Implementing Oil Field Temperature Data for Formation Specific Heat Content for Electric Power Generation – First Approximations

Richard J. Erdlac, Jr.
Erdlac Energy Consulting
Midland, TX

Previous funded geothermal investigations of the deep Delaware and Val Verde Basins of the West Texas region were conducted during the latter half of 2005 and into 2006. Support for this study was provided by the Department of Energy and the Texas State Energy Conservation Office. This work expanded upon previous database generation, enlarging an existing database to around 5,000 wells and over 8,000 temperature-depth (t-d) points. Further work at that time was curtailed due to a lack of continued funding into the next phase of the project. However, investigations have continued, though at a slower pace, to use this data for determining the heat content within potential target formations for electrical power generation.

Reeves County, in the northern part of the Delaware Basin in Texas, was chosen to initiate this next phase of geothermal investigation. Latitude and longitude information for some of the wells was previously collected using industry proprietary sources. Additional data was obtained from the Texas Railroad Commission using the GIS public website for cross correlation of well name and survey, block, and section location information to acquire the lat-long information listed on the website. Not all of the wells in the geothermal database had sufficient information to determine lat-long values, resulting in some wells being discarded from this present study. Many other wells within the county, some deep, were not part of the original database. No attempt to include these wells into the geothermal database was done at this time. The result was lat-long and temperature information for 725 wells scattered throughout the county.

Many of the wells had multiple temperature readings within a hole. This provided an opportunity to test the difference in temperature calculations at specific depth intervals using a linear and nonlinear approach. The linear temperature model assumed an average surface temperature of 21.1^{o}C (70^{o}F). For wells with a single bottom hole temperature (BHT) reading a thermal gradient was calculated from the surface temperature to the BHT reading over the depth of the well. This gradient was then used to determine calculated temperatures at target depths. Wells with multiple BHT measurements had multiple determinations of thermal gradient, with an average thermal gradient being determined for the well. This method was then compare to wells with multiple BHT readings that were plotted for each well and a best fit nonlinear function calculated based on the BHT readings and the average surface temperature. Temperatures could then be calculated for these wells at target depths for comparison with the linear fit calculation.

Presently in progress is the development of various contour maps at constant depth and at specific formation boundaries. These maps can be overlaid with a tectonic map of the area along with an oil and gas field production map. In this manner correlations can be observed as related to subsurface structure and produced oil and gas horizons as shown on the production map. Using the aquifer thermal carrying capacity equation and a range of rock porosities and the heat capacity calculations of the rock and fluid mixture, the volumetric method equation for determining available geothermal energy is applied to give an idea of the thermal carrying capacity of a target sedimentary reservoir.

Extension of this process to other counties within the original Delaware-Val Verde Basin geothermal study is still to be conducted. This approach can also be used in sedimentary rock within other basins for determining the subsurface geothermal potential along with estimates of retrievable energy. This in turn leads to development of a resource management plan over long term field production.