Unique Actuator and Fulcrum Lever Design Improves Reliability and Safety on Critical Steam Valve

Extracting oil from the Canadian oil sands is a challenge. This is especially true in areas where the oil sand is layered underground preventing the use of surface mining techniques. In this case, the bitumen must be separated from the sand underground so it can then be pumped out.

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Common bitumen extraction techniques used throughout the Alberta oil sand region include the Steam-Assisted Gravity Drainage (SAGD) and the High Pressure Cyclic Steam Stimulation (HPCSS). As the names imply, both processes require the controlled injection of high pressure steam into wells below the ground surface. Although the processes vary slightly, in both cases steam heats the bitumen, reducing its viscosity and loosening it from the sand so it can be collected and pumped to the surface. (See Figure 1&2). Needless to say, reliable steam injection control is a necessity. Due to the nature of the applications, severe service valves are required for steam injection. The valve actuators, which are equally critical, are also subject to difficult conditions.

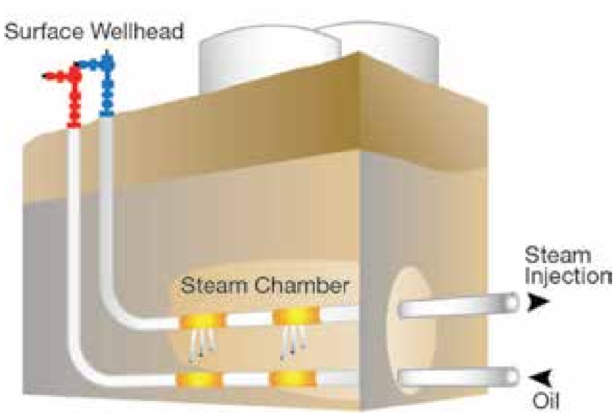

Figure 1. Steam-Assisted Gravity Drainage (SAGD).

A Canadian Natural Resources facility in Alberta that uses both SAGD and HPCSS processes understands the importance of steam flow control. This facility's main steam pipeline valve controls steam to both processes and is critical to plant operation, but due to the valve's cyclical operation and the combination of high radiant heat and low ambient temperatures, the electro-hydraulic actuator in service was prone to failures and oil seal leaks. This caused significant reliability and safety problems. The actuator problems caused serious hammer effect in the pipeline as well as hazardous oil spills. One failure resulted in leaking hydraulic oil that flashed and caused a fire. The severity of this incident required an immediate resolution to the actuator malfunctions.

The search began for a new actuator capable of handling the difficult environment, high thrust, and continuous control duty, while solving the reliability and safety problems of the electro-hydraulic actuator. Typical electric actuators were considered, but due to their high power requirements that prevent battery backup with a UPS and duty-cycle limitations, this solution was undesirable. The facility was faced with finding a rugged and reliable continuous-duty alternative.

CB Engineering, a local manufacturer's representative, recommended a unique solution utilizing a high-torque Beck electric actuator and a custom fulcrum-lever arrangement. This design has been used for years on large steam valves in the North American power industry and was an ideal fit for this application.

With this electric actuator, there is a significant contrast from conventional electric actuators. Unlike conventional electrics, these actuators use a unique, low horsepower motor and a high efficiency gear train. This design results in exceptional reliability without periodic maintenance and allows for continuous modulating duty. Further, the design means that the power required is a fraction of what a typical electric actuator uses; therefore, battery backup is easy to accomplish with nothing more than a standard UPS.

Figure 3. Actuator and fulcrum lever mounting assembly.

Figure 3 shows the installation of the new actuator and fulcrum lever mounting assembly. The fulcrum lever assembly accommodates high thrusts while maintaining long-term reliability and precision. These time-proven assemblies are virtually maintenance-free. At this Canadian Natural Resource facility, the installation has solved all of the reliability and safety concerns associated with the main steam pipeline valve.

Diagrams courtesy of Canadian Association of Petroleum Producers (CAPP).

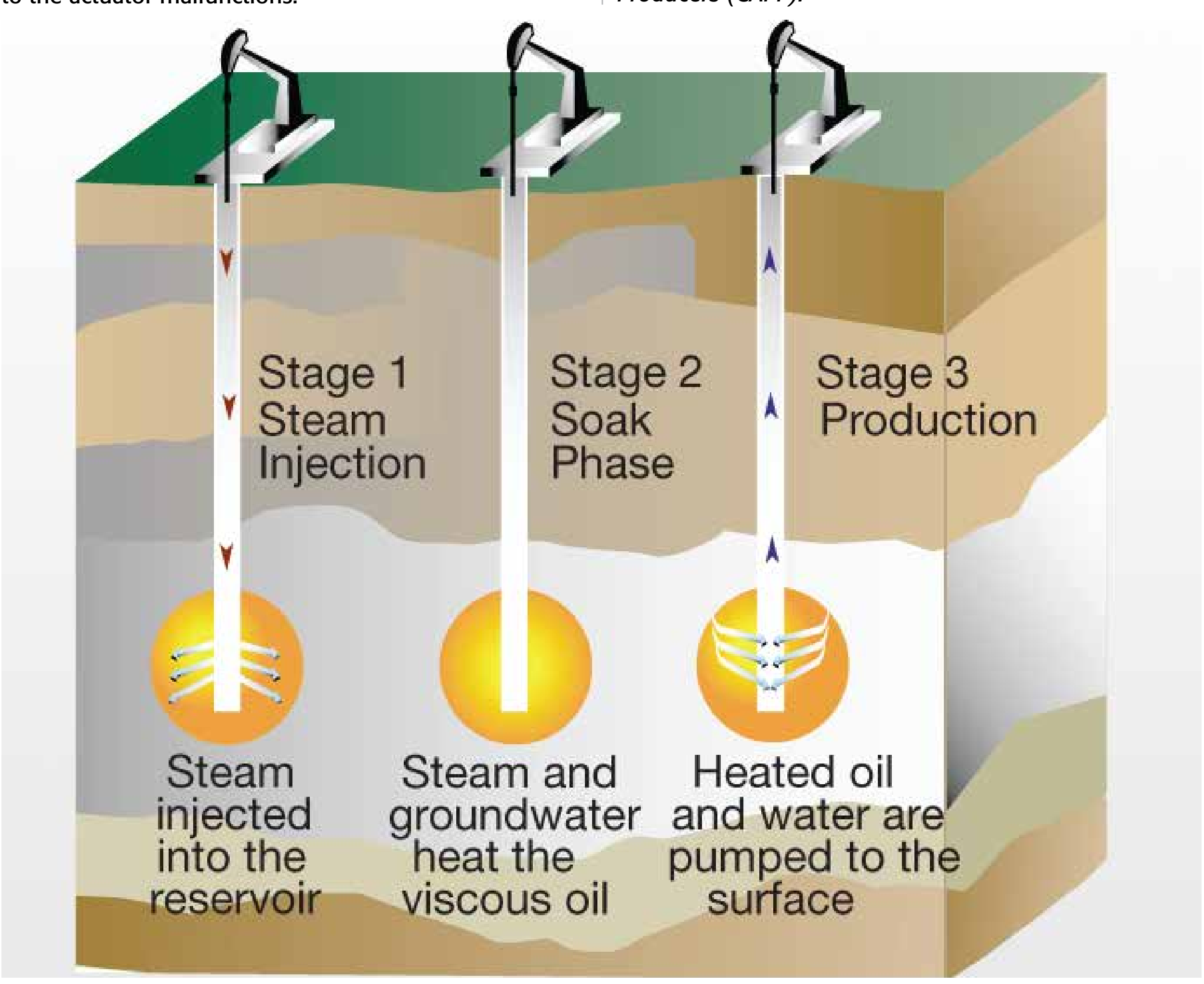

Figure 2. High Pressure Cyclic Steam Stimulation (HPCSS).