From: Eric Epstein <lechambon@comcast.net>
Subject: **Before the U.S. Nuclear Regulatory Commission Three Mile Island Alert Inc.'s Comments Re: PPL Bend LLC; Bell Bend Nuclear Power Plant Combined License Application; Notice of Intent to Conduct A Supplemental Scoping Process on the Revised Site Layout (Docket ID NRC-2008-0603)**
Date: July 16, 2012 12:11:23 PM EDT

July 16, 2012,

Cindy Bladey, Chief Rules, Announcements and Directives Branch (RADB)
U.S. Nuclear Regulatory Commission
Office of Administration
Mail Stop TWB-05-BO1M,
Washington, D.C. 20555-0001

Dear Ms. Bladey:

Enclosed please find Three Mile Island Alert Inc.'s Comments Re: PPL Bend LLC; Bell Bend Nuclear Power Plant Combined License Application; Notice of Intent to Conduct A Supplemental Scoping Process on the Revised Site Layout (Docket ID NRC-2008-0603).

Respectfully submitted,

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(LMQ1)

Before the U.S. Nuclear Regulatory Commission
Three Mile Island Alert Inc.'s Comments
Re: PPL Bend LLC; Bell Bend Nuclear Power Plant Combined License Application; Notice of Intent to Conduct A Supplemental Scoping Process on the Revised Site Layout (Docket ID NRC-2008-0603)

July 16, 2012,

Cindy Bladey, Chief Rules, Announcements and Directives Branch (RADB)
U.S. Nuclear Regulatory Commission
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Mail Stop TWB-05-BO1M,
Washington, D.C. 20555-0001

I. Introduction.

I am Eric Epstein ("Epstein" or Mr. Epstein"), the Chairman of Three Mile Island Alert, Inc. ("TMIA" or "TMI-Alert").

In that capacity, I am offering comments and testimony relating to PPL Bend Nuclear Power Plant's ("Bell Bend") Combined License Application; Notice of Intent to Conduct A Supplemental Scoping Process on the Revised Site Layout requested by the U.S. Nuclear Regulatory Commission (Docket ID NRC-2008-0603) .

Similarly, I am providing additional comments regrinding PPL Bend Nuclear Power Plant's Application Number NAB 20008-01401-P13 before the U.S. Army Corps of Engineers

II. Affected Interests.

Mr. Epstein has clearly defined interests at stake in the Application submitted by PPL Bell Bend ("PPL" or "the Applicant") , and actively pursued those interests at the Nuclear Regulatory Commission ("NRC") and the Susquehanna River Basin Commission ("SRBC"). TMI-Alert actively monitored the construction, licensing and operation of the Susquehanna Steam Electric ("SSES") Station since 1984.

TMI-Alert is a safe-energy organization based in Harrisburg, Pennsylvania and founded in 1977 with members throughout central and eastern Pennsylvania. TMIA monitors Peach Bottom, Susquehanna, and Three Mile Island nuclear generating stations. TMIA is the largest and oldest safe-energy group in central Pennsylvania.

TMIA has enjoys widespread public and political support in its role as a watchdog of nuclear power production. In the spring of 1987, TMIA was recognized by the Pennsylvania House of Representatives for 10 years of community service. The House, along with the City of Harrisburg, formally applauded TMIA's efforts on behalf of the community at their 20th and 25th anniversaries.

Mr. Epstein is the Chairman of TMI-Alert. He has served as either Spokesperson or Chairman of the organization since 1984.

Three Mile Island Alert membership has suffered through the 1979 meltdown at Three Mile Island Island Unit-2 and the forced shutdown of Peach Bottom Units 2 & 3 in 1987. TMIA's membership living with 50 miles of the the proposed Bell Bend Nuclear Generating Station ("BBNPP" or "Bell Bend") have immediate concerns relating to the plant's operation.

TMIA's membership have legitimate and historic concerns regarding radiological contamination resulting from radiological releases related to normal and abnormal operations that impact the value of its property, and interfere with the organization's rightful ability to conduct operations in an uninterrupted and undisturbed manner.

Mr. Epstein's participation may reasonably be expected to assist in developing a sound record. Epstein is well versed and an acknowledged nuclear expert, "...On careful review of the pleadings, we acknowledge Epstein's expertise in the areas of nuclear decommissioning, nuclear waste isolation, nuclear economics, nuclear safety, universal service, and community investment. (*See* Epstein Protest, para. 10." (1)

Mr. Epstein's most recent advocacy on behalf of TMIA membership living within proximity of the Susquehanna Steam Electric Station ("SSES") was well established at the NRC between 2006-2009. (2) The nature of his own property and business interests, and his responsibility to his membership are undisputed. Epstein has Standing on behalf of Three Mile Island Alert, Inc. Three Mile Island Alert ("TMIA") Inc. TMIA has numerous members that reside in the Susquehanna Steam Electric Station's proximity and throughout the Susquehanna River Valley. These members have concrete and particularized interests that will be directly affected by this proceeding.

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1 PA PUC Commission, Public Meeting held July 14, 2005, A-110550F0160 Joint Application of PECO Energy Company and Public Service Electric and Gas Company for Approval of the Merger of Public Service Enterprise Group Incorporated with and into Exelon Corporation.

2 Re: PPL Susquehanna LLC Application for Susquehanna Steam Electric Station's Renewed Operating Licenses NPF-14 and NPF-22 Docket Nos. 50-387 PLA-6110 and 50- 388.

Moreover, the Pennsylvania Constitution is clear in Article I, Natural Resources and the Public Estate Section 27.

> The people have a right to clean air, pure water, and to the preservation of the natural, scenic, historic and esthetic values of the environment. Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people.

TMIA's history and mission are germane and important to this proceeding. Many TMI-Alert members live are subject to radiological contamination, evacuation, loss of property, or other harms in the event of any mishap at the plant. *Id.* Members also use, recreate, fish and enjoy the segment of the Susquehanna River adjacent and below the the proposed site. (3)

As demonstrated by the above discussion and attached supporting materials, many of the members represented by Three Mile Island Alert would have standing in their own right. The issues in relicensing are germane to TMIA's stated mission. And, the individual participation of the members is not necessary to the claims or requested relief.

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3 An organization has standing to sue on behalf of its members when a member would have standing to sue in his or her own right, the interests at issue are germane to the organization's purpose, and participation of the individual is not necessary to the claim or requested relief." *Hunt v. Washington State Apple Advertising Cornrnn,* 432 U.S. 333, 343 (1977).

III. Discussion

PPL Bell Bend ("BNPP" or "Bell Bend") has repeatedly ignored or failed to factor, consider and address numerous water use and site-specific aquatic challenges to the Susquehanna River and its environs if this Application is approved.

The Applicant did not adequately consider the additional and aggregate impact another nuclear power plant will have on environment, habitat and ecosystem.

The magnitude of the amount of water used at nuclear power plants is readily evidenced at PPL's Susquehanna Steam Electric Station located on the Susquehanna River in Luzerne County. (4) The plant draws 0.86 million gallons per day from the Susquehanna River. For each unit, 14.93 million gallons per day are lost as vapor out of the cooling tower stack while 11 million gallons per day are returned to the River as cooling tower basin blow down. On average, 29.86 million gallons per day are taken from the Susquehanna River and not returned. This data is public information, and can be easily referenced by reviewing PPL's Pennsylvania Environmental Permit Report.

The proposed PPL Bell Bend nuclear power plant will be one of the largest nuclear reactors in the world. "Due to its sheer size and because it also has a lower thermodynamic efficiency (discussed in detail below), Bell Bend will draw an inordinately large amount of water from the Susquehanna River in order to cool the reactor.

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4 The Susquehanna Electric steam Station Unit 1 was placed on the Degraded Cornerstone Matrix by the Nuclear Regulatory Commission in 2011 and this lowest rankest nuclear unit in Region I. Please refer to Enclosure 1 for a complete description of PPL's declining performance.

The amount of water anticipated for use by the PPL proposed Bell Bend nuclear power plant is detailed in a recent report written by Normandeau Associates, paid for by PPL, and submitted to the Susquehanna River Basin Commission. (5)

Recent and consistent droughts in Pennsylvania (2002) as well as flooding (2006) have forced state and regulatory bodies to reexamine water as a commodity in the Commonwealth of Pennsylvania.

The SRBC Drought Management Information Sheet 5, droughts and low-water flow demonstrates that regular that droughts occur in the region. occurred quite recently, with droughts occurring every decade except the 1970s.

Mr. Gundersen sated, "One of the considerations for review is plant reliability, and the potential for drought would reduce the reliability of the plant during the middle of the summer exactly at the time the area's need is greatest."

"Like floods, the magnitude of drought events can be categorized based on historical frequency, i.e., 5-year droughts, 10-year droughts, 50-yea droughts, etc. (The higher numbers indicate more severe, and less frequent, droughts.) Droughts can affect the entire basin or cause localized water shortages."

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5 Expert Witness Report of Arnold Gundersen, Re: Bell Bend Nuclear Power Plant Application for Groundwater Withdrawal Application for Consumptive Use, BNP -2009-073, Susquehanna River Basin Commission, January 5, 2010.

Please refer to Enclosure 2 for the Expert Witness Report of Arnold Gundersen.

"Since the beginning of the 1900s, the basin has experienced droughts in every decade except the 1970s. The worst droughts occurred in 1930, 1939 and 1964. During the 1990s through mid-2000s, periodic low flows throughout the basin or in regions resulted in frequent droughts, including 1991, 1995, 1997, 1998, 1999, 2000, 2002 and 2006." (6)

In addition, a number of infestations, specifically Asiatic clams and Zebra mussels, have required power plants to prepare plans to defeat these aquatic invasions.

The Applicant did not address water quality, water use, aquatic communities, groundwater use, entrainment and impingement, and impact microbiologic organisms throughout the license application, but offered only cursory and superficial data, and failed to address numerous issues that could adversely impact the area surrounding the the proposed plant.

Nuclear power plants require large amounts of water for cooling purposes. PPL's Susquehanna Electric Steam Station power plant already removes large amounts water from the Susquehanna River. Animals and people who depend on these aquatic resources will also be affected Refer to Charts A-1 and A-2). PPL's Application will further place pressure on limited water resources. Freshwater withdrawals by Americans increased by 8% from 1995-2000, and Americans per capita water withdrawal is three times above the international average. (7)

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6 Gundersen, p. 16.

7 "U.S. National Report on Population and the Environment" (2006) published by the Center for Environment and Population, a nonprofit corporation based in Connecticut.

"Millions of fish (game and consumable), fish eggs, shellfish and other organisms are sucked out of the Susquehanna River and killed by nuclear power plants annually. Now large water consumers, including PPL, are compelled to invetorize mortality rates and identify species of aquatic life affected by water intakes. It is hard to know just what the impact on fisheries is, because cool water intakes have been under the radar screen compared to some types of pollution" said Pennsylvania Fish and Boat Commission aquatics resources chief Leroy Young. (8) "But any time you have a man-induced impact on top of what nature is doing, you're affecting the ecosystem," Young said.

PPL Bell Bend has not disclosed or quantified the how many fish (game and consumable), fish eggs, shellfish will be killed annually if this Application is approved. Is the Corps in possession of this data? Has it been made available to the public for review? Has the Corps established "acceptable levels" of fish kills? If so, where can that data be found? What impact will the Application have on shad ladders? What impact will this Application have on sport and commercial fishing?

On July 9, 2004, the Environmental Protection Agency (EPA) issued the Final Phase II rule implementing Section 316 (b) of the Clean Water Act: The first national standards for reducing fish kills at existing plants. "The rule established requirements for reducing adverse environmental impacts from the entrainment and impingement of aquatic organisms living near power plants."

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8 Ad Crable, *Intelligencer Journal*, January 15, 2005.

What will the Corp's compliance reporting requirements be in regard to onsite 316 (a) and 316 (b) monitoring? Where will the results be published? Has the Corps and EPA executed a MOU? What will the Corps compliance reporting requirements be in regard to off site tritium monitoring? Where will the results be published?

It is not uncommon for the plants to discharge chlorinated water (necessary to minimize bacterial contamination of turbines) or Clamtrol (chemical agent used to defeat Asiatic clam infestation) directly into the River. Will the water be treated with chemicals? How does PPL plan to defeat Asiatic clam and/or Zebra mussel infestations? (9)

DEP confirmed that zebra mussel adults and juveniles have been found in Goodyear Lake, the first major impoundment on the Susquehanna River's main stem below Canadarago Lake in New York. Zebra mussels are an invasive species posing a serious ecological and economic threat to the water resources and water users downstream in the river and Chesapeake Bay...In 2002, the first report of zebra mussel populations in the Chesapeake Bay Watershed were reported from Eaton Reservoir in the headwaters of the Chenango River, a major tributary to the Susquehanna River in New York. A short time later, zebra mussels also were found in Canadarago Lake, a lake further east in the Susquehanna main stem headwaters. Now, through DEP's Zebra Mussel Monitoring Network, reports were received that both zebra mussel adults and juveniles, called veligers, have made their way down to the Susquehanna main stem, (DEP, Update, July 16, 2004.)

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9 In February 1986, one celled organisms believed to be fungus, bacteria and algae like creatures were discovered at Three Mile Island. These creatures obscured the view of the reactor core and impeded the defueling of the damaged reactor. 9

How does PPL plan to defeat Asiatic clam and/or Zebra mussel infestations?

Nuclear plants use millions of gallons daily for coolant and to perform normal industrial applications. There are five nuclear generation units on the Susquehanna River. Two plants, with three units, are located on the Lower Susquehanna, and have the capacity to draw in as much as half the flow of a River in a day. Bell Bend will increase the pressure on the River's resources.

In its application to the SRBC, PPL has requested approval for consumptive use of up to 31 mgd as a measure of conservatism and to account for variability within the range of monitoring accuracy required by SRBC.

"As a result, the PPL proposed Bell Bend nuclear power plant will withdraw at least 15,000,000,000 (15 billion) gallons of water from the Susquehanna River every year."

"Consequently, each year the 4,000,000,000 (4 billion) gallons of water that will be returned to the river will have been heated and will contain additional chemical contaminants discussed below."

"The difference between what is withdrawn from and what is returned to the Susquehanna River each year will be *consumed* by the PPL proposed Bell Bend nuclear power plant, and as a result, this consumptive use of water amounts to 11,000,000,000 (11 billion) gallons per year."

"The 11,000,000,000 (11 billion) gallons of water withdrawn each year from the Susquehanna River will be emitted as water vapor from the proposed cooling towers."

It is hard to visualize exactly how much 11,000,000,000 (11 billion) gallons of water per year would be. To put the *consumed* water into a visual perspective, the 11 billion gallons of water would fill the equivalent of 50-football fields 500-hundred feet high with river water."

"Subsequently, in addition to the environmental burden of 4 billion gallons of heated and chemically contaminated water that will be dumped into the River each year, the Susquehanna River Basin and the Chesapeake Bay will face an enormous yearly consumption of Susquehanna River Water that will be withdrawn and never returned." (10)

How will the Corps account for the loss of water? How will the Corps track the chemicals dispersion and maintain a "chain of custody?" How often will the Corps test for differential water temperatures?

"Because both the hyperbolic tower and the forced draft tower evaporate water, as discussed in detail in the previous section, some river water must still be used to cool the power plant. *Make-up water* is the term used to describe the water used to replace the evaporated water."

"All hyperbolic or forced-air cooling towers also create dirty water called ***blow down water*** that is returned back to the river with contaminants concentrated within it. ***Make-up*** water is also used to replace ***blow down*** water."

"The dirty water released from the cooling towers back into the Susquehanna River as ***blow down*** will be approximately 25% of the amount of water that is withdrawn. For every four gallons the plant withdraws, it sends back one gallon of ***blow down.***"

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10 Gundersen, p. 4.

The blow down is a pollutant for three reasons:

"Three out of every four gallons of withdrawn evaporate water (consumptive use water) that will be initially drawn from the Susquehanna River will be returned to the river as blow down with four times more concentration of pollutants and minerals than when that water was withdrawn." (11)

"In addition to concentrating contaminants and minerals that already existed in the river, the blow down contains biocides and algaecides used within the cooling towers to prevent them from becoming clogged with mold and mildew."

"Along with chemical contamination and highly concentrated minerals, the dirty blow down water will be approximately 20 degrees hotter than the river water to which it is being returned."

"The PPL proposed Bell Bend nuclear power plant will use about 1% of the flow in the Susquehanna River for its ***make-up*** water due to evaporation."

"Whereas, in an air-cooled condenser design, the steam that leaves the turbine passes directly to a dry cooling tower thus using no river water. The air-cooled condenser sits at the base of a dry cooling tower." (12)

Water quality, fish kills, thermal inversion and effluent discharges, need to be included and factored into the Bell Bend Application.

Note: Bold face type added.

11 Gundersen, p. 10, (36.1)

12 Gundersen, p. 10, (38)

Water shortages on the Lower Susquehanna reached critical levels in the summer of 2002. During the 2002 drought, the SSES was exempted from water conservation efforts. For the month of August 2002, 66 of 67 Pennsylvania counties had below normal precipitation levels. (13)

The U.S. Geological Survey stated that "...changes in evaporation and transpiration during a drought depend on the availability of moisture at the onset of a drought and the severity and duration of a drought. Also, weather conditions during a drought commonly include below-normal cloud cover and humidity and above-normal wind speed. These factors will increase the rate of evaporation from open bodies of water and from the soil surface, if soil moisture is available."

Gundersen observed, "One of the considerations for review is plant reliability, and the potential for drought would reduce the reliability of the plant during the middle of the summer exactly at the time the area's need is greatest." (14)

What actions will Bell Bend take to curb water use during periods of conservation and/or drought?

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13 Pennsylvania Department of Environmental Protection, *Drought Report* and *Drought Conditions Summary*, August-September, 2002).

14 Gundersen, p. 16.

IV. Expert Testimony of Arnold D. Gundersen, MSNE, Regarding Consumptive Water Use of the Susquehanna River by the Proposed Bell Bend Nuclear Power Plant. (15)

"In conclusion, air-cooled condensers could be successfully integrated into the PPL Bell Bend project design and the use of such air-cooled condensers would completely eliminate the need for the PPL Bell Bend nuclear power plants to have such a projected massive consumptive water use from the Susquehanna River."

"However, the proposal presently in front of the Susquehanna Basin River Commission never discusses this viable alternative. Moreover, it is critical that the substitution of an air-cooled condenser and air-cooled cooling towers receive adequate analysis now, prior to final design and preliminary construction, as it is impossible to adapt the plant to the use of air-cooled condensers after the construction process is initiated."

"Finally, the *Draft* fee schedule as presently proposed by the Susquehanna River Basin Commission subsidizes huge consumptive water use at great risk to the Susquehanna River Watershed and the Chesapeake Bay Watershed. These two vital watershed communities are already challenged by frequently occurring drought conditions as well as the negative environmental impact of dirty water (*blowdown*) on the Susquehanna River and Chesapeake Bay fragile aquatic ecosystems." (16)

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15 Enclosure 2: Testimony and Vitae of Arnold Gundersen.

16 Gundersen, p. 22.

V. Expert Testimony of Keith L. Harner, P.E., Regarding PPL's "Conceptual Proposal to Develop and Implement A Cooperative Storage Asset Pool for Consumptive Use Mitigation." (17)

"The establishment of a cooperative and coordinated pooled asset program for consumptive use mitigation between stakeholders has the potential to offset negative impacts on the Susquehanna River system. However, the pooling proposal from PPL (which includes PPL and SRBC controlled facilities) does not meet or exceed existing regulations."

"A pooled asset plan should make it possible to utilize different mitigation sources to protect different sections of the river system, but the use of the Holtwood reservoir provides mitigation flow well below the consumptive uses of PPL. That release would only help the Conowingo Reservoir (Baltimore city) and the Chesapeake Bay."

"The lower Susquehanna River is one of the most vulnerable sections of the river during low flows. This proposal does not protect that section of the river. Even when all PPL's statements are assumed to be true (including that the 3rd party mitigation flows would be provided upstream of the proposed Bell Bend facility) there remains reduced flows in sections of the West Branch and lower Susquehanna River." (18)

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17 Enclosure 3: Testimony and Vitae of Keith L. Harner.

18 Harner, p. 12.

VI. On Site Alternatives

"In conclusion, air-cooled condensers could be successfully integrated into the PPL Bell Bend project design and the use of such air-cooled condensers would completely eliminate the need for the PPL Bell Bend nuclear power plants to have such a projected massive consumptive water use from the Susquehanna River.

"However, the proposal presently in front of the Susquehanna Basin River Commission never discusses this viable alternative. Moreover, it is critical that the substitution of an air-cooled condenser and air-cooled cooling towers receive adequate analysis now, prior to final design and preliminary construction, as it is impossible to adapt the plant to the use of air-cooled condensers after the construction process is initiated." (19)

VII. Compensatory Measures and Alternatives Fall Under the Purview of the SRBC.

It is clear black letter law that issues relating "Compensatory Measures" in the Present Application fall under the unambiguous purview of the SRBC.

> 18 CFR § 803.42 H) Other alternatives. (2) Alternatives to compensation may be appropriate such as discontinuance of that part of the project's operation that consumes water, imposition of conservation measures, utilization of an alternative source that is unaffected by the compensation requirement, or a monetary payment to the commission in an amount to be determined by the commission from time- to-time.

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19 Gundersen, pp. 18 & 22.

VIII. Remedies:

1) The U.S. Army Corps of Engineers should convene public hearings pursuant to PPL Bend Nuclear Power Plant's ("Bell Bend") Application ("PPL" or "the Applicant") number NAB 20008-01401-P13 to the U.S. Army Corps of Engineers ("the Corps), Re: PPL Bend Nuclear Power Plant's Application Number NAB 20008-01401-P13.

2) The U.S. Army Corps of Engineers should compel the Applicant to address, factor and analyze water use and site-specific aquatic challenges identified in TMI-Alert's comments.

3) It is clear black letter law that issues relating "Compensatory Measures" in this Scoping process fall under the unambiguous purview of the SRBC.

3) The US. Nuclear Regulatory Commission should compel the Applicant to address, factor and analyze water use and site-specific aquatic challenges identified in TMI-Alert's comments.

4) The US. Nuclear Regularity Commission should compel the Applicant to address, factor and analyze the issues raised by Arnold D. Gundersen in his Expert Testimony.

5) The US. Nuclear Regularity Commission should compel the Applicant to address, factor and analyze the issues raised by Keith L. Harner in his Technical Evaluation.

Respectfully submitted,

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Enclosures:

- Tables A-1 & A-2
- Enclosure 2 Testimony of Arnold D. Gundersen
- Enclosure 3 Testimony Keith L. Harner

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Table A-1, Table A-2, Table A-3 & Table A-4

"Nuclear Power and the Threat To Drinking Water"

Environment America Research & Policy Center

U.S. Public Interest Research Group

January, 2012

Table A-1: Total Population Receiving Drinking Water from Intakes within 50 Miles of Each US Nuclear Plant

Plant	State	Total Population Receiving Drinking Water from Intakes within 50 Miles of Plant
Browns Ferry	Alabama	619,428
Palo Verde	Arizona	124,500
Arkansas Nuclear	Arkansas	475,437
San Onofre	California	2,295,738
Diablo Canyon	California	66,450
Millstone	Connecticut	893,827
Saint Lucie	Florida	124,700
Vogtle	Georgia	398,523
Braidwood	Illinois	283,767
Dresden	Illinois	382,267
La Salle	Illinois	283,443
Quad Cities	Illinois	245,971
Clinton	Illinois	157,835
Duane Arnold	Iowa	84,403
Wolf Creek	Kansas	63,947
Waterford	Louisiana	1,449,287
River Bend	Louisiana	13,803
Pilgrim	Massachusetts	1,206,352
Fermi	Michigan	1,580,621
Palisades	Michigan	389,057
D.C. Cook	Michigan	254,584
Monticello	Minnesota	873,838
Prairie Island	Minnesota	478,021
Grand Gulf	Mississippi	9,116
Callaway	Missouri	31,346
Fort Calhoun	Nebraska	579,626
Cooper	Nebraska	3,490
Seabrook	New Hampshire	3,921,516
Salem	New Jersey	2,900,971
Hope Creek	New Jersey	2,900,971
Oyster Creek	New Jersey	1,076,424

Table A-1: Total Population Receiving Drinking Water from Intakes within 50 Miles of Each US Nuclear Plant (cont'd.)

Plant	State	Total Population Receiving Drinking Water from Intakes within 50 Miles of Plant
Ginna	New York	815,873
FitzPatrick	New York	548,848
Nine Mile Point	New York	548,848
Indian Point	New York	11,324,636
Shearon Harris	North Carolina	1,686,425
McGuire	North Carolina	1,646,516
Brunswick	North Carolina	215,985
Perry	Ohio	2,132,775
Davis-Besse	Ohio	1,550,459
Limerick	Pennsylvania	3,901,396
Beaver Valley	Pennsylvania	1,878,905
Three Mile Island	Pennsylvania	1,155,630
Peach Bottom	Pennsylvania	1,059,176
Susquehanna	Pennsylvania	848,626
Catawba	South Carolina	1,370,934
Oconee	South Carolina	799,932
Summer	South Carolina	487,462
Robinson	South Carolina	151,010
Sequoyah	Tennessee	659,341
Watts Bar	Tennessee	551,341
Comanche Peak	Texas	1,243,514
South Texas	Texas	2,751
Vermont Yankee	Vermont	3,114,882
North Anna	Virginia	1,138,798
Surry	Virginia	883,551
Columbia Generating Station	Washington	188,312
Kewaunee	Wisconsin	202,581
Point Beach	Wisconsin	202,581

(Note: Some plants do not appear in this list, since no surface water systems in the EPA's registry were within 50 miles of those plants. In some cases, groundwater-based drinking systems may be located near those plants; this report does not deal with those systems.)

Table A-2: Total Population Receiving Drinking Water from Sources within 12.4 miles (20 km) of U.S. Nuclear Plants

Plant	State	Total Population Receiving Drinking Water from Intakes within 12.4 Miles of Plant
Browns Ferry	Alabama	26,130
Arkansas Nuclear	Arkansas	38,930
Diablo Canyon	California	1,200
Millstone	Connecticut	56,473
Braidwood	Illinois	5,604
Dresden	Illinois	5,604
Wolf Creek	Kansas	2,679
Waterford	Louisiana	103,818
Pilgrim	Massachusetts	37,316
D.C. Cook	Michigan	27,397
Palisades	Michigan	32,418
Fermi	Michigan	60,334
Grand Gulf	Mississippi	912
Fort Calhoun	Nebraska	7,512
Seabrook	New Hampshire	47,785
Salem	New Jersey	6,199
Hope Creek	New Jersey	6,199
Ginna	New York	17,062
FitzPatrick	New York	29,400
Nine Mile Point	New York	29,400
Indian Point	New York	8,359,730
Shearon Harris	North Carolina	206,414
McGuire	North Carolina	895,538
Davis-Besse	Ohio	16,885
Perry	Ohio	59,946
Susquehanna	Pennsylvania	40,620
Beaver Valley	Pennsylvania	80,626
Peach Bottom	Pennsylvania	243,368
Three Mile Island	Pennsylvania	262,149
Limerick	Pennsylvania	923,538
Summer	South Carolina	8,303
Oconee	South Carolina	378,899
Watts Bar	Tennessee	2,359
Sequoyah	Tennessee	56,145
Comanche Peak	Texas	11,750
Vermont Yankee	Vermont	31,543
Surry	Virginia	422,300
Columbia Generating Station	Washington	49,319
Point Beach	Wisconsin	13,354

Table A-3: Total Population Receiving Drinking Water from Intakes within 50 Miles of Nuclear Plants by State

State	Population Receiving Drinking Water From Intakes Within 50 Miles of Nuclear Plants
Alabama	586,253
Arkansas	475,437
Arizona	124,500
California	2,362,188
Connecticut	1,511,605
Florida	124,700
Georgia	577,361
Iowa	278,996
Illinois	652,804
Indiana	219,766
Kansas	63,947
Louisiana	1,471,531
Massachusetts	4,821,229
Maryland	208,442
Maine	94,948
Michigan	1,521,523
Minnesota	935,100
Missouri	31,346
North Carolina	3,753,495
Nebraska	518,302
New Hampshire	374,368
New Jersey	3,286,373
New York	9,974,602
Ohio	2,844,794
Oregon	15,410
Pennsylvania	6,651,752
Rhode Island	63,499
South Carolina	1,185,917
Tennessee	803,424
Texas	1,246,265
Virginia	2,022,349
Vermont	31,440
Washington	172,902
Wisconsin	202,581
West Virginia	65,426
Total	**49,274,575**

Table A-4: Total Population Receiving Drinking Water from Intakes within 12.4 Miles (20 km) of Nuclear Plants by State

State	Population Receiving Drinking Water From Intakes Within 12.4 Miles of Nuclear Plants
Alabama	26,130
Arkansas	38,930
California	1,200
Connecticut	56,473
Illinois	5,604
Kansas	2,679
Louisiana	104,730
Massachusetts	93,444
Maryland	117,719
Michigan	92,752
North Carolina	1,101,952
Nebraska	7,512
New Hampshire	11,000
New Jersey	6,199
New York	8,406,192
Ohio	92,031
Pennsylvania	1,414,196
South Carolina	456,966
Tennessee	58,504
Texas	11,750
Virginia	426,532
Vermont	12,200
Washington	49,319
Wisconsin	13,354
West Virginia	3,186
Total	**12,610,554**

Enclosure 1

Degraded Cornerstone Matrix

The Susquehanna Electric Steam Station Unit 1 was placed on the Degraded Cornerstone Matrix by the Nuclear Regulatory Commission in the first quarter of 2011 and remains the lowest rankest nuclear reactor in Region I.

2011:

NRC to Mr. Timothy S. Rausch Senior Vice President and Chief Nuclear Officer PPL Susquehanna, LLC.

Bold face type added for emphasis

Therefore, beginning in the first quarter of 2011, the NRC has assessed the performance of Susquehanna Unit 1-to be in the Degraded Cornerstone column of the NRC's Action Matrix based on two White [findings] in the Initiating Events cornerstone. Consistent with the graded approach in the NRC's ROP, this results. In a corresponding increase in the NRC's inspection and assessment oversight of Susquehanna Unit 1. Specifically, we plan to schedule and perform a supplemental inspection

... [the] inspection will be conducted to provide assurance that the root causes and contributing causes of individual and collective risk-significant performance issues are understood, independently assess the extent of condition and extent of cause of individual and collective risk significant performance issues, and provide assurance that licensee corrective actions for risk significant performance issues are sufficient to address the root causes and contributing causes and prevent recurrence.

March 1, 2012

Dear Mr. Rausch:

On February 13, 2012, the U.S. Nuclear Regulatory Commission (NRC) completed its end-of-cycle performance review of Susquehanna Steam Electric Station (Susquehanna) Units 1 and 2. The NRC reviewed the most recent quarterly performance indicators (PIs) in addition to inspection results and enforcement actions from January 1, 2011, through December 31, 2011. This letter informs you of the NRC's assessment of your facility during this period and its plans for future inspections at your facility. This performance review and enclosed inspection plan do not include security information. A separate letter will include the NRC's assessment of your performance in the Security Cornerstone and its security-related inspection plan.

The NRC determined that the performance at Susquehanna Unit 1 during the most recent quarter was within the Degraded Cornerstone Column of the NRC's Reactor Oversight Process (ROP) Action Matrix because of one finding having low to moderate safety significance (i.e., white) and one PI having low to moderate safety significance (i.e., white), both associated with the Initiating Events Cornerstone. The White finding was related to an internal flooding event on July 16, 2010, which required the operators to insert a manual scram and isolate the normal heat sink. The White PI was related to the 1st quarter 2011 Unplanned Scrams per 7000 Critical Hours PI. Specifically, Unit 1 crossed the green-to-white PI threshold following unplanned scrams on April 22, May 14, and July 16, 2010, and January 25, 2011. Although the 2nd quarter 2011 Unplanned Scrams PI returned to Green from White, **Susquehanna Unit 1 will remain in the Degraded Cornerstone Column of the NRC Action Matrix until the associated supplemental inspection is completed satisfactorily.**

...Therefore, the NRC plans to conduct ROP baseline inspections at Unit 2. The NRC evaluates cross-cutting themes to determine whether a substantive cross-cutting issue (SCCI) exists in a particular area and to encourage licensees to take appropriate actions before more significant performance issues emerge.

Regarding Susquehanna, the NRC sustained an SCCI in the Corrective Action Program (CAP) component of the Problem Identification and Resolution (PI&R) cross-cutting area. Specifically, there were six findings with a PI&R cross- cutting aspect of P.1(c) - Evaluation of Identified Problems - during this assessment period, one of which included the July 16, 2010 flooding event which has been held open since the associated supplemental inspection was not completed at the end of the assessment period. The P.1(c) theme was originally identified in the 2010 Annual Assessment letter (ML110620317), and an SCCI was assigned in the 2011 Mid-Cycle Assessment letter (ML112430469).

For the current assessment period, the NRC has determined that the exit criteria defined in the 2011 Mid-Cycle Assessment letter have not been met. Specifically, there has not been a notable reduction in the number of findings with a P.1(c) cross- cutting aspect and PPL has not demonstrated sustainable performance improvement in this area (ML111330523, 112220409, 113120409, and 12045A383).

Therefore, the P.1(c) **SCCI will remain open until PPL has demonstrated sustainable performance improvement as evidenced by effective implementation of an appropriate corrective action plan that results in a notable reduction in the overall number of inspection findings with the same cross- cutting aspect, as well as no safety significant findings.**

Because this letter is the second consecutive letter documenting an SCCI with the same cross-cutting aspect, in accordance with NRC Inspection Manual Chapter 0305, section 14.04.c, the NRC requests your staff provide a verbal response discussing your progress and future plans in addressing this SCCI during the 2011 annual public meeting. The NRC will continue to monitor your staff's efforts and progress in addressing this SCCI through the baseline inspection program, the 95002 supplemental inspection, and the July 2012 biennial PI&R inspection.

The NRC also identified an SCCI in the Resources component of the Human Performance cross- cutting area. Specifically, PPL had four findings with a Human Performance cross-cutting aspect of H.2(c) - Documentation, Procedures, and Component Labeling, which included a green finding in each of the four quarters of the assessment period. This was originally identified as a cross cutting theme in the 2011 Mid-Cycle Assessment letter. For the current assessment period, the NRC has a concern with your progress in addressing and substantially mitigating this issue given that a reasonable duration of time has passed, findings with the same cross-cutting aspect continue to be identified as demonstrated by six consecutive quarters with an H.2(c) finding, and the delayed completion of a root cause analysis which resulted in limited implementation of corrective actions by the end of the assessment period. The PI&R H.2(c) SCCI will remain open until PPL has demonstrated sustainable performance improvement as evidenced by effective implementation of an appropriate corrective action plan that results in a notable reduction in the overall number of inspection findings with the same cross-cutting aspect, as well as no safety significant findings.

The NRC will monitor your staff's efforts and progress in addressing this SCCI through the baseline inspection program, the 95002 supplemental inspection, and the July 2012 biennial PI&R inspection.

The NRC also identified a cross-cutting theme in the Work Practices component of the Human Performance cross-cutting area. Specifically, PPL had five findings with a Human Performance cross-cutting aspect of H.4 (a) -human error prevention techniques, which included two green findings and a greater-than-green finding issued in the 1st quarter(ML110871605 and ML111180742), and one green finding in each of the 3rd and 4th quarters of the assessment period (ML113120409 and ML12045A383). The NRC determined that an H.4 (a) SCCI does not exist because the NRC does not, at this time, have a concern with your staff's scope of effort and progress in addressing the cross-cutting theme. Specifically, PPL recognized the H.4 (a) theme in the 3rd quarter 2011 and conducted analyses, including a root cause investigation, which were completed near the end of the assessment period.

Thus, the NRC concluded that more time is necessary for PPL to demonstrate the effectiveness of their corrective actions regarding human error prevention techniques in order for the NRC to evaluate the effectiveness and sustainability of these activities. The NRC will continue to monitor your staff's efforts and progress in addressing the theme until the theme criteria are no longer met.

The enclosed inspection plan lists the inspections scheduled through June 30, 2013....The NRC will schedule and conduct IP 92723 when your staff has notified us of your readiness for this inspection. The NRC will contact you as soon as possible to discuss changes to the inspection plan should circumstances warrant any changes.

Sincerely,

William M. Dean Regional Administrator 14

ENCLOSURE 2

January 5, 2010

SUSQUEHANNA RIVER BASIN COMMISSION

In the Matter of	)
RE: Bell Bend Nuclear Power Plant	)
Application for Groundwater Withdrawal	)
Application for Consumptive Use	)
BNP-2009-073	)

EXPERT WITNESS REPORT OF ARNOLD GUNDERSEN REGARDING CONSUMPTIVE WATER USE OF THE SUSQUEHANNA RIVER BY THE PROPOSED PPL BELL BEND NUCLEAR POWER PLANT

I, Arnold Gundersen, declare as follows:

1. My name is Arnold Gundersen. I am sui juris. I am over the age of 18-years-old.

2. Eric J. Epstein, a resident of 4100 Hillsdale Road, Harrisburg, PA 17112, and a PPL ratepayer and shareholder, has retained me as an expert witness. I have been asked to examine what alternative methods may be available and could be applied by PPL Bell Bend, LLC ("PPL" or "Applicant) for cooling the steam that is generated by the proposed Bell Bend plant in lieu of withdrawing and discharging significant quantities of water directly into the Susquehanna River. If any alternative methods are available, I have also been asked to discuss those alternatives so that the Susquehanna River Basin Commission (SRBC) will have the information necessary to complete its assessment.

3. I earned my Bachelor's Degree in Nuclear Engineering from Rensselaer Polytechnic Institute (RPI) cum laude. I earned my Master's Degree in Nuclear Engineering from RPI via an Atomic Energy Commission Fellowship. Cooling tower operation and cooling tower plume theory were my area of study for my Master's Degree.

4. I began my career as a reactor operator and instructor in 1971 and progressed to the position of Senior Vice President for a nuclear licensee prior to becoming a nuclear engineering consultant and expert witness. My Curriculum Vitae is Attachment 1.

5. I have qualified as an expert witness before the Nuclear Regulatory Commission (NRC) Atomic Safety and Licensing Board (ASLB) and Advisory Committee on Reactor Safeguards (ACRS), in Federal Court, the State of Vermont Public Service Board, the State of Vermont Environmental Court, and the Florida Public Service Commission.

6. I am an author of the first edition of the Department of Energy (DOE) Decommissioning Handbook.

7. I have more than 38-years of professional nuclear experience *including and not limited to*: Cooling Tower Operation, Cooling Tower Plumes, Consumptive Water Loss, Nuclear Plant Operation, Nuclear Management, Nuclear Safety Assessments, Reliability Engineering, In-service Inspection, Criticality Analysis, Licensing, Engineering Management, Thermohydraulics, Radioactive Waste Processes, Decommissioning, Waste Disposal, Structural Engineering Assessments, Nuclear Fuel Rack Design and Manufacturing, Nuclear Equipment Design and Manufacturing, Prudency Defense, Employee Awareness Programs, Public Relations, Contract Administration, Technical Patents, Archival Storage and Document Control, Source Term Reconstruction, Dose Assessment, Whistleblower Protection, and NRC Regulations and Enforcement.

Introduction

8. My declaration is intended to alert the Susquehanna River Basin Commission (SRBC) to significant problems in consumptive water use of the Susquehanna River if the proposed PPL Bell Bend nuclear plant is built as designed and allowed to use the Susquehanna River as its primary resource for *make-up* water for cooling.

9. Specifically, PPL has filed an application to build a 1,600 MWe Evolutionary Power Reactor (EPR) designed by AREVA named Bell Bend because of its location on the

Bell Bend of the Susquehanna River. In my professional opinion, the Bell Bend Combined License Application (COLA)[1], as filed with the U.S. Nuclear Regulatory Commission (NRC), has significant deficiencies in its analysis resulting in serious unresolved issues with consumptive water use that will negatively impact the health and vitality of the Susquehanna River Watershed and the Chesapeake Bay Watershed.

10. If completed, the proposed PPL Bell Bend nuclear power plant will be one of the largest nuclear reactors in the world. Due to its sheer size and because it also has a lower thermodynamic efficiency (discussed in detail below), Bell Bend will draw an inordinately large amount of water from the Susquehanna River in order to cool the reactor. The amount of water anticipated for use by the PPL proposed Bell Bend nuclear power plant is detailed in a recent report written by Normandeau Associates, paid for by PPL, and submitted to the Susquehanna River Basin Commission.

11. In its November 2009 report, entitled, *Instream Flow Study Plan To Assess The Effects Of Consumptive Use Of Water On Fish Habitat At The Bell Bend Project*, Normandeau Associates said,

> "November 2009 The Bell Bend Nuclear Power Plant (BBNPP) proposed by PPL is estimated to consumptively use up to 43 cubic feet per second (cfs) or 28 million gallons per day (mgd) of water from the Susquehanna River. Up to approximately 64 cfs or 41 mgd will be withdrawn from an intake located about 300 ft downstream of the Susquehanna Steam Electric Station (SSES) intake structure (Figure 1-1). Water not consumed will be returned to the river via a submerged discharge diffuser approximately 680 ft downstream of the BBNPP

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[1] **Combined license (COL)**
By issuing a combined license (COL), the U.S. Nuclear Regulatory Commission (NRC) authorizes the licensee to construct and (with specified conditions) operate a nuclear power plant at a specific site, in accordance with established laws and regulations. A COL is valid for 40 years from the date of the Commission finding, under Title 10, Section 52.103 (g), of the *Code of Federal Regulations* [10 CFR 52.103(g)], that the acceptance criteria in the combined license are met. A COL can be renewed for an additional 20 years.
In a COL application [COLA], the NRC staff reviews the applicant's qualifications, design safety, environmental impacts, operational programs, site safety, and verification of construction with ITAAC. The staff conducts its review in accordance with the Atomic Energy Act, NRC regulations, and the National Environmental Policy Act. All stakeholders (including the public) are given notice as to how and when they may participate in the regulatory process, which may include participating in public meetings and opportunities to request a hearing on the issuance of a COL *http://www.nrc.gov/reactors/new-reactors/col.html*

> intake. PPL has applied to the Susquehanna River Basin Commission (SRBC) for approval to withdraw water from the river at BBNPP and to use some of this water consumptively. In its application to SRBC, PPL has requested approval for consumptive use of up to 31 mgd as a measure of conservatism and to account for variability within the range of monitoring accuracy required by SRBC."[2]

12. As a result, the PPL proposed Bell Bend nuclear power plant will withdraw at least 15,000,000,000 (15 billion) gallons of water from the Susquehanna River every year.

13. Consequently, each year the 4,000,000,000 (4 billion) gallons of water that will be returned to the river will have been heated and will contain additional chemical contaminants discussed below.

14. The difference between what is withdrawn from and what is returned to the Susquehanna River each year will be *consumed* by the PPL proposed Bell Bend nuclear power plant, and as a result, this consumptive use of water amounts to 11,000,000,000 (11 billion) gallons per year.

15. The 11,000,000,000 (11 billion) gallons of water withdrawn each year from the Susquehanna River will be emitted as water vapor from the proposed cooling towers.

16. It is hard to visualize exactly how much 11,000,000,000 (11 billion) gallons of water per year would be. To put the *consumed* water into a visual perspective, the 11 billion gallons of water would fill the equivalent of 50-football fields 500-hundred feet high with river water.

17. Subsequently, in addition to the environmental burden of 4 billion gallons of heated and chemically contaminated water that will be dumped into the River each year, the Susquehanna River Basin and the Chesapeake Bay will face an enormous yearly consumption of Susquehanna River Water that will be withdrawn and never returned.

18. According to the Susquehanna River Basin Commission's website, the mission of the SRBC

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[2] Page 1, *Instream Flow Study Plan To Assess The Effects Of Consumptive Use Of Water On Fish Habitat At The Bell Bend Project*, November 2009

> "...is to enhance public welfare through comprehensive planning, water supply allocation, and management of the water resources of the Susquehanna River Basin. To accomplish this mission, the SRBC works to: reduce damages caused by floods; provide for the reasonable and sustained development and use of surface and ground water for municipal, agricultural, recreational, commercial and industrial purposes; protect and restore fisheries, wetlands and aquatic habitat; protect water quality and instream uses; and ensure future availability of flows to the Chesapeake Bay. The SRBC is uniquely qualified to carry out this mission. As a federal-interstate compact commission, its focus is defined by the natural boundaries of the river basin rather than the political boundaries of the member states. As such, the SRBC serves as a forum to provide coordinated management, promote communication among the members, and resolve water resource issues and controversies within the basin."

19. Moreover, the Susquehanna River Basin Commission has joined with other watershed commissions to form the Interstate Council on Water Policy and is a Chesapeake Bay Partner Community "committed to protecting water quality, the bay, and its many tributaries."

20. Since the Susquehanna River currently provides half of the fresh water that enters the Chesapeake Bay, I believe that the intended withdrawal *each day* of as much as 31,000,000 (31 million) gallons of the Susquehanna River's flow by the proposed PPL Bell Bend nuclear power plant will have a significant impact upon the downstream ecology that is not adequately addressed in the current application or appropriately reflected in the Susquehanna River Basin Commission's fee structure.

21. Consumptive water use is defined as "any use that permanently removes water from a watershed or a confined aquifer from which it is withdrawn by activities that result in substantial evaporation and evapotranspiration." Industrial cooling operations, like those intended for the proposed PPL Bell Bend nuclear power plant, are some of the activities that often result in substantial evaporation and evapotranspiration. http://www.njfb.org/waterquality/glossary.htm

22. A nuclear power plant like the PPL proposed Bell Bend unit uses steam created from water heated by the nuclear reactor to produce electricity. Any power plant, nuclear, coal or oil, that uses steam to turn a turbine that then creates electricity like the

proposed PPL Bell Bend nuclear power plant will do is governed by the laws of thermodynamics. Furthermore, according to the laws of thermodynamics, a physics rule known as the *Carnot cycle*[3] governs the maximum theoretical efficiency of these steam-generated turbine power plants.

23. In lay terms, the Carnot cycle simply means that no power plant is theoretically capable of converting one hundred percent of the heat it produces as steam into electricity. The maximum efficiency of a power plant like the PPL proposed Bell Bend Unit is capped by the difference between two key parameters: the high temperature of the steam (heat source) and the low temperature of the *heat sink*. The PPL Bell Bend nuclear power plant, like most current power plants located on rivers, would use as its heat sink the process of water evaporation in its cooling tower via water withdrawn from the Susquehanna River.

The Carnot Cycle

24. Whether a power plant operates with coal, oil, gas, or nuclear power as the PPL proposed Bell Bend Unit does, each method heats water in order to create steam. In turn the steam is used to turn a turbine and create electricity. By whatever method the steam is created, that is called the "heat source". After that steam turns the turbine, it is cooled, condensed back into water and returned back to the boiler or nuclear reactor from where was originally drawn.

25. This process of creating steam, turning a turbine, condensing the steam and returning it to a boiler or nuclear reactor is called the Carnot cycle. In a Carnot cycle, there must be a *heat source* to create the steam and a *heat sink* to cool the steam back into water. The *heat source* may be oil, coal, wood, gas or nuclear fuel, and the *heat sink* is always either water or air or a combination of both.

26. While all power plants may create heated steam through different *heat sources*, every power plant condenses its steam in a device called a condenser. Even though

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[3] **Carnot cycle** – the most efficient thermal cycle possible, consisting of four reversible processes, two isothermal and two adiabatic. *Jones and Childers Glossary,* http://www.mhhe.com/physsci/physical/jones/student/olc/student_glossary.mhtml

each condenser varies in shape and size, each condenser fulfills the same function: that is, condensers take in steam from a *heat source* and condense it back to water. This cooled steam now becomes water that is called *condensate*. After the cooled steam becomes condensate, it is pumped back to the *heat source* to be heated again. This repeating loop is called the *steam cycle*.

27. In order to turn steam back into condensate, condensers are compartmentalized to separate the heated steam from the *heat source* with a physically separate second loop that is called the *heat sink*. This second loop is filled with either water or air that is the applied cooling mechanism. The heat that leaves a condenser and migrates to the *heat sink* is called *waste heat*.

28. Nuclear plants are inherently less efficient than oil, natural gas, and coal fired power plants because of the Carnot cycle. On a per megawatt basis, nuclear plants also release more waste heat per megawatt than coal, oil, or natural gas fired power plants. The hotter the heat source can be made, the higher the Carnot efficiency. Since both coal and natural gas create higher temperatures by which to create steam than nuclear plants, coal and natural gas plants have a higher Carnot efficiency.

29. Thus, for a nuclear power plant like the PPL proposed Bell Bend unit, more waste heat will be released because it is more inherently less efficient than either coal or natural gas.

30. Additionally, because the PPL proposed Bell Bend nuclear power plant would be the largest size nuclear power plant yet constructed, its sheer size will also increase the waste heat sent to the *heat sink*.

Various Types of Heat Sinks

31. When water is plentiful at nuclear power plants in ocean locations, the steam is passed on the outside of the tubes within the condenser while ocean water passes through the inside of tubes on the other side of the condenser. This is called once through cooling and the ocean is quite literally the heat sink. The advantage of once through cooling is that it makes the nuclear power plants rather inexpensive to build

and operate in comparison to other nuclear power plants that do not have access to such an abundant and infinite water supply. Once through cooling of the condenser has become increasingly rare because the methodology of using ocean or river water to cool the condenser makes the river or ocean too warm thereby killing various aquatic organisms and negatively impacting the ecosystem.

32. River flow is limited and power plant output and *heat sink* demand has increased dramatically with these much larger reactors, so once through cooling is rarely used in inland locations. Due to its large size and inherently inefficient cooling methodology, the proposed PPL Bell Bend nuclear power plant cannot use the Susquehanna River for once through cooling of its condenser. If constructed, the proposed Bell Bend nuclear plant will send all of its waste heat into the air via some type of cooling tower, because the river flow is simply too low to support the consideration of using a once through condenser.

33. Therefore, some form of cooling tower must be relied upon to help cool the steam inside the condenser at the PPL proposed Bell Bend nuclear power plant. There are three types of cooling tower designs currently in use by the power generation industry.

33.1. The first cooling tower design is the large hyperbolic, natural draft cooling tower, which has come to symbolize most nuclear power plants. The shape of these hyperbolic cooling towers creates lift in the air and naturally pulls the air across water that is falling inside them.

33.1.1. Some of this water that is withdrawn from a river evaporates causing large vapor clouds to exit from the top of the cooling tower.

33.1.2. The remaining water is then circulated back through the condenser where it again absorbs heat from the heat source.

33.1.3. A side effect of the process of evaporating water and heating the air is that natural draft cooling towers also concentrate any impurities that are in the river water, basically making that water dirtier.

33.1.4. Additionally, these hyperbolic towers create large plumes of water vapor leaving the top of the tower that have adverse visual and environmental effects.

33.2. Mechanical-draft cooling towers cool countless other power plants around the country, including many nuclear power plants. In this application short squat towers are used instead of the large hyperbolic tower, which does not have fans.

33.2.1. Since these short squat towers cannot rely upon the natural shape of the hyperbolic tower to cool the water, large fans are placed above these cooling towers so that the fans actually pull air through each cell.

33.2.2. These mechanical-draft cooling towers are also called forced draft cooling towers and are a modular design with a lower visual profile.

33.2.3. These forced draft cooling towers also withdraw water from a river and release plumes of water vapor out the top and also concentrate contaminants in the remaining water as did their hyperbolic cooling tower cousins.

33.2.4. While they cost less to build than hyperbolic towers, they have an added operational expense because electricity is required to operate the fans.

33.3. The third design for power generation cooling towers does not use any river water to cool the power plant. This design is called dry cooling and requires a different condenser design than that presently designed for PPL proposed Bell Bend nuclear power plant.

33.3.1. Instead of applying water to cool the steam and then cooling that water with either river water or a combination of fans and river water as in a wet cooling tower, this design cools the steam directly with air and utilizes no outside water.

33.3.2. This design is called an *air-cooled condenser*. These *air-cooled condensers* are short and squat, thereby resembling the forced air towers

discussed in the previous section.

34. Because both the hyperbolic tower and the forced draft tower evaporate water, as discussed in detail in the previous section, some river water must still be used to cool the power plant. *Make-up water* is the term used to describe the water used to replace the evaporated water.

35. All hyperbolic or forced-air cooling towers also create dirty water called *blowdown water* that is returned back to the river with contaminants concentrated within it. *Make-up* water is also used to replace *blowdown* water.

36. The dirty water released from the cooling towers back into the Susquehanna River as *blowdown* will be approximately 25% of the amount of water that is withdrawn. For every four gallons the plant withdraws, it sends back one gallon of *blowdown.* The blowdown is a pollutant for three reasons:

36.1. Three out of every four gallons of withdrawn evaporate water (consumptive use water) that will be initially drawn from the Susquehanna River will be returned to the river as blowdown with four times more concentration of pollutants and minerals than when that water was withdrawn.

36.2. In addition to concentrating contaminants and minerals that already existed in the river, the blowdown contains biocides and algaecides used within the cooling towers to prevent them from becoming clogged with mold and mildew.

36.3. Along with chemical contamination and highly concentrated minerals, the dirty blowdown water will be approximately 20 degrees hotter than the river water to which it is being returned.

37. The PPL proposed Bell Bend nuclear power plant will use about 1% of the flow in the Susquehanna River for its *make-up* water due to evaporation.

38. Whereas, in an air-cooled condenser design, the steam that leaves the turbine passes directly to a dry cooling tower thus using no river water. The air-cooled condenser sits at the base of a dry cooling tower.

38.1. This design has the unique advantage of not having a secondary loop of additional river water required to cool the steam.

38.2. In the air-cooled condenser design, steam heat from the power plant passes through a tube directly into the air.

38.3. Also, in the air-cooled condenser design, steam is directly condensed by the air and then sent back into the power plant.

38.4. No intermediate river water is ever used in the air-cooled condenser design.

39. Dry cooling and an air-cooled condenser have several key advantages:

39.1. The first advantage of dry cooling and an air-cooled condenser is that there is no consumption of river water.

39.2. The second advantage is that without dirty water (or blow down) being sent back into the river, contamination to the river is lessened.

39.3. The third advantage is that there is no cloud of hot moist air leaving the tower, so these towers never produce a cloud of water vapor that has so many additional negative meteorological, environmental, and esthetic impacts.

40. While the air-cooled condenser design would offer many significant advantages for the proposed PPL Bell Bend environment and the overall health of the Susquehanna and Chesapeake watershed areas, these air-cooled designs do have two disadvantages for PPL:

40.1. The first drawback to the air-cooled design is that this design lowers the efficiency of the power plant slightly by increasing the backpressure on the turbine thus providing less electricity to generate and less income for the power plant owner. However, for most of the year, when temperatures are lower than 70 degrees, the efficiency of the air-cooled design is quite comparable to other cooling techniques.

40.2. The second disadvantage of the air-cooled design is that, because it is less

effective at removing the heat from steam than wet evaporative cooling, the air-cooled towers are more expensive to operate than either the hyperbolic or forced air-cooling towers.

41. While installing an air-cooled condenser is slightly more expensive than the approach chosen by PPL to use on the Bell Bend project, air cooled condensers would completely eliminate the significant problem of consumptive water use of the Susquehanna River. If PPL equipped its proposed Bell Bend project with air-cooled condensers, then the Susquehanna River Watershed area would not be facing the negative environmental burden of the Bell Bend nuclear power plant's evaporative losses, including:

41.1. A withdrawal of 31 million gallons per day of water of *make-up* water being drawn from the Susquehanna River to cool plant, or

41.2. Any dirty water *(blowdown water)* being returned to the Susquehanna River.

Detailed Discussion of Air Cooled Condensers

42. Air-cooled condensers consist of a modular design, are pre-built, and then are delivered to the site in individual modules. The air-cooled condenser design is even simpler than the current PPL proposed design for the Bell Bend unit.

43. In my review of the PPL design for its Bell Bend cooling towers, the evidence shows that the overall layout of the main steam and condensate system can in fact accommodate an air-cooled condenser. Furthermore, the only limitation an air-cooled condenser may place upon the proposed PPL Bell Bend nuclear power plant is that backpressure on the steam turbine may change slightly as a result of using an air-cooled condenser.

43.1. A slightly different turbine design will also be required to accommodate an air-cooled condenser due to the slight backpressure considerations with a dry cooling system. The additional cost of this turbine redesign and the backpressure considerations are nominal, especially when compared to the overall cost of the unit and the environmental costs of withdrawing 31 million gallons of water out

of the river daily.

43.2. Additionally, the efficiency of the proposed PPL Bell Bend Project will be reduced by no more than 1% from the slightly higher backpressure due to the use of an air-cooled condenser.

43.3. Moreover, with the air-cooled dry towers, when the ambient air temperatures are 70° or less there will be almost no difference in the electric output of the PPL proposed Bell Bend nuclear power plant as compared with the PPL currently designed evaporative towers.

43.4. At present, in the PPL proposed Bell Bend design, the turbine hall has a very large space underneath the turbine reserved for the intended water-cooled condenser. Therefore, removing the very large water-cooled condenser will provide more than enough space for steam lines to exit from the bottom of the turbine to an air-cooled condenser, seemingly without any additional major modifications.

44. While the Bell Bend design would have to be slightly modified to incorporate an air-cooled condenser, since no components have yet been bought, fabricated, or installed, the redesign cost to accommodate an air-cooled condenser is nominal in comparison to the overall cost of the project and compared to the significant and long-term environmental costs of using evaporative cooling towers to withdraw 15 billion gallons of water from the Susquehanna River every year.

45. Moreover, changing to an air-cooled condenser and air-cooled towers will not impact any aspect of the nuclear design that has already been approved by the Nuclear Regulatory Commission.

46. There are dozens of coal and natural gas-fired plants in the U.S. that use air-cooled condensers, and abundant examples of air-cooled condenser applications of similar or larger sized power plants worldwide.

46.1. For example, the largest air-cooled plant in the U.S. is the 1,650 MW Midlothian Energy natural gas combined cycle plant near Dallas, Texas, and the largest coal-fired air-cooled plant in the U.S. is the 330 MW Wyodak plant in Wyoming.

46.2. Worldwide, the largest air-cooled coal-fired plant in the world is the 4,000 MW Matimba power plant in South Africa.

Water Supply and Potential for Drought

47. In addition to water quality and consumptive water use, the Susquehanna River Watershed could be compromised due to drought. According to SRBC's comprehensive plan, SRBC is responsible for:

47.1. Supporting and encouraging "the sustainable use of water for domestic, industrial, municipal, commercial, agricultural, and recreational activities in the basin" by an inventory of available water resources.

47.2. Maintaining "an equitable system for allocating water for various uses, including the protection of instream flows and receiving waters of the Chesapeake Bay".

47.3. Ensuring "sustainability of water sources by improving systems and managing water resources more efficiently".

47.4. Mitigating "drought impacts through coordination and use of drought emergency powers".

48. If PPL used air-cooled condensers at its proposed Bell Bend nuclear power plant, no water would be drawn from the Susquehanna River.

48.1. My review of the evidence provided shows that PPL may not have considered the potential for a drought that would compromise the availability of Susquehanna River water in its engineering design of the 1600 MWe Bell Bend unit.

48.2. A modest but illustrious example of the magnitude of water used at nuclear power plant is readily evidenced at the Susquehanna Steam Electric Station (SSES), which is a two-unit nuclear power plant located on the Susquehanna

River very near to the location of the proposed Bell Bend nuclear power plant.

48.2.1. *Every day* SSES loses 14.93 million gallons of water as evaporative cooling tower water vapor from each of its two units.

48.2.2. Each day 11 million gallons of contaminated cooling tower basin *blowdown* water is returned to the Susquehanna River.

48.2.3. *At the present time, SSES takes on average 29.86 million gallons of water per day from the Susquehanna River that is not returned. However,* according to the NRC, once the Extended Power Uprate is fully implemented at the SSES, the plants will withdraw more than double the amount of water, with an upper limit of 65.4 million gallons per day, totaling almost 24 billion gallons of Susquehanna River Water per year.

> "...will withdraw an average of 60.9 gallons per day (mgd) (230 million L/d) of water from the Susquehanna River for cooling tower evaporative losses and other plant needs, with a maximum daily water withdraw estimate of 65.4 mgd (248 million L/d). This represents a 4.5 and 12.2 percent increase, respectively, in intake water withdrawn from the Susquehanna River from the pre-EPU conditions (NRC 2007a). Some of this water would be returned to the river as cooling tower blowdown, with the difference equaling the amount of the consumptive water use by SSES. Consumptive water use due to evaporation and drift of cooling water through the SSES cooling towers is expected to increase from 38 mgd (144 million L/d) to 44 mgd (166 million L/d). Based on the Susquehanna River's annual mean flow rate, an average annual loss of 0.5 percent of river water at the SSES location would result. During low-flow conditions, which usually occur in late August, the average evaporative loss at SSES could approach 1 percent of the river flow (PPL 2006b)."[4]

48.2.4. As currently designed, the proposed single unit Bell Bend station would withdraw an additional 31,000,000 (31 million) gallons per day.

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[4] US NRC, Environmental Impacts of Operation, Draft NUREG-1437, Supplement 35, 4-15, April 2008

49. According to the U.S. Geological Survey,

> "...changes in evaporation and transpiration during a drought depend on the availability of moisture at the onset of a drought and the severity and duration of a drought. Also, weather conditions during a drought commonly include below-normal cloud cover and humidity and above-normal wind speed. **These factors will increase the rate of evaporation from open bodies of water** and from the soil surface, if soil moisture is available." [Emphasis Added]
> http://geochange.er.usgs.gov/sw/changes/natural/et/

50. One of the considerations for review is plant reliability, and the potential for drought would reduce the reliability of the plant during the middle of the summer exactly at the time the area's need is greatest.

50.1. Droughts on the Susquehanna are not merely a theoretical consideration. According to the SRBC Drought Management Information Sheet[5], droughts and low-water flow but have occurred quite recently, with droughts occurring every decade except the 1970s.

> "Like floods, the magnitude of drought events can be categorized based on historical frequency, i.e., 5-year droughts, 10-year droughts, 50-year droughts, etc. (The higher numbers indicate more severe, and less frequent, droughts.) Droughts can affect the entire basin or cause localized water shortages.
>
> Since the beginning of the 1900s, the basin has experienced droughts in every decade except the 1970s. The worst droughts occurred in 1930, 1939 and 1964. During the 1990s through mid-2000s, periodic low flows throughout the basin or in regions resulted in frequent droughts, including in 1991, 1995, 1997, 1998, 1999, 2000, 2002 and 2006."

50.1.1. The 4,500 businesses in the Susquehanna River Basin employ 230,537 people, add $6.8 Billion (Dollars) to the region's economy, and depend upon the water from the Susquehanna River.[6]

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[5] *SRBC Drought Management Information Sheet*, http://www.srbc.net/hydrologic/docs/Drought%20Management%20(5_07).PDF

[6] *Economic Value of Water Resources: Direct Water-Dependent Businesses in the Susquehanna Basin*, Susquehanna River Basin Commission, Revised: November 2006.

50.1.2. Water shortages on the Lower Susquehanna reached critical levels during the summer of 2002, but during the 2002 drought, the Susquehanna Steam Electric Station's (SSES) two nuclear power plants were in fact exempted from water conservation efforts in order to meet the Region's demand for electricity.

50.1.3. During the month of August 2002, 66 of 67 Pennsylvania counties had below normal precipitation levels, while the Susquehanna Steam Electric Station's nuclear plants *did not take any measures or precautions to conserve water.*

50.1.4. The Bell Bend unit proposed by PPL would withdraw an additional 31,000,000 (31 million) gallons per day from the river obviously exacerbating a frequent drought situation in one of the nation's most critical watershed areas already facing many added usage burdens at the same time it is attempting to heal an environmentally challenged and fragile ecosystem.

51. The June 2009 issue of Power Magazine featured an article entitled *Air Cooled Condensers Eliminate Plant Water Use* in which author William Wurtz said,

> "The pragmatic developer may also select dry cooling early in a project because it increases plant siting options and its use can significantly accelerate approval of construction permits because water use issues are taken off the table. Shortening a project schedule by even six months can completely change the economics of a project and easily balance the increased capital cost of dry cooling options.
>
> Dry cooling applications in the U.S. have not been limited to arid regions but have also been specified for plants sited in eastern, northern, and mountain areas where water is typically more abundant..."

52. The evaporative cooling tower approach planned for Bell Bend and for which PPL has applied is a less costly construction alternative. Moreover, by applying SRBC'S current rate structure for water withdrawal, PPL has a financial incentive to use the low cost Susquehanna River water at the proposed Bell Bend unit rather than designing more environmentally compatible alternative.

53. If the full financial cost accounting of the environmental impact of extracting 20 million gallons per day of water from the Susquehanna River were applied to the PPL Bell Bend project, it is doubtful that the construction design for the PPL Bell Bend project would include evaporative cooling towers that feature large consumptive water losses. Realistic environmental cost accounting applied through a more stringent consumptive water use fee schedule would make the air-cooled condenser design a financially desirable alternative.

The Cost of Water

54. Presently, the Susquehanna River Basin Commission sets the rate schedule for water withdrawal from the Susquehanna River. A new schedule of fees was adopted December 17, 2009.

55. According to the newly instituted Application Fee Schedule in effect beginning January 1, 2010 through December 31, 2010:

55.1. PPL would be charged an application fee of $28,650 for up to ten million gallons per day plus $4,875 for every million gallons per day additional usage beyond that withdrawal rate. Because of its enormous withdrawal rates and the low application fee structure, the PPL proposed Bell Bend project will be charged an application fee of less than 3 tenths of one cent (3/10 of 1¢) per gallon for Bell Bend.

55.2. In comparison, smaller users will be charged $4,400 to apply for water withdrawal of 100,000 gallons per day. On a per gallon basis, smaller users will be charged an application fee of more than 4 cents (4¢) per gallon.

55.3. Thus, the Susquehanna River Basin Commission plans to charge small users 10 times more per gallon to apply for withdrawal from the Susquehanna River than it plans to charge PPL its proposed Bell Bend project.

55.4. The environmental impact of a 100,000 (100 Thousand) gallon per day withdrawal pales in comparison to a 31,000,000 (31 million) gallon per day withdrawal proposed by PPL it its COLA for Bell Bend.

55.5. The data reviewed shows that the consumptive water use intended by the PPL proposed Bell Bend project may require significant additional environmental review. The new SRBC fee schedule appears to erroneously encourage the consumptive water use of 31,000,000 (31 million) gallons per day proposed by PPL. Therefore, other users of the river water are effectively subsidizing the PPL Bell Bend application.

56. Furthermore, according to the Susquehanna River Basin Commission's new fee schedule, all users will be charged the same "Consumptive Use Mitigation Fee $0.28 for every 1,000 gallons consumed". The same fee is assessed to users drawing 100 times less water than the PPL proposed Bell Bend project is anticipated to withdraw. Therefore the "Consumptive Use Mitigation Fee" of $0.28, rewards large-scale users thereby encouraging large-scale use and its resulting negative environmental impact upon the River. Moreover, if Bell Bend were allowed to withdraw 31,000,000 (31 million) gallons of water under this fee schedule, then hundreds of other small water users will be precluded water use and access to water rights for the anticipated 60-year life of the PPL proposed Bell Bend nuclear power plant.

57. By choosing low fees for water withdrawal, the Susquehanna River Basin Commission appears to subsidize the consumptive water use anticipated by the PPL Bell Bend project. In turn, this subsidy reduces available water to downstream communities and increases the down stream pressures on the Susquehanna River and the Chesapeake Bay.

58. Before a Joint Meeting of the Senate Environmental Resources & Energy Committee and the Senate Agriculture and Rural Affairs Committee on September 20, 2005, Kathleen A. McGinty, Pennsylvania's former Secretary of the Department of Environmental Protection, submitted testimony entitled *Pennsylvania's Chesapeake Bay Tributary Strategy*[7]. Secretary McGinty said,

> "...a court order directed the federal agency to take action to restore the Chesapeake. Mandatory directives from EPA will come to Pennsylvania and other Bay states in 2010 if sufficient measures are

[7] http://www.depweb.state.pa.us/dep/cwp/view.asp?a=3&q=474519

> not in place by then to restore water quality in the Bay and its tributaries.
>
> More than half of our Commonwealth is within the Chesapeake Bay Watershed, with the Susquehanna River, the Bay's largest tributary, providing roughly half of the total freshwater flow...
>
> Pennsylvania is working with communities, watershed groups, farmers and businesses to develop new tools and put practical solutions on the ground to improve the quality of our waterways. It is imperative that we work aggressively to clean up what is one of our Commonwealth's greatest natural resources. It is true that the work we do at home ultimately serves to help the Bay. But our efforts are about making sure the water in Pennsylvania is safe to drink, healthy enough to sustain aquatic life and abundant in supply to sustain our economy."

59. Reiterating what the Secretary stated, an "abundant supply" of water is important to "sustain our economy". Yet as proposed, the PPL Bell Bend project reduces the River's flow at the same time it introduces more contaminated water back into the Susquehanna River. The PPL intended intensive consumptive water use at Bell Bend and its resulting reduction in water flow in the Susquehanna River seems counterproductive to the goals stated by the Pennsylvania's Secretary of the Department of Environmental Protection, especially when an air-cooled condenser design is available for substitution.

60. Since the Susquehanna River provides half of the fresh water that enters the Chesapeake Bay, the withdrawal of 31,000,000 gallons per day of the River's flow will have a significant impact on the down stream ecology that is not reflected in the SRBC fee structure.

61. The PPL proposed withdrawal of fresh water from the river, while also reintroducing concentrated contaminants back into the river, has the net effect of concentrating the pollutants that move downstream into Chesapeake Bay. Achieving Secretary McGinty's goal "to restore water quality in the Bay and its tributaries" will be nearly impossible if PPL is allowed to have the Bell Bend nuclear plant withdraw such a significant portion of river flow while providing almost no financial remuneration to the SRBC for the use of that water and remediation of the Susquehanna River. A realistic financial cost accounting of the environmental impact of the PPL Bell Bend

project upon the Susquehanna River and Chesapeake Bay Watersheds may help to ascertain how much money will be required to remediate the River.

62. In my opinion, the present design of the PPL Bell Bend nuclear power plant that calls for the withdrawal of huge amounts of water from the Susquehanna will exacerbate downstream problems in the Chesapeake Bay. The problem of such water intensive use would be entirely mitigated by the installation of an air-cooled condenser and air-cooled cooling towers prior to construction.

63. First, if the Susquehanna's flow is used by the PPL proposed Bell Bend nuclear power plant, more significant economic opportunities may be lost. The enormous consumptive water use of the PPL proposed Bell Bend project would limit Pennsylvania's ability to pursue other economic opportunities in the future. Specifically, there may be a need to use river water to extract natural gas in the Marcellus Shale deposits. The extraction and sale of natural gas from the Marcellus Shale will provide significant economic advantages in the form of revenue and employment, but only if adequate river water is available. The Bell Bend COL application will significantly reduce the amount of river water available for any additional projects.

64. Second, I have identified three additional problems with the PPL proposed Bell Bend application to withdraw large amounts of water from the Susquehanna River.

    64.1. It would increase downstream contamination of the Chesapeake,

    64.2. This loss of available water for small businesses would reduce employment opportunities all along the Susquehanna River.

    64.3. It would also limit the possible economic development of the Marcellus Shale that would benefit of the State of Pennsylvania.

65. All of these problems would be completely eliminated by the installation of air-cooled condensers on by PPL before construction begins on its proposed Bell Bend project. These air-cooled condensers are already in use in the electric industry but cannot be retrofitted for use at Bell Bend after the plant has begun construction.

66. The most likely reason that PPL is proposing such a large withdrawal of water from

the Susquehanna River for its Bell Bend nuclear power plant is that the SRBC present fee structure is so low that PPL has no motivation to address the long-term economic and environmental damage that would be mitigated by the installation of air-cooled condensers at Bell Bend.

Conclusion

67. In conclusion, air-cooled condensers could be successfully integrated into the PPL Bell Bend project design and the use of such air-cooled condensers would completely eliminate the need for the PPL Bell Bend nuclear power plants to have such a projected massive consumptive water use from the Susquehanna River.

68. However, the proposal presently in front of the Susquehanna Basin River Commission never discusses this viable alternative. Moreover, it is critical that the substitution of an air-cooled condenser and air-cooled cooling towers receive adequate analysis now, prior to final design and preliminary construction, as it is impossible to adapt the plant to the use of air-cooled condensers after the construction process is initiated.

69. Finally, the *Draft* fee schedule as presently proposed by the Susquehanna River Basin Commission subsidizes huge consumptive water use at great risk to the Susquehanna River Watershed and the Chesapeake Bay Watershed. These two vital watershed communities are already challenged by frequently occurring drought conditions as well as the negative environmental impact of dirty water (*blowdown*) on the Susquehanna River and Chesapeake Bay fragile aquatic ecosystems.

Attachments:

Attachment 1 – Curriculum Vitae

I declare under penalty of perjury that the foregoing is true and correct.

Executed this day, January 5, 2010 at Burlington, Vermont.

1/7/10

Arnold Gundersen, MSNE
Chief Engineer, Fairewinds Associates, Inc

I HEREBY CERTIFY that on this 5th day of January 2010, Arnold Gundersen, resident of Burlington Vermont, who is personally known to me or who produced the following identification, personally appeared before me, and he swore, subscribed, and acknowledged before me that he executed the foregoing as his free act and deed as an expert witness of said case, for the uses and purposes therein mentioned, and that he did take an oath.

In witness whereof, I have hereunto set my hand and seal in the County and State aforesaid.

OFFICIAL NOTARY _____, NOTARY PUBLIC
STATE OF VERMONT

MY COMMISSION EXPIRES: Feb 2011

CURRICULUM VITAE

Arnold Gundersen
Chief Engineer, Fairewinds Associates, Inc
December 2009

Education and Training

ME NE	Master of Engineering Nuclear Engineering Rensselaer Polytechnic Institute, 1972 U.S. Atomic Energy Commission Fellowship Thesis: Cooling Tower Plume Rise
BS NE	Bachelor of Science Nuclear Engineering Rensselaer Polytechnic Institute, Cum Laude, 1971 James J. Kerrigan Scholar
RO	Licensed Reactor Operator, U.S. Atomic Energy Commission License # OP-3014

Qualifications – including and not limited to:

- Chief Engineer, Fairewinds Associates, Inc
- Nuclear Engineering, Safety, and Reliability Expert
- Federal and Congressional hearing testimony and Expert Witness testimony
- Former Senior Vice President Nuclear Licensee
- Former Licensed Reactor Operator
- 39-years of nuclear industry experience and oversight
    - Nuclear engineering management assessment and prudency assessment
    - Nuclear power plant licensing and permitting – assessment and review
    - Nuclear safety assessments, source term reconstructions, dose assessments, criticality analysis, and thermohydraulics
    - Contract administration, assessment and review
    - Systems engineering and structural engineering assessments
    - Cooling tower operation, cooling tower plumes, thermal discharge assessment, and consumptive water use
    - Nuclear fuel rack design and manufacturing, nuclear equipment design and manufacturing, and technical patents
    - Radioactive waste processes, storage issue assessment, waste disposal and decommissioning experience
    - Reliability engineering and aging plant management assessments, in-service inspection
    - Employee awareness programs, whistleblower protection, and public communications
    - Quality Assurance (QA) & records

Publications

Co-author — *DOE Decommissioning Handbook, First Edition*, 1981-1982, invited author.

Co-author — *Decommissioning the Vermont Yankee Nuclear Power Plant: An Analysis of Vermont Yankee's Decommissioning Fund and Its Projected Decommissioning Costs*, November 2007, Fairewinds Associates, Inc.

Co-author — *Decommissioning Vermont Yankee – Stage 2 Analysis of the Vermont Yankee Decommissioning Fund – The Decommissioning Fund Gap*, December 2007, Fairewinds

Associates, Inc. Presented to Vermont State Senators and Legislators.
Co-author — *Vermont Yankee Comprehensive Vertical Audit – VYCVA – Recommended Methodology to Thoroughly Assess Reliability and Safety Issues at Entergy Nuclear Vermont Yankee*, January 30, 2008 Testimony to Finance Committee Vermont Senate
Co-author — *Act 189 Public Oversight Panel Report*, March 17, 2009, to the Vermont State Legislature by the Vermont Yankee Public Oversight Panel.
Author — Fairewinds Associates, Inc *First Quarterly Report to the Joint Legislative Committee*, October 19, 2009.

Patents
Energy Absorbing Turbine Missile Shield – U.S. Patent # 4,397,608 – 8/9/1983

Committee Memberships
Vermont Yankee Public Oversight Panel – appointed 2008 by President Pro-Tem Vermont Senate
National Nuclear Safety Network – Founding Board Member
Three Rivers Community College – Nuclear Academic Advisory Board
Founding Member of Connecticut Low Level Radioactive Waste Advisory Committee – 10 years
Founding Member Radiation Safety Committee, NRC Licensee
ANSI N-198, Solid Radioactive Waste Processing Systems

Honors
U.S. Atomic Energy Commission Fellowship, 1972
B.S. Degree, Cum Laude, RPI, 1971, 1st in nuclear engineering class
Tau Beta Pi (Engineering Honor Society), RPI, 1969 – 1 of 5 in sophomore class of 700
James J. Kerrigan Scholar 1967–1971
Teacher of the Year – 2000, Marvelwood School
Publicly commended to U.S. Senate by NRC Chairman, Ivan Selin, in May 1993 – "It is true...everything Mr. Gundersen said was absolutely right; he performed quite a service."

Nuclear Consulting and Expert Witness Testimony
U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB)
Declaration of Arnold Gundersen Supporting Supplemental Petition of Intervenors Contention 15: Detroit Edison Cola Lacks Statutorily Required Cohesive QA Program, December 8, 2009.

U.S. NRC Region III Allegation Filed by Missouri Coalition for the Environment
Expert Witness Report entitled: *Comments on the Callaway Special Inspection by NRC Regarding the May 25, 2009 Failure of its Auxiliary Feedwater System,* November 9, 2009.

Vermont State Legislature Joint Fiscal Committee Expert Witness regarding Entergy Nuclear Vermont Yankee
The First Quarterly Report to the Joint Legislative Committee regarding reliability issues at Entergy Nuclear Vermont Yankee, issued October 19, 2009 and oral testimony to the Vermont State Legislature Joint Fiscal Committee.
(http://www.leg.state.vt.us/JFO/Vermont%20Yankee.htm).

Florida Public Service Commission (FPSC)
Gave direct oral testimony to the FPSC in hearings in Tallahassee, FL, September 8 and 10, 2009 in support of Southern Alliance for Clean Energy (SACE) contention of anticipated licensing and construction delays in newly designed Westinghouse AP 1000 reactors proposed by Progress Energy Florida and Florida Power and Light (FPL).

Florida Public Service Commission (FPSC)
NRC announced delays confirming my original testimony to FPSC detailed below. My supplemental testimony alerted FPSC to NRC confirmation of my original testimony regarding licensing and construction delays due to problems with the newly designed Westinghouse AP 1000 reactors in *Supplemental Testimony In Re: Nuclear Plant Cost Recovery Clause By The Southern Alliance For Clean Energy*, FPSC Docket No. 090009-EI, August 12, 2009.

Florida Public Service Commission (FPSC)
Licensing and construction delays due to problems with the newly designed Westinghouse AP 1000 reactors in *Direct Testimony In Re: Nuclear Plant Cost Recovery Clause By The Southern Alliance For Clean Energy*, FPSC Docket No. 090009-EI, July 15, 2009.

Vermont State Legislature Joint Fiscal Committee Expert Witness Oversight Role for Entergy Nuclear Vermont Yankee (ENVY)
Contracted by the Joint Fiscal Committee of the Vermont State Legislature as an expert witness to oversee the compliance of ENVY to reliability issues uncovered during the 2009 legislative session by the Vermont Yankee Public Oversight Panel of which I was appointed a member along with former NRC Commissioner Peter Bradford for one year from July 2008 to 2009. Entergy Nuclear Vermont Yankee (ENVY) is currently under review by Vermont State Legislature to determine if it should receive a Certificate for Public Good (CPG) to extend its operational license for another 20-years. Vermont is the only state in the country that has legislatively created the CPG authorization for a nuclear power plant. Act 160 was passed to ascertain ENVY's ability to run reliably for an additional 20 years. Appointment from July 2009 to May 2010.

U.S. Nuclear Regulatory Commission
Expert Witness Declaration regarding Combined Operating License Application (COLA) at North Anna Unit 3 *Declaration of Arnold Gundersen Supporting Blue Ridge Environmental Defense League 's Contentions* (June 26, 2009).

U.S. Nuclear Regulatory Commission
Expert Witness Declaration regarding Through-wall Penetration of Containment Liner and Inspection Techniques of the Containment Liner at Beaver Valley Unit 1 Nuclear Power Plant *Declaration of Arnold Gundersen Supporting Citizen Power's Petition* (May 25, 2009).

U.S. Nuclear Regulatory Commission
Expert Witness Declaration regarding Quality Assurance and Configuration Management at Bellefonte Nuclear Plant *Declaration of Arnold Gundersen Supporting Blue Ridge Environmental Defense League's Contentions in their Petition for Intervention and Request for Hearing*, May 6, 2009.

Pennsylvania Statehouse
Expert Witness Analysis presented in formal presentation at the Pennsylvania Statehouse, March 26, 2009 regarding actual releases from Three Mile Island Nuclear Accident. Presentation may be found at: http://www.tmia.com/march26

Vermont Legislative Testimony and Formal Report for 2009 Legislative Session
As a member of the Vermont Yankee Public Oversight Panel, I spent almost eight months examining the Vermont Yankee Nuclear Power Plant and the legislatively ordered Comprehensive Vertical Audit. Panel submitted Act 189 Public Oversight Panel Report March 17, 2009 and oral testimony to a joint hearing of the Senate Finance and House Natural Resources March 19, 2009. (See: http://www.leg.state.vt.us/JFO/Vermont%20Yankee.htm)

Finestone v FPL (11/2003 to 12/2008) Federal Court
Plaintiffs' Expert Witness for Federal Court Case with Attorney Nancy LaVista, from the firm Lytal, Reiter, Fountain, Clark, Williams, West Palm Beach, FL. This case involved two plaintiffs in cancer cluster of 40 families alleging that illegal radiation releases from nearby nuclear power plant caused children's cancers. Production request, discovery review, preparation of deposition questions and attendance at Defendant's experts for deposition, preparation of expert witness testimony, preparation for Daubert Hearings, ongoing technical oversight, source term reconstruction and appeal to Circuit Court.

U.S. Nuclear Regulatory Commission Advisory Committee Reactor Safeguards (NRC-ACRS)
Expert Witness providing oral testimony regarding Millstone Point Unit 3 (MP3) Containment issues in hearings regarding the Application to Uprate Power at MP3 by Dominion Nuclear, Washington, and DC. (July 8-9, 2008).

Appointed by President Pro-Tem of Vermont Senate to Legislatively Authorized Nuclear Reliability Public Oversight Panel
To oversee Comprehensive Vertical Audit of Entergy Nuclear Vermont Yankee (Act 189) and testify to State Legislature during 2009 session regarding operational reliability of ENVY in relation to its 20-year license extension application. (July 2, 2008 to present).

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB)
Expert Witness providing testimony regarding *Pilgrim Watch's Petition for Contention 1 Underground Pipes* (April 10, 2008).

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB)
Expert Witness supporting *Connecticut Coalition Against Millstone In Its Petition For Leave To Intervene, Request For Hearing, And Contentions Against Dominion Nuclear Connecticut Inc.'s*

Millstone Power Station Unit 3 License Amendment Request For Stretch Power Uprate (March 15, 2008).

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB)
Expert Witness supporting *Pilgrim Watch's Petition For Contention 1: specific to issues regarding the integrity of Pilgrim Nuclear Power Station's underground pipes and the ability of Pilgrim's Aging Management Program to determine their integrity.* (January 26, 2008).

Vermont State House – 2008 Legislative Session

- House Committee on Natural Resources and Energy – Comprehensive Vertical Audit: *Why NRC Recommends a Vertical Audit for Aging Plants Like Entergy Nuclear Vermont Yankee (ENVY)*
- House Committee on Commerce – Decommissioning Testimony

Vermont State Senate – 2008 Legislative Session

- Senate Finance – testimony regarding Entergy Nuclear Vermont Yankee Decommissioning Fund
- Senate Finance – testimony on the necessity for a Comprehensive Vertical Audit (CVA) of Entergy Nuclear Vermont Yankee
- Natural Resources Committee – testimony regarding the placement of high-level nuclear fuel on the banks of the Connecticut River in Vernon, VT

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB)
MOX Limited Appearance Statement to Judges Michael C. Farrar (Chairman), Lawrence G. McDade, and Nicholas G. Trikouros for the "Petitioners": Nuclear Watch South, the Blue Ridge Environmental Defense League, and Nuclear Information & Resource Service in support of *Contention 2: Accidental Release of Radionuclides, requesting a hearing concerning faulty accident consequence assessments made for the MOX plutonium fuel factory proposed for the Savannah River Site.* (September 14, 2007).

Appeal to the Vermont Supreme Court (March 2006 to 2007)
Expert Witness Testimony in support of *New England Coalition's Appeal to the Vermont Supreme Court Concerning: Degraded Reliability at Entergy Nuclear Vermont Yankee as a Result of the Power Uprate.* New England Coalition represented by Attorney Ron Shems of Burlington, VT.

State of Vermont Environmental Court (Docket 89-4-06-vtec 2007)
Expert witness retained by New England Coalition to review Entergy and Vermont Yankee's analysis of alternative methods to reduce the heat discharged by Vermont Yankee into the Connecticut River. Provided Vermont's Environmental Court with analysis of alternative methods systematically applied throughout the nuclear industry to reduce the heat discharged by nuclear power plants into nearby bodies of water and avoid consumptive water use. This report included a review of the condenser and cooling tower modifications.

U.S. Senator Bernie Sanders and Congressman Peter Welch (2007)
Briefed Senator Sanders, Congressman Welch and their staff members regarding technical and engineering issues, reliability and aging management concerns, regulatory compliance, waste storage, and nuclear power reactor safety issues confronting the U.S. nuclear energy industry.

State of Vermont Legislative Testimony to Senate Finance Committee (2006)
Testimony to the Senate Finance Committee regarding Vermont Yankee decommissioning costs, reliability issues, design life of the plant, and emergency planning issues.

U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (NRC-ASLB)
Expert witness retained by New England Coalition to provide Atomic Safety and Licensing Board with an independent analysis of the integrity of the Vermont Yankee Nuclear Power Plant condenser (2006).

U.S. Senators Jeffords and Leahy (2003 to 2005)
Provided the Senators and their staffs with periodic overview regarding technical, reliability, compliance, and safety issues at Entergy Nuclear Vermont Yankee (ENVY).

10CFR 2.206 filed with the Nuclear Regulatory Commission (July 2004)
Filed 10CFR 2.206 petition with NRC requesting confirmation of Vermont Yankee's compliance with General Design Criteria.

State of Vermont Public Service Board (April 2003 to May 2004)
Expert witness retained by New England Coalition to testify to the Public Service Board on the reliability, safety, technical, and financial ramifications of a proposed increase in power (called an uprate) to 120% at Entergy's 31-year-old Vermont Yankee Nuclear Power Plant.

International Nuclear Safety Testimony
Worked for ten days with the President of the Czech Republic (Vaclav Havel) and the Czech Parliament on their energy policy for the 21st century.

Nuclear Regulatory Commission (NRC) Inspector General (IG)
Assisted the NRC Inspector General in investigating illegal gratuities paid to NRC Officials by Nuclear Energy Services (NES) Corporate Officers. In a second investigation, assisted the Inspector General in showing that material false statements (lies) by NES corporate president caused the NRC to overlook important violations by this licensee.

State of Connecticut Legislature
Assisted in the creation of State of Connecticut Whistleblower Protection legal statutes.

Federal Congressional Testimony
Publicly recognized by NRC Chairman, Ivan Selin, in May 1993 in his comments to U.S. Senate, "It is true...everything Mr. Gundersen said was absolutely right; he performed quite a service." Commended by U.S. Senator John Glenn for public testimony to Senator Glenn's NRC Oversight Committee.

PennCentral Litigation
Evaluated NRC license violations and material false statements made by management of this nuclear engineering and materials licensee.

Three Mile Island Litigation
Evaluated unmonitored releases to the environment after accident, including containment breach, letdown system and blowout. Proved releases were 15 times higher than government estimate and subsequent government report.

Western Atlas Litigation
Evaluated neutron exposure to employees and license violations at this nuclear materials licensee.

Commonwealth Edison
In depth review and analysis for Commonwealth Edison to analyze the efficiency and effectiveness of all Commonwealth Edison engineering organizations, which support the operation of all of its nuclear power plants.

Peach Bottom Reactor Litigation
Evaluated extended 28-month outage caused by management breakdown and deteriorating condition of plant.

Special Remediation Expertise:
Director of Engineering, Vice President of Site Engineering, and the Senior Vice President of Engineering at Nuclear Energy Services (NES).

- NES was a nuclear licensee that specialized in dismantlement and remediation of nuclear facilities and nuclear sites. Member of the radiation safety committee for this licensee.
- Department of Energy chose NES to write *DOE Decommissioning Handbook* because NES had a unique breadth and depth of nuclear engineers and nuclear physicists on staff.
- Personally wrote the "Small Bore Piping" chapter of the DOE's first edition Decommissioning Handbook, personnel on my staff authored other sections, and I reviewed the entire Decommissioning Handbook.
- Served on the Connecticut Low Level Radioactive Waste Advisory Committee for 10 years from its inception.
- Managed groups performing analyses on dozens of dismantlement sites to thoroughly remove radioactive material from nuclear plants and their surrounding environment.
- Managed groups assisting in decommissioning the Shippingport nuclear power reactor. Shippingport was the first large nuclear power plant ever decommissioned. The decommissioning of Shippingport included remediation of the site after decommissioning.
- Managed groups conducting site characterizations (preliminary radiation surveys prior to commencement of removal of radiation) at the radioactively contaminated West Valley site in upstate New York.
- Personnel reporting to me assessed dismantlement of the Princeton Avenue Plutonium Lab in New Brunswick, NJ. The lab's dismantlement assessment was stopped when we uncovered extremely toxic and carcinogenic underground radioactive contamination.

- Personnel reporting to me worked on decontaminating radioactive thorium at the Cleveland Avenue nuclear licensee in Ohio. The thorium had been used as an alloy in turbine blades. During that project, previously undetected extremely toxic and carcinogenic radioactive contamination was discovered below ground after an aboveground gamma survey had purported that no residual radiation remained on site.

Teaching and Academic Administration Experience

Rensselaer Polytechnic Institute (RPI) – Advanced Nuclear Reactor Physics Lab
Community College of Vermont – Mathematics Professor – 2007 to present
Burlington High School
Mathematics Teacher – 2001 to June 2008
Physics Teacher – 2004 to 2006
The Marvelwood School – 1996 to 2000
Awarded Teacher of the Year – June 2000
Chairperson: Physics and Math Department
Mathematics and Physics Teacher, Faculty Council Member
Director of Marvelwood Residential Summer School
Director of Residential Life
The Forman School & St. Margaret's School – 1993 to 1995
Physics and Mathematics Teacher, Tennis Coach, Residential Living Faculty Member

Nuclear Engineering 1970 to Present

Vetted as expert witness in nuclear litigation and administrative hearings in federal, international, and state court and to Nuclear Regulatory Commission, including but not limited to: Three Mile Island, US Federal Court, US NRC, NRC ASLB & ACRS, Vermont State Legislature, Vermont State Public Service Board, Florida Public Service Board, Czech Senate, Connecticut State Legislature, Western Atlas Nuclear Litigation, U.S. Senate Nuclear Safety Hearings, Peach Bottom Nuclear Power Plant Litigation, and Office of the Inspector General NRC.

Nuclear Engineering, Safety, and Reliability Expert Witness 1990 to Present

- Fairewinds Associates, Inc – Chief Engineer, 2005 to Present
- Arnold Gundersen, Nuclear Safety Consultant and Energy Advisor, 1995 to 2005
- GMA – 1990 to 1995, including expert witness testimony regarding the accident at Three Mile Island.

Nuclear Energy Services, Division of PCC (Fortune 500 company) 1979 to 1990
Corporate Officer and Senior Vice President - Technical Services
Responsible for overall performance of the company's Inservice Inspection (ASME XI), Quality Assurance (SNTC 1A), and Staff Augmentation Business Units – up to 300 employees at various nuclear sites.

Senior Vice President of Engineering
Responsible for the overall performance of the company's Site Engineering, Boston Design Engineering and Engineered Products Business Units. Integrated the Danbury based, Boston based and site engineering functions to provide products such as fuel racks, nozzle dams, and transfer mechanisms and services such as materials management and procedure development.

Vice President of Engineering Services
Responsible for the overall performance of the company's field engineering, operations engineering, and engineered products services. Integrated the Danbury-based and field-based engineering functions to provide numerous products and services required by nuclear utilities, including patents for engineered products.

General Manager of Field Engineering
Managed and directed NES' multi-disciplined field engineering staff on location at various nuclear plant sites. Site activities included structural analysis, procedure development, technical specifications and training. Have personally applied for and received one patent.

Director of General Engineering
Managed and directed the Danbury based engineering staff. Staff disciplines included structural, nuclear, mechanical and systems engineering. Responsible for assignment of personnel as well as scheduling, cost performance, and technical assessment by staff on assigned projects. This staff provided major engineering support to the company's nuclear waste management, spent fuel storage racks, and engineering consulting programs.

New York State Electric and Gas Corporation (NYSE&G) — 1976 to 1979
Reliability Engineering Supervisor
Organized and supervised reliability engineers to upgrade performance levels on seven operating coal units and one that was under construction. Applied analytical techniques and good engineering judgments to improve capacity factors by reducing mean time to repair and by increasing mean time between failures.

Lead Power Systems Engineer
Supervised the preparation of proposals, bid evaluation, negotiation and administration of contracts for two 1300 MW NSSS Units including nuclear fuel, and solid-state control rooms. Represented corporation at numerous public forums including TV and radio on sensitive utility issues. Responsible for all nuclear and BOP portions of a PSAR, Environmental Report, and Early Site Review.

Northeast Utilities Service Corporation (NU) — 1972 to 1976
Engineer
Nuclear Engineer assigned to Millstone Unit 2 during start-up phase. Lead the high velocity flush and chemical cleaning of condensate and feedwater systems and obtained discharge permit for chemicals. Developed Quality Assurance Category 1 Material, Equipment and Parts List. Modified fuel pool cooling system at Connecticut Yankee, steam generator blowdown system and diesel generator lube oil system for Millstone. Evaluated Technical Specification Change Requests.

Associate Engineer
Nuclear Engineer assigned to Montague Units 1 & 2. Interface Engineer with NSSS vendor, performed containment leak rate analysis, assisted in preparation of PSAR and performed radiological health analysis of plant. Performed environmental radiation survey of Connecticut Yankee. Performed chloride intrusion transient analysis for Millstone Unit 1 feedwater system. Prepared Millstone Unit 1 off-gas modification licensing document and Environmental Report Amendments 1 & 2.

Rensselaer Polytechnic Institute (RPI) — 1971 to 1972
Critical Facility Reactor Operator, Instructor
Licensed AEC Reactor Operator instructing students and utility reactor operator trainees in start-up through full power operation of a reactor.

Public Service Electric and Gas (PSE&G) — 1970
Assistant Engineer
Performed shielding design of radwaste and auxiliary buildings for Newbold Island Units 1 & 2, including development of computer codes.

Public Service, Cultural, and Community Activities

2005 to Present – Public presentations and panel discussions on nuclear safety and reliability at University of Vermont, NRC hearings, Town and City Select Boards, Legal Panels, Television, and Radio

2007-2008 – Created Concept of Solar Panels on Burlington High School; worked with Burlington Electric Department and Burlington Board of Education Technology Committee on Grant for installation of solar collectors for Burlington Electric peak summer use

Vermont State Legislature – Ongoing Public Testimony to Legislative Committees

Certified Foster Parent State of Vermont – 2004 to 2007

Mentoring former students – 2000 to present – college application and employment application questions and encouragement

Tutoring Refugee Students – 2002 to 2006 – Lost Boys of the Sudan and others from educationally disadvantaged immigrant groups

Designed and Taught Special High School Math Course for ESOL Students – 2007 to 2008

Featured Nuclear Safety and Reliability Expert (1990 to present) for Television, Newspaper, Radio, & Internet
Including, and not limited to: CNN (Earth Matters), NECN, WPTZ VT, WTNH, VPTV, WCAX, Cable Channel 17, The Crusaders, Front Page, Mark Johnson Show, Steve West Show, Anthony Polina Show, WKVT, WDEV, WVPR, WZBG CT, Seven Days, AP News Service, Houston Chronicle, Christian Science Monitor, New York Times, Brattleboro Reformer, Rutland Herald, Times-Argus, Burlington Free Press, Litchfield County Times, The News Times, The New Milford Times, Hartford Current, New London Day, evacuationplans.org, Vermont Daily Briefing, Green Mountain Daily, and numerous other national and international blogs

NNSN – National Nuclear Safety Network, Founding Advisory Board Member, meetings with and testimony to the Nuclear Regulatory Commission Inspector General (NRC IG)

Berkshire School Parents Association, Co-Founder

Berkshire School Annual Appeal, Co-Chair

Sunday School Teacher, Christ Episcopal Church, Roxbury, CT

Washington Montessori School Parents Association Member
Episcopal Marriage Encounter National Presenting Team with wife Margaret
Provided weekend communication and dialogue workshops weekend retreats/seminars
Connecticut Episcopal Marriage Encounter Administrative Team – 5 years
Northeast Utilities Representative Conducting Public Lectures on Nuclear Safety Issues

Personal and Family Data

Born January 4, 1949, Elizabeth, NJ
Married in 1979 to Margaret Gundersen, certified paralegal and founder of Fairewinds Associates, Inc, www.fairewinds.com
Children:
Elida Gundersen, age 27, paramedic & crew chief, Charleston County EMS, Charleston, SC
Eric Gundersen, age 30, founder Development Seed, www.developmentseed.org, Washington, DC

Contact Information

Address: 376 Appletree Point Road, Burlington, VT 05408
E-Mail: arnie@fairewinds.com
Telephones: Office: (802) 865-9955 Cell: (802) 238-4452 Fax: (802) 304-1051

End

Enclosure 3

REVIEW OF
PPL'S SUSQUEHANNA RIVER BASIN
COMMISSION PRESENTATION
JUNE 23, 2011
ENTITLED

"CONCEPTUAL PROPOSAL TO DEVELOP AND IMPLEMENT A CORPERATE STORAGE ASSET POOL FOR CONSUMPTIVE USE MITIGATION"

November 2011

Keith L. Harner, PE
700 North Hawthorne Street
York, Pa 17404

Table of Contents

1.0 Introduction

PPL made a presentation to the Susquehanna River Basin Commission (SRBC) on June 23, 2011 for a "Conceptual Proposal to Develop and Implement a Corporate Storage Asset Pool for Consumptive Use Mitigation". This review will follow the power point presentation as provided by PPL.

2.0 Presentation Review

2.1 Regulatory Framework for Proposal – Page 3 of Presentation

- **18 CFR § 806.22 provides for SRBC discretion to determine the acceptable manner of CU mitigation**

Consumptive use regulations are covered under:

> "18 CFR § 803.2 b) In addition, §§803.42, 803.43 and 803.44 contain the following specific purposes: Protection of public health, safety and welfare; stream quality control; economic development; protection of fisheries and aquatic habitat; recreation; dilution and abatement of pollution; the regulation of flows and supplies of surface and ground waters; the avoidance of conflicts among water users; the prevention of undue salinity; and protection of the Chesapeake Bay."

And

> "18 CFR § 803.42 H) Other alternatives.
> (2) Alternatives to compensation may be appropriate such as discontinuance of that part of the project's operation that consumes water, imposition of conservation measures, utilization of an alternative source that is unaffected by the compensation requirement, or a monetary payment to the commission in an amount to be determined by the commission from time-to-time.

(3) The commission shall, in its sole discretion, determine the acceptable manner of compensation or alternatives to compensation, as applicable, for consumptive uses by a project. Such a determination will be made after considering the project location, anticipated amount of consumptive use and its effect on the purposes set forth in §803.2 of this part, and any other pertinent factors.

(c) *Quantity of consumptive use.* For purposes of evaluating a proposed project, the commission shall require estimates of anticipated consumptive use from the project sponsor. The commission, as part of the project review, shall evaluate the proposed methodology for monitoring consumptive losses and compensating flows including flow metering devices, stream gauges, and other facilities used to measure the consumptive use of the project or the rate of streamflow. If the commission determines that additional flow measuring devices are required, these shall be provided at the expense of the project sponsor and shall be subject to inspection by the commission at any time. When the project is operational, the commission shall be responsible for determining when compensation is required and shall notify the project sponsor accordingly. The project sponsor shall provide the commission with periodic reports in the time and manner as it requires showing actual consumptive uses associated with the project. The commission may use this data to modify, as appropriate, the magnitude and timing of the compensating releases initially required when the project was approved.

(d) *Quality of compensation water.* The physical, chemical and biological quality of water used for compensation shall at all times meet the quality requirements for the purposes listed in §803.2, as applicable. "

The Susquehanna River Basin Commission (SRBC) regulations allow for alternative methods to be used as mitigation for consumptive uses. The preceding sections of the regulations set forth the criteria for an alternative method. It should be noted that any alternative would be required to protect existing fisheries and aquatic habitat.

2.2 SRBC Consumptive Use Program – Page 4 of Presentation

- ***"...the intent of the Commission's CU mitigation program is to replace CU during low flow periods*** **to avoid worsening conditions beyond the natural.**
- ***"...mitigation can be driven ... to protect the local stream source, or it can be driven ...*** **with the goal of not reducing inflows to the Chesapeake Bay."**

The actual full section of the SRBC Consumptive Use Mitigation Plan states:

> "Mitigation Goal As laid out in the Compact, the intent of the Commission's CU mitigation program is to replace CU during low flow periods to avoid worsening conditions beyond the natural. The implementation of the mitigation can be driven by local conditions to protect the local stream source, or it can be driven by conditions at a downstream location, with the goal of not reducing inflows to the Chesapeake Bay beyond the 1-in-20-year (P95) monthly flows in August, September, and October. It is likely the final mitigation strategy will incorporate aspects of both local and basin wide implementation."

The SRBC Plan also acknowledges that the existing Q7-10 flow requirements do not protect the stream/river ecosystems nor do they provide Federal Energy Regulatory Commission (FERC) flows to the Conowingo pond in times of low flow. The SRBC Plan also states that final mitigation strategy is likely to incorporate aspects of both local and basin wide implementation.

Page 5 of the presentation provides a fairly accurate history of the SRBC consumptive use program. Page 6 of the presentation states that pooling of assets and cooperative management of the assets are the best means to meet basin needs. Basin needs should be looked at as a whole with all assets and uses within the river system

included, not just PPL's and SRBC's. Page 7 lists PPL's consumptive uses and mitigation which is assumed to be correct. Page 8 states that there are inefficiencies in the present system.

2.3 Opportunities with Respect to Current Use of Storage – Page 9 of Presentation

- **Commission or private regulation of storage (either low flow augmentation or for CU make-up) typically results in enhanced flow conditions above points of use. (e.g., water released from Cowanesque for TMI improves streamflow conditions between the source water and point of use.)**
- **These enhanced conditions already afford the Commission flexibility in siting and approving CU make-up storage in the basin.**
- **New opportunities for storage development in the basin (which are generally limited) can best leverage the benefits provided by existing storage assets via consideration of pooling concepts and cooperative management.**

While all these statements have merit, 18 CFR §803.42 Standards for consumptive uses for water also contains the following requirement:

> "i) The required amount of compensation shall be provided by the applicant or project sponsor at the point of taking (for a surface source) or another appropriate site as approved by the commission to satisfy the purposes outlined in this paragraph (b) (1). If compensation for consumptive use from a surface source is to be provided upstream from the point of taking, such compensation shall reasonably assure no diminution of the flow immediately downstream from the point of taking which would otherwise exist naturally, plus any other dedicated augmentation. "

Release of the mitigation flows upstream of the consumptive use does provide enhanced stream flows upstream of the consumptive use, but any analysis of mitigation (pooled or otherwise) should also include documentation that during drought conditions

a release from an upstream asset provides the total mitigation assumed at the point of consumption. Using PPL's example, documentation should be provided that a release from the Cowanesque Lake would not be diminished by the time it travels downstream (over 260 stream miles) to the intake of Three Mile Island (TMI).

2.4 PPL Pooled Asset Proposal - Page 10

- **Consolidate PPL-owned existing (Lake Chillisquaque) and future storage assets (as approved by SRBC) in to a corporate storage asset pool for the collective use by existing and future PPL CU projects in the basin.**
- **Operate the asset pool in coordination with SRBC operation of Cowanesque (for PPL) and other SRBC controlled assets to optimize local basin flow conditions and flows to the Chesapeake Bay.**
- **Manage developed assets on a collective basis (joint use basis, not dedicated to specific CU projects) for greatest efficiency and in concert with SRBC managed assets to minimize PPL in-lieu payment to the Commission and to maximize public interest benefit.**

2.5 PPL Basin-wide CU Mitigation Assets – Page 11

- **PPL-Owned Storage Assets**
  - **Lake Chillisquaque (existing) 8.6 MGD**
  - **Rushton Mine (West Branch) - 10+ MGD**
  - **Greenwich Mine (West Branch – currently discharges to Allegheny Basin)**
  - **Holtwood Pond - 14+ MGD**
- **Third-Party Assets**
  - **PPL is currently evaluating the feasibility of accessing certain 3rd party assets for inclusion in the asset pool (up to 30 MGD capability, subject to a non-disclosure agreement)**
    - Greatest near-term development potential

This review of PPL's proposal will assume that all statements on pages 11 and 12 of the presentation are true. Those assumptions are: the Rushton mine and Holtwood

pond will produce 10 and 14 MGD respectively and the 30 MGD third party assets will enter upstream of the intake and the flow is adequate to offset the total CU of the proposed Bell Bend Nuclear Power Plant (Bell Bend). The flow table on page 12 of the presentation would then look like this:

Flow Point	Existing	PPL Mitigation	Added column	Pooled Asset Mitigation
HUC 2050106	48.4	48.4	48.4	+
Susquehanna U/S of W/B confluence	7.6	7.6	7.6	+
West Branch	-15.4	-5.4	-5.4	deficit reduced but still a deficit
Susquehanna D/S of W/B confluence	-7.8	2.2	2.2	+
D/S Swatara Creek	-7.8	2.2	2.2	+
D/S Brunner Intake	-19.4	--------	-9.4	deficit
Chesapeake Bay	-19.4	4.6	4.6	+

Summary of PPL consumptive use and mitigation flows:

Consumptive Use

SSES	40.8 MGD
Montour	24.0 MGD
Brunner Island	11.3 MGD
Phoenix Links	0.3 MGD
Bell Bend	30.0 MGD
Total CU	106.4 MGD

Proposed Mitigation

Cowanesque	48.4 MGD
Chillisquaque	8.6 MGD
Rushton	10.0 MGD
Holtwood	14.0 MGD
3rd party	30.0 MGD
Total Mitigation	111.0 MGD

Even if sufficient engineering data were provided to justify all the statements PPL has made in their presentation, this proposal still leaves sections of the West Branch and the main Susquehanna River with reduced flows as indicated on the preceding table. These lower flows occur even though the proposal provides mitigation flows which exceed consumptive uses by 4.6 MGD. PPL's proposal does not meet the requirements of 18 CFR §803.2. It does not protect the fisheries and aquatic habitat of the River.

3.0 Engineering data required to justify assumptions:

Rushton Mine will provide 10 MGD mitigation flows.

1. Disturbance of mining areas creates a very complex hydrological matrix. There are changes to the surface runoff characteristics, connections between surface water and ground water, shallow ground water and deep ground water and interconnections between different watersheds by mine passageways. Documentation should be provided to justify that the 10 MGD treated mitigation flow directed to the West Branch is not just a diversion of natural ground water migration to the headwater streams in the area. The increased pumping in dry weather could also result in the disappearance of flows from the small headwater streams which may try to recharge the ground water being withdrawn.
2. The quality of the mitigation water must be addressed. All streams in the area are designated by DEP to be in a non-attained condition. The stream to which this proposed discharge is directed is already degraded due to metals and most likely PH due to mine drainage. The treatment of 10 MGD

can be costly for the initial treatment plant construction ($11.1 million for the Lancashire mine treatment system for 10.5 MGD), as well as, the continued operation of the plant. Provide documentation that discharge of 10 MGD mitigation flows from the mine will not have an adverse effect on the receiving stream.
3. Stage, storage, discharge curves should be incorporated into the SRBC OASIS model to determine the effect of this mitigation flow on the entire watershed.

Holtwood will provide 14 MGD mitigation flows.

1. Stage, storage, discharge curves should be incorporated into the SRBC OASIS model to determine the effect of this mitigation flow on the entire watershed.
2. If the SRBC OASIS model has not been updated to include all the power generation facilities in the lower basin it should be updated. Exelon just updated their OASIS model for the Conowingo and Muddy Run projects in June 2011. That model includes guaranteed releases from the Holtwood reservoir. The update of the SRBC model will allow PPL to determine if there is sufficient volume of water in the reservoir when mitigation flows are required to be discharged.

Third party flows:

1. Provide documentation that the flows will enter above the proposed Bell Bend intake.
2. Stage, storage, discharge curves should be incorporated into the SRBC OASIS model to determine the effect of this mitigation flow on the entire watershed.
3. Documentation indicates that Bell Bend will need 31 MGD of consumptive use mitigation. If less than 27.9 MGD of mitigated flows are provided above the intake for the proposed facility, then the Susquehanna River below the confluence of the West Branch would see a deficit flow.
4. The Susquehanna River water quality at the proposed facility location is in a non-attainment condition. Provide documentation that the discharge of the mitigation flows and the proposed facility will not have an adverse quality impact on the Susquehanna River.

4.0 Recent Susquehanna River Reports

PPL provided a report in September 2007 entitled "HOLTWOOD REDEVELOPMENT PROJECT FERC PROJECT NO. 1881 CONSUMPTIVE USE STUDY EFFECT OF 17 CFS ON BIOLOGICAL RESOURCES BETWEEN THE BRUNNER ISLAND STATION AND SAFE HARBOR IMPOUNDMENT" written by Kleinschmidt Energy and Water Resources Consultants. The following is the summary of the report:

> "The change in water surface elevation corresponding to 17 cfs in the stretch between the Brunner Island and the Safe Harbor Impoundment is approximately one-tenth of the typical standard error in field measurement techniques of 0.1 ft. It is Kleinschmidt's opinion that there will be no measurable effects on either the aquatic habitat or the biological resources located in this section of the River as related to the 17 cfs of consumptive use at the Brunner Island Station."

This conclusion is based upon the change of water surface elevation. The report does not include any analysis of the existing water quality or the effects of reduced flows would have on water quality. The report also does not address any potential impact on the fish habitat as a result in the change in water quality by the proposed reduced flows.

Since that time, there have been several recent reports completed for the Susquehanna River. The Consumptive Use Mitigation Plan – SRBC 2008, Ecosystem Flow Recommendations for the Susquehanna River Basin – The Nature Conservancy 2010, and the draft Susquehanna River Management Plan – PA Fish and Boat

Commission 2011. All three reports include sections on consumptive use. All three reports make statements that the existing requirement for the mitigation of the Q7-10 flow rates does not adequately protect the ecosystems of the Susquehanna River. The following paragraphs from the Susquehanna River Management Plan draft best expresses the concerns about future consumptive use increases in the Susquehanna River Basin:

> "A potentially significant threat to aquatic communities in the Susquehanna River Basin is increased consumptive use (CU) of water to meet expanding societal demands for water. CU is defined by SRBC as water that is used in a way it is not returned to the basin, including through evaporation, irrigation, use in products and diversions out of the Susquehanna watershed. Consumptive water use regulation, adopted by the SRBC in 1976 and most recently updated in November 2010, requires project sponsors to provide mitigation, either through providing compensatory water or fees, for their water use during low flow events. The maximum current use potential in the basin is estimated to be 882.5 million gallons per day (mgd) and is projected to increase to 1,202.2 mgd by 2025 of which, mitigation is required for 116.7 mgd and 390.3 mgd, respectively. Historically, actual usage falls somewhat below the actual permitted usage, but management based on permitted values allows for more conservative estimates for resource protection (SRBC 2008)."

And

> "The most recent CU mitigation plan has recognized the need for revised mitigation thresholds from the historic Q7-10 threshold to be more responsive to demonstrated aquatic and riparian resource needs, potentially including recently observed disease-related mortality of smallmouth bass and largemouth bass in the Susquehanna River and major tributaries. The 2008 Plan quantifies the need to secure more storage to achieve mitigation flows at the permitted levels, and the SRBC is currently working with partners to develop and acquire innovative storage options in order to set more protective/responsive CU mitigation goals (SRBC 2008)."

The following paragraph from the Ecosystem Flow Recommendations for the Susquehanna River Basin – The Nature Conservancy 2010 is of particular concern. This is the very section of the river which will see reduced low flows under the PPL proposal.

> "Water quality, specifically DO concentrations, is directly correlated to low flow magnitudes. Allowable point source discharges are calculated using the assimilative capacity of the 7-day, 1 in 10 year, low flow event (Q7-10). Under the Q7-10 condition, effluent discharge must not cause DO concentrations to fall below the standard of 4 mg/L. On the lower Susquehanna the Q7-10 flow translates to the monthly Q99 for July and August and the monthly Q96 for September and October (USGS unpublished data). During summer and fall, flows less than the monthly Q96 could result in DO concentrations less than 4 mg/L. Further, egg, larval and juvenile fishes, and species such as the eastern hellbender and wood turtle, require higher concentrations (5 mg/L), and most likely, higher flows. Chaplin et al. (2009) also demonstrated that DO concentrations in shallow margin and backwater are frequently lower than in main channel habitats. In other words, even if DO concentrations exceed 4 mg/L in the main channel, they may likely be lower in shallow margin and backwater habitats that are critical for egg, larval, and juvenile life stages (EPA 1986, Greene 2009). Therefore, water withdrawals should not cause streamflows to fall below the monthly Q96 more often than they would under unregulated conditions, and flows greater than the monthly Q96 may be necessary to maintain water quality conditions that support sensitive species, life stages and habitats."

5.0 Conclusions:

The establishment of a cooperative and coordinated pooled asset program for consumptive use mitigation between stakeholders has the potential to offset negative impacts on the Susquehanna River system. However, the pooling proposal from PPL (which includes PPL and SRBC controlled facilities) does not meet or exceed existing regulations. A pooled asset plan should make it possible to utilize different mitigation sources to protect different sections of the river system, but the use of the Holtwood reservoir provides mitigation flow well below the consumptive uses of PPL. That release would only help the Conowingo Reservoir (Baltimore city) and the Chesapeake Bay. The lower Susquehanna River is one of the most vulnerable sections of the river during low flows. This proposal does not protect that section of the river. Even when all PPL's statements are assumed to be true (including that the 3rd party mitigation flows would be provided upstream of the proposed Bell Bend facility) there remains reduced flows in sections of the West Branch and lower Susquehanna River.

Appendix A

Reference Documents

From the SRBC website:

Groundwater Management Plan

Lower Susquehanna Comprehensive Water Resource Study

SRBC Comprehensive Plan

Consumptive Use Mitigation Plan

Agricultural Consumptive Water Use

Water Assessment & Protection Strategic Plan (PDF)

From PPL Website:

HOLTWOOD REDEVELOPMENT PROJECT FERC PROJECT NO. 1881, CONSUMPTIVE USE STUDY, EFFECT OF 17 CFS ON BIOLOGICAL RESOURCES BETWEEN THE BRUNNER ISLAND STATION AND SAFE HARBOR IMPOUNDMENT

PDF reports found on the web:

Ecosystem Flow Recommendations for the Susquehanna River Basin – The Nature Conservancy 2010

Draft Susquehanna River Management Plan – PA Fish and Boat Commission 2011

Appendix A

Reference Documents Continued

PDF reports found on the web continued:

HYDROLOGIC CHARACTERIZATION OF A LARGE UNDERGROUND MINE POOL IN CENTRAL PENNSYLVANIA, Jay W. Hawkins, Eric F. Perry, and Mike Dunn

APPENDIX 2 - Model Development and Verification SRBC OASIS model

OPERATIONS MODELING CALIBRATION REPORT ADDENDUM TO CONOWINGO HYDROELECTRIC PROJECT-RSP 3.11 FERC PROJECT NUMBER 405 AND MUDDY RUN PUMPED STORAGE PROJECT

EXPERT WITNESS REPORT OF ARNOLD GUNDERSEN REGARDING CONSUMPTIVE WATER USE OF THE SUSQUEHANNA RIVER BY THE PROPOSED PPL BELL BEND NUCLEAR POWER PLANT - supplied by Eric Epstein

Appendix B

Professional History

Keith L. Harner
700 North Hawthorne Street
York, PA 17404
(717)845-5482

EDUCATION

Pennsylvania State University, State College, PA, March 1976
B.S. Civil Engineering

CONTINUING EDUCATION

PADOT Bridge Inspection Certification
Penn State Management Certification Program
ArcINFO, ArcVIEW, ArcGIS
AutoCAD
OSHA Trench Training
Urban Hydrology and Storm Water Management

PROFESSIONAL REGISTRATION

Pennsylvania Professional Engineer - PE-033769-E (1984)

WORK EXPERIENCE

County of Lancaster - Assistant County Engineer - April 1993 - December 2009

- Acting Department Head since 2008
- Responsible for the preparation and oversight of a $5,000,000 budget
- Provided construction management for projects ranging from $10,000 to $600,000
- Responsible for the preparation of the County's Act 167 Storm Water Management Plans
- Provided supervision for over 50 employees
- Arranged and conducted public meetings and hearings
- Provided property and right-of-way acquisition services
- Prepared PADEP permit applications
- Prepared State and Federal grant applications
- Served as project manager for County subdivision and design projects
- Prepared construction specifications and plans for County projects

Dover Township - Township, Water and Sewer Authority Engineer - July 1986 - April 1993

- Served as Engineer to the Township Supervisors, Water Authority and Sewer Authority
- Provided Subdivision and Land Development reviews
- Provided construction management for all public works projects
- Oversaw the computerized water and sewer billing
- Inspected pubic works improvements installed by developers
- Completed traffic studies for Township roads
- Provided construction stakeout for Township projects
- Assisted with budget preparation

City of York, City Engineer - January 1985 - July 1986

- Department Head
- Responsible for preparation and oversight of the department budget
- Designed, bid and provided construction management for projects ranging from $50,000 to $250,000
- Provided traffic studies for City Streets
- Completed project stakeout and construction inspection of pubic works projects
- Reviewed stormwater management and erosion sedimentation plans
- Provided Right-of-way surveys

Huth Engineers Inc. - Project Engineer - November 1979 - January 1985

- Performed sewer system inflow and infiltration studies
- Provided hydrology and hydraulic engineering design
- Performed dam inspections
- Designed pubic works projects with costs up to $1.5 million
- Performed bridge inspections
- Provided resident engineer services for a sewage treatment plant upgrade