Pooling training for shale gas development

A new multi-university initiative is providing valuable training for those seeking to ensure best practice is used in the shale gas and tight oil sectors, write Hilary Clement Olson, Azra Nur Tutuncu and Jim Ladlee.

As an abundant power generation feedstock that produces less carbon dioxide (CO2) than other fossil fuels, natural gas is set to play a critical role in the world’s energy mix. In the US, the integration of enhancements made in two proven technologies – horizontal drilling and hydraulic fracturing – has opened up more than 100 years supply of shale gas for homes and businesses.

Hydraulic fracturing has been used since the 1940s in more than 1 million wells within the US. But, while many technologies used to produce shale gas are not new, their broader utilisation in the last decade has made an understanding of them and more recently developed techniques vital for regulators and policymakers, who must make daily decisions based on their knowledge of the fundamentals.

Now, a new multi-university initiative is making best-practices training available to people working in the rapidly growing shale gas and tight-oil sector. Although the initial phase of the training programmes give priority to government agency personnel in the US, broader participation by policymakers and international regulatory agency representatives is anticipated as the programme matures and its funding base expands.

The joint shale resources training initiative was developed as an educational consortium by The University of Texas at Austin, Colorado School of Mines and Pennsylvania State University. The training programmes are led by faculty and researchers at each academic institution and are designed to ensure that regulators and policymakers have access to the latest technology and operational expertise to assist in the critical oversight of shale gas and tight oil development. ExxonMobil and GE are inaugural sponsors of the initiative.

Regional expertise

Through collaboration, sharing of resources and drawing upon each university’s significant resources, the consortium is helping to develop best-management practices and offering new oil and gas regulators the chance to learn the latest science-based concepts related to petroleum geology, drilling and production technology, environmental management practices, and federal and state regulatory requirements, with a special focus on shale gas development. Specific topics include:

- Petroleum geology, both conventional and unconventional;
- Petroleum engineering, including principles of reservoir characterisation, drilling and completion operations, well design and operations, and facility design and operations;
- Environmental management technologies and practices, including water treatment and management, waste treatment and management, air emission control technologies, spill prevention and planning and response; and;
- Federal and state oil and gas regulatory requirements, including permitting and reporting, plus compliance assessment.

Training occurs via a workshop format with classroom content specifically designed for the regulator and policymakers. Instructors are selected from a specialised pool of university faculty, agency personnel and consultants.

Shaped by latest studies

Recent studies conducted in the US on regulations, compliance assessment, public perception and oil and gas operations, specifically those related to shale-gas development, have helped guide the training curriculum.

One recent interdisciplinary study by the Energy Institute at The University of Texas at Austin examined a broad array of issues associated with hydraulic fracturing in several prominent shale plays in the US. The study found that most compliance assessment issues are associated with conventional gas drilling rather than being specific to hydraulic fracturing and shale-gas production. For example, failure of well-bore casing and cementing is a risk to manage for all wells, whether they are fracture stimulated or not. Some practices concerning well design and construction, combined with effective oversight, are the keys to mitigating risks to groundwater.

The same study found no evidence of aquifer contamination from hydraulic fracturing chemicals in the subsurface by fracturing operations, and observed no leakage from hydraulic fracturing at depth. The researchers of the study highlight that surface spills of fracturing fluids appear to have the potential for greater risks to groundwater sources than hydraulic fracturing itself. Thus, an additional important area of regulatory oversight related to shale gas development includes the management of wastewater from flowback and produced water.

Much of the public discussion concerning shale-resource development and hydraulic fracturing has underscored water resources. In particular, the recent shale-gas transformation of the US natural gas industry has focused attention on water consumption for energy production. In fact, the water consumption for the production of shale gas is reported to be lower (0.6-1.8 gallons/million British thermal units) than that for other fossil fuels (1-8 gallons/million Btu for coal mining and washing, and 1-62 gallons/million Btu for US onshore oil production). Natural gas-fired combined cycle power plants have some of the lowest consumption of water per unit of electricity generated, according to a discussion paper published in 2010 by the Energy Technology Innovation Policy research group, at Harvard Kennedy School. These environmental factors related to natural gas operations are important elements to present to regulators and policymakers.

As shale-resource development expands to further the development of natural gas and oil in the US, it is important that state agencies maintain their ability to effectively oversee industry activities. Access to sound scientific understanding of shale-energy development, as well as a full awareness of the technologies required to produce these resources safely and efficiently while protecting the environment is critical. The universities involved in this ambitious training initiative are confident that the benefits will positively impact state and federal regulators, policymakers, and the energy industry. The consortium anticipates that the training programme will broaden the initiative to the international arena and contribute substantially to global efforts of shale natural gas and tight oil resource development.

The Universities

The Education, Training and Outreach Program at The University of Texas at Austin’s Center for Petroleum and Geosystems Engineering supports the southern states, including Alabama, Arkansas, Louisiana, Mississippi, New Mexico, Oklahoma and Texas. The Penn State Institutes of Energy and the Environment serve the northeast and midwest states, including Maryland, New York, Ohio, Pennsylvania and West Virginia. The Colorado School of Mines’ Unconventional Natural Gas and Oil Institute provides training for western states, including Colorado, Montana, North Dakota, Utah and Wyoming.

The University of Texas at Austin

The recent funding by ExxonMobil and GE provides the Center for Petroleum and Geosystems Engineering (CPGE) at The University of Texas at Austin with the resources needed to broaden its partnerships and create a new training programme for regulators in the oil and gas industry that is both collaborative and interdisciplinary. CPGE is already involved with workforce education, regulatory training and capacity...
building in the area of carbon storage for the US Department of Energy.

In addition, support from the National Science Foundation has enabled CPGE to create and deliver professional development workshops related to petroleum technology and the energy-climate-water nexus for K-12 (primary and secondary) school teachers serving minorities. CPGE also applies its training and outreach expertise to its new Energy Regulators Institute.

CPGE develops engineering skills and technology innovation related to energy and the environment, with special emphasis on the production of hydrocarbons from both conventional and unconventional sources. Technology initiatives at CPGE involve a broad approach that balances environmental impact with the affordability of resources, and this is no more important than when focusing on the role of natural gas in the current global energy transition.

Research programmes in the area of unconventional oil and gas resources cover a wide spectrum, including the identification of best practices in well drilling, completion and operation for the Barnett shale play in Texas; the development of fracture fluid additives that will enhance flowback and recovery from gas shales; improved conductivity of proppant packs; optimisation of hydraulic fracture network geometry in horizontal wells and naturally fractured reservoirs; and water usage and recycling in shale-gas operations. By applying educational best-practices to its outreach activities, CPGE is able to transfer its technological expertise to provide educators, regulators and policymakers with an independent understanding of the underlying technical issues related to energy and the environment.

**Colorado School of Mines**

The Unconventional Natural Gas and Oil Institute (UNGI) in the Petroleum Engineering Department at Colorado School of Mines encourages and supports multi-disciplinary research in all areas of unconventional natural gas and oil exploration and development. The institute nurtures understanding of the global emergence of unconventional shale-gas and tight-oil resources by bringing together world-class researchers and organisations seeking solutions to complex problems.

UNGI encourages active member involvement to accelerate the learning curve from ongoing applications to bridge the gap between scientific knowledge and practical engineering applications. The institute promotes the understanding of worldwide unconventional-gas and oil resources and their significance to the energy needs of the future by offering a customised form of the highly recognised “super-school”, which has been taught at Mines Petroleum Engineering Department and also in many countries including Austria, Brazil, China, Egypt, Kazakhstan, Libya, Myanmar, Netherlands, Peru, Russia and United Arab Emirates for the past 21 summers as an education and outreach programme to the oil and gas industry employees, state and government agency representatives and research organisations.

**Pennsylvania State University**

The new Shale Gas Regulators Training programme affords Penn State a unique opportunity to further develop shale gas best management practices and to offer new regulators the chance to learn the latest science-based concepts related to geology, petroleum technology and environmental quality.

The Penn State Institutes of Energy and the Environment will coordinate the project at Penn State, bringing together the historic research, education and service missions of the university. Serving as a conduit for the transmission of science, education and field-based experience, Penn State can help leverage the common ground found in consistent regulation and the science of best management practices.

Penn State is a leader in energy-related research collaborations that span disciplines, colleges and campuses. A few of the research initiatives specific to natural-gas exploration include the development of manufactured ceramic proppants from industrial waste materials and a detailed geological model of the Marcellus formation that has the potential to increase production and decrease treatment of water used during drilling and hydraulic fracturing.

Penn State has been active across the Appalachian basin with conferences on natural gas utilisation, workforce development, academic research, and more, that have involved stakeholders from national and state agencies, secondary and post-secondary education, elected officials, mineral and land owners, non-governmental organisations, legal professions and the general public interested in shale development.

Last year, Penn State Extension presented science-based information about all aspects of shale exploration and development at more than 700 shale education meetings, reaching more than 114,000 people at face-to-face events. To support university research and education assets related to natural-gas development, the university created the Penn State Marcellus Center for Outreach and Research (MCOR) to provide science-based programming and research on technical aspects of natural gas development.