Kansas Department of Health and Environment

Division of Environment

Bureau of Air

REGULATORY IMPACT STATEMENT CONSISTING OF:

I. ENVIRONMENTAL BENEFIT STATEMENT

AND

II. ECONOMIC IMPACT STATEMENT

Pursuant to K.S.A. 77-416

PROPOSED NEW PERMANENT AIR QUALITY REGULATION:

K.A.R. 28-19-325 Compressed Air Energy Storage

August 2010

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Background of Proposed New Regulation

Introduction

In Enrolled House Bill 2369, effective May 28, 2009, the Kansas Legislature enacted new law related to energy, including the Compressed Air Energy Storage Act in K.S.A. 66-1272 through 66-1279.[1]

This Act requires the Kansas Corporation Commission (KCC) to "establish rules and regulations establishing requirements, procedures and standards for the safe and secure injection of compressed air into storage wells, which shall include maintenance of underground storage of compressed air."[2] The KCC rules and regulations are required to address issues that include site selection, design and operation criteria, and requirements for monitoring, safety, and closure. The KCC is authorized by the Act to establish rules and regulations for fees related to permitting, monitoring, and inspecting compressed air energy storage facilities.

Additionally, the Compressed Air Energy Storage Act requires the Kansas Department of Health and Environment (KDHE) to "establish rules and regulations establishing requirements, procedures and standards for the monitoring of air emissions coming from compressed air energy storage wells and storage facilities to ensure the wells and facilities comply with the Kansas air quality act."[3] This Act requires that the rules and regulations be established by the KCC and the KDHE within 18 months after the effective date of the Act. As a result of the Compressed Air Energy Storage Act, the KDHE Bureau of Air is proposing a new regulation, Kansas Administrative Regulation (K.A.R.) 28-19-325, Compressed Air Energy Storage (CAES).

CAES History and Development

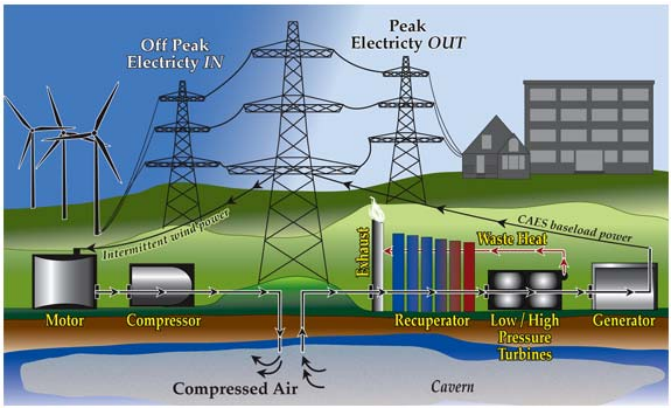
Compressed air energy storage (CAES) uses electricity to compress air, which is then stored in a large reservoir (typically an underground geologic formation, but some designs use large pipes aboveground). The stored compressed air is later withdrawn, heated via combustion (in most designs), and expanded through turbines to generate electricity. Suitable geologies for CAES reservoirs include salt (domal or bedded), hard rock (e.g. limestone), and porous rock (e.g. aquifers, depleted oil and gas fields).

The concept of using CAES to aid electrical generation is more than 30 years old. There currently are only two existing CAES plants in the world, one operating in Germany since 1978

and one operating in Alabama since 1991. The 321 MW (megawatts) Huntorf plant, located in northern Germany, has a storage volume capable of three hours of rated output and is used to provide peak shaving, spinning reserves[4], and voltage (VAR) support[5]. The 110 MW McIntosh plant, in Alabama, has a storage volume capable of 26 hours of full power generation and is used to provide peak shaving and spinning reserves. Both CAES plants use solution-mined caverns in salt domes for compressed air storage.

Although CAES historically was intended and used for peak shaving and load following, new interest and applications are developing for this technology. Climate change concerns, heavy dependence on foreign oil, and high energy prices have intensified the drive towards renewable energy, such as wind and solar, to produce baseload power. Most states, including Kansas, have set renewable energy standards requiring increased production of energy from renewable power sources. Electric utilities are being required to produce a specified fraction of their electricity from renewable sources, with standards varying between 10 and 30 percent. The intermittent nature of wind and solar energy, limited connectivity within the grid, and grid management issues, suppress these renewables from becoming baseload power providers on their own. However, renewable energy coupled with compressed air energy storage (CAES) may become a reliable baseload power source. (See Figure 1.) Several studies have been conducted and reports written to support this concept, including a CAES literature review by Samir Succar and Robert H. Williams.[6]

Figure 1. Renewable energy, wind, coupled with CAES to produce baseload power.



Source: www.WindSoHy.com - Technologies

Two wind/CAES projects have been in development stages for at least five years and are gradually edging closer to fruition. The Norton Energy Storage project is located in Norton, Ohio, and has just recently seen new interest with First Energy acquiring the rights to the project

in December 2009. The Iowa Stored Energy Park is located in Dallas Center, Iowa, and reached the point of drilling the first test well on March 2, 2010.[7]

There are projects under consideration in other states, as well. Magnum Energy LLC recently has acquired the rights to a large salt deposit in the Utah desert for the purpose of developing an energy hub, which would be used for storage of natural gas, compressed air from wind energy, and potentially carbon dioxide captured from coal-fired power plants.[8] Gaelectric has been investigating prospects for wind/CAES facilities in Montana. As of late 2009, Gaelectric was pursuing federal funding for a demonstration project using depleted gas fields for air storage.[9] WindSoHy, based in Kansas, is promoting potential wind/CAES projects in Kansas and the Texas panhandle, both possessing ideal wind and geological resources.[10] The two Kansas projects would utilize depleted oil and gas fields for air storage.

CAES Air Emissions – Regulatory Development

Currently, there are no regulations (federal, state, or local) specifically for air emissions from compressed air energy storage (CAES) facilities. Air permits issued to the McIntosh (Alabama) and Norton Energy Storage (Ohio) facilities were developed for the combustion turbines in their CAES operations. Stationary combustion turbines are regulated under New Source Performance Standards, 40 CFR Part 60, Subpart KKKK, which establishes emissions limitations for nitrogen oxides (NO_x) and sulfur dioxide (SO_2).

With the McIntosh and Norton facilities using salt caverns and limestone, respectively, for injection and storage of compressed air, so far there has been little concern regarding contaminants being carried with the stored air and introduced to the atmosphere upon withdrawal. Potential CAES development in depleted oil and gas fields raises questions and concerns and highlights the need for CAES-specific air emissions regulation.

Pursuant to the Compressed Air Energy Storage Act, the KDHE Bureau of Air is proposing a new CAES regulation that encompasses the following:

- Air permit, applicability;
- Site emissions characterization, including determination of volatile organic compounds and hazardous air pollutants that may be in the storage formation and that may be emitted as a result of CAES operation;
- Annual emissions testing and report submittal;

- Quarterly leak detection inspections.

The proposed regulation covers only the air emissions coming from compressed air energy storage wells and storage facilities to ensure that the wells and facilities comply with the Kansas Air Quality Act. This Regulatory Impact Statement, consisting of an Environmental Benefit Statement and Economic Impact Statement, is submitted in support of the proposed air quality regulation for CAES.

I. Environmental Benefit Statement

1) Describe the need for the proposed new regulation and the environmental benefit to accrue as a result of the regulation.

a) Need

The Compressed Air Energy Storage Act, K.S.A. 66-1272 through 66-1279, was enacted by House Bill 2369 on May 28, 2009. K.S.A. 66-1275 of the Act directs the KDHE to establish regulations for compressed air energy storage, and the federal Clean Air Act requires air emissions permits for stationary sources that emit or have the potential to emit regulated pollutants.

b) Environmental Benefit

Compressed air energy storage regulation will ensure that there is appropriate investigation and study of proposed CAES sites, particularly related to the potential emission of any underground contaminants to the above ground ambient environment, and deter any unintended consequences of underground CAES.

2) As applicable, summarize the research indicating the level of risk to the public health or the environment being removed or controlled by the proposed regulation.

Research is yet to be done on what level of risk CAES may pose to the public health or the environment. However, what is known is the nature and presence of hydrocarbon constituents trapped in liquid and gaseous forms underground, particularly in oil and gas fields where CAES facilities in Kansas likely would be located. The proposed regulation

would ensure monitoring and control of any volatile organic compounds or hazardous air pollutants that may be emitted as a result of a CAES facility's operation.

3) If specific contaminants are to be controlled by the proposed regulation, describe the indicating level at which the contaminants are considered harmful according to current available research.

The federal Clean Air Act (CAA) requires the EPA to set National Ambient Air Quality Standards for pollutants determined to be harmful to public health and the environment. Additionally, the CAA requires that the EPA regulate emissions of toxic air pollutants through rules or standards and control technology requirements. Combustion byproducts (i.e., carbon monoxide, nitrogen dioxide, sulfur dioxide, and particulate matter) are criteria pollutants subject to the NAAQS and certain New Source Performance Standards (NSPS). Hydrocarbons that may be present may fall under NSPS or Maximum Achievable Control Technology (MACT) regulations for VHAP, volatile hazardous air pollutants. There remain many unknowns, which is the basis for the site characterization requirement in the proposed regulation.

II. Economic Impact Statement

1) Is the proposed regulation mandated by federal law as a requirement for participating in or implementing a federally subsidized or assisted program?

No, not at this time.

2) Does the proposed regulation exceed the requirements of applicable federal law?

No. CAES facilities utilizing combustion must meet the requirements of applicable federal law and subsequent state law. Since there are new CAES designs that may not utilize combustion, federal law and regulations may not cover all CAES facilities.

3) Describe the costs to agencies, to the general public, and to persons who are affected by or are subject to the proposed regulation as follows:

a) Capital and annual costs of compliance with the proposed regulation and the persons who will bear those costs.

Capital cost of the facility is not taken into consideration for this analysis. Only site characterization, quarterly leak detection and repair (LDAR), and annual reporting are considered. It is not yet known whether emissions controls will be necessary since there is no prior experience or study from which to draw related facts or assumptions, so there is no emissions control estimate at this time. It is estimated that compliance costs incurred by the owner or operator would amount to the following:

Table 1. Estimated Compliance Costs

Activity	Initial Costs	Annual Costs
Initial Site Emissions Characterization (Evaluating potential underground contaminants that may be emitted.) Plan preparation, assuming 160 hours x $60/hour. Sample collection, assuming 80 hours x $60/hour. Sample analysis, assuming 20 samples x $500/sample.	 $ 9,600 $ 4,800 $10,000 $24,400	
Air Emissions Permit Fee - Approximate (If needed; fee determined by K.A.R. 28-19-304.)	$4,000	
Leak Detection Equipment Options (*if necessary*): Point source detection (labor intensive); or Passive IR gas imaging; or Image multi-spectral sensing (IMSS)	 $2,000 - $12,000 $80,000 $125,000	
Leak Detection Activity (*if required*): Point source detection (low-tech), assuming 80 hours x $40/hour x 4 people; or Gas imaging (high-tech), assuming 40 hours x $40/hour x 2 people.		 $12,800 $3,200
Quarterly Emissions Testing (*if required*) Emissions sample collection, assuming 40 hours per quarter x $40/hour; and Emissions sample testing, assuming 10 samples per quarter x $500/sample x 4 quarters.		 $6,400 $20,000 $26,400
Recordkeeping & Reporting, assuming 24 hours x $14/hour.		$336
Annual Report Preparation, assuming 24 hours x $40/hour.		$960
Estimated Total, No Leak Detection Required, No Emissions Testing Required	$28,400	
Estimated Total, Low-Tech Leak Detection Option (Point source detection), & Emissions Testing	$40,400	$40,496
Estimated Total, High-Tech Leak Detection Option (Optical gas imaging technology), & Emissions Testing	$118,400	$30,896

b) Initial and annual costs of implementing and enforcing the proposed regulation, including the estimated amount of paperwork, and the state agencies, other governmental agencies, or other persons or entities who will bear the costs.

It is expected that costs associated with the implementation and enforcement of this regulation will be minimal and will be absorbed by existing resources.

c) Costs that would likely accrue if the proposed regulation is not adopted, the persons who would bear the costs and those who will be affected by the failure to adopt the regulation.

Should the proposed regulation not be adopted, it will be noted as a failure to comply with a statutory requirement. Additionally, failure to regulate CAES facilities could result in a failure to avoid unintended consequences (such as public health effects or adverse ambient or source monitoring effects following an inadvertent release of potential contaminants to a surrounding area), with subsequent costs incurred by the owner or operator, the public, and the State. No other costs are expected to accrue as a result of not adopting the CAES regulation.

d) A detailed statement of the data and methodology used in estimating the costs described in this economic impact statement.

Not applicable.

e) Describe any less costly or less intrusive methods that were considered by the agency and why such methods were rejected in favor of the proposed regulation.

There is no known less costly or less intrusive method available for consideration.

f) Consultation with League of Kansas Municipalities, Kansas Association of Counties, and Kansas Association of School Boards for determination of potential revenue increases or decreases or imposition of functions or responsibilities that increase expenditures or fiscal liability for cities, counties, or school districts.

The department has provided copies of this Regulatory Impact Statement to each of these organizations concurrently with this submittal.

[1] Sec. 32 through 39, "The Compressed Air Energy Storage Act," Enrolled House Bill 2369, effective May 28, 2009 (K.S.A. 66-1272 through K.S.A. 66-1279). Available at: www.kslegislature.org.
[2] Sec. 34, Enrolled House Bill 2369, effective May 28, 2009 (K.S.A. 66-1274; L. 2009, ch. 141, § 34; May 28).
[3] Sec. 35, Enrolled House Bill 2369, effective May 28, 2009 (K.S.A. 66-1275; L. 2009, ch. 141, § 35; May 28).
[4] Spinning reserve is defined as the generation capacity that is online but unloaded and that can respond within 10 minutes to compensate for generation or transmission outages. Source: Jim Eyer and Garth Corey, Sandia National Laboratories. "Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide." February 2010.
[5] VAR support, or voltage support, means absorbing and injecting reactive power, expressed in units of voltage ampere reactive (VAR); localized reactive power compensation. Source: Jim Eyer and Garth Corey, Sandia National Laboratories. "Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide." February 2010.
[6] Samir Succar and Robert H. Williams. "Compressed Air Energy Storage: Theory, Resources, and Applications for Wind Power." Princeton Environmental Institute, Princeton University. April 8, 2008. Available at: http://www.princeton.edu/~ssuccar/.
[7] Dan Piller. "Underground Drill Tests Begin for Energy Storage Project." *Des Moines Register*. March 2, 2010. Available at: http://www.desmoinesregister.com/article/20100302/BUSINESS/3020366/-1/AMES/Underground-drill-tests-begin-for-energy-storage-project.
[8] The Associated Press. "Utah Company Wants to Turn Caverns Into Batteries." *The Salt Lake Tribune*. February 7, 2010. Available at: http://www.sltrib.com/ci_14353801?IADID=Search-www.sltrib.com-www.sltrib.com.
[9] Keith McGrane, Gaelectric. "CAES in Power Systems with High Wind Penetration." Presentation to EirGrid Group Annual Customer Conference & Workshop – 13th & 14th October 2009.
[10] See http://www.windsohy.com.