The Authoritative Resource on Safe Water [SM]

Statement

of Don Broussard, Lafayette, La. Utilities System

before the

House Subcommittee

on Environment and Hazardous Materials

on

Geologic Carbon Sequestration

July 24, 2008

Headquarters Office:
6666 W. Quincy Avenue, Denver CO 80235
T 303.794.7711 // **F** 303.347.0804
www.awwa.org

Government Affairs Office:
1300 Eye Street NW, Suite 701W
Washington, DC 20005
T 202.628.8303 // **F** 202. 628.2846

American Water Works Association

Government Affairs Office
1300 Eye Street NW
Suite 701W
Washington, DC 20005-3314
T 202.628.8303
F 202.628.2846

Headquarters Office
6666 West Quincy AVE
Denver, CO 80235
T 303.794.7711
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Good morning. My name is Don Broussard and I am the Water Operations Manager for the Lafayette Utilities System in Lafayette, Louisiana. Lafayette Utilities System is an electric generation, transmission and distribution utility; a water production, treatment and distribution utility; a wastewater collection and treatment utility; and a telecommunications wholesaler. The utility serves a retail and wholesale population of approximately 170,000 and part of our electric generation comes from coal-fired generation units.

I am appearing here today on behalf of the American Water Works Association (AWWA). AWWA is the world's oldest and largest association dedicated to safe water. Our utility members serve safe and affordable drinking water to more than 80 percent of the American people. AWWA represents over 4,700 water utilities that produce approximately 80% of the drinking water in the United States. We appreciate the opportunity to provide our views on geologic carbon sequestration this morning.

While I am speaking for AWWA, I am reminded of the intrinsic relationship between serving water utility customers and electric utility customers. As is often the case with municipal utilities, our utility serves both electricity and water customers. Many cities anticipate significant sustained increase in water and electricity demands as populations increase. Water and energy efficiency and renewable energy, although important, alone won't suffice to meet these increased demands.

I. Overview

Our overarching concern regarding geologic carbon sequestration is the potential contamination of underground sources of drinking water (USDW) from such activities and the potential for other unintended, and possibly harmful, consequences. AWWA is particularly concerned about the potential for contamination of sole source aquifers and suggests that these aquifers be provided with special protective measures. An aquifer receives the designation of "sole source aquifer" if it is located in an area where there are few or no alternative sources to the ground water resource, and where if contamination occurred, using an alternative source would be extremely expensive.

AWWA urges caution on the implementation of large-scale, commercial geologic carbon sequestration, as little data are available regarding the potential effects of this technology on drinking water resources. While several federal agencies and non-

governmental entities are conducting research on this topic, the data from this research will not be available for several years.

We understand the need to support states in ongoing permitting issues, but AWWA recommends that commercial-scale carbon sequestration not be deployed until the results of the large-scale Department of Energy pilot projects have been received and reviewed. By waiting for these results, both the Environmental Protection Agency and the Department of Energy will be better able to fully understand the effects of carbon sequestration on USDWs. Then any necessary modifications can be made to the regulations and sequestration technology before companies invest in processes that may have severe and unintended consequences.

II. Contamination Concerns

AWWA has several technical concerns regarding the geological carbon sequestration program and the potential impact of carbon sequestration on USDWs. Our biggest concern is the prevention of degradation of USDWs. Protection of USDWs should be a key priority of any carbon sequestration program, and the focus of the current program appears to be commercialization of the technology. Preventing degradation should not just be limited to contaminants with established Maximum Contaminant Levels (MCLs), but should also include other constituents whose presence may either make groundwater more difficult to treat or impact the beneficial uses of that groundwater.

Water chemistry in an underground setting is complex. Several references on geologic carbon sequestration discuss changes in the carbonate cycle, resulting in lowered pH conditions and the release of iron, manganese, arsenic, and possibly other inorganics into groundwater surrounding the injection zone. These reactions, and others, may occur in other USDW zones if they are contaminated by carbon dioxide. Additionally, silica and boron, depending on aquifer composition, can dissolve into the groundwater. Silica is often a major concern for industrial applications and has also been found to interfere with adsorption processes used in drinking water treatment, such as arsenic removal. The impact of carbon dioxide injection on the mobilization and migration of these previously immobile species due to the changes in water chemistry (e.g., pH) brought about by the introduction of carbon dioxide should be extensively explored. We need appropriate subsurface monitoring technologies identified and developed to prevent or respond to potential contamination of USDWs by these inorganic compounds.

AWWA has concerns regarding aquifers and their potential contamination due to the acidic nature of carbon dioxide in either a gas or supercritical liquid state, and the impact that it may have on surrounding strata. Without neutralization, there is the possibility that the carbon dioxide could change the equilibrium state for the sediments within those strata. Also, while the gas would be well below existing groundwater aquifers that are of greatest importance, the long-term potential for that gas to pocket or find fissures in the confining layer is a significant concern.

AWWA is concerned about the potential for contamination of USDWs due to the presence of other compounds, such as nitrogen, carbon monoxide, sulfur dioxide, hydrogen sulfide, and possibly mercury, in the carbon dioxide injection stream. The purity of the injection stream is expected to vary by project for many reasons including different facility operating conditions, coal compositions and in-place pollution removal technologies. Plant operators should be encouraged to remove as many pollutants as is technologically feasible from the injection stream, with the goal of preventing the introduction of compounds that could possibly contaminate USDWs. As was suggested with carbon dioxide, preventing degradation of USDWs by these compounds should be a key priority during the implementation of carbon sequestration technology.

III. Construction Concerns

The construction of the injection wells is a critical issue to AWWA, both in terms of the materials used and the depth of injection. Since the injection wells will be encased in cement, the long term integrity of the cements that will be used during construction will need to be extensively tested under real-world conditions. It is important to note that as the injection wells are constructed, they will be penetrating existing USDWs and essentially be permanently "living" in the USDWs. As a result, there is the potential for adverse impacts to the USDWs through the operation of the carbon dioxide injection well. Also, it is unclear whether EPA and DOE will restrict injection to depths below which carbon dioxide would be a supercritical fluid or whether those agencies would allow injections into formations where carbon dioxide would be a gas. More research is

needed on these topics to fully understand the potential impact that these things could have on USDWs.

IV. Future Needs for Underground Storage

As the demand for water increases during the upcoming century and changes in climate impact traditional water supplies, water utilities will look for new sources of drinking water. It is likely that, as a result of these changes, there will be a greater reliance on groundwater through both new supplies and conjunctive use. The possibility exists that utilities might want to use some of these injection site aquifers as new potable sources. In fact, in several communities across the country, waters that were previously considered to be unusable, due to a salinity that was above 10,000 TDS, are now being used as drinking water sources. Using desalination technology, the water sources are treated to EPA's drinking water standards and provided to water utility customers. As desalination technology improves, even more saline water may be used in the future. Therefore, AWWA suggests that the selection standards for potential injection aquifers, and for USDWs, be reviewed and revised to prevent contamination of aquifers that might be considered viable USDWs in the near future.

While AWWA has not yet performed an exhaustive study of the impact of carbon sequestration on current or future water supplies, we are concerned that neither the state of the science nor the existing regulations are sufficiently developed to where carbon sequestration can seriously be considered as a greenhouse gas mitigation

technique. History has shown that many of the previously mentioned issues still need to be addressed and, for some of these issues, no acceptable resolution mechanisms are currently available.

For example, there are potential project sites for which there are no good records of abandoned wells that tap the very same strata used for carbon dioxide sequestration. There is a presumption that even states with oil and gas or mining operations have excellent and current reports and maps indicating abandoned wells and mines. This is not the case. Many states with extractive industries do have maps and surveys which are not sufficiently precise for geologic sequestration. Generally speaking, these are states with extractive industries such as mining or oil and gas, such as my home state. Other states have antiquated data or virtually *no data* to indicate the presence of very old abandoned wells or mines. Studies have shown that injected carbon dioxide has been pretty good at finding these abandoned wells and these wells allow for the transmission of the carbon dioxide out of the confined aquifer, into potential USDWs, and then eventually to the surface. Some of these abandoned wells or mines might be more than 100 years old. This information on wells and mines is essential to prevent inadvertent cross contamination and release of briny water and/or other contaminants into drinking water systems (USDWs). Obtaining that data will be expensive and take considerable time.

The injection of carbon dioxide into deep saline aquifers causes a shift in the subsurface pressure gradients surrounding the injection site. This can cause saline aquifers

located close to the carbon dioxide plume to be displaced into existing USDWs, contaminating the freshwater aquifer and rendering it unusable as a drinking water resource. There is also the potential for USDWs to be displaced in both the horizontal and vertical directions due to changes in subsurface pressures. Water rights issues may be raised if a USDW is displaced, as a utility may be planning to utilize a USDW, but suddenly finds out that it can not, as the USDW has been displaced into an area where another utility has jurisdiction. Also, as many of the saline aquifers transverse state boundaries, AWWA imagines there may be significant permitting questions raised for a saline aquifer that exists to two different states. We anticipate that either Congress or EPA will have to issue guidance on which state is the correct permitting authority for a geologic carbon sequestration project when the receiving geologic formation crosses state boundaries. This would be particularly important since so many underground formations cross state boundaries. AWWA notes that the proposed rule by EPA opted to not address geologic formations that cross state boundaries.

It should be noted that groundwater storage of water resources may become a favorable adaptation strategy for water management under climate change. This could be especially true for areas in the United States that will lose storage (e.g. decreasing snowpack) and/or require more storage (e.g. increasing population). Groundwater storage may be a better option than surface water storage options such as dams, which are prone to high costs, environmental opposition, and potentially higher evaporation rates under climate change. As such, this bolsters AWWA's concern regarding the unintended consequences of geologic carbon sequestration. In addition, any permitting

for geologic carbon sequestration should include an evaluation of the long-term need for the geologic area to serve as groundwater storage.

Finally, AWWA would like to see the issue of long-term liability resolved. EPA's proposed geologic carbon sequestration rule cannot address financial responsibility of the sequestration site after the formal period of post-injection site care has ended (default of 50 year length). Since EPA does not have the power to assign responsibility after this period of time has expired, we call on Congress to develop legislation that will address the issue of who has to assume financial responsibility of the sequestration site after the site closure requirements have been fulfilled. AWWA anticipates that this legislation would provide for a means by which drinking water utilities could recover any costs incurred as a result of USDW contamination by geologic carbon sequestration activities. Examples of potential costs include the installation of advanced water treatment technologies and/or development of alternative water sources.

V. Research Needs

As AWWA supports basing regulations on good science, we suggest that research be performed that addresses the potential unintended consequences on drinking water sources of emerging environmental technologies such as biofuels and carbon sequestration. Research on the geologic sequestration of carbon dioxide should take a holistic approach, encompassing a review of potential impacts on current and future underground sources of drinking water. AWWA estimates that the financial need for

research on climate change as it relates to drinking water utilities is on the order of $25,000,000 per year for a ten year period. This includes some smaller research projects on geologic carbon sequestration, however more funding would be required for the drinking water industry to perform large-scale research projects similar to those funded by the Department of Energy.

AWWA is aware of several ongoing research and pilot projects related to the geologic sequestration of carbon dioxide. However, we are concerned that the results of these projects may not be available until after EPA's regulation on geologic carbon sequestration has been finalized. AWWA believes that the results of this research are crucial to the development of a comprehensive regulation that protects water resources from the potential unintended consequences of geologic carbon sequestration. In particular, AWWA believes that research on the potential pathways for contamination of USDWs has not yet been completed. As a result, we are concerned that the appropriate subsurface monitoring methods and technologies have not been adequately identified or developed. AWWA believes that more detailed research is needed to identify the specific requirements for subsurface monitoring that can protect USDWs from contamination due to geologic carbon sequestration.

The proposed scale of carbon sequestration is unprecedented compared with traditional enhanced oil and gas recovery, increasing the potential for unintended consequences. As such, AWWA recommends that DOE and EPA include the drinking water utilities that are directly impacted by the carbon sequestration pilot projects as stakeholders.

Potentially impacted utilities must be involved in the development of appropriate aquifer monitoring programs for the pilot programs to appropriately ensure that the water resources are not adversely affected. This will allow the utilities to gain first hand experience regarding how the sequestration process will be implemented.

AWWA believes that other geo-engineering options need to be considered if certain geologic carbon sequestration is not an option in certain regional or state geologic formations either due to risks to USDWs or unacceptable geologic characteristics. AWWA does not believe we should put all our eggs in the geologic sequestration basket. AWWA does not profess to be an expert on these techniques but is aware of the research into the use of algae, bacteria and other geo-engineering methods to destroy or immobilize CO_2. It is possible that these might be preferable to geologic carbon sequestration in some locations.

VI. Conclusion

In conclusion, AWWA is concerned that the proposed large-scale sequestration of carbon dioxide in underground aquifers may have significant impacts on the public, the environment, and drinking water utilities. We believe that the drinking water community has a responsibility to advocate for stewardship of the USDWs and that the most responsible action for us at this time is to voice our concerns on geologic carbon sequestration. We are very much aware of the impacts that climate change will have on water utilities across the county and recognize that something needs to be done to

address climate change. We also recognize the need to have energy, and that all fuel types, including coal, are essential. If geologic carbon sequestration does not prove to be the most optimal method for dealing with carbon dioxide we are indeed in a difficult position as a country. While we acknowledge that geologic carbon sequestration has been identified as a means to combat climate change, AWWA urges caution in moving forward with this technology.

AWWA recognizes that at this point in time, geologic carbon sequestration is not particularly energy efficient as the collection, handling and injection of carbon dioxide is very energy and water intensive. We have heard it mentioned that the entire geologic carbon sequestration process results in a 30% parasitic energy load on the power plant, and that the water consumption could be two to four times greater. We are concerned about the cumulative energy and water footprint involved in this process and wonder if a net power gain is still realized when the extra consumption of water and power is included in the evaluation.

We recommend that commercial-scale geologic carbon sequestration technology not be deployed until the results of the large-scale DOE pilot projects have been received and reviewed, which will provide EPA and DOE a better understanding of the effects of carbon sequestration on USDWs. This will allow EPA and DOE time to adapt regulations and technologies to prevent adverse and unintended consequences to USDWs. Until the time when this technology is sufficiently developed, AWWA encourages EPA and DOE to engage in the following activities:

- Study and use of green/non-GHG power to eliminate carbon footprints;
- Implementation and support of water and energy conservation programs; and,
- Improvement of programs dedicated to encouraging increased power and water efficiencies on the industrial, residential and municipal fronts;
- Study other geo-engineering approaches to carbon dioxide destruction or immobilization.

Thank you for your time and I would be happy to respond to any questions.

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- I am Don Broussard, the Water Operations Manager for Lafayette, La., Utilities System.

- Lafayette Utilities System is an electric generation, transmission and distribution utility; a water production, treatment and distribution utility; a wastewater collection and treatment utility; and a telecommunications wholesaler.

- I am appearing here today on behalf of the American Water Works Association (AWWA), the world's oldest and largest association dedicated to safe water.

- Our overarching concern regarding geologic carbon sequestration is the potential contamination of underground sources of drinking water (USDW) and the potential for other unintended, and possibly harmful, consequences.

- AWWA is particularly concerned about the potential for contamination of sole source aquifers and suggests that these aquifers be provided with special protective measures.

- Water chemistry in an underground setting is complex; we need to consider how geologic carbon sequestration could change the carbonate cycle, resulting in lowered pH conditions, and the potential release of iron, manganese, arsenic, and possibly other inorganics into groundwater surrounding the injection zone.

- We recommend that commercial-scale geologic carbon sequestration technology not be deployed until the results of the large-scale DOE pilot projects have been received and reviewed, which will provide EPA and DOE a better understanding of the effects of carbon sequestration on USDWs.

- AWWA would like to see the issue of long-term liability resolved.

- The construction of the injection wells is a critical issue to AWWA, both in terms of the materials used and the depth of injection.

- As the demand for water increases and changes in climate impact traditional water supplies, water utilities will look for new sources of drinking water…there will likely be a greater reliance on groundwater and the possibility exists that utilities might want to use some of these injection-site aquifers as new potable sources.