STAR
Frac Completion System

Frac Casing Newsletter

Winter/Spring 2006

GeoSierra

Individual Highlights:

GeoSierra

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GeoSierra's Azimuth Controlled Hydraulic Fracturing Breakthrough Casing System for Oil Field Applications

GeoSierra recently completed field trials of its new multiple-azimuth controlled frac casing system at two (2) sites, an extremely stiff saprolite residuum and a clean dense sand site. The multiple azimuth frac casing system consists of eight (8) extruded steel segments that enable four (4) fracs to be installed in a single borehole at four (4) different azimuths. The casing system was developed from the more than fifteen (15) years of experience GeoSierra's personnel have in azimuth control of vertical hydraulic fractures in weakly cemented sediments. The frac casing system is applicable to enhanced recovery in shallow depth petroleum reservoirs in soft sediments; such as sands, tar sands, soft chalks and diatomites.

The ability to control multiple frac at different azimuths from a single borehole will result in a significant enhancement to petroleum production and a major improvement in recovery of reserves from the reservoir. The azimuth controlled vertical hydraulic fracturing technology has up to now been used primarily to install subsurface Permeable Reactive Barriers (PRBs) for groundwater remediation. These PRBs are vertical permeable hydraulic fractures filled with iron filings extending from near surface down to depths in excess of 130 feet below ground surface. The hydraulic fractures are coalesced to form a continuous PRB both vertically and laterally along its entire length. The early history (1990-1995) of demonstration of the azimuth controlled vertical hydraulic fracturing technology is reviewed on page 2 of this newsletter along with the commercial implementation and success of the technology in the environmental field in the years 1995 to 2005.

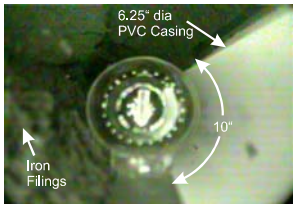
Excavation of Multiple Fracs Generated by STAR Frac Casing

The Early Demonstration Trials of Azimuth Controlled Vertically Hydraulic Fracturing Technology - Years 1990 to 1995

A series of field hydraulic fracturing experiments in loose sands and peat layers, lead to the realization that the azimuth of vertical hydraulic fractures could be controlled by the fracture initiation device, Hocking et. al. 1992. The initial artificial fracture in the sediment had to be of a sufficient size and generated in such a fashion that the fracture would propagate preferentially from the initial fracture in the required azimuth bearing. The sediments were all weakly cemented with low cohesion and did not exhibit brittle like behavior.

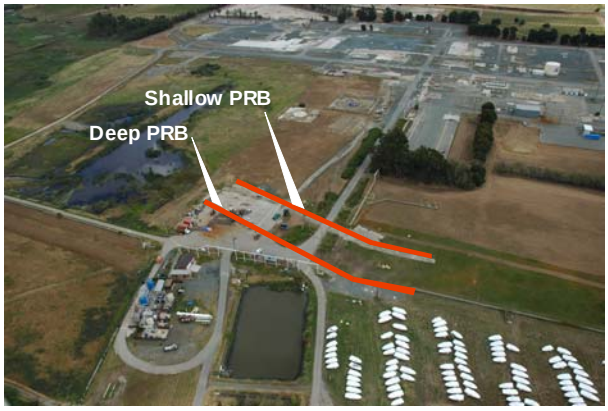
Excavated Azimuth Controlled Vertical Hydraulic Fractures

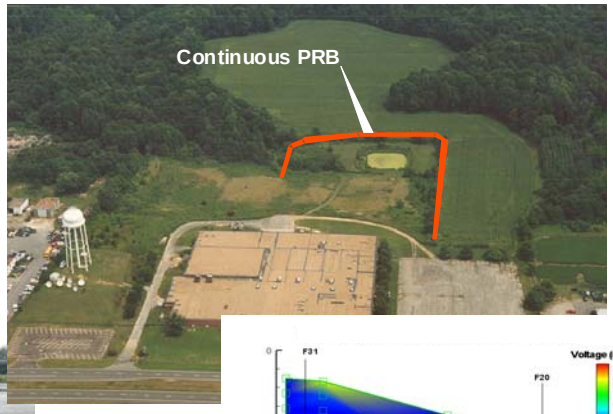
Further work in different geological conditions, Fowler 1993 and Felice and Hocking 1994, demonstrated that the technique was applicable to a wide range of weakly cemented sediments. To date the technique has been demonstrated to work in a range of soil and stress conditions, from loose cohesionless sands, partly cemented dense sands and silts to over consolidated clays and peats. The early field experiments all conducted at shallow depth were excavated. Later experiments conducted at greater depths were recorded from downhole camera, inclined resistivity & magnetometer probing and subsurface imaging.



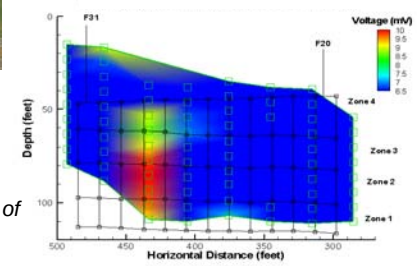
Commercial Success of Azimuth Controlled Vertical Hydraulic Fracturing Technology in the Environmental Field - Years 1995 to 2005

GeoSierra's azimuth controlled vertical hydraulically fracturing technology has installed over twenty (20) PRBs at numerous sites throughout the US for groundwater remediation. Over 8,000 linear feet of vertical PRBs have been installed by the technology ranging in depth from near ground surface down to depths exceeding 130 feet. The continuous coalesced vertical fractures form a permeable treatment zone of iron filings of up to 6 inches in thickness, through which groundwater passes unimpeded. The iron filings within the PRB strip the chlorine atoms from contaminants in the groundwater, thus destroying these contaminants and resulting in clean groundwater exiting the PRB. Real time imaging technology provides the frac operator a real frac injected geometry image of the PRB as it is being installed and shows coalescence of the fracture segments both vertically and laterally. Many of the PRBs have been field verified for thickness with inclined profiling by soil both resistivity and magnmetometer probes.





The commercial implementation of the technology in the environmental field has lead to the 3rd generation frac initiation and azimuth control tools and a 3rd generation mixing and pumping unit. The real time imaging technology has been enhanced in resolution over the years providing a reliable image of the subsurface injected geometry. GeoSierra has developed proprietary gels, cross-linkers and breakers applicable to the environmental field.



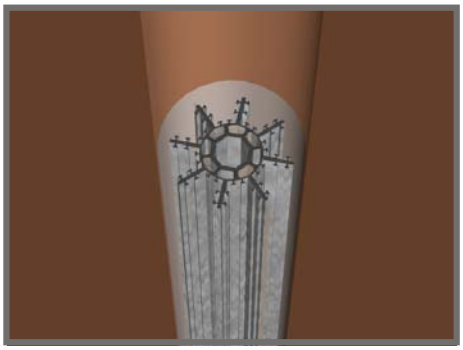
Real Time Image of Frac Propagation

Multiple Azimuth Controlled Frac Casing System The STAR Frac Casing Completion System

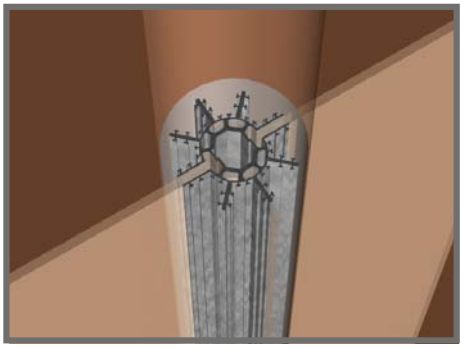
GeoSierra's multiple azimuth controlled frac casing is referred to as the ***STAR*** frac casing completion system. *STAR* being the acronym ***S***egmented ***T***ubular ***A***zimuth controlled & multiple ***R***adial frac completion system. The *STAR* frac completion system is assembled from eight (8) extruded segments initially sealed and bolted together to form a well bore casing suitable for installation in a mud rotary borehole and cemented in place.

To initiate and propagate the fractures at the required azimuths, first the central production cavity and other frac initiation cavities are sanded off to avoid cross injection into cavities for subsequent fracturing. Diametrically opposite cavities are injected simultaneously to form the first azimuth controlled vertical hydraulic fracture. Following the first fracture completion, the diametrically opposite cavities for the second fracture are washed clean of sand. Then the second fracture is initiated and generated perpendicular to the first fracture by injection into the appropriate diametrically opposite casing cavities for the second fracture. Subsequently the third and fourth fractures are initiated and propagated in a similar fashion.

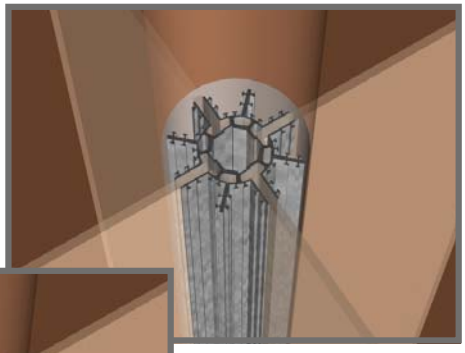
Following completion of all of the fracs, the central production bore is washed clean of sand and the casing system is then immediately ready for production. Each of the extruded segments are slotted to act as a screen to stop back flow of proppant from each of the fracs. Upon opening each individual frac, the casing is racheted open and held open by wedges to ensure the casing system does not close and pinch off the hydraulic connection with the central production bore and the highly permeable installed fracs.



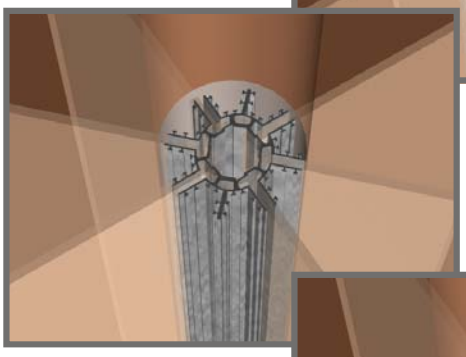
STAR Frac Casing Positioned in Borehole



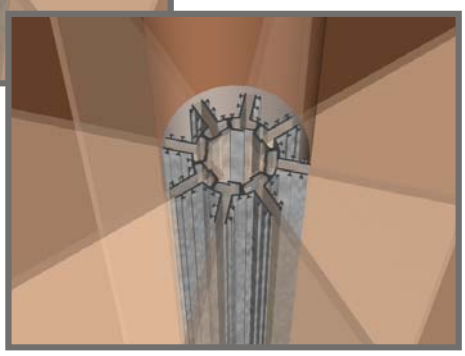
1st Frac Initiation & Propagation



2nd Frac Initiation & Propagation



3rd Frac Initiation & Propagation



4th Frac Initiation & Propagation

Earlier STAR Prototype Frac Casings

GeoSierra

Headquarters

3560 Engineering Dr.
Norcross, GA 30092

PHONE:
(678) 514-3300

FAX:
(678) 514-3323

UK Office

Glebe House
Bletchingley Rd.
Nutfield, Surrey
United Kingdom RH1
4HP

PHONE:
01737 822115

FAX:
01737 822538

Business Development

Jim Ortman
jortman@geosierra.com

PHONE:
(678) 514-3309

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www.geosierra.com

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Initiation and Propagation of Each Hydraulic Fracture using the STAR Frac Casing Completion System

The *STAR* casing system's frac initiation cavities are individually connected at the top of the casing to the central production bore through orifices located at different elevations in the well bore. The placement of a packer on the bottom of the frac injection string enables each of the diametrically opposite frac initiation cavities to be selected and injected independently from the second and subsequent fracture initiation cavities. Upon completion of the first fracture, the injection string and packer are raised to select the second frac initiation cavities, and thus initiate and propagate the second fracture independent of the first and subsequent fracture cavities. The process is repeated until all four azimuth controlled radial fracs are completed resulting in an eight star shape pattern of fracs extending from the well bore.

The frac initiation and propagation of the fractures at the various azimuths plus the subsequent placing the well bore on production are conducted by a single frac rig with minimal runs of injection and wash out strings. The casing system is designed to be a production casing without the need for perforations or the placement of additional screens.

Each individual Frac Initiated & Propagated by Dedicated Tubing to Dilating Cavities in Production Version of STAR Frac Casing

Diametrically Opposite Cavities are Dilated to Initiate Azimuth Controlled Frac

Partnering Opportunities for the STAR Frac Casing Completion System

GeoSierra is interested in hearing from potential operators or services companies interested in partnering opportunities in using the STAR casing frac completion system. The total depth the system can be used effectively has at this stage not been determined. Provided the ratio of the horizontal principal stresses in situ is not high there are no technical reasons why the system can not be used at considerable depth. US and foreign patents are pending for the *STAR* frac completion system.

About GeoSierra…

GeoSierra, a privately owned company, is based in Atlanta, GA and is known for our expertise and patented technology involving vertical and horizontal hydraulic fracturing of unconsolidated sediments for remediation of contaminated groundwater and soil. The *STAR* frac casing completion system described in this newsletter leverages our expertise and is a natural extension of our products and services. While we are capable of providing turnkey completion of projects from investigation, testing, design and construction, we are interested in participating in teaming arrangements with specialized solution providers focusing on petroleum recovery and related services