STATE OF WISCONSIN
DIVISION OF HEARINGS AND APPEALS

In the Matter of the Wisconsin Pollutant Discharge Elimination System Permit No. WI-0000965-09-0 (WPDES Permit) Issued to Wisconsin Public Service Corporation (Pulliam)	Case No. DNR-13-056
In the Matter of the Wisconsin Pollutant Discharge Elimination System Permit No. WI-0000965-09-0 (WPDES Permit) Issued to Wisconsin Public Service Corporation (Pulliam)	Case No. DNR-13-066

CORRECTED PRE-FILED DIRECT TESTIMONY OF RACHEL WILSON ON BEHALF OF THE SIERRA CLUB

Background

Q. What is your name and address?

A. My name is Rachel Wilson and I am a Senior Associate with Synapse Energy Economics, Incorporated ("Synapse"). My business address is 485 Massachusetts Avenue, Suite 2, Cambridge, Massachusetts 02139.

Q. Please summarize your educational background and recent work experience.

A. At Synapse, I conduct research and write testimony and publications that focus on a variety of issues relating to electric utilities, including: integrated resource planning; federal and state clean air policies; emissions from electricity generation; environmental compliance

technologies, strategies, and costs; electrical system dispatch; and valuation of environmental externalities from power plants.

I also perform modeling analyses of electric power systems. I am proficient in the use of spreadsheet analysis tools, as well as optimization and electricity dispatch models to conduct analyses of utility service territories and regional energy markets. I have direct experience running the Strategist, PROMOD IV, PROSYM/Market Analytics, PLEXOS, and PCI Gentrader models, and have reviewed input and output data for a number of other industry models.

Prior to joining Synapse in 2008, I worked for the Analysis Group, Inc., an economic and business consulting firm, where I provided litigation support in the form of research and quantitative analyses on a variety of issues relating to the electric industry.

I hold a Master of Environmental Management from Yale University and a Bachelor of Arts in Environment, Economics, and Politics from Claremont McKenna College in Claremont, California.

A copy of my current CV is attached as **Exhibit 1**.

Q. On whose behalf are you testifying in this case?

A. I am testifying on behalf of the Sierra Club.

Q. Have you testified previously before the Wisconsin Division of Hearings and Appeals?

A. No.

Q: Have you testified as an expert in any previous administrative tribunals or courts either by prefiled testimony, live testimony, affidavit or in deposition in the last 5 years?

A: Yes. The proceedings in which I have testified are listed below.

- **Oklahoma Corporation Commission (Cause No. PUD 201400229):** Direct testimony evaluating the modeling of Oklahoma Gas & Electric supporting its request for approval and cost recovery of a Clean Air Act compliance plan and Mustang modernization, and presenting results of independent Gentrader modeling analysis. On behalf of Sierra Club. December 16, 2014.

- **Michigan Public Service Commission (Case No. U-17087)**: Direct testimony before the Commission discussing Strategist modeling relating to the application of Consumers Energy Company for the authority to increase its rates for the generation and distribution of electricity. On behalf of the Michigan Environmental Council and Natural Resources Defense Council. February 21, 2013.

- **Indiana Utility Regulatory Commission (Cause No. 44217)**: Direct testimony before the Commission discussing PROSYM/Market Analytics modeling relating to the application of Duke Energy Indiana for Certificates of Public Convenience and Necessity. On behalf of Citizens Action Coalition, Sierra Club, Save the Valley, and Valley Watch. November 29, 2012.

- **Kentucky Public Service Commission (Case No. 2012-00063)**: Direct testimony before the Commission discussing upcoming environmental regulations and electric system modeling relating to the application of Big Rivers Electric Corporation for a Certificate of Public Convenience and Necessity and for approval of its 2012 environmental compliance plan. On behalf of Sierra Club. July 23, 2012.

- **Kentucky Public Service Commission (Case No. 2011-00401)**: Direct testimony before the Commission discussing STRATEGIST modeling relating to the application of Kentucky Power Company for a Certificate of Public Convenience and Necessity, and for approval of its 2011

environmental compliance plan and amended environmental cost recovery surcharge. On behalf of Sierra Club. March 12, 2012.

- **Kentucky Public Service Commission (Case No. 2011-00161 and Case No. 2011-00162)**: Direct testimony before the Commission discussing STRATEGIST modeling relating to the applications of Kentucky Utilities Company, and Louisville Gas and Electric Company for Certificates of Public Convenience and Necessity, and approval of its 2011 compliance plan for recovery by environmental surcharge. On behalf of Sierra Club and Natural Resources Defense Council (NRDC). September 16, 2011.

- **Minnesota Public Utilities Commission (OAH Docket No. 8-2500-22094-2 and MPUC Docket No. E-017/M-10-1082)**: Rebuttal testimony before the Commission describing STRATEGIST modeling performed in the docket considering Otter Tail Power's application for an Advanced Determination of Prudence for BART retrofits at its Big Stone plant. On behalf of Izaak Walton League of America, Fresh Energy, Sierra Club, and Minnesota Center for Environmental Advocacy. September 7, 2011.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to present total cost estimates for constructing and operating cooling towers at the Pulliam Plant, Units 7 and 8, owned by Wisconsin Public Service Corporation ("WPSC"). I also discuss economic achievability of the cooling towers and the expected impact on electric rates in WPSC's service territory.

Q. What documents have you reviewed in preparing your testimony?

A. The documents I relied on in formulating my opinions are footnoted in the testimony below. Moreover, I have reviewed the prefiled direct testimony of Bill Powers, P.E., and Dr. Peter Henderson also filed on behalf of Sierra Club in this matter.

Q. Please summarize your conclusions.

A. My conclusions are as follows:

1. A cooling tower for Pulliam units 7 and 8 would have minimal impacts on WPSC finances.

2. A cooling tower for units 7 and 8 would have minimal impacts on WPSC rates.

3. A cooling tower would have cost benefits to the commercial fishing industry compared to the current one-through cooling system used at Pulliam.

Impact of WPSC Finances from Cooling Tower

Q. You are aware of Mr. Powers's testimony about the estimated installed cost of a 6-cell cooling tower for Pulliam Units 7 and 8?

A. Yes. I am relying on Mr. Powers's cost estimates for the basis of my opinion. Mr. Powers estimates the total cost of the 6-cell inline conventional cooling tower for units 7 and 8 to be $14,190,000, and the total cost of the plume-abated conventional cooling tower to be $17,770,000. Both estimates are in 2015 dollars.

Q. Did you rely on other opinions of Mr. Powers in formulating your testimony related to the financial impact to WPSC?

A. Yes. I relied on the following four other opinions offered by Mr. Powers in my cost calculations:

1. The total capacity of Pulliam Units 7 and 8 is 200 MW.
2. The average capacity factor of the two units is 48 percent.
3. The average MISO wholesale energy price is $32.9/MWh in 2013$.
4. The closed cycle cooling retrofit at Pulliam would reduce the cooling water flowrate at Units 7 and 8 to 110,000 gallons per minute (gpm).

Q. Have you formulated an opinion on the total cost to WPSC of the cooling tower technology proposed by Mr. Powers?

A. Yes. In my opinion, the inline conventional cooling tower technology proposed by Mr. Powers would have an estimated net present value (NPV) of approximately $15 to $19 million, depending on the wholesale price of energy in the MISO market. Those costs are presented in Table 1, below.

Table 1. Net Present Value Cost of Inline Conventional Cooling Towers at Pulliam 7 and 8.

NPV (2015$, millions, 2015-2035)	Wholesale energy price of $35/MWh	Wholesale energy price of $66/MWh
Capital Revenue Requirement	$14	$14
Tax depreciation	($3)	($3)
Cooling O&M Costs	$2	$2
Construction Outage Costs	$0	$2
Energy Penalty	$2	$4
Total	**$15**	**$19**

The plume-abated cooling tower technology would have an estimated NPV of approximately $19 to $22 million. Those costs are presented in Table 2.

Table 2. Net Present Value Cost of Plume-Abated Cooling Towers at Pulliam 7 and 8.

NPV (2015$, millions, 2015-2035)	Wholesale energy price of $35/MWh	Wholesale energy price of $66/MWh
Capital Revenue Requirement	$17	$17
Tax depreciation	($4)	($4)
Cooling O&M Costs	$3	$3
Construction Outage Costs	$0	$2
Energy Penalty	$2	$4
Total	**$19**	**$22**

Q. What is the basis of that opinion?

A. These cost estimates include the capital costs, operating and maintenance costs, construction outage costs, and the energy penalty associated with the cooling tower technology. I assume that construction of the cooling towers occurs in 2015 with operation beginning in 2016, which is a "worst-case scenario" from a present-value cost perspective, as costs that are incurred further into the future are lower in present-value terms. In reality, permitting and construction would require several years, causing the present-value costs to be lower. NPV was calculated over a 21-year period, including one year for construction and 20 years of operation. Tax depreciation was calculated on a 20-year straight-line basis using a tax rate of 40.14 percent.[1]

Additional detail on the cost components is described here:

[1] Wisconsin Public Service Corporation. Electric Cost of Service Study. Test year ended December 31, 2015.

1. *Capital costs*: The engineering cost estimate for constructing a cooling tower at Pulliam is $14,190,000 for a conventional tower and $17,770,000 for a plume-abated tower. I amortized these costs over the 20-year useful life of the tower using a nominal discount rate of 8 percent.[2] Capital costs are independent of energy production and thus apply at any capacity factor. The resulting present value of capital cost is $14 million for a conventional tower and $17 million for a plume-abated tower.

2. *Operating costs*: The operation and maintenance (O&M) costs of the cooling towers were estimated by Mr. Powers. He assumes an annual maintenance cost of $45,000 per year and a cost for chemical treatment at $330/day. For the plume-abated cooling tower, Mr. Powers estimates a periodic rebuild maintenance cost that occurs in Year 10 (2025) at 20-25 percent of the original cooling tower cost and Year 20 (2035) at 30 to 35 percent of the original cost. I used the upper bounds of these ranges, and included a periodic rebuild cost of $1.4 million in 2025 and $1.9 million in 2035.[3]

   The present value of O&M costs was estimated at $2 million for the inline conventional tower and $3 million for the plume-abated tower, over the 20-year lives of the towers. These operating costs are also independent of capacity factor.

3. *Construction outage costs*: A large portion of the actual construction of the cooling tower can occur while the generating units are still

[2] Wisconsin Public Service Corporation. WPSC-MI 2015 Rate Case. October 17, 2014 Filing. James Beyer Exhibit.

[3] It is unclear from the testimony of Mr. Powers if the periodic rebuild maintenance cost applies only to the plume-abated tower, or also to the inline conventional tower. I have applied it only to the plume-abated tower; however, if the cost also applies to the conventional tower, I would expect total O&M cost to increase from $2 million to $3 million, and total NPV to change from $15-19 million to $16-$19 million.

operating; however, there must be an outage period when the tower is actually connected to the plant. As discussed by Mr. Powers, the EPA estimates in the May 2014 final 316(b) Phase II Technical Development Document that cooling tower retrofits at fossil plants require only four weeks of outage beyond the annual maintenance outage.[4] During this outage period, the plant operator avoids fuel and variable O&M costs at the units, but also loses generation revenue during that period.

Lost generation is estimated to be about 69,120 MWh. Avoided O&M costs were estimated based on 20 years of historical FERC Form 1 data for Pulliam 7 and 8, and weighted based on the capacity of the units. Non-fuel O&M costs were estimated to be approximately $3.65/MWh and fuel costs were estimated at $20.30/MWh. Energy market revenue was estimated at two different prices: 1) the Annual Energy Outlook (AEO) Energy Market Module 2014 price of approximately $66/MWh in 2015; and 2) the average MISO market wholesale price reported by Mr. Powers, converted to 2015$[5] and escalated by the compound annual growth rate of .86 percent found in the price stream from AEO – approximately $35/MWh in 2015. Lost generation is valued at an NPV of $0.45-1.73 million, depending on the wholesale price for energy. Those costs are shown in Table 3.

[4] U.S. EPA, *Technical Development Document for the Final Section 316(b) Existing Facilities Rule*, *EPA-821-R-14-002*, May 2014, p. 8-34, Exhibit 8-11. Net Construction Downtime for Closed-cycle Retrofit.
[5] To convert to 2015$, I use an inflation rate of 3 percent, taken from: Wisconsin Public Service Corporation. WPSC-MI 2015 Rate Case. October 17, 2014 Filing. James Beyer Exhibit.

Table 3. Construction Outage Costs.

Construction Outage (2015$, millions)	Wholesale energy price of $35/MWh	Wholesale energy price of $66/MWh
Lost Revenue	$2	$5
Avoided O&M	$2	$2
Profit loss (lost revenue - avoided O&M)	$1	$3
Net cost (profit loss net of taxes)	**$0.45**	**$1.73**

4. *Energy penalty costs*: The installation of cooling towers leads to a small loss of net generation at the Pulliam plant. Mr. Powers estimates that "energy penalty" to be approximately 1.2 percent, which is equivalent to 10,092 annual MWh. The annual generation penalty was then multiplied by the wholesale electricity price projections for MISO to estimate the lost revenue. The energy penalty results in NPV costs to WPSC of approximately $2-4 million, depending on the energy market price.

Economic Achievability of Cooling Tower Costs

Q. Have you considered economic achievability of the costs of the cooling tower technology proposed by Mr. Powers?

A. Yes. The costs of cooling towers at Pulliam 7-8 are certainly affordable for WPSC.

Q. What is the basis of your opinion?

A. The Pulliam plant is owned by Wisconsin Public Service Corporation, a regulated utility. In 2014, WPSC held $4.279 billion in total assets, received

operating revenues of $1.683 billion, and reported $138 million in net income for the year.[6]

WPSC's corporate parent is Integrys Energy Group, Inc., which also owns Peoples Gas, North Shore Gas, Minnesota Energy Resources, and Michigan Gas Utilities. In 2014, Integrys held $11.282 billion in total assets, received operating revenues of $4.144 billion, and reported $277 million in net income for the year. [7]

As of June 2014, Integrys Energy Group, Inc. and Wisconsin Energy Corporation have entered into a definitive agreement under which Wisconsin Energy, a company valued at nearly $15 billion in assets,[8] will acquire Integrys in a cash and stock transaction valued at $9.1 billion. The merger is expected to be completed during the summer of 2015. Post-merger, the combined company is "committed to accelerated investment in Integrys territories, including their 5-year plan to invest up to $3.5 billion in infrastructure and operational initiatives."[9]

It seems clear that a company of this magnitude can afford the $15-19 million (inline conventional) or $19-22 million (plume-abated) net present value cost of a conventional cooling tower at Pulliam 7-8; the upper bound of the cost range is slightly more than one percent of WPSC's annual revenues.

These values represent the total NPV cost of the cooling tower technologies. The annual revenue requirements associated with these net present values are shown in Table 4.

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[6] Wisconsin Public Service Corporation. Form 10-K, United States Securities and Exchange Commission, Fiscal Year 2014.
[7] Integrys Energy Group, Inc. Form 10-K, United States Securities and Exchange Commission, Fiscal Year 2014.
[8] Wisconsin Energy to acquire Integrys Energy Group. October 6, 2014 News Release.
[9] Wisconsin Energy to acquire Integrys Energy Group. June 23, 2014 Fact Sheet.

Table 4. Annual Revenue Requirements Associated with Cooling Tower Installation.

Annual Revenue Requirement (2015$, millions)	Wholesale energy price of $35/MWh	Wholesale energy price of $66/MWh
Conventional Cooling Towers	$1.60	$1.95
Plume Abated Cooling Towers	$1.92	$2.28

Impact to Customer Rates

Q. Have you considered the impact on rates if the technology proposed by Mr. Powers is selected?

A. Yes. Because the Pulliam plant is owned and operating by a regulated utility, the costs of cooling towers would be passed on to ratepayers in WPSC's service territory. In my opinion, rates will be impacted, but increases will be minimal. In general, I would expect to see a rate impact of approximately 0.2 percent on average across all customer classes due to the installation of the cooling towers.

Q. What is the basis for your opinion?

A. I have reviewed the most recent cost of service study[10] and rate order for WPSC by the Public Service Commission of Wisconsin. The authorized revenue requirement in that docket was just over $1 billion.[11] The upper limit for the annual revenue requirements for a cooling tower would be just over $2 million as shown in Table 4. These additional revenue requirements would increase total revenue requirements by approximately 0.2 percent, leading to a similar percentage increase in rates.

[10] Wisconsin Public Service Corporation. Electric Cost of Service Study. Test year ended December 31, 2015.
[11] Public Service Commission of Wisconsin. Application of Wisconsin Public Service Corporation for Authority to Adjust Electric and Natural Gas Rates. 6690-UR0123. Final Decision. December 18, 2014.

Cost Benefit to Commercial Fishing

Q. Have you formulated an opinion as to the benefit to commercial fishing if the cooling tower is installed rather than the once-through cooling system?

A. I believe that the installation of a cooling tower at Pulliam 7 and 8 would result in a benefit to the commercial fishing industry.

Q. Did you rely on the testimony of Dr. Henderson in formulating your opinions?

A. Yes. On page 10, lines 12-14 of his testimony, Dr. Henderson presents total baseline impingement of fish at Pulliam 7 and 8, and states that "it must be assumed that 100 percent of the impinged fish die." On page 17, line 6 Dr. Henderson states that yellow perch form 9.2 percent of the total number of fish impinged, and based on that testimony, I calculate the number of yellow perch that are currently impinged at Pulliam 7 and 8.

Table 5. Estimated Annual Deaths of Yellow Perch Due to Impingement.

Impingement	Unit 8	Unit 7	Total
Estimated Fish Killed	140,407	62,143	202,550
% Yellow Perch			9.20%
Yellow Perch Deaths Per Year Due to Impingement	**12,917**	**5,717**	**18,635**

In his testimony, Dr. Henderson states page 14, lines 2-5: "(Y)ellow perch are commercially important and are already in decline. Closed-cycle cooling can reduce these losses to negligible levels and must therefore be considered the control option of choice if aquatic life is to be conserved." I thus assume that the cooling tower would result in 100 percent survival of the fish that were previously impinged.

Q. What is your opinion on the economic impact to commercial fishing?

A. A recent determination from the WDNR BPJ estimated the value per pound of yellow perch to be $6.04/lb in 2009$.[12] The average weight of an adult yellow perch is estimated to be between 0.18 and 0.38 pounds at three and five years of age, respectively.[13] Assuming 100 percent survival of the yellow perch that were previously impinged, I estimate that the annual benefit of the surviving yellow perch is between $22,809 and $48,152 per year, depending on the weight of the fish, as shown in Table 6.

Table 6. Total Annual Value of Yellow Perch that are no Longer Lost to Impingement.

Avoided Impingement	Value	
Yellow Perch Impingement Avoided	18,635	
Weight of Average Adult Yellow Perch (lbs)	0.18	0.38
Cumulative Weight of Surviving Yellow Perch (lbs)	3,354	7,081
Yellow Perch value/lb (2015$)	$6.80	
Total Annual Value of Surviving Yellow Perch (2015$)	**$22,809**	**$48,152**

I would expect the value to the commercial fishing industry to increase if avoided entrainment were included in the calculation of benefits.

Q. Does this complete your testimony?

A. Yes.

[12] Wisconsin Department of Natural Resources, WPDES Permit Fact Sheet p. 19, Attachment A: BTA Determination for Bay Front Generating Station (Nov. 2009), Permit No. WI-0002-997-07-0. December 6, 2012.

[13] The Wisconsin Department of Natural Resources estimates that the yellow perch may grow to an average weight of up to 0.68 lbs at an age of seven years. I believe that 0.18-0.38 pounds represents a conservative range by which to estimate the benefits to the commercial fishing industry. See: Mecozzi, Maureen. Yellow Perch. Wisconsin Department of Natural Resources, Bureau of Fisheries Management. PUBL-FM-710 08. August 2008. Available at: http://dnr.wi.gov/topic/Fishing/documents/species/yellowperch.pdf