Recycling Mine Pool Water for Electricity Generation: Limerick Generating Station

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Mine Pool Water from Coal Mining

- Contaminated ground water inflows
- Stored in abandoned portions of mine
- Continues to rise after mine closed
- Acidity from drainage can pollute rivers and streams
- 200 billion gallons of water annual discharge in PA anthracite region
Limerick Generating Station Uses Recycled Mine Pool Water for Cooling

- First nuclear plant and first baseload facility to use mine pool water
- Two 1,200 MW reactors—enough electricity for two million homes
- Schuylkill River can only provide cooling water for six months of the year
- Creeks, reservoirs, and Delaware River provided water remainder of the year
Limerick Mine Pool Water Recycling Project

- Beginning 2003, non-acidic water from Wadesville Mine Pool, Pottsville, and Still Creek Reservoir, Tamaqua, used
- Water released into Schuylkill River upstream of plant to augment flow during shortages, held during surplus availability
Results of Limerick Mine Pool Water Recycling Project

- 40% of cooling water requirements satisfied by mine pool and reservoir
- Reduced plant’s consumption of freshwater from natural waterbodies
- Increased flows in the rivers that comprised previous dry season water withdrawal network
Amount of released mine pool water varies greatly from year to year depending on weather, which determines need

- 2005—852.5 million gallons
- 2006—91.05 million gallons
- 2007—521.4 million gallons
Exelon Schuylkill River Watershed Restoration Program Fund

- Supports restoration projects in the Schuylkill River Basin
- Overseen by the Schuylkill River Heritage Area
- Exelon contributions based on quantity of consumptive cooling water not required to be augmented
The Limerick Generating Station Water Supply Modification Demonstration Project and Wadesville Mine Pool Withdrawal and Stream Flow Augmentation Demonstration Project

Interim Update – August 2011

August 31, 2011
Agenda

• Overview of the Demonstration
  – Background
  – The Demonstration

• Review of Demonstration 2003 -2010

• Review of 2011 Results to Date

• Restoration and Monitoring Fund

• Summary and Conclusions
• Pre Demonstation Dockets restrict consumptive use withdrawals from the Schuylkill River.

• Consumptive use makeup water is required when:
  – Water temperature is > 59°F or
  – Schuylkill River flows at Pottstown are < 560 CFS

• These provisions require an average water augmentation of 35 MGD (24,300 GPM) for about 6 months/yr.
Using a Mine as a Underground Reservoir
The Wadesville Mine

- Water Quality investigations
  - Priority pollutants
  - Radionuclides
  - Pesticides
  - NPDES parameters
- Characteristics of Wadesville mine pool
  - Alkalinity 300-400 mg/l
  - Acidity <1 mg/l
  - pH 6-8 (neutral)
  - Temperature 55-60°F
  - Water storage estimate of 3.4 billion gallons
The Demonstration

• To understand effects of potential water supply changes and determine whether the changes should be incorporated into a permanent docket:
  – To understand the overall effects of greater reliance on the Schuylkill River water resources:
    • Evaluate effects of eliminating the 59°F temperature restriction
  – To understand effects of using water augmentation from:
    • Wadesville Mine
    • Tamaqua’s Still Creek Reservoir
  – To understand effects of reducing the use of water diverted from the Delaware River
  – Understanding the overall effects on public water supplies
  – Determine what conditions are appropriate for a new Docket
Provisions of the Demonstration

• Multiyear Demonstration (9 Years) including:
  – Consumptive use augmentation from:
    • Wadesville Mine
    • Still Creek Reservoir
    • Perkiomen Creek (10 CFS or recreational events flow)
  – Suspending the 59°F temperature restriction
  – Monitor effects of mine water on the Schuylkill River and drinking water intakes
  – Reduce Delaware Diversion flows
  – Support specific recreational events/times in East Branch & Perkiomen
  – Maintain at least 10 cfs in the East Branch during the Demonstration
  – Creation of a restoration and monitoring fund
Review of 2003 - 2010

- “Wet years” 2003, 2004, & 2009 (wettest year)
- “Dry years” 2005, 2007 (lowest flow), 2008 (driest year), & 2010
- 2006 - dry periods but near record flooding in late June
- 2007 had the lowest flow of the Demonstration recorded on October 2nd of 319 CFS including 19 CFS of augmentation ($Q_{7-10} = 313$ CFS)
- No reported impacts on water purveyors
- All years were very successful
- No unexpected observations related to the Demonstration
- Consumptive water use by LGS in 2005 – 2010 did not impact DO
- Demonstration continued for an additional year
Monitoring in 2011

- Independent* Monitoring was conducted for:
  - Mine pool – water level, discharge rate, and quality
  - Public water supplies – water quality
  - Schuylkill River – flow and rainfall, biology and water quality (upper), DO and water quality (lower)
  - Norwegian Creek and East Norwegian Creek – water quality
  - Still Creek Reservoir – discharge and water quality
  - Little Schuylkill River – flow and water quality
  - East Branch Perkiomen Creek – flow, water quality, and biology

* With oversight by PADEP and DRBC with analysis performed by a licensed laboratory
Review of 2011 Results to Date

• 9th year of the Demonstration
• June 4th – Start of the 2011 Demonstration
• Augmentation releases:
  – 2 from the Wadesville Mine:
    • July 15th through the 20th
    • July 25th
  – 3 from Still Creek Reservoir:
    • July 5th through the 11th
    • July 15th through the 20th
    • July 26th through the 27th
• July 2011 was one of the hottest on record (approx. 6°F hotter than normal)
• August 2011 is the wettest August on record – 14.78 inches of rain at Landingville from August 1 – 23
River Discharge at Pottstown in 2003-2010

Mean daily discharge of the Schuylkill River at Pottstown
River Discharge at Pottstown in 2003-2011

Mean Streamflow - Schuylkill River @ Pottstown

- 2003
- 2004
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011

Long-term mean (1928-2010)
Discharge of Schuylkill River at Pottstown in 2011 to Date

Mean daily discharge of the Schuylkill River at Pottstown
River Discharge below 560 cfs at Pottstown in 2011 to Date

Mean daily discharge of the Schuylkill River at Pottstown
Site map of dissolved oxygen monitoring stations
Example of Diel Fluctuation in pH and DO
Mean Daily DO in 2011
Hourly measurements at Limerick Intake DO, Temp and pH Data
June 4 through August 8 2011
Hourly measurements at PA American

PA American Intake DO, Temp and pH Data
June 4 through August 8 2011

- DO mg/l
- pH Units
- 4 mg/l
- Temp °F
Hourly measurements at Vincent Dam

Vincent Dam DO and Temp Data
June 4 through August 8 2011

DO (mg/l) - pH (units)

Date


Temp (°F)

45 50 55 60 65 70 75 80 85 90 95

DO mg/l
4 mg/l
Temp °F
Hourly measurements at Black Rock

Black Rock Dam DO, Temp and pH Data
June 4 through August 8 2011
Hourly measurements at Norristown

Norristown Pool DO, Temp and pH Data
June 4 through August 8 2011

- DO mg/l
- pH Units
- 4 mg/l
- Temp °F
Site map of sampling stations
Relation of daily mean water temperature measured in East Norwegian Creek and at Stations 107 and 109 in the Schuylkill River.
## Wadesville Mine

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<td>TDS&lt;sup&gt;1&lt;/sup&gt;</td>
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<td>DO&lt;sup&gt;1&lt;/sup&gt;</td>
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<td>Specific conductance (umhos/cm)</td>
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<td>pH (SU)</td>
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<td>Temperature (°C)</td>
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<sup>1</sup> Total concentrations in mg/L unless otherwise indicated
Site map of monitoring stations
Mean daily water temperature measured in Still Creek, Little Schuylkill River (LSR) upstream of Still Creek, LSR downstream of Still Creek, and LSR near Tamaqua, June-July 2011.
East Branch and Perkiomen Creek Coliform Monitoring Stations

Figure 4.10-1.
Location of water quality monitoring stations on East Branch Perkiomen Creek and Perkiomen Creek.

Legend
- Monitoring Stations
Restoration and Monitoring Fund

• Contributions to the Fund:
  – 2005  $158,000
  – 2006  $271,000
  – 2007  $162,000
  – 2008  $169,149
  – 2009 $224,441
  – 2010 $215,480
  – 2011 through mid August ≈ $107,000

• Potential new funding methodology would be based on Schuylkill River Total Consumptive Use (gallons/yr.)
Summary and Conclusions

- 2011 has been successful thus far with no significant findings or issues of concern.
- Data and analysis results have not shown any unexpected or issues of concern linked to the Demonstration.
- All Demonstration objectives have been achieved.
- The Demonstration has provided significant benefits Delaware River Basin.
• Based on the data, Exelon believes a new Docket should be issued approving long-term continuation of the provisions of the Demonstration.

• Long-term continuation of the provisions of the Demonstration will provide a number of important direct and indirect benefits.

• Until a new Docket is approved, the Demonstration should continue.

• We would appreciate your support for the permanent Docket.
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