STATE OF IOWA
BEFORE THE IOWA UTILITIES BOARD

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| IN RE: | ) | |
| APPLICATION OF INTERSTATE POWER AND LIGHT COMPANY FOR A GENERATING FACILITY SITING CERTIFICATE | ) | DOCKET NO. GCU-07-01 |

# DIRECT TESTIMONY OF WILLIAM E. POWERS ON BEHALF OF THE OFFICE OF CONSUMER ADVOCATE

OCTOBER 22, 2007

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## I. Qualifications

I am a Registered Professional Mechanical Engineer in the State of California, a member of the American Society of Mechanical Engineers, and a member of the Air & Waste Management Association. I have over twenty years of experience in the fields of power generation and emissions testing.

I graduated from Duke University with a Bachelor of Science degree in Mechanical Engineering in 1978. I received a Master's degree in Public Health in Environmental Sciences from the University of North Carolina, Chapel Hill in 1981. During graduate school, I worked for the U.S. Environmental Protection Agency (EPA). After receiving my Master's degree, I went to work at the Naval Energy and Environmental Support Activity in Port Hueneme, California. My primary responsibilities included evaluating U.S. Navy shore installation power plants. In this capacity, my work on coal-fired power plants included emissions testing and combustion efficiency testing at coal units, including units at Camp Lejeune, North Carolina, and Charleston, South Carolina. Another aspect of my work was upgrading air emission control systems and testing their resultant performance.

At the Naval Energy and Environmental Support Activity, I was recognized as Engineer of the Year in 1986, and I was presented with the Department of Defense Productivity Excellence Award in 1985.

In 1989, I began work with ENSR, a consulting and engineering firm in Southern California that served primarily industry clients. As manager of air engineering and air emission measurements, I oversaw air emissions testing and worked as head of the air engineering group in ENSR's west coast office. My responsibilities included evaluations of combustion equipment and air pollution control equipment, Best Available Control Technology (BACT) evaluations, preparation of emission inventories and emissions testing. In 1991, I was recognized as Engineer of the Year at ENSR.

In 1993, I left ENSR to form my own consulting firm, Powers Engineering, which I have owned an operated ever since. At Powers Engineering, I have performed many emissions tests, emissions inventories and 40 to 50 BACT analyses and Lowest Achievable Emission Rate (LAER) analyses. I have also contributed to guidance documents prepared for 1) the Electric Power Research Institute on power plant air emission controls and air cooling and 2) private power developers on emissions limits and control options for coal- and natural gas-fired power plants. As a result, I am thoroughly familiar with current control technologies for air pollution sources including alternative coal combustion techniques.

I have been involved in detailed assessments of integrated gasification combined cycle facilities (IGCC) facilities for several years. I served as an expert for the cities of Houston and Dallas on IGCC as a fully commercial coal-burning alternative to the pulverized coal (PC) technology proposed by Texas Utilities (TXU) for eight 900 MW boilers in East Texas. In this capacity, I also analyzed East Texas as a candidate location for $CO_2$ sequestration due to the presence of mature oilfield $CO_2$ enhanced oil recovery opportunities and a deep saline aquifer underlying the entire region. I have also provided testimony addressing IGCC in proceedings respectively challenging the 1,500 MW Thoroughbred coal plant in Kentucky, the 500 MW Weston Unit plant in Wisconsin, and the 300 MW City Utilities coal plant in Springfield.

**II. Black & Veatch Analysis of Alternatives to Proposed Supercritical PC Plant**

Black and Veatch (B&V) conducted the Site Evaluation Study – Coal Technology Assessment for Alliant Energy in this case. The draft document was completed in March 2007 and was written by B&V employee Sam Scupham (DR response No. 182). The study compared three alternatives: 600 MW supercritical pulverized coal (PC), 600 MW circulating fluidized bed (CFB), and 600 MW integrated gasification combined cycle (IGCC). The study concluded that supercritical PC had the lowest capital cost and busbar costs, and that IGCC had a slightly lower cost per ton of $CO_2$ removed if $CO_2$ capture retrofits would be necessary. The study states that "newly constructed supercritical PC boilers are currently being designed to provide main and reheat steam at 1,050 $^{o}$F or higher. Advancements in metal alloys allow main steam temperature of 1,112 $^{o}$F and reheat temperatures of 1,148 $^{o}$F." A supercritical PC with main and reheat steam temperatures of 1,050 $^{o}$F is what B&V identifies as the most cost-effective option for

Alliant Energy. PC units with main steam temperature of 1,112 °F are not identified as a separate ultrasupercritical (USC) PC technology.

Mr. Scupham of B&V also prepared the January 2007 Clean Coal Technology Selection Study for Florida Power & Light (FPL) in the Glades 2,000 MW power plant proceeding in that state. In this study the following technologies were evaluated: subcritical PC, ultrasupercritical PC (USC), CFB, and IGCC. The study defines USC as operating pressures exceeding 3,600 psig and steam temperatures approaching 1,100 °F.[1] B&V states that although use of USC would be a technology advancement in the U.S., based on document success of the technology in Europe and Japan USC is not a significant technology risk for FPL.[2] The study notes that the efficiency gain for increased steam pressure is not as great as that for increased steam temperature. The report includes a table listing 15 USC units with steam temperature at or above 1,100 °F. B&V determines that USC with steam pressure of 3,715 psig and steam and reheat temperatures of 1,112/1,130 °F is significantly more cost-effective than any other option available to FPL.[3]

These two B&V technology assessments were written at almost the same time by the same author. Yet the suite of PC technologies evaluated is different in each case, and the most-cost effective technology is different as well. Great detail on the existing status of USC technology is provided in the FPL study as a precursor to identifying USC as decisively more cost-effective than other alternatives. This detailed analysis of USC is missing from the Alliant Energy analysis. USC is not even identified as a separate category of PC in the B&V study prepared for Alliant Energy.

A comparison of the two studies gives the impression that FPL had decided to move forward with USC and therefore had instructed B&V to promote the cost and efficiency advantages of USC in the study. In contrast, Alliant Energy did not intend to pursue USC at the Marshalltown site. B&V was apparently instructed to sidestep any discussion of

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[1] B&V, FP&L, Clean Coal Technology Selection Study, January 2007, p. 3-1.
[2] Ibid, p. 3-2.
[3] Ibid, p. 1-4.

USC and to leave the impression that the supercritical PC design preferred by Alliant was state-of-the-art. This leads the reader of the B&V study for Alliant to a very different conclusion than is reached in the B&V FPL study.

B&V appears to have simply molded its engineering analysis to the wishes of the client in each case. As a result, little stock can be placed in the impartiality or technical validity of the June 2007 B&V analysis of the IGCC alternative to the proposed supercritical boiler. For example, B&V identifies GE and Shell technologies as inappropriate gasifier options for PRB, in the case of the GE gasifier, and for PRB with $CO_2$ capture, in the case of the Shell gasifier. B&V identifies that PRB has only been gasified in large quantities using ConocoPhillips E-Gas gasification technology, yet avoids any detailed analysis of the use of the ConocoPhillips gasification technology for this project.[4]

B&V states GE technology is not considered economical for PRB coal.[5] B&V states that the Shell dry gasifier is not cost-effective relative to water quench gasifiers if $CO_2$ capture is contemplated. B&V states that if $CO_2$ capture is added to the IGCC, there may be a technical preference to use quench gasifiers because they are better suited to the application.[6] If the one gasifier technology that is demonstrably appropriate for the situation at hand is not analyzed in detail in the IGCC study, which it is not, it is difficult to consider the B&V IGCC assessment as anything more than an obligatory technical submittal to justify a predetermined position that IGCC will not be used.

## III. Lack of Understanding of Potential Impacts of Unit 4 Cooling Tower Blowdown Discharge on Iowa River

Alliant does not know the total dissolved solids (TDS) concentration in the Iowa River, either during periods of normal flow or extreme low flow. The primary pollutant in the blowdown that could negatively affect aquatic life under extreme low flow conditions is TDS. The extreme daily low water flow in Iowa River appears to be about 3 Mgd (4.8

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[4] B&V, Alliant Energy on behalf of WP&L and IPL, IGCC Technology Study – 2007 Update, Final Report, June 2007, p. 3-17.
[5] Ibid, p. 3-17.
[6] Ibid, p. 9-4.

cfs) [B&V, Site Evaluation Study, Confidential Schedule B, p. 3-8]. Alliant indicates that as much as 1.1 million gallons per day (Mgd) of blowdown with a TDS as high as 2,500 parts per million (ppm) could be directed to the Iowa River from proposed Unit 4. Water with a TDS concentration of 2,500 ppm is considered brackish and would be detrimental to freshwater aquatic life. Removing TDS from water requires expensive reverse osmosis technology. Alternatively this water could be injected into a subsurface saline aquifer, or dry cooling could be specified to eliminate the blowdown discharge altogether. All of these alternatives require significant investment. The lack of technical analysis on the part of Alliant regarding the impact of Unit 4 blowdown discharges on aquatic life in the Iowa River is a significant deficiency.

**IV. Volume of Makeup Water Being Dedicated to Unit 4 Is Significant**

B&V estimates a cooling tower makeup water demand of 4,700 gpm (B&V, Site Evaluation Study, Confidential Schedule B, p. 3-8). This is a bit less than 7 Mgd. This is greater than the water consumption of Marshall County's entire population, which is estimated at approximately 6 Mgd (DR response170: 2006 population, 39,555; per capita water consumption, 151 gallons per day). The water consumption of proposed Unit 4 will be equivalent to that of a city of 40,000 people. As noted above, the Iowa River nearly runs dry under certain seasonal conditions. It is not clear that under all foreseeable conditions there is sufficient makeup water available for Unit 4 that would not involve a tradeoff with higher uses of that water, such as for crop watering during periods of extended drought. No analysis is provided by B&V to demonstrate that under extreme but foreseeable conditions of low water availability in the immediate area there will be adequate makeup water available for Unit 4 without potentially compromising higher use agricultural or potable water supply uses.

**V. Black & Veatch Air Cooling Analysis**

B&V appears to have applied the same "client oriented" approach to its assessment of the use of air cooling. Neither Alliant nor B&V know if the high TDS and high flowrate of cooling tower blowdown will have a substantive negative impact on aquatic organisms in the Iowa River during periods of extreme low flow. Yet no matter, the plant will use wet cooling and the river organisms will simply have to adapt to elevated salt concentrations when these organisms are already heavily stressed by high water temperature and reduced dissolved oxygen concentrations.

Alliant dismisses the relevance of the proposed dry-cooled 420 MW Dry Forks PC in Wyoming asserting that the region is arid and this is the only reason dry cooling has been specified for the project. The heaviest concentrations of dry-cooled power plants in the U.S. are Massachusetts, New York, and Nevada. The prevalence of dry cooling in Massachusetts and New York is in part due to a desire to protect rivers from unnecessary degradation due makeup water withdrawals or blowdown discharge directly to the river. The availability of water for use in cooling towers is not a primary issue in these two states.

The poor efficiency cited by B&V for dry cooling in DR response No. 169 is unsubstantiated and wrong. See June 2005 Powers EPRI/CEC cooling conference paper that compares the efficiency and cost of wet towers and dry cooling for a 500 MW PRB-fired supercritical PC plant in Wisconsin, with climate conditions almost identical to those at the Marshalltown, Iowa site. The paper is provided as **Attachment A**. The results of this paper were summarized in a March 2007 Power Engineering editorial on the use of dry cooling in new power plants. See **Attachment B**. The average annual efficiency penalty of a properly designed air-cooled condenser for the proposed Alliant PC unit would be 2 percent on an annual basis and less than 4 percent on hot summer days. B&V cites an efficiency penalty of 2.5 to 3 percent on an annual basis and 10 percent on hot summer days. Ten (10) percent is an erroneous and obviously unacceptable number. No supporting citations or calculations are provided for the erroneous 10 percent efficiency loss value.

Again, B&V appears to be putting client interests ahead of solid engineering. The client apparently has no interest in considering the use of dry cooling, without yet knowing what impact the discharge of up to 1.1 Mgd of Unit 4 cooling tower blowdown with a TDS concentration of up to 2,500 ppm could have on Iowa River aquatic life during summertime low flow periods when power demand is generally highest. The objective of the B&V dry cooling analysis appears to be little more than a technical backfilling exercise to support the client's predetermined desire to use a wet cooling tower at the site.

This concludes my testimony.