Statement of David P. Russ
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Before the House Science, Space, and Technology Committee
Energy Subcommittee and Environment Subcommittee
To Review Federal Hydraulic Fracturing Research Activities
April 26, 2013

Thank you, Chairwoman Lummis and Chairman Stewart and members of the Subcommittees for the opportunity to appear today to review with you Federal hydraulic fracturing research activities, the progress in coordinating research called for in Executive Order 13605 and the associated interagency Memorandum of Agreement (MOA), and the Department of the Interior's (Interior) role and responsibilities in carrying out this work. I am David P. Russ, the U.S. Geological Survey (USGS) Regional Director for the Northeast Region. I manage USGS science centers and activities in the northeastern United States and coordinate USGS shale gas studies in the Northeast. I represented Interior in meetings of the Steering Committee formed through the MOA. Interior supports the responsible development of natural gas as a clean energy source, so it is important to understand this resource as well as investigate and evaluate potential environmental impacts associated with shale gas development.

In 2012, President Obama issued an Executive Order (EO), "Supporting Safe and Responsible Development of Unconventional Domestic Natural Gas Resources," as a component of his "all of the above" energy strategy. The goal of the EO is to ensure coordination among Federal agencies regarding natural gas development activities. In support of this effort, Interior, the Department of Energy (DOE), and the U.S. Environmental Protection Agency (EPA) signed an MOA to develop a research program aimed at improving our understanding of these resources as well as the potential environmental, human health, and safety impacts of hydraulic fracturing and associated operational activities. Through this effort, the three agencies are building upon current work and collaboratively identifying and prioritizing new research and development activities that support sound management and policy decisions by Federal, State, tribal, and local entities. The goal is to produce decision-ready information to help ensure the prudent development of energy resources and the protection of human health and the environment. The three agencies are working together and engaging other organizations in this effort.

The interagency collaboration builds on the core capabilities of each agency to ensure that our efforts are complementary and non-duplicative. The USGS does not regulate, nor does it manage lands or other resources. USGS core capabilities serve the Nation by providing reliable, impartial scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; study and assess water, biological, energy, and mineral resources; and enhance and protect our quality of life. The USGS conducts scientific research and assessments of geologically based energy resources, including unconventional resources such as shale gas and shale oil. USGS programs that monitor and investigate the Nation's surface water and groundwater resources are fundamental in determining water availability and quality, including the potential impacts of resource extraction on drinking water, healthy ecosystems, and the sustainability of living species. USGS core capabilities also include the assessment of land-use change, critical to understanding the impacts of energy development activities on ecosystems and the socio-economics of communities, and the investigations of earthquakes, including earthquakes induced by

the hydraulic fracturing process or the deep subsurface disposal of the wastewater that is produced during the production of oil and gas.

Federal Multiagency Coordination on Unconventional Oil and Gas Research

The Federal government has long played a role in conducting research on the formation, accumulation, and alteration of oil and gas resources and on the impact of energy resource occurrence and production on environmental and human health. These impacts can vary locally and regionally and depend on differences in the geological characteristics of the rocks, the overlying topography and drainages, and the effects of production-related activities. These characteristics along with economic factors largely govern the locations where oil and gas production will occur and of the possibilities for degradation of the environment. The emergence of technologies such as horizontal drilling, advanced drill bits and geophysical logging, and hydraulic fracturing have enabled a new class of unconventional oil and gas (UOG) resources to substantially add to our Nation's energy resources and to reduce our reliance on imported hydrocarbon resources. To meet the challenge of safely and responsibly maximizing the contribution these resources make to the total energy supply, DOE, EPA, and Interior signed a multiagency MOA to develop a collaborative research framework. That framework is currently under development.

As part of our interagency research collaboration, we will identify the most critical research needs and opportunities to be included in the framework in a manner consistent with the roles, responsibilities, and available budgets of each of the agencies. Our effort encompasses a number of research topics, including:

- U.S. UOG resources: assessment, characterization, and management
- Water Quality
- Water Availability
- Air Quality and Greenhouse Gas Emissions
- Effects on People and Their Communities
- Ecological Effects
- Induced Seismicity

Interior's Role and Responsibilities

Interior, through the USGS, has ongoing and planned activities covering a range of research topics. Specific activities in FY 13 and FY 14 are described in more detail below, but in general, USGS envisions a continuation of prior work that builds on core USGS competencies. For example, the USGS has historically had responsibility for assessing the undiscovered, technically recoverable hydrocarbon resources of the Nation and will continue this function for unconventional resources. Using geologic mapping and geochemical techniques, the USGS will also evaluate the geologic parameters of oil and gas basins under current or anticipated near-term development. Potential impacts to water quality from hydraulic fracturing related activities are one of the primary concerns of communities and public-health officials. The USGS will identify and model water-quality changes associated with the life cycle of UOG production. The USGS will determine the impact of well injection and produced waters on groundwater quality through monitoring and research. This will be accomplished, in part, through baseline surface-water and groundwater quality sampling and modeling. For water availability research, the USGS will support streamgage baseline monitoring in States where production is ongoing or planned. The USGS

will also provide water-resource information on water withdrawals, will develop water budgets to understand how much water is required to produce UOG deposits, and will develop predictive tools and statistical models for estimating the amount of water needed for drilling and production operations. To better understand the potential effects of UOG activities on people and their communities, the USGS will develop decision tools to evaluate and predict human health impacts. There is a diverse set of stressors that may ultimately degrade ecosystems where UOG operations are performed. The USGS will review data and monitoring protocols to evaluate potential impacts of UOG activities on habitats and species. The USGS will also conduct wastewater toxicity testing and vulnerability assessments to identify and prioritize regions, aquatic communities, and wildlife habitats that have the greatest potential for impact from UOG activities. Beginning in the 1960s, research has demonstrated that the deep injection of large volumes of fluids underground can induce earthquakes. The USGS will calibrate physics-based models against field and lab data to support the development of best management practices for minimizing induced seismicity. The USGS will analyze seismic data to update the national probabilistic seismic risk maps in ways that account for induced earthquakes.

FY 2013 Activities

The impacts of the final FY 2013 Operating Plan consistent with the current Continuing Resolution and sequestration reductions are still being assessed. As a result, USGS may not be able to fully implement the plans for FY 2013 described below.

Energy resource studies include resource characterization and assessments of undiscovered, technically recoverable UOG resources for high-priority shale and tight oil and gas accumulations. An assessment was completed for the Utica Shale in the Appalachians and will be completed for the Bakken Formation in North Dakota and Montana before the end of 2013. Work will continue on thermal maturity studies for selected rock formations in the Appalachians and Great Lakes basin that demonstrate the potential for some rock formations to host shale gas deposits. The USGS is also developing a methodology to estimate the amount of water needed for and produced by production of these UOG resources and expects to work with EPA on new laboratory methods for analysis of produced waters.

The USGS plans studies on the potential effects of UOG development on habitats and aquatic species in streams in the upper Chesapeake watershed and upper Delaware River in northern Pennsylvania, including sensitive freshwater mussels.

Seismicity is being analyzed in regions where deep fluid injection is prevalent to document changes in seismicity associated with hydraulic fracturing-related activities. Studies are also underway to identify space and time correlations between fluid injection and induced seismicity to better understand the dynamic linkages between fluid pressure and volume and stress changes in the earth and to identify why some sites are more prone than others to induced earthquakes.

The USGS is conducting research and assessment activities to characterize the surface water and groundwater resources of the Williston Basin (containing the Bakken Formation) and Powder River Basin. The purpose of the Williston and Powder River Basins Groundwater Availability Study is to quantify current groundwater resources in this aquifer system, evaluate how these resources have changed over time, and provide tools to better understand system response to future human demands and

environmental stress. The USGS is also participating on American Society of Testing Materials (ASTM) panels to guide development of best practices for groundwater quality and quantity studies.

Laboratory studies are being conducted to understand the release of soluble chemicals associated with UOG production in order to improve well sampling methods. Field and laboratory studies are underway to identify natural and isotopic and geochemical tracers that may help indicate the origin of waters, gases, and solutes in groundwater.

2014 USGS Hydraulic Fracturing Budget Request

The President's Budget for 2014 for UOG hydraulic fracturing research is $18,613,000 and 58 FTE, a program increase of + $13,035,000 and +32 FTE above the 2012 enacted level. Specific budget numbers are in the table at the end of this statement.

The 2014 request would expand the collaborative, interagency research effort with DOE and EPA to address the highest priority challenges and to answer the critical research questions posed in the multiagency research plan. The USGS would focus on research that builds upon and enhances ongoing studies funded through base appropriations, as well as conduct new and innovative investigations, assessments, technique development, modeling, and monitoring to address urgent research questions and to provide decision-ready products to other Federal agencies, States, and industry.

With the funding requested in 2014, the USGS would conduct research that assesses potential ecological impacts from UOG production. This research would include how changes in land use, water quality, and water quantity from hydraulic fracturing operations affect biological communities and specific species of management concern. The USGS would conduct studies to identify those practices that minimize risks or mitigate impacts to ecological resources, as well as identify socioeconomic impacts from UOG production on nearby communities. These studies would examine how development would affect the production of critical ecosystem services and would address the potential for estimating the value of these services. In addition, an ecosystem services analytical framework would be developed for evaluating the environmental and social consequences of developing unconventional oil and gas resources.

Energy resource assessments provide critical evaluations of where future energy development might take place, or equally important, where it is unlikely to take place. In 2014, a portion of the requested funding would allow the USGS to begin an assessment of the size and location of UOG resources in a new basin, similar to the assessments underway in the Barnett Shale, Permian Basin, and Bakken Formation. These and other assessments would form a foundation for planning where and what kind of additional studies are needed, such as those involving produced waters and potential environmental impacts. Work would also focus on the potential contamination of drinking water and consumptive loss of water resources.

With proposed funding in 2014, the USGS would analyze seismic and geologic data and subsurface stress data in areas near induced earthquakes to determine those factors that affect seismicity from the subsurface disposal of produced waters. This information could be used to guide changes to disposal operations, such as adding new wells or changing injection parameters. Cataloging the presence or absence of earthquakes induced by injection activities would yield critical information on the regions and conditions that are favorable for induced seismicity. This would be combined with probabilistic seismic

hazard analysis to assess the contribution from induced seismicity to the hazard and risk of damaging earthquakes.

In 2014, the USGS would use a portion of the requested funding to expand baseline surface water and groundwater quality monitoring and to support the continued development of analytical methods for the detection of contaminants associated with produced and flowback waters in the environment, including an enhancement of methods for sampling and measuring methane. This would include enhanced methods for monitoring and characterization of "stray gas." The USGS would support research on the development of geochemical methods and groundwater flow models used to determine if hydraulic fracturing fluids and other drilling materials are contaminating water supplies. These tools and monitoring data would enable assessments and prioritization of key human and ecological exposure pathways associated with natural or anthropogenic contaminants created and mobilized throughout the lifecycle of hydraulic fracturing activities.

Drilling for and development of resources require large quantities of water and can produce large volumes of fluids during flowback and production. In 2014, funds would be used to (1) assess the water needs associated with UOG development in selected pilot areas, (2) begin evaluation of the volumes and spatial distributions of non-potable (brackish) water resources, and (3) characterize flowback fluids and produced waters from hydraulically fractured wells.

With the proposed funds in 2014, the USGS will continue to compile water-quality data collected by other agencies from across the Nation, potentially leading to a better understanding of water quality trends in relation to UOG development.

With proposed funding in 2014, geologic mapping conducted by the USGS in cooperation with the State Geological Surveys would support research on the geological parameters of UOG basins and would provide information to address fundamental questions pertaining to the likelihood of specific rock formations containing economically viable shale gas and oil resources. In particular, three-dimensional geologic models and a better understanding of rock structures and stratigraphy would be critical to characterizing the hydro-geologic framework of regions producing UOG. Geologic maps would provide information on potential flow paths for migrating hydraulic fracturing fluids and methane, important for assessing the risk for contamination of near-surface aquifers as well as a more complete understanding for the potential for induced seismicity.

Conclusion

The research activities required to address questions related to hydraulic fracturing draw on the core capabilities of USGS scientists in geology, seismology, energy resource assessment, and biologic and hydrologic research and monitoring. I have briefly described many of our current and proposed hydraulic fracturing-related efforts in this statement, but a number of other USGS programs also contribute to an improved understanding of these issues.

Thank you again for the opportunity to discuss the activities of the USGS and the interagency effort to understand this important natural resource and the potential impacts of its development. We appreciate your interest in and support for our science.

Hydraulic Fracturing							
		2013 Full Yr. CR (PL 112-175)	**2012 Enacted**	**Changes**	**Program Changes (+/-)**	**2014 Budget Request**	**Change from 2012 Enacted (+/-)**
Fisheries Program		*108*	108	0	2,200	2,308	2,200
	FTE	*1*	1	0	10	11	10
Energy Resources		*5,850*	4,600	1,250	0	5,850	1,250
	FTE	*29*	23	6	0	29	6
Contaminant Biology		*0*	0	0	1,400	1,400	1,400
	FTE	*0*	0	0	5	5	5
Earthquake Hazards		*800*	300	500	1,200	2,000	1,700
	FTE	*2*	1	1	2	4	3
Groundwater Resources		*520*	520	0	2,100	2,620	2,100
	FTE	*1*	1	0	6	7	6
Hydrologic Research & Development		*1,300*	50	1,250	950	2,250	2,200
	FTE	*1*	0	1	1	2	2
Science Synthesis, Analysis and Research Program		*0*	0	0	185	185	185
	FTE	*0*	0	0	0	0	0
National Cooperative Geologic Mapping Program		*0*	0	0	2,000	2,000	2,000
	FTE	*0*	0	0	0	0	0
Total Requirements ($000)		***8,578***	**5,578**	**3,000**	**10,035**	**18,613**	**13,035**
	Total FTE	***34***	**26**	**8**	**24**	**58**	**32**

* 2012 FTE amounts reflect actual usage, not 2012 enacted formulation estimates.

Note: References to the *2013 Full Yr. CR* signify annualized amounts appropriated in P.L. 112-175, the Continuing Appropriations Act. These amounts are the 2012 enacted numbers annualized through the end of FY 2013 with a 0.612 percent across-the-board increase for discretionary programs. Exceptions to this include Wildland Fire Management, which received an anomaly in the 2013 CR to fund annual operations at $726.5 million. The *2013 Full Yr. CR* does not incorporate reductions associated with the Presidential sequestration order issued in accordance with section 251A of the Balanced Budget and Emergency Deficit Control Act, as amended (BBEDCA), 2 U.S.C. 109a. This column is provided for reference only.

The 2013 Column in this table refers to levels consistent with the FY 2013 USGS Operating Plan budget developed under the initial 2013 Continuing Resolution (P.L. 112-175); this figure does not reflect the most recent Continuing Resolution (P.L. 113-6) that became law on March 26 or the results of sequestration reductions. The hydraulic fracturing funds are a crosscut of activities, as the research, assessment, and monitoring activities serve other purposes as well. The impacts of the final Operating Plan consistent with the current Continuing Resolution and sequestration reductions are still being assessed.