

February 2021 – CSUR Technical Webinar #1

Using Direct Contact Steam Generation to unlock tight reservoirs

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**TECHNICAL
WEBINAR
SERIES**



USING DIRECT CONTACT STEAM GENERATION TO UNLOCK TIGHT RESERVOIRS

PRESENTED BY

BRIAN KAY, P. ENG. CHIEF TECHNOLOGY OFFICER
AND

STELLA ZHANG, M.SC., RESERVOIR ENGINEERING MANAGER
(GENERAL ENERGY RECOVERY INC.)

Representatives from General Energy Recovery Inc. (GERI) were guest speakers during CSUR's Technical Webinar Series for February 2021. Brian Kay, GERI's Chief Technology Officer, and Stella Zhang, Reservoir Engineering Manager, elaborated on their organization's Direct Contact Steam Generation (DCSG) Technology for Light & Tight Reservoirs.

GERI's DCSG Technology was initially developed for applications in Enhanced Oil Recovery (EOR) schemes for heavy oil reservoirs and bitumen recovery. The key advantages of GERI's DCSG Technology include an emission-free system and its portability (small unit) & scalability. With these key advantages and additional research, GERI's technical team has developed potential applications for this technology in conjunction with flue gas or CO₂ injection for enhanced recovery in light oil and tight reservoirs.

For conventional (heavy oil) reservoirs, the main reason for instituting steam injection is to enhance the production from the reservoir via oil viscosity reduction and at the same time improve the relative permeability to oil & gas, to re-pressurize the reservoir, and for CO₂ sequestration (if applicable). The speakers indicated that with GERI's system, they have been able to reduce the steam-to-oil ratio noticeably in their field trials and installations. Another notable benefit that they foresee with their system is to be able to minimize or even mitigate paraffin (wax) related operational issues for light & tight reservoirs.

Although there are no existing field applications in light & tight reservoirs, GERI's extensive simulation work, using various scenarios and numerous operational conditions, suggests that the DCSG system has the potential to improve the production profile and increase overall recoveries. As such, a field pilot is required to validate & tune their simulation work and to allow for further optimization of their DCSG Technology for application in tight reservoirs.

Based on the speakers' comments, there is significant interest for this technology, including around the environmental benefits that it provides. Therefore, although relatively new, GERI's business activities appear to be "picking up steam"!

Summary

A Direct Contact Steam Generation (DCSG) solution that injects both steam and hot combustion flue or exhaust gases into the reservoir has the potential to greatly improve the Steam-Oil-Ratio (SOR) for increased oil recovery in heavy and medium reservoirs as well as delivering the added environmental benefits related to reduced water and emissions. Reservoir production is increased by reducing oil viscosity through heat and repressuring the reservoir with the DCSG combustion gases.

GERI's portable DCSG system was initially piloted in post-CHOPS wells in the Lloydminster area in partnership with oil operators. Each pilot test included both at least one steam and production cycle. For two pilots, a history matched reservoir model was first developed to assess the feasibility and approach for injection and production. A third-party multi-well CHOPS model integrated with CMG STARS simulator was used to forecast reservoir performance by history matching the oil, water and sand production data for the selected test well and several surrounding wells.

The initial test was a huff/puff test followed by a second injection cycle with noticeable production gains in the offset wells resulting in a combined SOR of less than 0.6 compared to typical industry SOR of 3.0 or more. To date over 18,000 barrels of incremental oil production has been realized from the test well and surrounding offset wells. Furthermore, the field trials were able to quantify the environmental benefits of DCSG. In addition to the reduced SOR, DCSG used 13% less water from the incremental combustion steam/water and reduced emissions with 70% of the CO₂ sequestered in the formation. DCSG emissions are indirect, with even less emissions if electric compressors are used.

Based on the results of the DCSG pilots, it is expected that a DCSG technology which injects both steam and hot combustion exhaust gases into the reservoir can be effective in other enhanced oil recovery applications. These applications include using DCSG in Steam Assisted Gravity Drainage (SAGD) fields as well as tight unconventional resource development.

For tight oil or low permeability reservoirs, DCSG can provide energy and re-pressurize the reservoirs, but also introduce a sweep effect, thereby, increasing recovery. Although the heat impact introduced by steam may not be as great as it is on heavy oil reservoirs, it can reduce oil viscosity and increase oil mobility. For light oil with high paraffin content, waxing could be a production issue. Wax precipitation envelope shows strong dependence on temperature and some dependence on pressure; therefore, DCSG may have a solution by keeping the reservoir temperature and pressure at a level that is away from the wax precipitation range in the reservoir or by reducing the heat sink at the wellbore.

A history matched multi-well reservoir model was developed on a tight and lighter reservoir, with oil density of 20 API and average permeability of 40 md to assess the feasibility of DCSG. Simulation results showed that even with a very short period of injection (15 – 40 days) of steam plus flue gases, incremental oil recovery for the first year could be 3 to 4 times compared to the no-injection scenario.

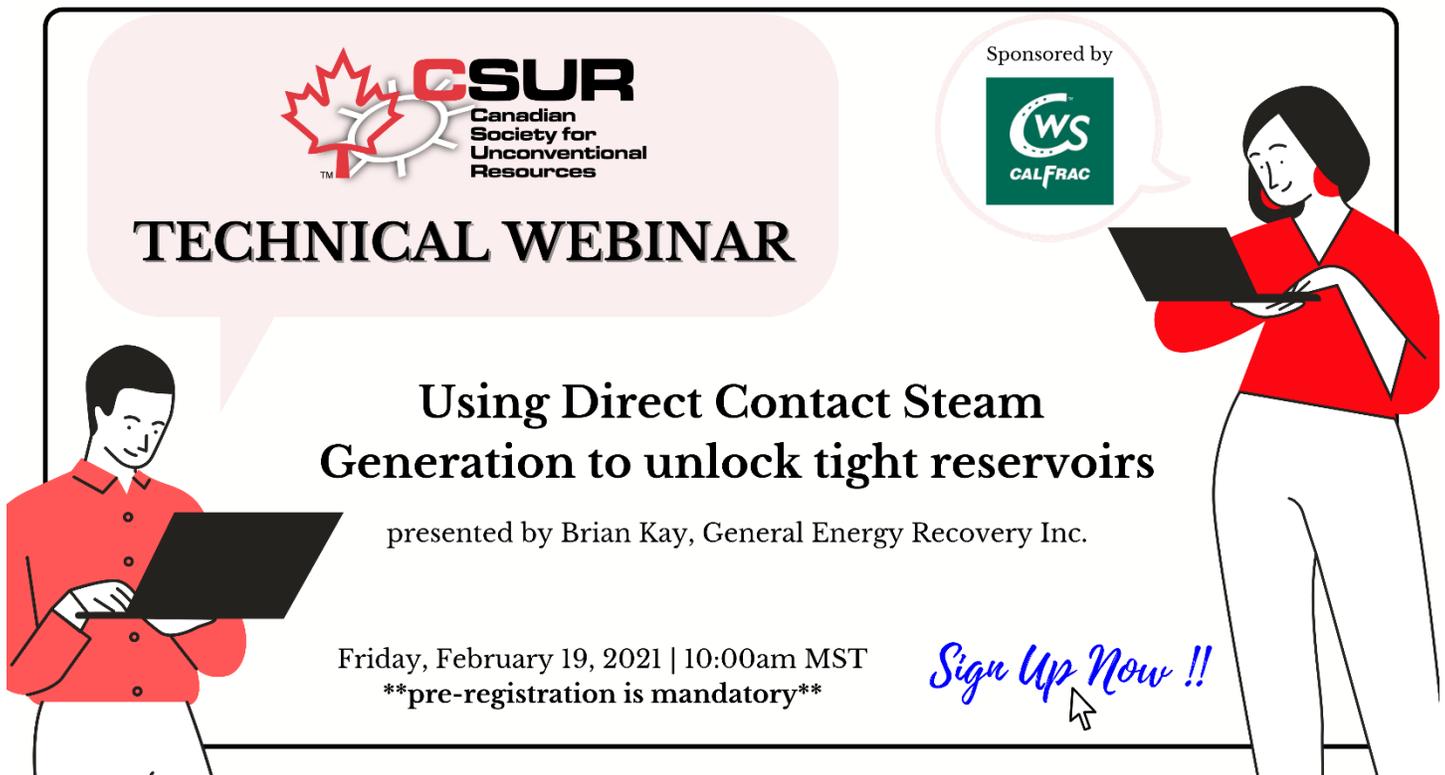
The presentation will describe the application of DCSG technology for unconventional resource development and show the simulation scenarios and results.

PRESENTER: Brian Kay, P. Eng. Chief Technology Officer, and Stella Zhang, M.Sc., Reservoir Engineering Manager - General Energy Recovery Inc.

Brian has worked in the energy industry for more than 40 years with large majors, intermediates and junior oil companies after graduating with a B.Sc. in Chemical Engineering from Queen's University. He has experience with drilling and completions, operations, and engineering, across light oil, gas, and heavy oil projects. In the last 10 years, Brian has focused on new thermal technology innovation, design prototyping and field testing. He has held a central role in the development of GERI's Direct Contact Steam Generation solution, designing and building systems that reduce the environmental footprint thermal projects, leading to more efficient reservoir recovery in both thermal and non-thermal oil fields.

General Energy Recovery Inc. (GERI) is headquartered in Calgary, Alberta, with operations based out of Lloydminster, is a service and technology company focused on providing our clients with steam and flue gases for enhanced heavy oil production. GERI has developed a novel, portable DCSG that has the capability of steam, CO₂, nitrogen, and heat output equivalent up to 12 GJ/hr with 80% steam quality.

Stella graduated with an M.Sc. in Materials Engineering from Sichuan University in 1997. She has worked for over two decades in the oil and gas industry in Canada, focused on exploitation, asset management, and reservoir development. Her experience spans various types of reservoirs ranging from light oil, retrograde gas condensate, heavy oil and oil sands. Stella worked for ConocoPhillips Canada for 10 years, managing asset development and BD activities, utilizing her reservoir engineering expertise. Prior to joining GERI, she was senior exploitation engineer at Baytex Energy, identifying and evaluating acquisition opportunities and reservoir development. Stella joined GERI in 2016 as the company's Reservoir Engineering Manager, focusing on DCSG reservoir application and market feasibility. Stella has led the development of reservoir/field applications of GERI's DCSG technology.



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presented by Brian Kay, General Energy Recovery Inc.

Friday, February 19, 2021 | 10:00am MST
****pre-registration is mandatory****

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