geoconvention
Calgary • Canada • May 13-17 2019

A Technology Roadmap to Improve Wellbore Integrity

Andrew Wigston
Natural Resources Canada

Leah Davies, Jay Williams
Wellbore Integrity and Abandonment Society

Summary

Canada is a hydrocarbon superpower, with 10% of the world's proved crude oil reserves (3rd largest), and 1.2% of its natural gas reserves (15th) at the end of 2016 (British Petroleum, 2017). Even as the world transitions to less carbon-intensive energy sources, crude oil and natural gas will continue to provide 50% of the globe's energy needs for decades (British Petroleum, 2018), including here in Canada (National Energy Board, 2017). Improving the environmental performance of the upstream oil and gas sector while maintaining a competitive business environment is a priority for the Canadian oil and gas industry and government regulators.

Wellbore leakage has received considerable attention over the past number of years for a number of reasons. The predominant leakage fluid is natural gas, which is largely composed of methane – a potent greenhouse gas (GHG). Federal and provincial governments, along with industry, have pledged to reduce methane emissions from the upstream oil and gas sector (e.g. Environment and Climate Change Canada (ECCC), 2018a). According to ECCC, wellbore leakage emissions were estimated to be 7.1 megatonne CO_2 equivalent ($MtCO_2e$) in 2016 which constituted ~4.4% of total upstream sector emissions (ECCC, 2018b). The potential for potable groundwater contamination and lack of knowledge regarding it was raised in the Council of Canadian Academies' 2014 report on the Environmental Impacts of Shale Gas Extraction in Canada. Lastly, wellbore leakage is a significant cost to industry and provides no economic return. The cost to remediate wells ranges from tens of thousands for simple jobs, to millions for complex ones, with the average estimated to be ~$150k (Dusseault et al., 2014).

In Alberta, which contains the vast majority of Canada's ~577,000-plus oil and gas wells (Canadian Association of Petroleum Producers, 2017), around 5% of its ~440,000 wells drilled are reported to have developed leaks (Boyer, 2016). Thus, while the majority don't develop leaks, the cost to deal with leaky wells is still enormous given their absolute number.

Industry and government regulators in Canada have worked together to successfully improve wellbore integrity for decades. For example, the average daily emission rate of wellbore leakage for non-serious wells in Alberta has declined by 40% from 2000 levels to ~13 m^3/day in 2016 (Alberta Energy Regulator, 2016), and the median, or typical rate, is much less than this (Dusseault et al., 2014).

In order to continue to improve the environmental and economic performance of the upstream oil and gas industry Natural Resources Canada (NRCan), in collaboration with Canada's Wellbore Integrity and

Abandonment Society (WIAS) launched a process to develop a *Technology Roadmap to Improve Wellbore Integrity*. The TRM brought together experts from industry, academia, and government to examine wellbore integrity issues that may arise during the entire life cycle of a well. Considering that many operators have low incidences of wellbore leakage it shows that existing technology and practices are very effective for the most part. Thus, the TRM captures, at a high-level, best practices to address wellbore integrity issues where possible. For remaining knowledge and technology gaps, it provides recommendations on research and development (R&D) to address these. The TRM is not an exhaustive document as the subject is too large and complex to capture in one report (and best practice documents on some aspects already exist, e.g. Enerform's 2017 Industry Recommended Practice #25 for Primary Cementing). Rather, the intent of the TRM is provide a high-level document that: (i) is a reference source; (ii) will help foment and facilitate discussions on how to address barriers to improved wellbore integrity; and (iii) will help guide R&D so that it is focused on topics that will have the most cost-effective environmental and economic impact.

The large and varied subject of wellbore leakage was broken into six topics: (i) Magnitude and Impacts of Wellbore leakage; (ii) Drilling and Completions; (iii) Leak Source Identification; (iv) Remediation of Leaks; (v) Abandonment; and, (vi) Improving Industry Knowledge, Best Practices, and Regulations to Reduce Wellbore Leakage. Reports were commissioned for each and were produced by a cross-section from academia and industry. Draft reports were presented at an open workshop in Calgary 2016 attended by over 100 participants. The draft reports were revised based on attendees feedback and expert reviews. The TRM is a high-level summary of these topic-specific reports. Both the topic reports and the TRM are available on NRCan's Technology Roadmap website.

References

Alberta Energy Regulator. 2016a. Surface Casing Vent Flow and Gas Migration— Natural Gas Emissions Rates (Draft Copy), June 2016, 10 p.

Boyer, G., 2016. In-situ well integrity seminar/workshop, Calgary, June 30th, 2017, Alberta Energy Regulator, 23 p.

British Petroleum. 2017. BP Statistical Review of World Energy June 2017. 66th Edition. Retrieved from https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/downloads.html

British Petroleum. 2018. BP Energy Outlook 2018 edition. BP energy economics. Retrieved from bp.com/energyoutlook.

Canadian Association of Petroleum Producers. 2017. Technical Report - Statistical Handbook for Canada's Upstream Petroleum Industry, October/2017.

Council of Canadian Academies. 2014. Environmental Impacts of Shale Gas Extraction in Canada. Ottawa (ON): The Expert Panel on Harnessing Science and Technology to Understand the Environmental Impacts of Shale Gas Extraction, Council of Canadian Academies.

Dusseault, M., R.E. Jackson and D. MacDonald. 2014. Towards a Road Map for Mitigating the Rates and Occurrences of Long-Term Wellbore Leakage. Downloaded from: http://geofirma.com/wp-content/uploads/2015/05/lwp-final-report_compressed.pdf.

Environment and Climate Change Canada. 2018a. Technical Backgrounder: Federal methane regulations for the upstream oil and gas sector. Accessed January 2018. https://www.canada.ca/en/environment-climate-change/news/2018/04/federal-methane-regulations-for-the-upstream-oil-and-gas-sector.html

Environment and Climate Change Canada. 2018b. National Inventory Report 1990-2016: Greenhouse Gas Sources and Sinks in Canada. Part 1.

National Energy Board. 2017b. Canada's Energy Future 2017 Supplement: Conventional, Tight and Shale Oil Production. Appendix Data and Figures. Available from https://www.neb-one.gc.ca/nrg/ntgrtd/ftr/2017cnvntnll/index-eng.html