Florida Public Service Commission
Ten-Year Site Plan Workshop
September 7, 2011

Tampa Electric Company Update
Agenda

• Status update of U.S. Department of Energy grant for carbon sequestration pilot project and impact on generation reserves.
• Results of studies for possible modification of 20% reserve margin criterion.
• Tampa Electric’s Polk Power Station Unit 1, entered commercial service in 1996 and was partially funded by U.S. DOE Clean Coal Technology program.

• DOE views Clean Coal Technology, now including Carbon Capture and Sequestration, as important to the nation’s long term energy future.
**Clean Coal Technology = Advanced Coal Power Systems**

- Two “super clean” coal-based IGCC demonstration plants have operated reliably: Tampa Electric IGCC Power Plant in Mulberry, Fla., and PSI Energy Wabash River IGCC Power Plant in West Terre Haute, Ind.
- The JEA Northside Generating Station in Jacksonville, Fla., is one of the world’s largest circulating fluidized bed combustion power plants.
- Future demonstrations of carbon capture and storage technologies are planned at multiple commercial-scale integrated gasification combined-cycle (IGCC) coal power plants that will be operational by 2015.

**Highlights — Research and Development**

- Demonstrations of two mercury control technologies for existing plants aimed at 50-70 percent removal now and 90 percent removal in a few years.
- Lignite drying technology that can raise generating efficiency and lower pollution.
- Moving clean coal technology forward, including improvements to IGCC, bringing down the cost of CO₂ capture, finding better ways to store carbon dioxide, moving toward a hydrogen economy.
- By 2012, advanced turbines, capable of firing up to 100 percent hydrogen, will be integrated into power plants that separate and capture CO₂.
- Continued concentration on lowering the costs of pre- and post-combustion capture of CO₂.
- Continued concentration on identifying, validating, and testing suitable sites for safe, long-term CO₂ storage.
- By 2015, build on IGCC advancements achieved over the past five years to at least double the amount of carbon dioxide sequestered, compared with earlier goals.

All data in million short tons. Figures are rounded. Total emissions reductions are due to several factors, which include increased commercialization and deployment of clean coal technologies.

(Source: Energy Information Administration, Environmental Protection Agency)
DOE’s Southeast Regional Carbon Sequestration Partnership (SECARB) information

Composite Map of CO₂ Sources and Geologic Storage Formations

The distance between stationary source and geologic storage formation is calculated as the shortest straight-line distance from each point. While these results do not give a complete picture of the transportation and infrastructure requirements, it does give a first-order interpretation of the magnitude of the requirements.

The sources in SECARB match up well with the potential storage reservoirs. For example, more than 70 percent of all sources (by volume) in the SECARB region are located within 50 kilometers of a storage site. Approximately 40 percent of the sources are co-located with an appropriate storage site. This especially occurs in the Gulf Coast region where many of the sources overlie saline formations, coalbeds, or both.

The table below identifies how many years’ storage is possible, given the current annual emissions and the known CO₂ storage resource.

<table>
<thead>
<tr>
<th>State</th>
<th>Estimated Years of Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Oil and Gas</td>
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<tr>
<td>AL</td>
<td>5</td>
</tr>
<tr>
<td>FL</td>
<td>143</td>
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<tr>
<td>GA</td>
<td>90</td>
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<td>LA</td>
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<td>54</td>
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<td>NC</td>
<td>77</td>
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<td>SC</td>
<td>40</td>
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<td>TN</td>
<td>66</td>
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<tr>
<td>TX**</td>
<td>373</td>
</tr>
<tr>
<td>VA</td>
<td>46</td>
</tr>
<tr>
<td>Federal Offshore</td>
<td>N/A</td>
</tr>
</tbody>
</table>

| Total | 1,085 | 29,652 | 65,875 | 935**** |

* Low estimates used.
** Eastern Texas, TRC Districts 1–6.
*** Years of CO₂ storage at the current emission rates (State CO₂ storage resource/State annual emissions).
**** Average years storage for whole SECARB area (total CO₂ storage resource/total annual emissions).
Polk Carbon Sequestration Demonstration Project

- On September 7, 2010, the U.S. DOE announced the funding of a project to demonstrate a warm gas cleanup system (WGC) to remove sulfur at elevated temperature along with the integration of Carbon Capture and Sequestration (CCS).
- DOE funding level is $168.8M.
- Project is designed to treat a portion (≈25%) of the syngas produced by the Polk 1 gasifier by removing sulfur and CO\textsubscript{2}, then returning the treated gas to the process for use in power production.
- Operation of the pilot project would take place in 2014 and early 2015.
Key Project Participants/Goals

- **US Department of Energy**
  - Funding project, $168.8M, Clean coal program and ARRA funds
  - Demonstrate WGC/CCS at operating IGCC, high visibility strategic project for DOE
- **RTI International**
  - Prime contractor, WGC technology owner
  - Develop WGC technology for licensing revenue
- **Tampa Electric**
  - Host site, sequestration permitting/operation
  - Evaluate technology, demonstrate CCS, option to retain equipment for future use
  - Utilize one injection well from ongoing Regional Reclaimed Water Project
- **Shaw Group**
  - Engineering, construction, operation
  - Potential technology owner
- **BASF**
  - CO₂ capture technology owner
- **University of South Florida**
  - Geologic research and modeling
Regional Reclaimed Water Project
Utilize waste water from City of Lakeland to increase water supply to Polk and offset ground water use.

**Project Elements**

**Pipeline** - Approximately 15 miles of pipeline routed from Lakeland reservoir on SR60 to Polk Power Station

**Treatment System** - Process reclaimed water using a reverse osmosis system in conjunction with pretreatment technologies

**Injection Wells** - Construction of 2 deep wells for disposal of treatment system effluent.

In service in 2013
CCS Project Synergies with Reclaimed Water Project

- Lakeland reclaimed water project requires installation of two underground injection wells.
- Geologic evaluation for water injection is useful to understand CO₂ injection potential.
- During the CCS demonstration period, one well could be used for CO₂ injection and still serve as backup to primary water injection well.
- Use of injection well for CO₂ is considered an “in-kind” contribution towards DOE cost sharing requirement (no incremental expense for Tampa Electric or it’s customers).
PPS Site Suitability for CCS

• Suitable Deep Injection Zone – (4100’ to 8000’, CO₂ fluid).
• Excellent Confining Unit/Caprock.
• Geologic/Structural Traps.
• Seismic Suitability/Stability.
• Well Inventory, very few penetrations through confining layer.
• Phosphate Mining & Adjacent Land Use.
• Geochemistry of Injection Zone – indicates very rapid trapping.
Project Status / Schedule

• Front End Engineering Design (FEED) nearing completion.
• Definitive agreements for detailed engineering, construction and operation being negotiated.
• Construction to take place in 2013.
• Operation to take place in 2014 and first half of 2015.
Operational Objectives and Impacts

• Project will use 25% slipstream of syngas.
• Demonstration equipment can be isolated at any time at TEC’s sole discretion.
• Operation of project will reduce net plant output (on the order of 10 MW, to be determined with detailed engineering).
• Project can be isolated, if required, on peak, so rated unit capacity will not change.
• Maintenance of the demonstration system should be able to be done with no impact to Polk Unit 1.
Cost Impacts/Funding

• DOE co-funding will cover the direct costs of this project for Tampa Electric and it’s customers.

• Agreements are being developed to provide for reimbursement of labor expense, fuel costs, purchased power and other incremental costs associated with the project.

• Tampa Electric’s contribution will be limited to the “in-kind” value of utilizing injection well 2 for \( \text{CO}_2 \) storage. No incremental expense.
Agenda

- Status update of U.S. Department of Energy grant for carbon sequestration pilot project and impact on generation reserves.
- Results of studies for possible modification of 20% reserve margin criterion.
Reserve Margin Considerations

- Peninsular Florida with limited interconnections.
- IOUs provide a large amount of supply side support for state.
- Forced outages occur randomly.
- Instantaneous peaks may exceed planning peaks.
- Size of units versus total TEC system.
- Historic peak demand versus available capacity.
## TEC Generating Units

<table>
<thead>
<tr>
<th>Type</th>
<th>Unit</th>
<th>Net Summer MW</th>
<th>% of TEC System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Big Bend 1</td>
<td>385</td>
<td>9% *</td>
</tr>
<tr>
<td>Base</td>
<td>Big Bend 2</td>
<td>385</td>
<td>9% *</td>
</tr>
<tr>
<td>Base</td>
<td>Big Bend 3</td>
<td>365</td>
<td>9%</td>
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<tr>
<td>Base</td>
<td>Big Bend 4</td>
<td>417</td>
<td>10%</td>
</tr>
<tr>
<td>Base</td>
<td>Polk 1</td>
<td>220</td>
<td>5%</td>
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<tr>
<td>Intermediate</td>
<td>Bayside 1</td>
<td>701</td>
<td>16%</td>
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<tr>
<td>Intermediate</td>
<td>Bayside 2</td>
<td>929</td>
<td>22%</td>
</tr>
<tr>
<td>Peaking</td>
<td>Bayside 3</td>
<td>56</td>
<td>1%</td>
</tr>
<tr>
<td>Peaking</td>
<td>Bayside 4</td>
<td>56</td>
<td>1%</td>
</tr>
<tr>
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<td>Bayside 5</td>
<td>56</td>
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<tr>
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<td>Bayside 6</td>
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<tr>
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<td>Big Bend CT4</td>
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<td>1%</td>
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<tr>
<td>Peaking</td>
<td>Polk 2</td>
<td>151</td>
<td>4%</td>
</tr>
<tr>
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<td>151</td>
<td>4%</td>
</tr>
<tr>
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<td>151</td>
<td>4%</td>
</tr>
<tr>
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<td>Polk 5</td>
<td>151</td>
<td>4%</td>
</tr>
<tr>
<td>Peaking</td>
<td>COT</td>
<td>6</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>****</td>
<td><strong>4,292</strong></td>
<td><strong>From 2011 TYSP Schedule 1</strong></td>
</tr>
</tbody>
</table>

*Operate on one FGD system (18% total)
Historic Peak Demand Versus Available Capacity

- **Monthly 2007-2010**
  - Actual monthly peak demand versus available capacity
    - 2007  2 months short
    - 2008  2 months short
    - 2009  1 month short
    - 2010  1 month short

- **Annual 2007-2010**
  - Short 3 out of 4 years on annual peak
  - Short 4 out of 4 years on annual peak if TEC was at a 15% RM
Summary

- Decreasing the current 20% reserve margin criterion to 15% will increase the risk of interruption to firm customers during peak demand.
- The relative size of generating units to the total system makes adequate reserve margin more critical.
- Recent history indicates that a 20% reserve margin is appropriate.