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BURNETT NYLAH

Drilling and Testing Academic Press
Susan 1, a hot water production well, was drilled late in 1980 for the City of Susanville, California, as part of its geothermal space-heating project. A history of drilling, logging, completion and pump testing of this well is presented. Susan 1 was drilled to 930 feet using local river water with a 17-1/2-inch bit from 50 to 540 feet and a 12-1/2-inch bit from 540 to 927 feet. A 12-3/4-inch solid casing was set from surface to 350 feet, a slotted casing from 350 to 538 feet, and a 8-5/8-inch slotted casing from 520 to 925 feet. Interpretations of the following logs and test data from this well are presented: drilling logs (penetration rate, water loss and gain, return temperatures); formation logs (description of well cuttings, caliper, spontaneous potential, electrical resistivity, gamma ray, neutron); production logs (temperature, spinner); and pump test data.
Geothermal Energy Update CRC Press
In accordance with the requirements of 10 CFR Part 711, environmental assessments are being prepared for significant activities and individual projects of the Division of Geothermal Energy (DGE) of the Energy Research and Development Administration (ERDA). This environmental assessment of geopressure well testing addresses, on a regional basis, the expected activities, affected environments, and possible impacts in a broad sense. The specific part of the program addressed by this environmental assessment is geothermal well testing by the take-over of one or more unsuccessful oil wells before the drilling rig is removed and completion of drilling into the geopressured zone. Along the Texas and Louisiana Gulf Coast (Plate 1 and Overlay) water at high temperatures and high pressures is trapped within Gulf basin sediments. The water is confined within or below essentially impermeable shale sequences and carries most or all of the overburden pressure. Such zones are referred to as geopressured strata. These fluids and sediments are heated to abnormally high temperatures (up to 260

C) and may provide potential reservoirs for economical production of geothermal energy. The obvious need in resource development is to assess the resource. Ongoing studies to define large-sand-volume reservoirs will ultimately define optimum sites for drilling special large diameter wells to perform large volume flow production tests. In the interim, existing well tests need to be made to help define and assess the resource. The project addressed by this environmental assessment is the performance of a geothermal well test in high potential geothermal areas. Well tests involve four major actions each of which may or may not be required for each of the well tests. The four major actions are: site preparation, drilling a salt-water disposal well, actual flow testing, and abandonment of the well.

Vale Exploratory Slimhole Elsevier

This report deals the preliminary geological and geophysical work needed to ascertain the characteristics of the geothermal reservoir below the town of Pagosa Springs, Colorado. cf. Introd.

Fundamentals, Applications and Advanced Techniques

Drilling, Completion, and Testing of Geothermal Wells CD-1 and CD-2, Caliente, NevadaTwo geothermal test wells were drilled in January 1983, in Antelope Canyon to access the potential for resource utilization by the City of Caliente's proposed space heating district. Both holes, drilled into bedrock at 220 feet, encountered hot water in the upper part of the hole (40 to 100 feet) and cooler water below (100 to 210 feet). A series of pumping tests were completed in February 1983, including pump-efficiency tests, stepped draw-down tests, and 1-, 2-, and 3-day sustained pumping tests. The test results indicated that the transmissivity of the thermal aquifer is very, very high. Five water samples were collected for chemical analyses during the course of CD-1 pump tests. The samples were collected to determine the water quality for the proposed space heating district and possible reinjection, and to establish a water chemistry base-line for comparative analysis of fluid chemistry during the course of the pumping and from subsequent development. 7 refs., 18 figs., 3 tabs.Drilling and Testing of an Exploratory Well Truckhaven Geothermal Area Imperial County CaliforniaFinal Project ReportOverview of Drilling and Completion Practices in Geopressured-geothermal WellsExperience in the DOE's Wells of Opportunity program, drilling and testing geopressured-geothermal reservoirs is reviewed and some conclusions concerning drilling and completion practices, ways to cut operating costs for these tests, and long-term production applications are presented.Geothermal Well Test AnalysisFundamentals, Applications and Advanced Techniques Maurer Engineering developed special high-temperature geothermal turbodrills for LANL in the 1970s to overcome motor temperature limitations. These turbodrills were used to drill the directional portions of LANL's Hot Dry Rock Geothermal Wells at Fenton Hill, New Mexico. The Hot Dry Rock concept is to drill parallel inclined wells (35-degree inclination), hydraulically fracture between these wells, and then circulate cold water down one well and through the fractures and produce hot water out of the second well. At the time LANL drilled the Fenton Hill wells, the LANL turbodrill was the only motor in the world that would drill at the high temperatures encountered in these wells. It was difficult to operate the turbodrills continuously at low speed due to the low torque output of the LANL turbodrills. The turbodrills would stall frequently and could only be restarted by lifting the bit off bottom. This allowed the bit to rotate at very high speeds, and as a result, there was excessive wear in the bearings and on the gauge of insert roller bits due to these high rotary speeds. In 1998, Maurer Engineering developed an Advanced Geothermal Turbodrill (AGT) for the National Advanced Drilling and Excavation Technology (NADET) at MIT by adding a planetary speed reducer to the LANL turbodrill to increase its torque and reduce its rotary speed. Drilling tests were conducted with the AGT using 12 1/2-inch insert roller bits in Texas Pink Granite. The drilling tests were very successful, with the AGT drilling 94 ft/hr in Texas Pink Granite compared to 45 ft/hr with the LANL turbodrill and 42 ft/hr with a rotary drill. Field tests are currently being planned in Mexico and in geothermal wells in California to demonstrate the ability of the AGT to increase drilling rates and reduce drilling costs.

Development Drilling, Testing and Initial Production of the Beowawe Geothermal Field

Geothermal Reservoir Engineering offers a comprehensive account of geothermal reservoir engineering and a guide to the state-of-the-art technology, with emphasis on practicality. Topics covered include well completion and warm-up, flow testing, and field monitoring and management. A case study of a geothermal well in New Zealand is also presented. Comprised of 10 chapters, this book opens with an overview of geothermal reservoirs and the development of geothermal reservoir engineering as a discipline. The following chapters focus on conceptual models of geothermal fields; simple models that illustrate some of the processes taking place in geothermal reservoirs under exploitation; measurements in a well from spudding-in up to first discharge; and flow measurement. The next chapter provides a case history of one well in the Broadlands Geothermal Field in New Zealand, with particular reference to its drilling, measurement, discharge, and data analysis/interpretation. The changes that have occurred in exploited geothermal fields are also reviewed. The final chapter considers three major problems of geothermal reservoir engineering: rapid entry of external cooler water, or return of reinjected water, in fractured reservoirs; the effects of exploitation on natural discharges; and subsidence. This monograph serves as both a text for students and a manual for working professionals in the field of geothermal reservoir engineering. It will also be of interest to engineers and scientists of other disciplines.

Drilling and Testing of an Exploratory Well Truckhaven Geothermal Area Imperial County California

The principal objectives of the geopressured-geothermal reservoir resource assessment program are to obtain data related to the following: 1.2.1--Reservoir parameters and characteristics, including permeability, porosity, areal extent, net thickness of productive sands, methane content, and formation compressibilities; 1.2.2--Ability of a geopressured well to flow at the high rates, i.e., 40,000 bbls/day, expected to achieve the resource recovery required for economic commercial operations; 1.2.3--Reservoir production drive mechanisms and physical and chemical changes that may occur with various production rates and conditions; 1.2.4--Aquifer fluid properties, including chemical composition, dissolved and suspended solids, hydrocarbon content, in situ temperature, and pressure; 1.2.5--Techniques and strategies for completion and production of geopressured wells for methane, thermal, and hydraulic energy production, including examination of producibility using computer simulators employing parameters determined by well testing; 1.2.6--Disposal well parameters, such as optimum injection rate and pressures (transient and pseudo steady state), chemical compatibility of fluids, temperature-solubility relationships, and the economic considerations of injection, including evaluation of filtering and inhibition techniques in the process steam; and 1.2.7--The long-term environmental effects of an extensive commercial application of geopressured-geothermal energy, i.e., subsidence, induced seismicity, and fluid disposal.

INEL-1 Well, Butte County, Idaho

The Department of Energy (DOE) has initiated a program to evaluate the feasibility of developing the geothermal-geopressured energy resources of the Louisiana-Texas Gulf Coast. As part of this effort, DOE is contracting for the drilling of design wells to define the nature and extent of the geopressure resource. At each of several sites, one deep well (4000-6400 m) will be drilled and flow tested. One or more shallow wells will also be drilled to dispose of geopressured brines. Each site will require about 2 ha (5 acres) of land. Construction and initial flow testing will take approximately one year. If initial flow testing is successful, a continuous one-year duration flow test will take place at a rate of up to 6400 m3 (40,000 bbl) per day. Extensive tests will be conducted on the physical and chemical composition of the fluids, on their temperature and flow rate, on fluid disposal techniques, and on the reliability and performance of equipment. Each project will require a maximum of three years to complete drilling, testing, and site restoration.

Support Research for Development of Improved Geothermal Drill Bits

During Phases 2 and 3 of the Lake City GRED II project two slim holes were cored to depths of 1728 and 4727 ft. Injection and production tests with temperature and pressure logging were performed on the OH-1 and LCSH-5 core holes. OH-1 was permanently modified by cementing an NQ tubing string in place below a depth of 947 ft. The LCSH-1a hole was drilled in Quaternary blue clay to a depth of 1727 ft and reached a temperature of 193 oF at a depth of 1649 ft. This hole failed to find evidence of a shallow geothermal system east of the Mud Volcano but the conductive temperature profile indicates temperatures near 325 oF could be present below depth of 4000 ft. The LCSH-5 hole was drilled to a depth of 4727 ft and encountered a significant shallow permeability between depths of 1443 and 1923 ft and below 3955 ft. LCSH-5 drilled impermeable Quaternary fanglomerate to a depth of 1270 ft. Below 1270 ft the rocks consist primarily of Tertiary sedimentary rocks. The most significant formation deep in LCSH-5 appears to be a series of poikoilitic mafic lava flows below a depth of 4244 ft that host the major deep permeable fracture encountered. The maximum static temperature deep in LCSH-5 is 323 oF and the maximum flowing temperature is 329 oF. This hole extended the known length of the geothermal system by 3/4 of a mile toward the north and is located over 1/2 mile north of the northernmost hot spring. The OH-1 hole was briefly flow tested prior to cementing the NQ rods in place. This flow test confirmed the zone at 947 ft is the dominant permeability in the hole. The waters produced during testing of OH-1 and LCSH-5 are generally intermediate in character between the deep geothermal water produced by the Phipps #2 well and the thermal springs. Geothermometers applied to deeper fluids tend to predict higher subsurface temperatures with the maximum being 382 oF from the Phipps #2 well. The Lake City geothermal system can be viewed as having shallow (elevation> 4000 ft and temperatures of 270 to 310 oF), intermediate (elevation 2800 to 3700 ft and temperatures 270 to 320 oF) and deep (elevations

Drilling and Testing

Two geothermal test wells were drilled in January 1983, in Antelope Canyon to access the potential for resource utilization by the City of Caliente's proposed space heating district. Both holes, drilled into bedrock at 220 feet, encountered hot water in the upper part of the hole (40 to 100 feet) and cooler water below (100 to 210 feet). A series of pumping tests were completed in February 1983, including pump-efficiency tests, stepped draw-down tests, and 1-, 2-, and 3-day sustained pumping tests. The test results indicated that the transmissivity of the thermal aquifer is very, very high. Five water samples were collected for chemical analyses during the course of CD-1 pump tests. The samples were collected to determine the water quality for the proposed space heating district and possible reinjection, and to establish a water chemistry base-line for comparative analysis of fluid chemistry during the course of the pumping and from subsequent development. 7 refs., 18 figs., 3 tabs.

User Coupled Confirmation Drilling Program Case Study

During April-May, 1995, Sandia National Laboratories, in cooperation with Trans-Pacific Geothermal Corporation, drilled a 5825' exploratory slimhole (3.85" diameter) in the Vale Known Geothermal Resource Area (KGRA) near Vale, Oregon. This well was part of Sandia's program to evaluate slimholes as a geothermal exploration tool. During drilling we performed several temperature logs, and after drilling was complete we performed injection tests, bailing from a zone isolated by a packer, and repeated temperature logs. In addition to these measurements, the well's data set includes: 2714' of continuous core (with detailed log); daily drilling reports from Sandia and from drilling contractor personnel; daily drilling fluid records; numerous temperature logs; pressure shut-in data from injection tests; and comparative data from other wells drilled in the Vale KGRA. This report contains: (1) a narrative account of the drilling and testing, (2) a description of equipment used, (3) a brief geologic description of the formation drilled, (4) a summary and preliminary interpretation of the data, and (5) recommendations for future work.

Evaluation of a Geothermal Well Logging, DST and Pit Test

As a result of geopressured resource assessment studies in the Gulf Coast region, the Brazoria fairway, located in Brazoria County, Texas was determined to be an optimum area for additional studies. A plan is presented for drilling, completion, and testing of one geopressured-geothermal well and two disposal wells in Brazoria County, Texas. The objectives of the well drilling and testing program are to determine the following parameters: reservoir permeability, porosity, thickness, rock material properties, depth, temperature, and pressure; reservoir fluid content, specific gravity, resistivity, viscosity, and hydrocarbons in solution; reservoir fluid production rates, pressure, temperature, production decline, and pressure decline; geopressured well and surface equipment design requirements for high-volume production and possible sand production; specific equipment design for surface operations, hydrocarbons distribution, and effluent disposal; and possibilities of reservoir compaction and/or surface subsidence. (JGB).

INEL/Snake River Geothermal Drilling and Testing Plan

The Beowawe geothermal field in north central Nevada is generating 16MW using two production wells (Ginn 1-13 and 2-13) and one injection well (Batz). Drilling the second production well (Chevron Ginn 2-13) in 1985 led to the discovery of a second productive strand of the Malpais fault zone. The wells are completed in the Malpais fault zone and are capable of producing 420+°F geothermal fluid at rates exceeding 1,000,000 lbs/hr. Initial testing suggests that the completion zones of the two production wells have no pressure communication, therefore providing what is essentially a second production zone for future development. Injection of produced fluids into a fault parallel with the Malpais shows no pressure communication with other wells. One year of production in the system shows no pressure depletion or enthalpy decline in the producing area. 1 tab., 6 figs., 5 refs.

Drilling, Completion, and Testing of Geothermal Wells CD-1 and CD-2, Caliente, Nevada

A plan for drilling a 7500 ft exploratory hole is described. This hole would be drilled at the Idaho National Engineering Laboratory, so that it could be immediately used by one of the government facilties. The plan details the hole design, describes the drilling program, proposes a testing program, and estimates costs. (MHR).

Geopressured-Geothermal Drilling and Testing Plan, Volume II, Testing Plan; Dow Chemical Co. - Dept. of Energy Dow-DOE Sweezy No. 1 Well, Vermilion Parish, Louisiana

Experience in the DOE's Wells of Opportunity program, drilling and testing geopressured-geothermal reservoirs is reviewed and some conclusions concerning drilling and completion practices, ways to cut operating costs for these tests, and long-term production applications are presented.

An Environmental Report on the Drilling and Production Testing of an Exploratory Geothermal Well in Pagosa Springs, Colorado

This paper briefly discusses logging and testing operations and certain related physical aspects in geothermal well evaluations. A good understanding of thermal and hydrological characteristics of geothermal reservoirs are essential in geothermal well evaluations. Within geothermal reservoirs, in evaluating the wells, the two most important parameters that first could be estimated, then measured or calculated, are temperature and productivity. Well logs and wireline surveys are means of measuring formation temperatures. Drill Stem Tests (DST's) or Pit Tests are means of determining formation productivity. Geochemistry and Petrology are currently accepted as two evaluation yardsticks in geothermal well evaluations. investigations of cuttings and cores during drilling operations, along with studies on formation waters could be used in a predictive nature for temperature and productivity and could yield useful information on the resource.

Geopressured-geothermal Drilling and Testing Plan General Crude Oil - Dept. of Energy Pleasant Bayou No. 2 Well Brazoria County, Texas

This report covers the drilling and testing of the slim well 56-4 at the Reese River Geothermal Project in Lander County, Nevada. This well was partially funded through a GRED III Cooperative Funding Agreement # DE-FC36-04GO14344, from USDOE.

Fort Bliss Exploratory Slimholes

The work reported herein is a continuation of the program initiated under DOE contract E(10-1)-1546* entitled "Program to Design and Experimentally Test an Improved Geothermal Bit"; the program is now DOE Contract EG-76-C-1546*. The objective of the program has been to accelerate the commercial availability of a tolling cutter drill bit for geothermal applications. Data and experimental tests needed to develop a bit suited to the harsh thermal, abrasive, and chemical environment of the more problematic geothermal wells, including those drilled with air, have been obtained. Efforts were directed at the improvement of both the sealed (lubricated) and unsealed types of bits. The unsealed bit effort included determination of the rationale for materials selection, the selection of steels for the bit body, cutters, and bearings, the selection of tungsten carbide alloys for the friction bearing, and preliminary investigation of optimized tungsten carbide drilling inserts. Bits build** with the new materials were tested under stimulated wellbore conditions. The sealed bit effort provided for the evaluation of candidate high temperature seals and lubricants, utilizing two specially developed test apparatus which simulate the conditions found in a sealed bit operating in a geothermal wellbore. Phase I of the program was devoted largely to (1) the study of the geothermal environment and the failure mechanisms of existing geothermal drill bits, (2) the design and construction of separate facilities for testing both drill-bit seals and full-scale drill bits under simulated geothermal drilling conditions, and (3) fabrication of the MK-I research drill bits from high-temperature steels, and testing in the geothermal drill-bit test facility. The work accomplished in Phase I is reported in References 1 through 9. In Phase II, the first generation experimental bits were tested in the geothermal drill-bit test facility. Test results indicated that hardness retention at temperature, but not at the expense of fracture toughness, was a primary requirement for geothermal bit bearings. Materials selections for the MK-II bit were made based on these results. Also in Phase II, effort was directed at the screening of elastomers for use as a high-temperature seal for sealed bits. References 10 though 13 report the work performed in Phase II. This report summarizes the work on Phase III, encompassing the period from May 18, 1977, to May 19, 1978. There were two major tasks in Phase III which consisted of material selection, fabrication and testing of MK-III bits and Seal and lubricant evaluation. [DJE -2005].

Vale Exploratory Slimhole

Geothermal Well Test Analysis: Fundamentals, Applications and Advanced Techniques provides a comprehensive review of the geothermal pressure transient analysis methodology and its similarities and differences with petroleum and groundwater well test analysis. Also discussed are the different tests undertaken in geothermal wells during completion testing, output/production testing, and the interpretation of data. In addition, the book focuses on pressure transient analysis by numerical simulation and inverse methods, also covering the familiar pressure derivative plot. Finally, non-standard geothermal pressure transient behaviors are analyzed and interpreted by numerical techniques for cases beyond the limit of existing analytical techniques. Provides a guide on the analysis of well test data in geothermal wells, including pressure transient analysis, completion testing and output testing Presents practical information on how to avoid common issues with data collection in geothermal wells Uses SI units, converting existing equations and models found in literature to this unit system instead of oilfield units

Geopressured -- Geothermal Drilling and Testing Plan

The book comprises two parts: Pressure and Flow Well Testing (Part I) and Temperature Well Testing (Part II), and contains numerous authors' developments. Due to the similarity in Darcy's and Fourier's laws the same differential diffusivity equation describes the transient flow of incompressible fluid in porous medium and heat conduction in solids. Therefore it is reasonable to assume that the techniques and data processing procedures of pressure well tests can be applied to temperature well tests. The book presents new methods to determine the formation of permeability and skin factors from tests conducted in simulated wells, designing interference well tests, processing constant bottom-hole pressure tests, estimation of the formation temperature and geothermal gradients from temperature surveys and logs, in-situ determination of the formation thermal conductivity and contact thermal resistance of boreholes, temperature regime of boreholes (cementing of production liners), and the recovery of thermal equilibrium in deep and superdeep wells. Processing and analysis of pressure and geothermal data are shown on numerous field examples from different regions of the world. The book is intended for students, engineers, and researchers in the field of hydrocarbon geophysics and geology, groundwater searching and exploitation, and subsurface environment examination. It will be also useful for specialists studying pressure and temperature in parametric deep and superdeep wells.

Annual Report

This book is a detailed prognosis covering the acquisition, completion, drilling, testing and abandonment of the Frank A. Godchaux, III, Well No. 1 under the Wells of Opportunity Program. The well is located approximately 12 miles southeast of the city of Abbeville, Louisiana. Eaton Operating Company proposes to test a section of the Planulina sand at a depth ranging from 15,584 to 15,692 feet. The reservoir pressure is estimated to be 14,480 psi and the temperature of the formation water is expected to be 298 F. The water salinity is calculated to be 75,000 ppm. The well is expected to produce 20,000 barrels of water per day with a gas content of 44 standard cubic feet pre barrel. The well was acquired from C and K Petroleu, Inc. on March 20, 1981. C and K abandoned the well at a total depth of 16,000 feet. The well has a 7-5/8 inches liner set at 13,387 feet. Eaton proposes to set 5-1/2 inch casing at 16,000 feet and produce the well through the casing using a 2-3/8 inch tubing string for wireline protection and for pressure control. A 4,600 foot saltwater disposal well will be drilled on the site and testing will be conducted similar to previous Eaton tests. The total estimated cost to perform the work is $2,959,000. An optional test from 14,905 to 15,006 feet may be performed after the original test and will require a workover with a rig on location to perform the plugback. The surface production equipment utilized on previous Eaton WOO tests will be utilized on this test. This equipment has worked satisfactorily and all parties involved in the testing are familiar with its operation. The Institute of Gas Technology and Mr. Don Clark will handle the sampling and testing and reservoir evaluation, respectively, as on the previous Eaton tests.