SHALLOW ENGINEERED GEOTHERMAL SYSTEMS (SEGS) USING NATURALLY BURNING UNDERGROUND COAL SEAM

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There are over 600 burning underground coal seams in the United States and we are simply wasting the heat from them and allowing the CO2 and other toxic gases to emit. A group of professionals who have different interest in the burning underground coal is proposing a unique and sustainable way to harness this wasted heat. We plan of conducting a feasibility study on utilizing the heat from burning coal fires to generate geothermal power. This adds an additional category to the conventional definition of an Engineered Geothermal System. The burning underground coal seams usually occurs at a depth of tens of meters to hundreds of meters and it is much shallower than the depth that is required to make the conventional EGS utilization possible. The saving of the drilling cost itself may justify of considering this unique way to produce geothermal power.

There are challenges associated with this new concept. First, it is the understanding of this group that there is no good estimate as to how many of these naturally burning coal seams existing in the world. Underground coal fires occur in many countries including China, India, the United States, Indonesia, Venezuela, Australia, South Africa, Germany, Romania and the Czech Republic. Although we have a better estimate as to how many of the human caused underground coal fires exist, due to the lack of detecting technique of underground heat source, we can only estimate general areas where the surface temperature is elevated. No good way to assess the depth of the heat source. For this reason, we team up with a group at Stanford (Ide, 2010) who has been working on their geophysical measurement techniques to assess the volume of the burning coal fire. The second difficulty is the lack of predictability of the thermal evolution of the underground burning coal fire. The burning front moves as a result of complex set of parameters. The third area that this group plans to improve is the general understanding of the heat transfer in the subsurface ground structure. Again, the source of difficulty is the complex formation of ground structure composed of rock, soil, vegetation, void, water and air.

Only after we overcome the three difficulties; resource location, thermal evolution and subsurface heat transfer, we can make an educated assessment of the existing naturally burning coal seams in the world, make a sustainable system design for a geothermal power plant and identify the zone in underground where the temperature is high enough to be utilized but not too high to damage the system structure. These areas of improvement will give added confidence to the economical analysis done by Chiasson and his collaborators to investigate a feasibility of developing a binary geothermal power plant that utilize the heat of burning coal fires. Chiasson and others (2005, 2007) showed that it would be possible to obtain the Levelized Cost of Electricity (LCOE) as low as $0.07/kWh for an optimized binary power plant.

Chiasson, A.D. and Yavuzturk, C. (2005). “Modeling the viability of underground coal fires as a heat source for electric power generation”, Proceedings 30Th Workshop on Geothermal Reservoir Engineering Stanford University, January 31- February 2.

Chiasson, A.D., C. Yavuzturk, and D.E. Walrath (2007). “Evaluation of electricity generation from underground coal fires and waste banks”, Journal of Energy Resources Technology, Vol. 129, 81-88.

Ide, S.T. (2010). “Anatomy of a coalbed fire: From characterization to CO2 pilot injection design at a coal fire near Durango, CO.” SPE 141134 STU.