CIV E 240
Technical Communications

EPCOR Genesee Generating Station Phase 3
Project Background
Tuesday, January 9, 2007
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Presentation Resources

- EPCOR website (www.epcor.ca/) accessed December 2006.
Breakdown of Canada’s Fossil Fuel Energy Reserves

Canadian Coal Distribution
Estimated Quantities of Coal in Alberta (GT)

<table>
<thead>
<tr>
<th>Type</th>
<th>Production</th>
<th>Remaining Reserves</th>
<th>Ultimate Potential</th>
<th>Ultimate in place</th>
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<tbody>
<tr>
<td>Low and Medium</td>
<td>Surface</td>
<td>0.2</td>
<td>0.8</td>
<td>1.2</td>
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<td></td>
<td>Underground</td>
<td>0.1</td>
<td>0.0</td>
<td>2.0</td>
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<tr>
<td>Bituminous</td>
<td>Surface</td>
<td>0.1</td>
<td>1.8</td>
<td>7.5</td>
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<td></td>
<td>Underground</td>
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<td>0.9</td>
<td>150.0</td>
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<tr>
<td>High Volume Bituminous</td>
<td>Surface</td>
<td>0.7</td>
<td>8.3</td>
<td>9.3</td>
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<tr>
<td></td>
<td>Underground</td>
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<td>21.1</td>
<td>460.0</td>
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<td>Subtotal</td>
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<td>1.2</td>
<td>33.3</td>
<td>630.0</td>
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</tbody>
</table>

Alberta Electricity Generation Capacity

<table>
<thead>
<tr>
<th>Alberta Generating Capacity [MW]</th>
<th></th>
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<tbody>
<tr>
<td>Coal</td>
<td>5,840</td>
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<tr>
<td>Gas</td>
<td>4,277</td>
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<tr>
<td>Hydro</td>
<td>900</td>
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<tr>
<td>Wind</td>
<td>275</td>
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<td>Biomass</td>
<td>178</td>
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<tr>
<td>Fuel Oil</td>
<td>8</td>
</tr>
<tr>
<td>Subtotal</td>
<td>11,477</td>
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</tbody>
</table>

Interconnections

| British Columbia | 630     |
| Saskatchewan     | 150     |
| Subtotal         | 950     |
| Grand Total      | 12,427  |
Development of Wetaskiwin Surface Coal Deposits – Four Coal Fired Power Plants

Four plants – 4277 MW capacity (~34% of Alberta electrical generation capacity)
Genesee Generating Station

Genesee Generating Station (con’t)

- EPCOR coal-fired power plant providing power to province.
- Three generating units:
  - units G1 & G2 – each 381 MW net/410 MW gross (built in 1989 and 1994, respectively)
  - unit G3 – 450 MW net/490 MW gross ($695 M unit recently completed in 2005)*
- Large surface mine adjacent to station.
Genesee Generating Station (con’t)

- Located 60 minutes southwest of Edmonton.
- Operating design parameters for G1 & G2:
  - each unit has net annual production ~3,150 GWh
  - each unit requires ~1.7 million tonnes of coal annually
  - each unit produces 39 tonnes of ash per hour

Genesee Generating Station (con’t)

- Operating design parameters for G3:
  - typical net annual production – 3,745 GWh
  - requires 1.8 million tonnes of coal annually
  - ash production ~41 tonnes per hour

- G1/2/3 coal requirements – 5.2 to 5.4 million tonnes annually
- G1/2/3 ash production – 119 tonnes per hour
- G 1/2/3 uptimes ~92%
Genesee Mine Site

- Joint venture of EPCOR and Fording Coal Ltd.
- Operated using draglines, loaders, trucks, bulldozers.
- Coal seams exposed by two draglines (50.5 m³ and 81 m³ buckets) and world’s longest boom – 128 m length.
- Mining parameters:
  - 170 million tonnes, sub-bituminous B coal – 40-yr supply
  - depth of overburden range – 3 to 60 metres
  - mining rate for G1/2/3 – 5.2 to 5.4 million tonnes per year
Genesee Mine Dragline Operations

Genesee Coal Handling Facility & Settling Ponds
Genesee Cooling Pond

- Artificial pond covering 735 hectares.
- Contains 34 million cubic metres (m$^3$) of water.
- Can provide cooling water for up to four 400 MW units (1,600 MW combined).
- Water level in pond maintained by pumping water from North Saskatchewan River and supplemented with local runon.

Satellite View of Genesee Generating Station
Project Components

- North Saskatchewan River
- Cooling Pond
- Mine Site
- Generating Station
G3 Supercritical Boiler Technology

- Higher temperatures and steam pressures together with high efficiency steam turbine create a more efficient process for converting thermal energy into electricity.
- Process uses less coal per MW hour of electrical energy than conventional subcritical process, thereby reducing emissions.
- Furnace temperatures of supercritical pressure boiler reaches 1,400°Celsius.
- G3 boiler produces steam at 26 Megapascals - ~50% higher than G1 & G2.
Layout of Genesee Generating Station

Electricity Production at Coal Fired Power Plants

- Coal is burned to produce heat to boil water from cooling pond.
- Pressurized steam from boiling water spins a large fan (turbine).
- Turbine rotates large magnet to create an electrical charge (generator).
G3 Process

Pulverized coal from surface mine

To Transmission Lines

Cooling Pond

G3 Project Components

- Boiler Island
  - boiler (burner, super heater, etc.)
  - induced draft/primarily air/forced draft fan
  - coal handling system
  - ash handling system
  - flue gas desulphurization (FGD) unit and fabric filter baghouse
Selected Features of G3 Boiler Island

- Spiral water wall
- Multi-lead ribbed tube for water wall
  - Uniform heat absorption and stable fluidity
  - Reduction of boiler plant pressure loss
  - Sufficient margin for DNB
- Advanced Hitachi-NE burner & compartment wind-box
  - Reduction of NOx emission
  - Reduction of excess air for combustion
  - Reduction of inerted carbon in fly ash
  - Lower stable operating load

- High reliability for advanced steam conditions
  - Proven high strength material
  - Lower thermal stress construction

- MPS pulverizer
  - Longer life
  - No capacity deterioration
  - Low power consumption

G3 Project Components (con’t)

- Turbine Island
  - turbine-generator
  - condensate system (condenser, extraction pumps, etc.)
  - circulating water system (pump, screen, and auxiliary equipment)
  - feedwater heating system (pumps, feedheaters, etc.)
  - auxiliary systems (instrument air compressor, chemical dosing equipment, etc.)
G3 Steam Turbine

Other G3 Project Components

- Electrical Instrument and Control
  - 600-V motor control center
  - distribution control system
- Civil Engineering and Architecture
  - boiler-turbine building
  - turbine-generator pedestal
  - heating and ventilation system
- Elevator and lift devices
- Lighting and services
G3 Project Components (con’t)

- Sulphur removal – a dry lime system is used as Genesee coal has low sulphur content.
- Particulate removal – fabric filter (badhouse) system is used.
- Bottom ash (flyash) is returned to mined area with haul trucks where it is used for fill and disposal.
G3 Development Schedule

G3 – Manpower Forecast
G3 Construction Details

- Construction of $695 million facility completed on-time and on-budget.
- 36-month construction period began in late 2001.
- Number of workers on-site peaked at 2,100; with 42 contractors and 16 unions.
- Work-site reached two million hours without a lost time injury in 2004.
- EPCOR responsible for overall construction management.
- Hitachi Canada (Calgary) lead contractor for construction of boiler house.
- Colt Engineering (Edmonton) led construction and engineering for balance of plant.

G3 Construction Details (con’t)

- Installation of 256-tonne turbine generator.
- Four million kilograms of steel.
- 311 km of pressure piping for boiler systems and superstructure.
- Excavation of 360 thousand tonnes of soil.
- 50,000 cubic meters of concrete.
- Construction of a 138-meter tall stack.
- Development of sophisticated switchyards, emissions management units, and electrical distribution systems.
G3 Environmental Performance

- CO₂ emissions:
  - 8 to 10% lower than existing G1 & G2 units
  - 18% lower than average Alberta coal generation
- SO₂ emissions:
  - 57% below Alberta standards
  - FGD unit captures up to 77% of SO₂ emissions
  - meets US EPA emissions standards
- NOₓ emissions:
  - 20% reduction, meets Alberta standards
- Particulate Matter emissions: >99.8% capture efficiency

Power Plant Air Monitoring Programs

- Regional ambient air monitoring (continuous and passive)
- Acid deposition assessment program
- Mercury deposition assessment program
- EPCOR/TAU Stack Emissions Monitoring Program:
  - Wabamun – 1 stack
  - Sundance – 3 stacks
  - Keephills – 2 stacks
  - Genesee – 2 stacks
Regional Air Monitoring Program – Continuous Monitoring

Meadows Air Monitoring:
- wind speed and direction, air temperature, relative humidity
- continuous SO₂ and NO₂

Wagner Air Monitoring Station:
- wind speed and direction, air temperature, relative humidity
- continuous SO₂ and NO₂

Genesee Air Monitoring Station:
- wind speed and direction, air temperature, relative humidity
- continuous SO₂, NO₂, PM₂.₅, and O₃
- PM₁₀ and PM₂.₅ every 6th day
- metals scan of PM₂.₅ filters

Power Air Monitoring Station:
- wind speed and direction, air temperature, relative humidity
- continuous SO₂, NO₂, and PM₂.₅
- PM₁₀ and PM₂.₅ every 6th day
- metals scan of PM₂.₅ filters

Regional Air Monitoring Program – Passive Monitoring

Air Monitoring Legend
- Continuous Station

Passive Station:
1 - NOₓ O₃
2 - NOₓ
3 - NOₓ SO₂ O₃
4 - NOₓ SO₂
4b - NOₓ SO₂
4d - NOₓ SO₂
4e - NOₓ SO₂
5 - NOₓ SO₂
6 - NOₓ SO₂ O₃
7 - NOₓ O₃
8 - NOₓ
9 - NOₓ SO₂
10 - NOₓ SO₂ O₃
11 - NOₓ O₃
12 - O₃
13 - O₃
14 - O₃
15 - NOₓ O₃
16 - NOₓ O₃
Genesee- NOₓ SO₂ O₃
Air Monitoring Program –
Acid Deposition Monitoring (two sites)

Air Monitoring Program –
Mercury Deposition Monitoring