Issues and risks associated with the proposed pumping technologies

Environment

Acceptable Risk of Technology

Introduction

While the emerging technologies usually present benefits to both the users and the proprietors such advancements are usually associated with certain degree of risks. According to Roeser (2012), risks arising from the technological advancements are serious ethical issues especially in the 21st century due to accidents and pollution on the environment and consequently leading to the various harmful effects. The identification of the acceptable risk of technology adopted should, therefore, be undertaken as a vital component of the risk management in the organizational daily operations (Boudet et al., 2014). The technologies whose risks go below the accepted threshold can be adopted without any major serious concerns while riskier advancements are abandoned. Hydraulic fracturing is increasingly becoming an appropriate method for extracting natural gas and oil from shale deposits, especially in the US due to the benefits such as an increased ability to extract large volumes of the natural resources. The popularity of the technology is observed in the projections that about 90% of the future wells may require fracking to increase production (Clark et al., 2012). Furthermore, the process allows for a safe methodology without incurring the risks associated with the deep drilling in the geological formations (Zhai et al., 2018). The purpose of this essay is to evaluate the acceptable levels of risk that are associated with the new pumping technologies in hydraulic fracking. The proposed technology whose acceptable risk is examined entails the operation of the optimized positive displacement pump technology.

Optimized Positive Displacement Pump Technology

The amount of the pumping required is dictated by the time scheduled for each stage of the fracking process and the mechanical properties of the rock (Rivers, Zhu, & Hill, 2012). The reduction of the environmental impact and improved economic conditions may require that a fracturing stage is processed within a short time. The shorter processing time may however imply that there are an increased number of pumps that are installed in the extraction site. Using the example of hydraulic process in North America, some of the operating conditions include pumping of 2. 45 Ml volume of liquid into the rock over a period of 210 min with the pump flow rates of 16, 000 l/min (Josifovic et al. 2016). Furthermore, the positive displacement pumps in the site should be more than formation breakdown pressure (62 MPa). After the breakdown phase, the pumping changes from a low speed and high pressure stage to a high speed and high flow rate (propagation phase). An optimized pump technology can deliver adequate pressures and flows for a conventional fracking process. 4. 6% improvement in energy efficiency can be achieved through the adoption of the optimized pump system (Josifovic et al. 2016). Similarly, the proposed pump technology can lead to CO (carbon oxides) and NOx (nitrogen oxides) by 1. 5 kg and 8. 16 kg respectively.

Josifovic et al. (2016) highlight that the existing approach to hydraulic fracturing entails transportation, installation, and operation of large amounts of industrial hardware in temporary locations. A significant amount of the identified equipment consists of fleeting pumps that are used to stimulate the wells using high pressure and flows. Given the increasing dependency on fracking as a mode of gas and oil extraction the pump equipment is observed as a vital component that helps in the transmitting the fluid into the well core. Reciprocating plunger pumps have traditionally been used to transmit the mixture of water, sand, and chemical additives into the wells under high pressures of about 15, 000 psi with flow rates that exceed 100 barrels per minute at times (Treida & Poole, 2012). The evolution of the pumping technology has occurred across the fracking history with the factors such as size, horsepower, and pressure capabilities (Rivers, Zhu, & Hill, 2012). The primary basis of the evolution of the pumps includes the need to meet the pressure and flow requirements in the well stimulation. Further requirements for the development of the pumps include the required capacity to withstand the operating conditions.

Despite the advancements to meet the operational and structural efficiency, the pumping equipment is associated with certain risks that should be evaluated and assessed before the adoption of the respective technologies. Transport and pollution are some of the key issues in the design of high efficiency of pumps that leads to a considerable level of risk. For instance, over 90% of carbon dioxide emissions and other pollutants associated with hydraulic fracturing arise from the use of the pump equipment (Small et al., 2014). While there is no explicitly defined limit for carbon dioxide emission, organizations are focusing on range of measures to significantly cut the release of the gas into the environment. An acceptable risk level for CO_2 can thus be observed to consist of low amounts of the gas emitted into the atmosphere to avoid the adverse impact of the greenhouse effect.

The other impacts of the environment arise due to the noise pollution arising from the operations. The pumps further require large amount of power to operate. The power is generated by diesel generators that are adversely associated with the environmental pollution. The optimized pump technology allows for the reduction in the size of the equipment and consequently reduces the fuel consumption significantly. Similarly, noise pollution associated with the running of 6–20 large industrial engines simultaneously on full load conditions. The local communities are the most affected by the noise pollution (Gandossi, 2013). The accepted noise levels vary from one location to another as well as whether the source of noise is indoor or outdoor. According to the Environmental Protection Agency (EPA) the accepted levels of noise in an outdoor area with the human activity is 55 decibels while 70 decibels is recommended for all areas to prevent hearing loss (Radtke et al., 2017). While the optimized pumps are designed to reduce the levels of noise in the fracking process, the noise population can exceed the accepted limits due to the combination of several engines to provide the enough power for running the machine.

On the transportation issue, the entire fracking equipment is designed to be portable due to the temporary nature of the operations. The need for portability therefore significantly affects the size of the pump and other pieces of equipment. The size of the pump is limited by the amount of the space that is available on the trucks. The size of the truck is limited by the transport legislation. The EU legislation for instance provides a 32, 000 l of water or petrol as a maximum volume that can be carried by the trucks (Josifovic et al., 2016). The acceptable size limits of the pumps should therefore be related to the standard sizes of the trucks that carry the pumps and other fracking equipment.

Mitigation of the Risks

The mitigation of the risks is based on the factors such as the need to reduce pollution and transport constraints. The pumps can be powered using recovered gas. The utilization of the recovered gas not improves the air quality but also promotes economic benefits. The recovered gas also assists in the reduction of the site noise and traffic. The engine manufacturers have accomplished the effective use of the recovered through the adoption of the dual or hybrid power station (Josifovic et al., 2016). The dual power station allows the use of both the conventional diesel and the recovered gas. The use of the natural gas to power the pump is also expected to reduce the adverse environmental impacts. Noise mitigations can also be achieved through adoption of the noise wall mitigation strategies. Minimization of the pump load not only reduces the strain on the transportation but also decreases the overall power requirement in the fracking pad. The pump manufacturers must consequently consider the strict road (load) and transport regulations that affect the size frac-truck significantly. The pump assembly manufacturers must specify the maximum dimensions of their units to meet the required sizes.

Conclusion

Hydraulic fracturing has significantly increased the production of oil and gas from shale deposits. However, some of the risks associated with the current fracturing approaches include the environmental impact and hazards. Improved pump efficiency is not only vital in the reduction of the adverse environmental effects but can also lead to significant economic benefits. Optimization of the pump engine technology can lead to 4. 6% improvement in energy efficiency while significantly, decreasing both the CO_2 and emission. Regardless of the risks associated with the optimized pump technology, the adoption of the relevant mitigation strategies can significantly improve the usability and effectiveness of the pumping operations.