Entingh 2006). Mansure and Blankenship (2008) discussed how well construction costs can be updated using Bureau of Labor Statics (BLS) data. Mines (2008) has incorporated that approach into GETEM.

Impact of Inflation, Rig Availability, and Other Economic Drivers on Well Construction Costs

To compare the cost of wells drilled at different times one must account for changing prices of goods and services. Past work (Mansure et al. 2006) determined the most appropriate currently available Producer Price Index (PPI) from the BLS. PPI updates are available on a monthly basis, important in a time of rapid cost changes. Recent rig day rate and other (steel, cement, rental items, expendable items, services, and labor) price increases and decreases have significantly destabilized well construction costs as reflected in “well construction” PPI on Figure 1. The BLS refers to their PPI as an index of drilling costs, but the index is actually for all of well construction including drilling contractor costs as well as casing, cementing, etc. Figure 1 shows that the most recent well construction cost trend is downward. In periods where the PPI for well construc-

![Figure 1. Comparison of BLS drilling PPI, CPI, and chained GDP Price Indices vs. time.](image-url)
tion is relatively stable (1985 to 2000), predictions of future well construction costs, including the impacts of DOE GTP goals, are more robust and justifiable than during disruptive periods. A disruptive rise in well construction prices occurred during 2005 followed by a chaotic period during which well construction prices appeared to begin to stabilize. Before well construction prices could stabilize, the 2008 world economic slump began and well construction prices have started to fall – another disruptive event. Well construction costs take months to fully respond to changes in the stock market, availability of capital, and energy supply and demand, so well construction costs are still trying to catch up to recent economic changes. At this point in time, there is no way of knowing how much more and for how long well construction costs will fall.

The temptation is to assume that the recent (post 2005) rise in well construction costs is a bubble and that the well construction costs will return to prior values. That is, it is natural to hope that a future balance between oil supply and demand will bring back stable well construction economic conditions like those between 1985 and 2000. But rather than returning to prior well construction costs it seems just as likely that changing global oil & gas economics will result in well constructions costs above those of 2004 corrected for inflation. To get insight into disruptive events in the drilling industry, one can look at oil prices (price data from the Federal Reserve Bank and the Energy Information Agency – EIA) and rig counts (rig count data from Baker Hughes) shown in Figure 2. Natural gas prices and rig count show a similar relationship and response recent economic conditions (Figure 3). Discussion of these figures is provided in Mansure and Blankenship (2008).

What will well construction costs be in the future? The apparent stable PPI for well construction between 1985 and 2000 was not sustainable; costs had to go up. The rise and fall in oil prices in the 1970’s and early 1980’s left the US land drilling industry with an excess of rigs. Throughout the 1990’s, except in niche operations, e.g. coal bed methane drilling, rig rates were as much as $2k/day below the rate of return required to borrow money from the bank, purchase a new rig, and pay back the bank (Pierce, 2008). It took about twenty years after the 1980 disruptive event for US land drilling contractors to get back to real profitability including rig capitalization. Significant new construction of drilling rigs began in 2005, but has essentially stopped. Rig count is now down over 50% (Figure 2) from Oc-

---

**Figure 2.** Comparison of oil price and rig count vs. time.

**Figure 3.** Comparison of natural gas price and rig count vs. time.

**Figure 4.** Comparison of cement and steel PPIs to CPI and GDP chained vs. time.

**Figure 5.** Index of recent rig day rate vs. GDP and CPI. (Note: rig day rate data runs as much as 3 months in arrears.)
October 2008. According to the Land Rig Newsletter (Feb. 2009), a major concern is will there be a repeat of the 1980’s when the drilling industry stagnated; however, general consensus is that because of lessons learned in the 1980’s over supply this time is not as large and rig rates will rebound as soon as the demand for energy picks up. However, rig rates are just one part of well construction costs.

Besides the drilling rig, other major costs of well construction include steel, cement, rental items (mostly items made of steel), expendable items (e.g. drilling mud), services, and labor. Figure 4 shows BLS PPI price changes in steel and cement compared CPI and chained GDP. In 2004 rig day rate (Pierce, 2008) was the only well construction cost driver believed to have been priced below a sustainable rate. Notwithstanding the recent changes in cement and steel shown in Figure 4, it is reasonable to assume steel, cement, rental items, expendable items, services, and labor on average increase in proportion or slightly more than the CPI. While the majority of the costs drivers other than rig rate (Figure 5) are not dropping significantly (Figure 4), the recent drop in the PPI for well construction (Figure 1) suggests that well construction costs over corrected upward in 2005.

Closing Remarks

The importance of accurate, documented and analysis of well construction costs to the DOE Geothermal Program has been demonstrated by recent work including The Future of Geothermal Energy (MIT, 2006). This type of cost data and analysis should be continued. The oil price increase in 2005 followed by the collapse in 2008 created economically disruptive events in the drilling industry. Review of the Bureau of Labor Statistics Producer Price Index for drilling suggests that well construction prices have not had time to stabilize since these disruptive events. Furthermore, until world energy markets stabilize, well construction costs will probably not be able to stabilize.

More rigorous methodology than just the BLS PPI for well construction is needed to understand changes in well construction cost drivers. Currently it is merely assumed that the BLS PPI index is representative of geothermal well construction costs. A more detailed analysis of other data sources may provide greater insight into the significance of the PPI for well construction and what to expect regarding future well construction costs.

Acknowledgements

Sandia National Laboratories is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.

References


The Land Rig Newsletter: http://landrig.com/.