

IGCC Working Group

September 14, 2006



Pacific Power | Rocky Mountain Power | PacifiCorp Energy

Agenda

- Introduction
- Regulatory Perspectives on IGCC
 - ▶ Idaho, Harry Hall
 - ▶ Oregon, Lisa Schwartz
 - ▶ Utah, Becky Wilson
 - ▶ Washington, Graciela Etchart & Yohannes Mariam
- Lunch
- Regulatory Perspectives on IGCC (cont'd)
 - ▶ Wyoming, Mary Burns
- PacifiCorp Presentation, Technology Guarantees
- PacifiCorp Presentation
 - ▶ Water Usage Comparisons
 - ▶ O&M Comparisons
- Feedback, discussion of issues. Planning for next meeting

Regulatory Perspectives on IGCC

- Harry Hall, Staff Engineer, Idaho Public Utilities Commission
- Lisa Schwartz, Oregon Public Utility Commission Staff
- Becky Wilson, Director, Utah Division of Public Utilities
- Graciela Etchart & Yohannes Mariam, Washington Utilities & Transportation Staff
- Commissioner Mary Burns, Wyoming Public Service Commission

IGCC Working Group Afternoon Session

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Technology Suppliers – Vendor Guarantees

Provide a summary of warranties/guarantees that can be provided under an arrangement that provides turnkey design, procurement, construction, commissioning, and startup.

- What will be the initial warranty period? What will be covered?
- Willingness to enter into a contract with liquidated damages for contract performance criteria such as output, heat rate, and schedule?
- Warranted reliability and availability levels (%) during the initial warranty period? On coal? With gas backup?
- Level of availability/reliability is expected during commissioning?
- Duration of commissioning period?
- Types of long term programs that can be provided to ensure high reliability/availability? Level of reliability/availability that can be provided under these types of long term programs?

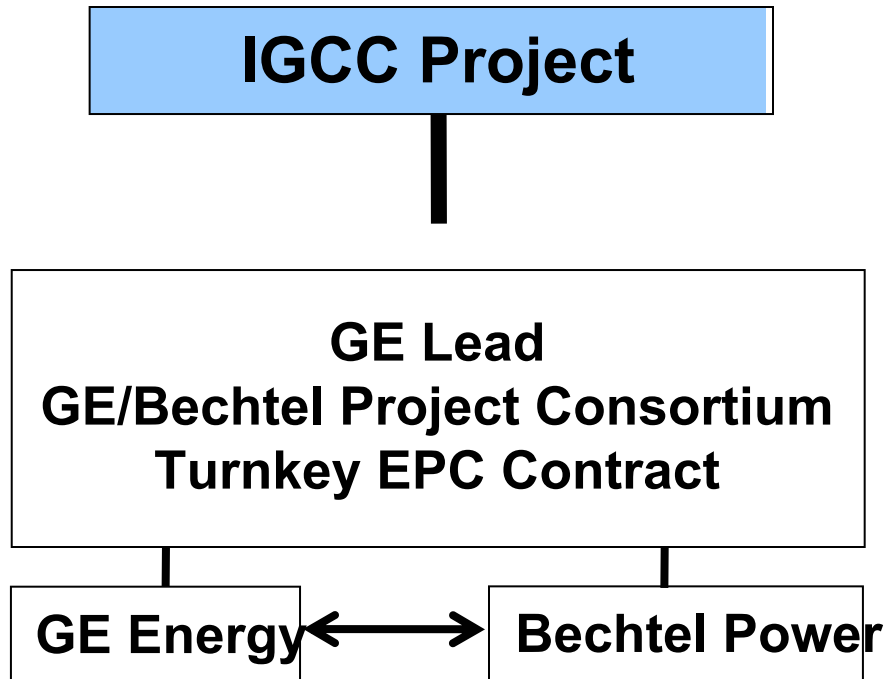
Technology Suppliers – Vendor Guarantees

Request was forwarded to:

- General-Electric Energy
- ConocoPhillips/Fluor/Siemens
- Siemens Power Generation

GENERAL ELECTRIC ENERGY RESPONSE

True Single Point Responsibility



Contract Scope

EPC Firm Price w/

Guaranteed:

- Schedule
- Output
- Heat Rate
- Air Emissions
- Performance LDs

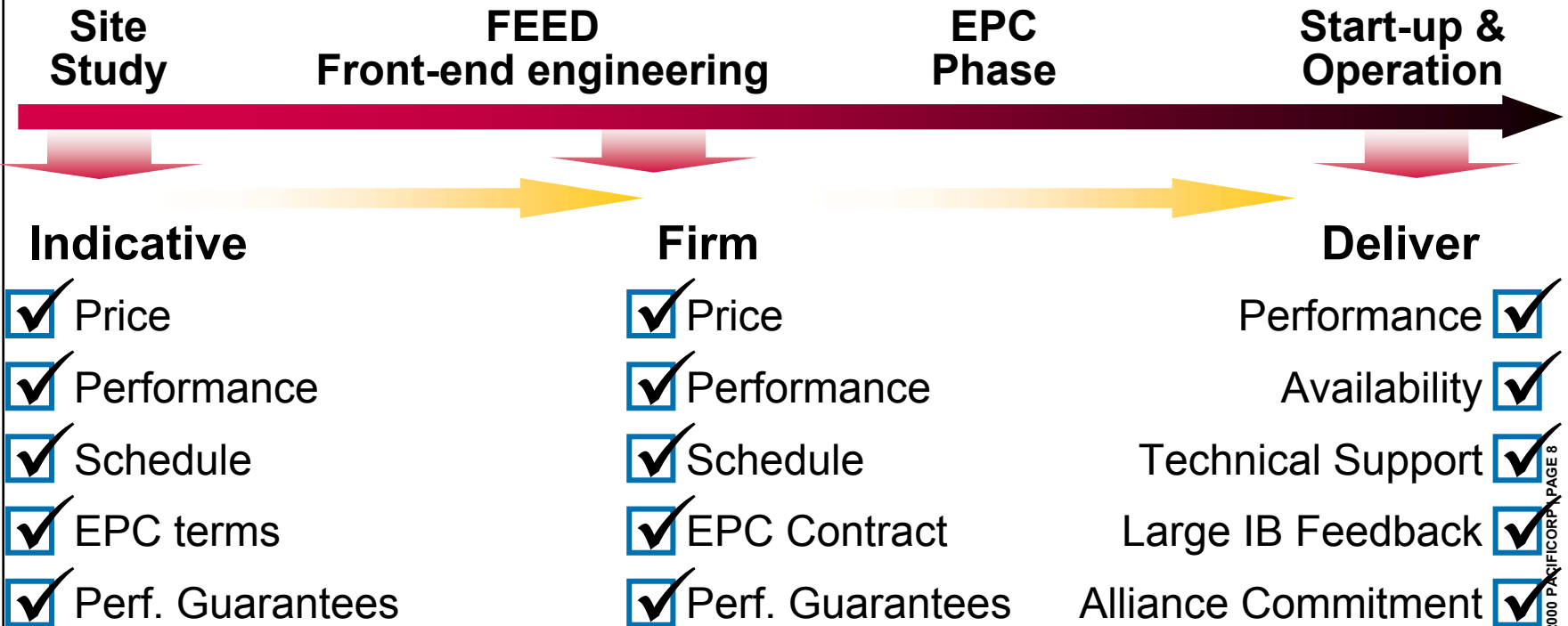
Facilitates Project Financing



IGCC Alliance



GENERAL ELECTRIC ENERGY RESPONSE (CONT'D)



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CONOCO-PHILLIPS (Gasifier Technology Supplier)

“ConocoPhillips is working with two EPC consortiums, Kiewit & WorleyParsons and Fluor & Siemens, on project specific offerings to deliver a technology and EPC product package complete with appropriate guarantees for financing IGCC projects.”

SIEMENS (IGCC Plant Supplier)

"It is our intent to structure an IGCC EPC contract similar to that of a pulverized coal EPC contract, with some recognition for new technologies involved with an IGCC plant. That would include plant warranties, performance warranties, and liquidated damages associated with performance and schedule. Siemens will also provide a range of services after commercial operation, from Technical Field Assistance to parts to outage services to full O&M services for an IGCC plant. If a customer chooses to pursue full O&M with Siemens, the terms of that O&M contract would include availability and reliability provisions. With regards to specific terms for either the EPC or services contracts, those terms would be agreed upon between Siemens and its customer after defining the scope of each of those contracts and negotiating the appropriate commercial terms."

Water and O&M Comparisons IGCC to Pulverized Coal Plants Afternoon Session

September 14, 2006

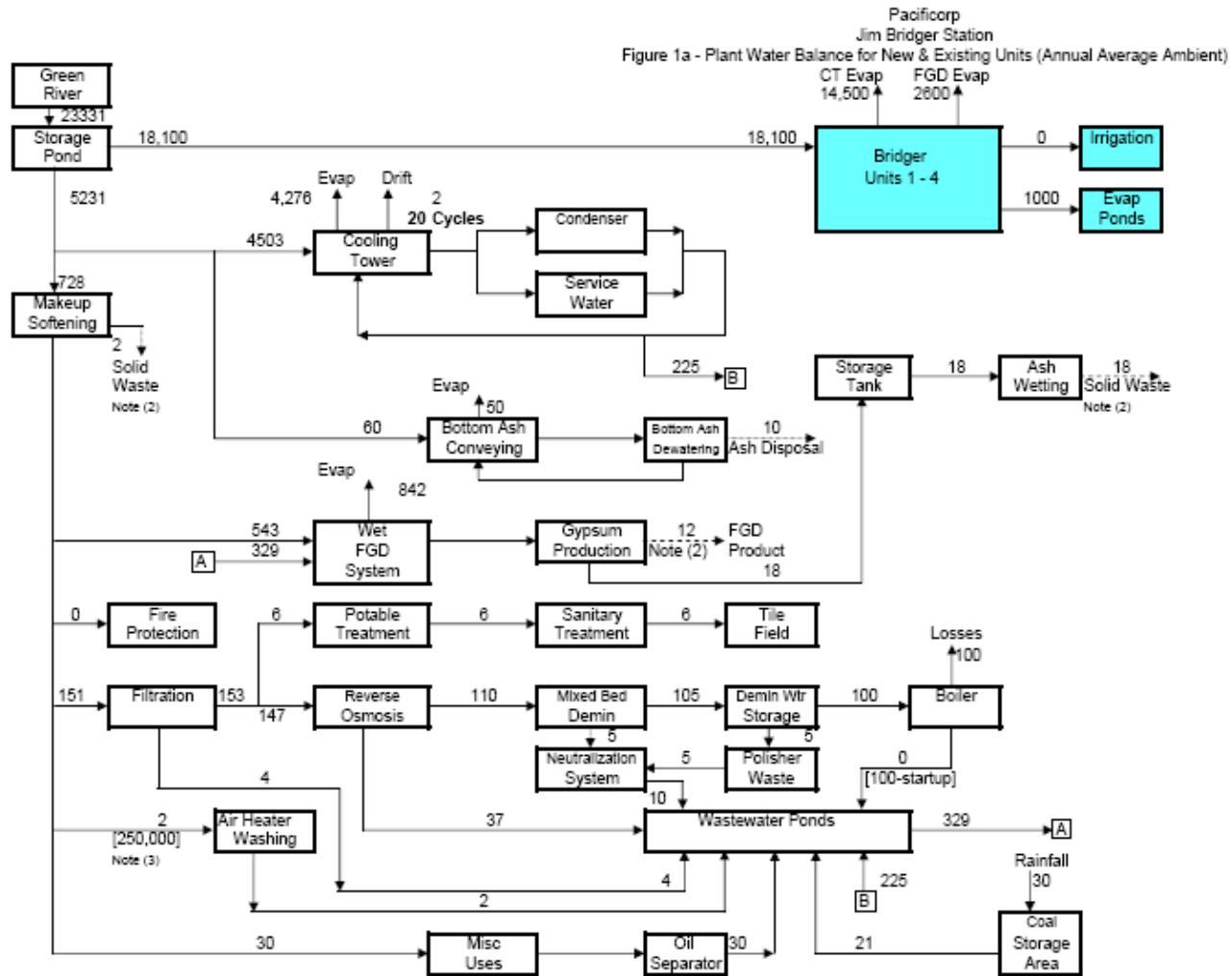


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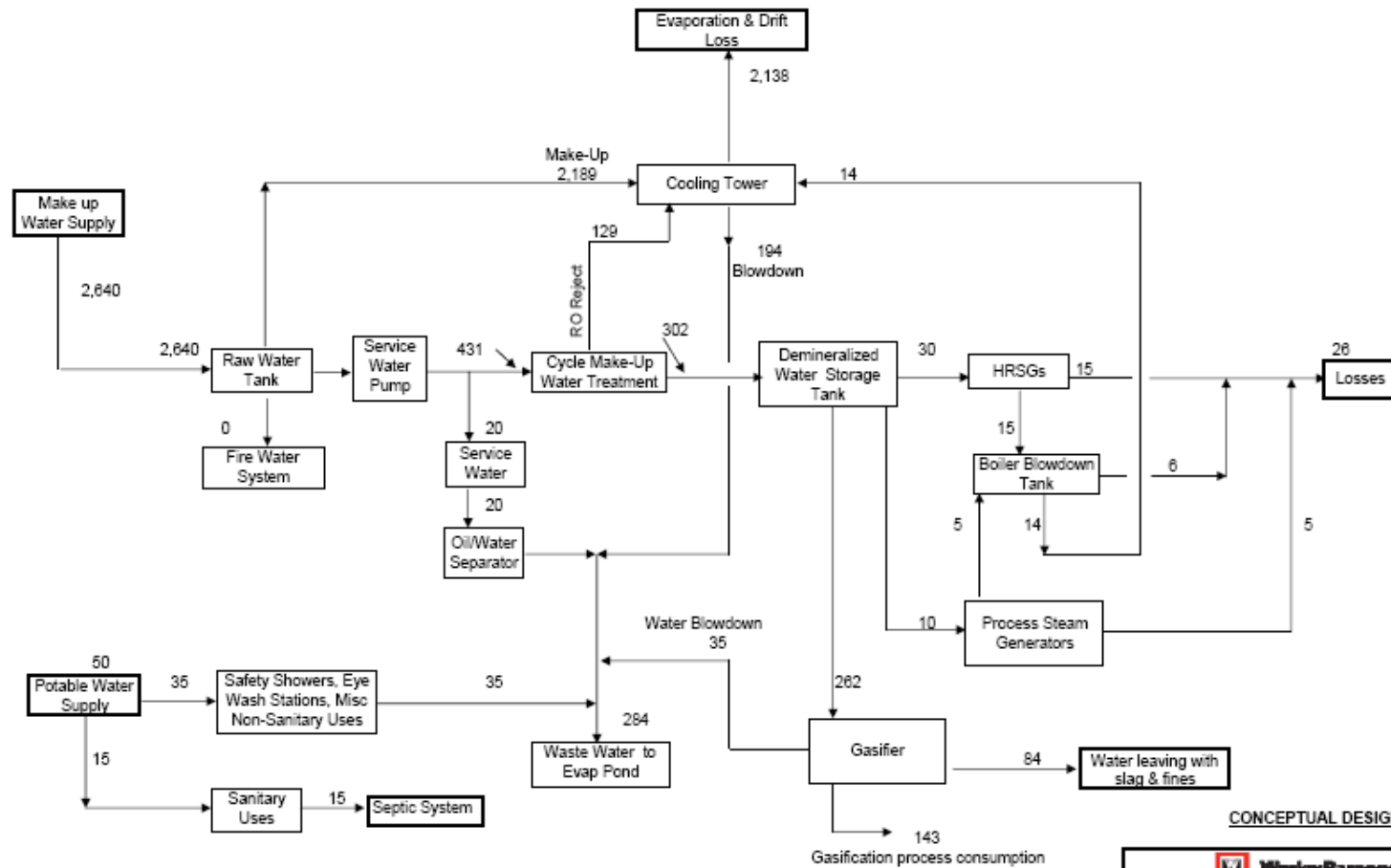
Water Use

- Water in power plants is used for:
 - ▶ Condenser cooling – generally use cooling towers where primary water loss is through evaporation.
 - ▶ Flue Gas Desulfurization (Scrubbers) – Use water; wet scrubbers use more than dry scrubbers.
 - ▶ Process cooling – low consumptive use
 - ▶ Boiler – some blowdown but low consumptive use
 - ▶ Gasifier – Cooling and steam – waste liquids created
 - ▶ Air separation units for gasification – large cooling load; generally use cooling towers.
 - ▶ Entrained in ash and sludges – relatively small amount
 - ▶ Potable water

Supercritical Technology–Water Balance (Bridger 5)



IGCC Water Balance – WorleyParsons Report



Notes:

1. The water balance is based on a IGCC plant with a ConocoPhillips Gasifier.
2. Assumes RO / EDI type Demin Plant
3. Cooling Tower cycles of Concentration is estimated at 12.
4. Cycle losses and boiler blowdown estimated at 1/2% condensate flow each

Units: All flows are in GPM unless otherwise noted.

Summary Balance:

In Flow	2,690	gpm	4,340	ac-ft/yr
Out Flow	2,690	gpm	4,340	ac-ft/yr
Difference	0			

CONCEPTUAL DESIGN

PacifiCorp IGCC Study Update - Hunter Site		
Preliminary Water Balance - E Gas Gasifier		
2 x2x1 - 7FB CTGs, Syn Gas Firing - Design Case		
Black Butte Coal		
49.5 Degrees, 51%RH - Base Load, Unfired HRSG		
DWG No:	Rev	Date:

Water use variables

- Cooling tower cycles of concentration
 - ▶ Wide variety of numbers used in studies
 - Range from 3 to 20 cycles
 - PacifiCorp tends to operate at higher cycles (12 to 20) based on emphasis on water conservation & higher quality of makeup water
- Waste Disposal
 - ▶ Zero discharge versus discharge permit
 - ▶ Eastern plants more likely to have a discharge permit
- Water Reuse
 - ▶ Use of cooling tower blowdown in scrubber
 - ▶ Re-use boiler and gasifier blowdown streams

Water Use “Rules of Thumb” for Western Plants

- Typical water use for a sub-critical pulverized coal unit is 8.0 to 8.5 gpm/MW
 - ▶ For example: Jim Bridger 1-4 uses 18,100 gpm for 2,120 MW ~ 8.5 gpm/MW
 - ▶ For a 500 MW plant this is equal to :
 $500\text{MW} \times 8.5 \text{ gpm/MW} \times 1.613 \text{ ac-ft/gpm-yr} = 6,855 \text{ ac-ft/yr}$
- Typical water use for a IGCC plant is 5.0 to 5.5 gpm/MW
 - ▶ For a 500 MW plant this is equal to :
 $500\text{MW} \times 5.5 \text{ gpm/MW} \times 1.613 \text{ ac-ft/gpm-yr} = 4,436 \text{ ac-ft/yr}$

4,436/6,452 is ~ 35% reduction in water use

Water Use at SCPC and IGCC Plants

From specific PacifiCorp studies (gpm):

	<u>SCPC- JB5</u>	<u>IGCC-Htr4</u>
Cooling Tower Evap.	4,278	2,138
CT Blowdown & Waste Water	0	284
FGD System (stack)	842	0
Gasification Consumption	0	143
Ash Handling	42	84
Misc. Uses & Losses	<u>129</u>	<u>41</u>
Total	5,291	2,690

Water Use at SCPC and IGCC Plants

From specific PacifiCorp studies (gpm/MW)

	<u>SCPC- JB5</u>	<u>IGCC-Htr4</u>
Cooling Tower Evap.	5.70	4.14
CT Blowdown & Waste Water	0	0.55
FGD System (stack)	1.12	0
Gasification Consumption	0	0.28
Ash Handling	0.06	0.16
Misc. Uses & Losses	<u>0.17</u>	<u>0.08</u>
Total	7.05	5.21

Water Usage Comparisons

Comparisons from the PacifiCorp water balances with both units using South West Wyoming coal:

	<u>SCPC-JB5</u>	<u>IGCC-Htr4</u>
Net MW	750	516
Net Heat Rate (Btu/kWh)	9,152	8,655
Makeup Water (gpm)	5,291	2,690
Gallons/MW	7.05	5.21
% Reduction/MW		25% reduction

Water Use Options

- IGCC water use can be reduced by using dry or hybrid (wet/dry) cooling technology for the steam turbine.
- Hybrid cooling can reduce water use by 35% compared to conventional cooling towers.
- Compared to the wet cooling IGCC case a totally dry cooling system on an 500 MW IGCC would:
 - ▶ Reduce water use by about 2,330 gpm
 - Annual water use would decrease from ~ 4,300 ac-ft/yr to ~ 580 ac-ft/yr
 - ▶ Increase capital cost by about \$40 million
 - ▶ Increase design heat rate by ~ 200 Btu/kWh on average.
- Dry cooling requires a water cost close to \$3.50 per 1000 gallons to be economic (PacifiCorp costs ~ \$1.00/1000gal)

O&M Comparisons - IGCC & Supercritical PC

- Comparison between a supercritical pulverized coal facility and an IGCC plant on the same site.
- Jim Bridger 5 site
- Southwest Wyoming coal (SWW)
- IGCC costs based on WorleyParsons study – adjusted to PacifiCorp conditions
- SCPC costs based on historical and performance expectations based on operating similar plants
- Economy of scale (PC=750 MW, IGCC=500 MW)

IGCC Comparison

OPERATING & MAINTENANCE COSTS	WorleyParsons (000's \$)	As Adjusted (000's \$)
Fixed O&M:		
Annual Operating Labor	\$7,661	\$7,650
Maintenance Labor	\$9,314	\$9,175
Administrative and Support Labor	\$4,244	\$2,500
Maintenance Material & Contract Maint.	\$19,413	\$16,150
Insurance	\$0	\$325
Total Fixed O&M	\$40,633	\$35,800
\$/kW-net	\$81.77	\$72.05
Variable O&M:		
Chemicals	\$1,383	\$1,735
Waste Disposal	\$3,127	\$825
Byproduct Credits	(\$515)	(\$275)
Total Variable O&M	\$3,995	\$2,285
\$/MWh	\$1.02	\$0.58
Total Annual O&M (in 2006 dollars)	\$44,628	\$38,085

Comparison of IGCC to SCPC Estimates

	IGCC As Adjusted (000's \$)	SCPC Jim Bridger 5 (000's \$)
OPERATING & MAINTENANCE COSTS		
MW Capacity	497	790
Fixed O&M:		
Annual Operating Labor	\$7,650	\$2,355
Incremental Operators	52	16
Maintenance Labor	\$9,175	\$4,415
Incremental Maintenance Workers	62	30
Administrative and Support Labor	\$2,500	\$897
Maintenance Material & Contract Maint.	\$16,150	\$9,081
Insurance	\$325	\$402
Total Fixed O&M	\$35,800	\$17,150
\$/kW-net	\$72.05	\$21.71
Variable O&M:		
Chemicals	\$1,735	\$5,806
Waste Disposal	\$825	\$740
Byproduct Credits	(\$275)	(\$676)
Total Variable O&M	\$2,285	\$5,870
\$/MWh	\$0.58	\$0.94
Total Annual O&M (in 2006 dollars)	\$38,085	\$23,020

Miscellaneous

Next IGCC Working Group Meeting – **October 19, 2006**

North Temple Office 130K / Lloyd Center Tower 1075G

“IPCC Special Report on Carbon dioxide Capture and Storage,”
Summary Report for Policy Makers (available off web)

Please forward any email address changes to:

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