

Welcome

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Energy & Telecommunications Interim Committee

to

Colstrip SES

Energy & Telecommunications
Interim Committee Meeting
October 4 & 5, 2007 (Colstrip)

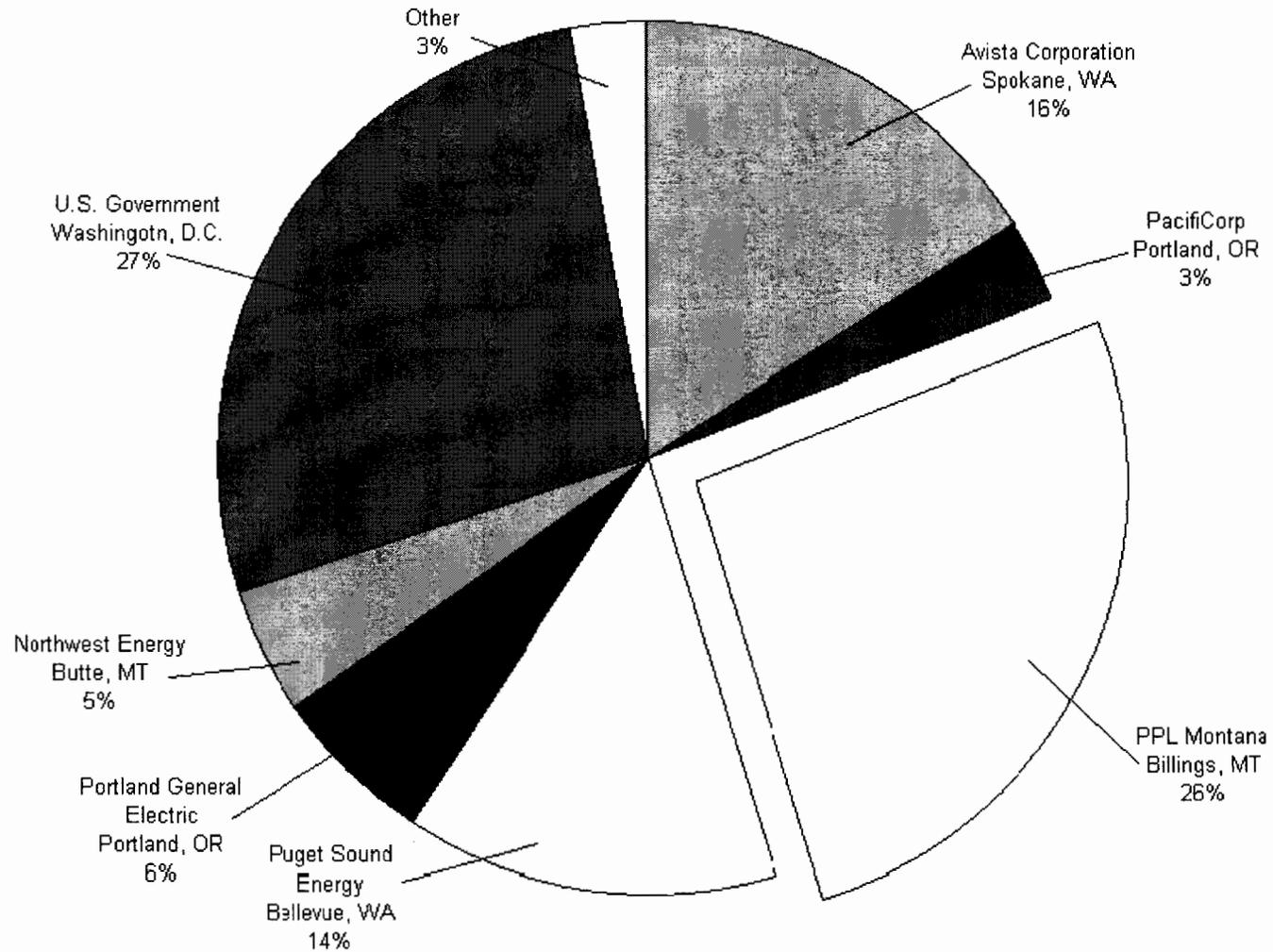
Exhibit #1



***VPP is a Journey,
not a Destination***

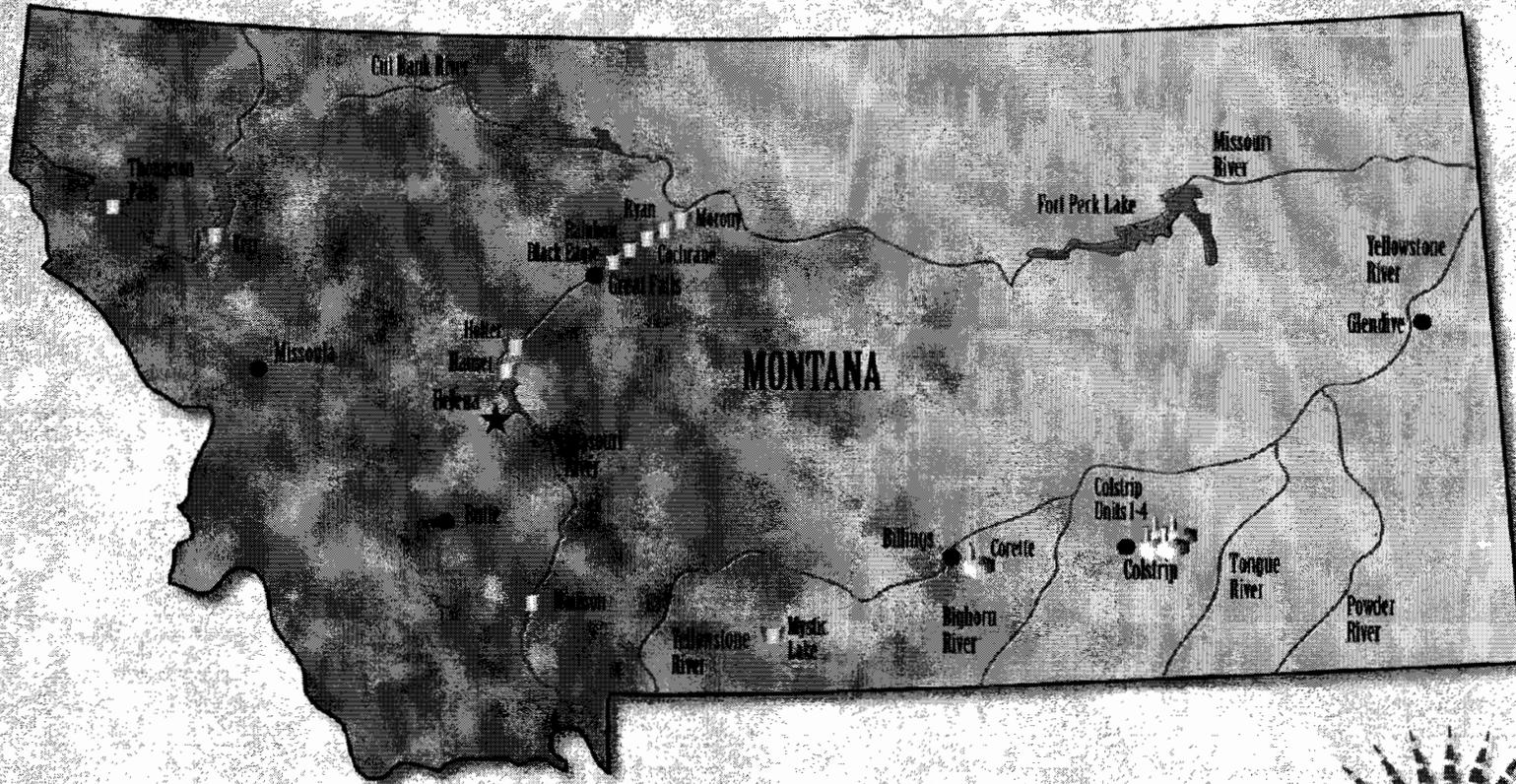


Electricity producers in Montana . . .

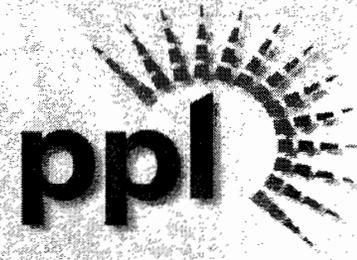


All generation capacity numbers based on summer capacity data for 2002 as published by the WECC.

PPL Montana Generation . . .



Hydroelectric Plant	Coal Fired Plant
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PPL MONTANA™

PPL Montana Generation Resources



Hydro

11 Units; 577 MW

Fossil (Coal)

2 Stations; 728 MW

Colstrip Ownership



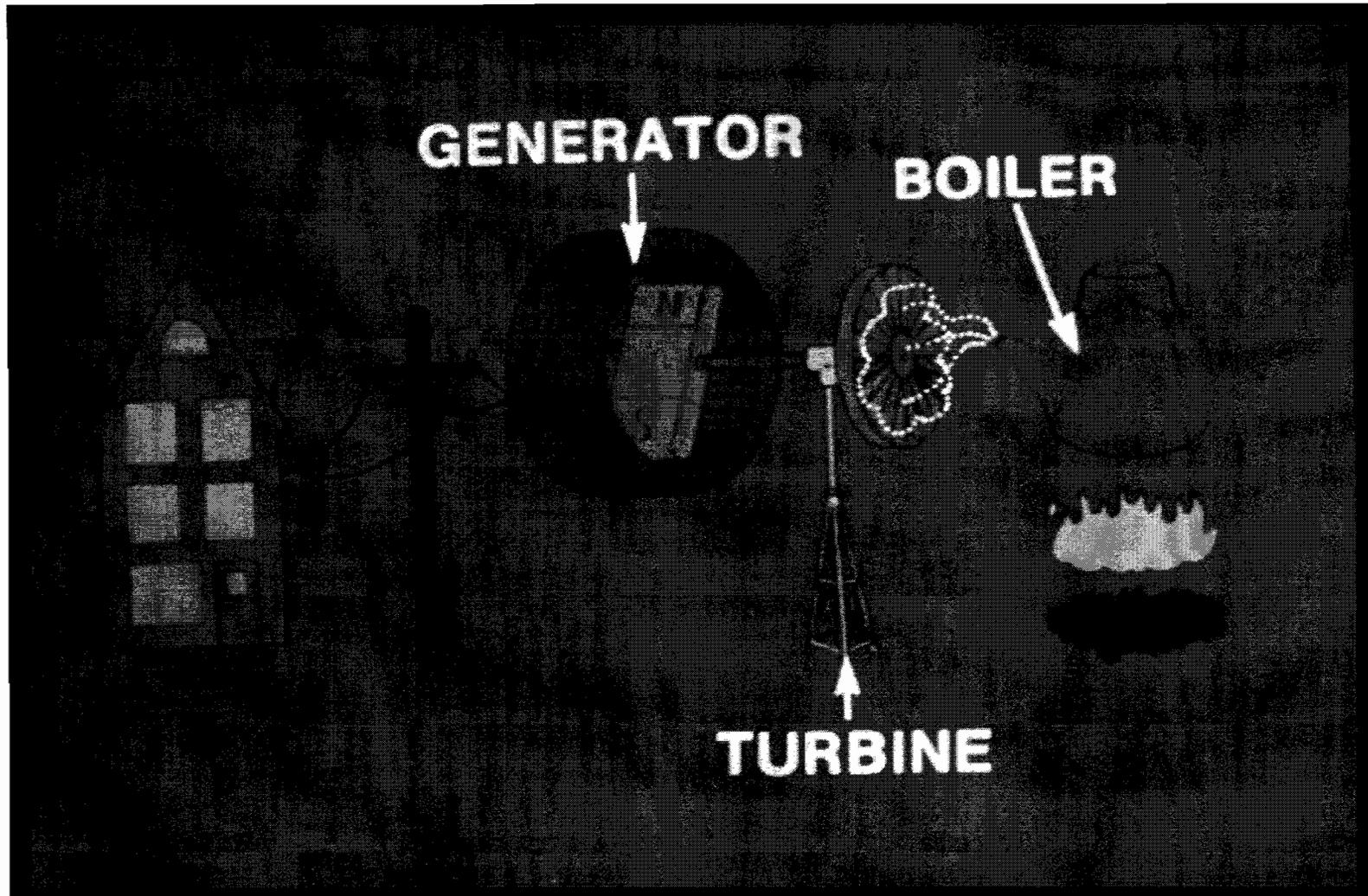
	<u>Unit 1&2</u>	<u>Unit 3&4</u>	<u>Total</u>	<u>Total MW</u>
■ <u>Puget</u>	50%	25%	32%	736 MW
■ <u>PPL</u>	50%	15%	25%	575 MW
■ <u>PGE</u>		20%	14%	322 MW
■ <u>NorthWestern Energy</u>		15%	11%	242 MW
■ <u>Avista</u>		15%	11%	242 MW
■ <u>PacifiCorp</u>		10%	7%	161 MW

Colstrip Plant . . .

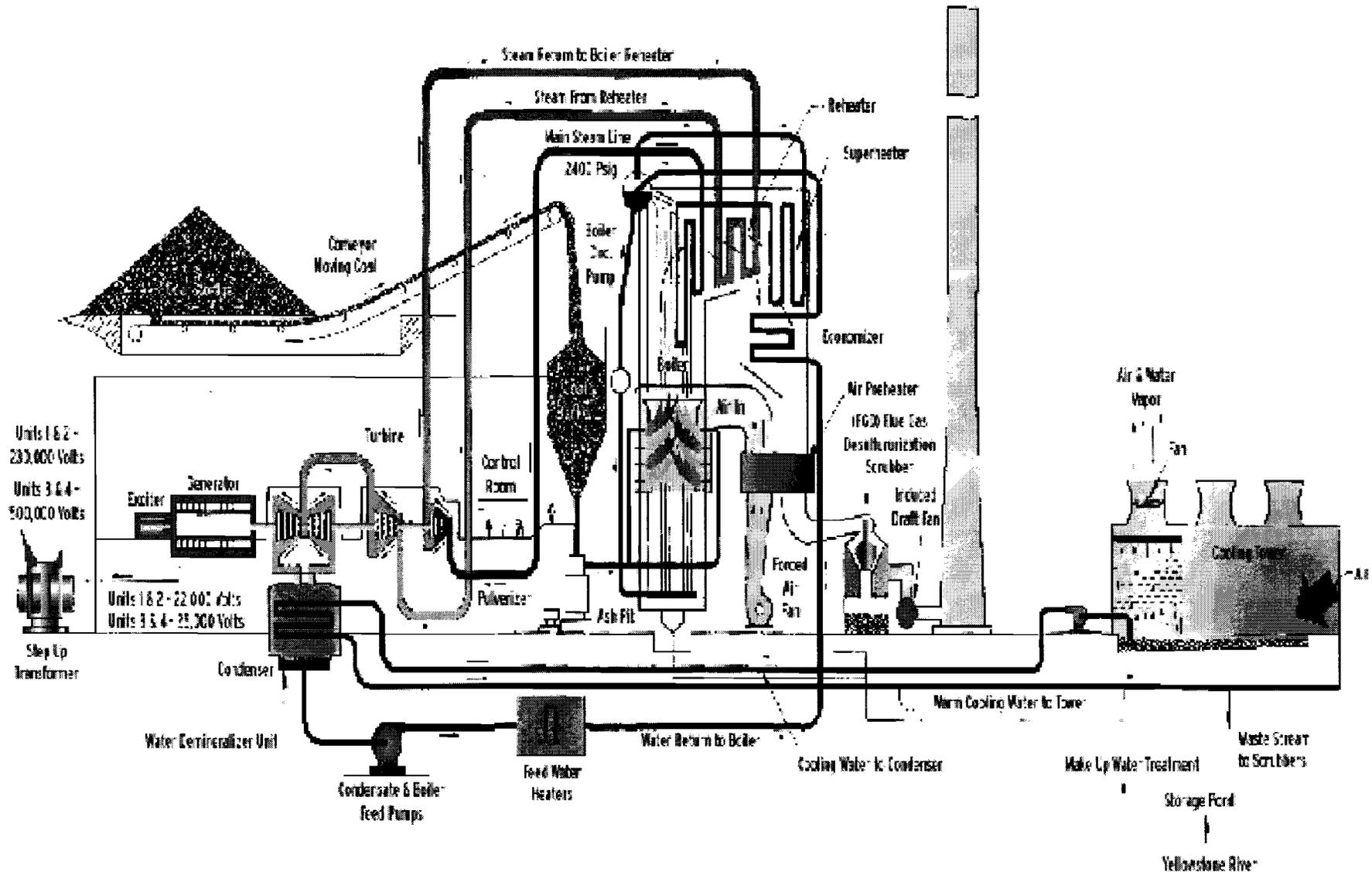


- **Total 2276 Megawatts**
- **350 Employees**
 - **Annual payroll (Including T&B)-\$38 million**
- **Consume 10 Million tons of coal per year**
 - **274 cars to run one day**
 - **1 carload fuels Colstrip for 5 minutes**
- **2007 Budgets**
 - **O&M Budget-\$97.6M**
 - **Capital-\$52.6M**

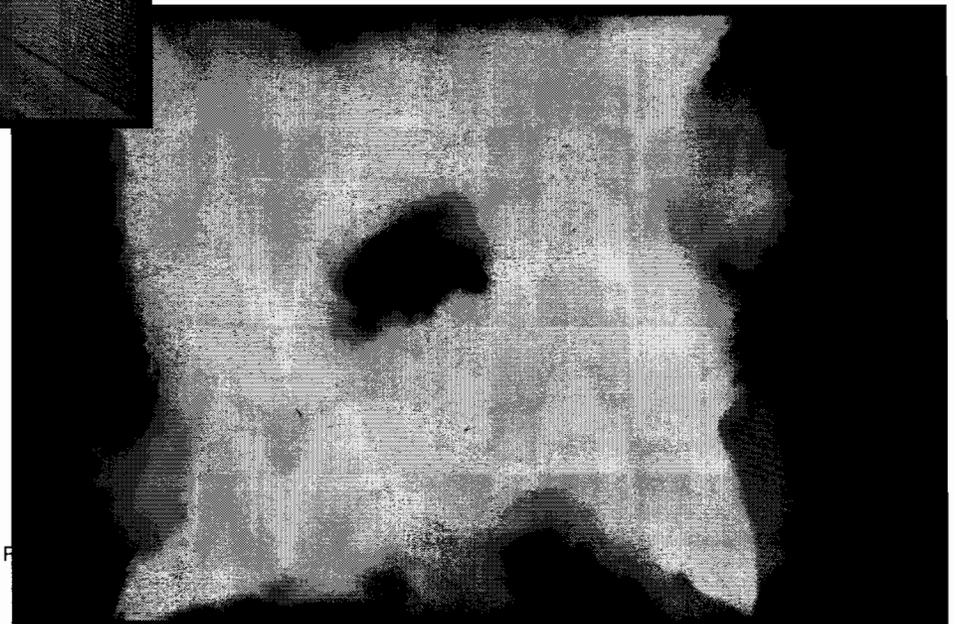
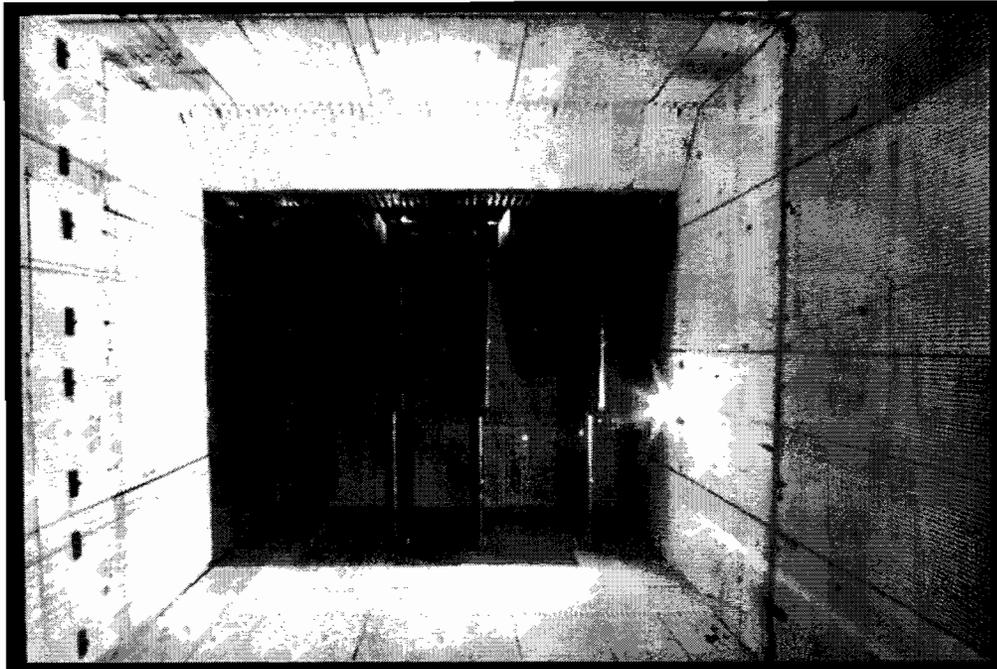
How Fossil Electricity is Generated



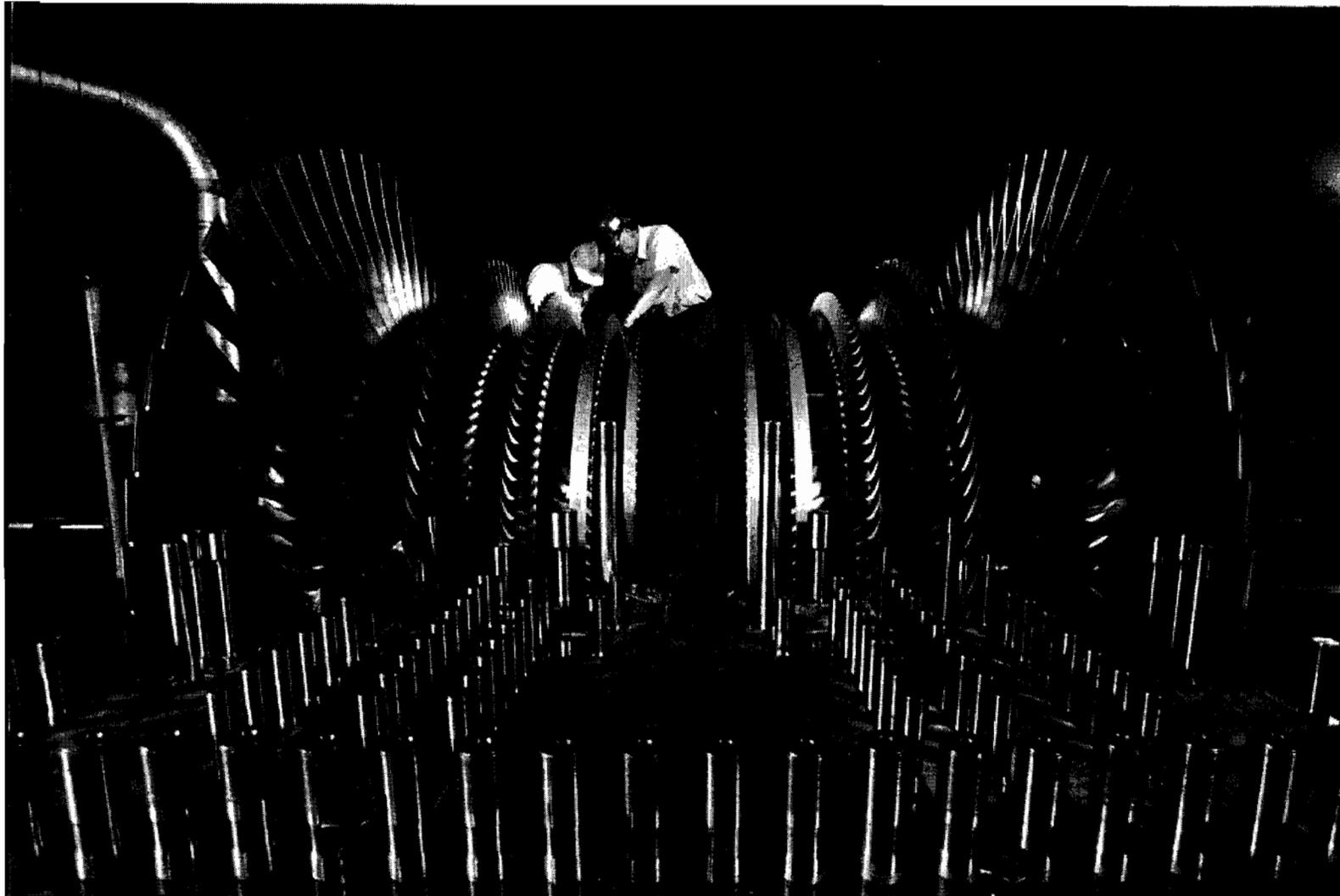
How Colstrip Generates Electricity



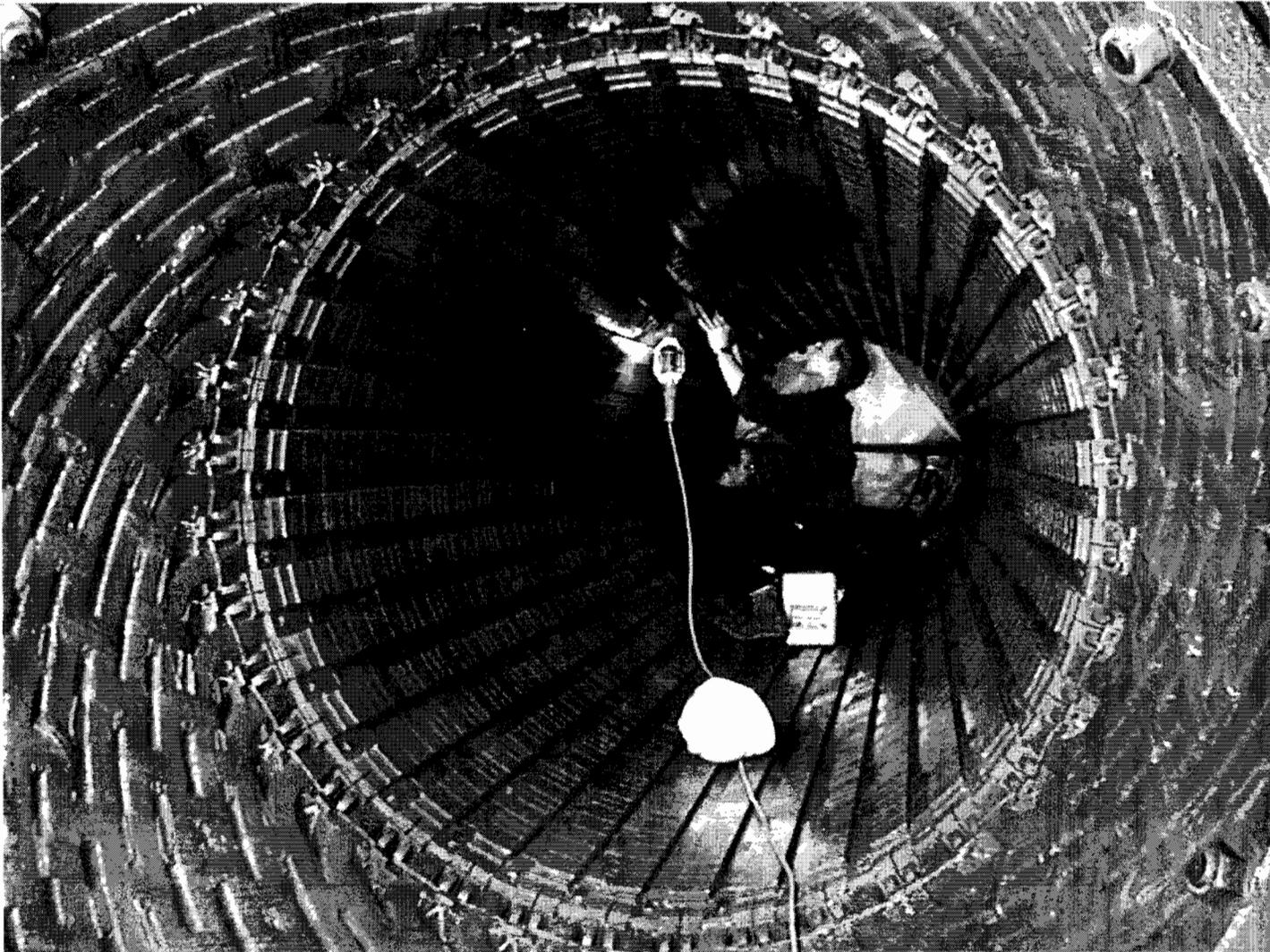
Tangential Fired Boiler



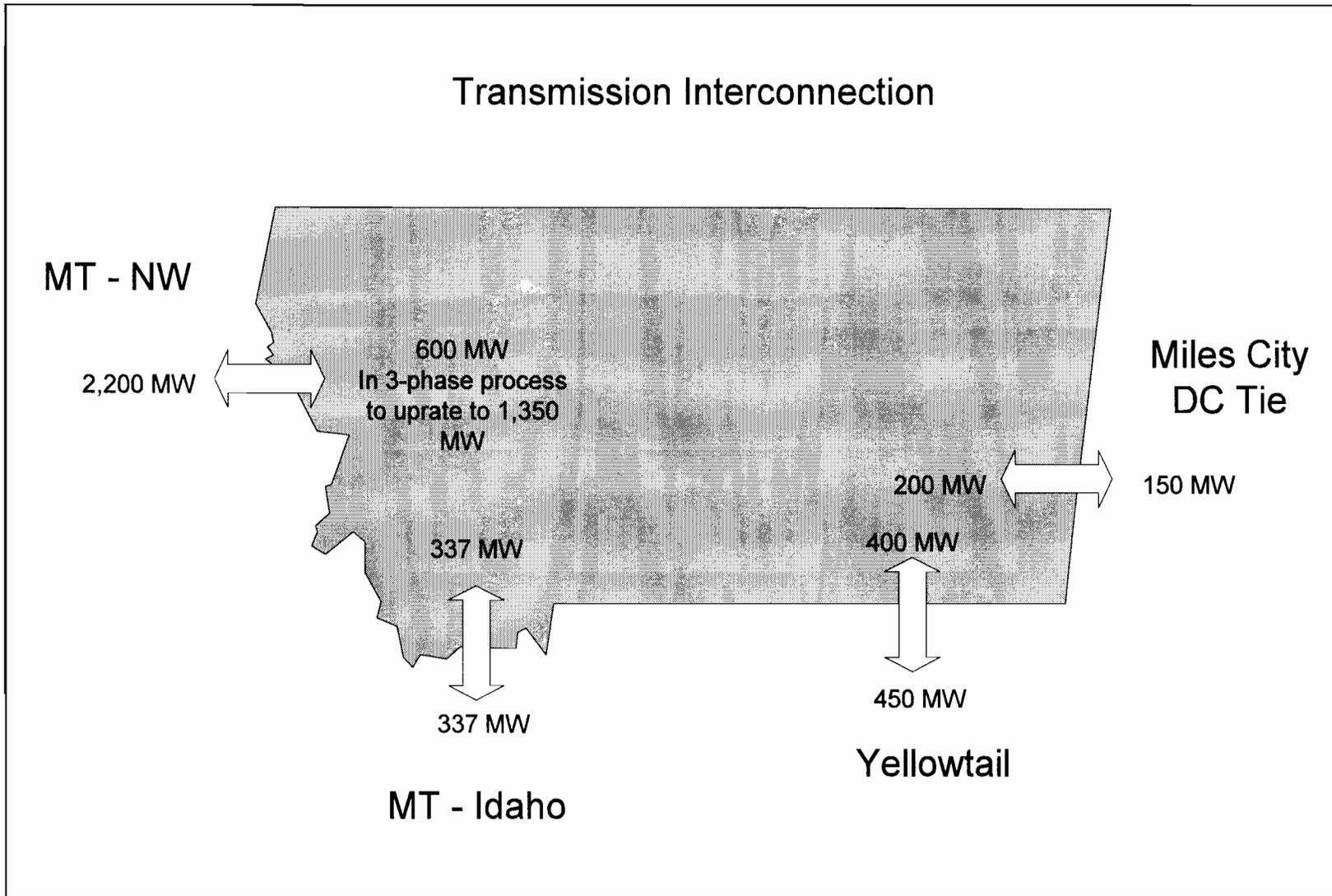
Steam Turbine



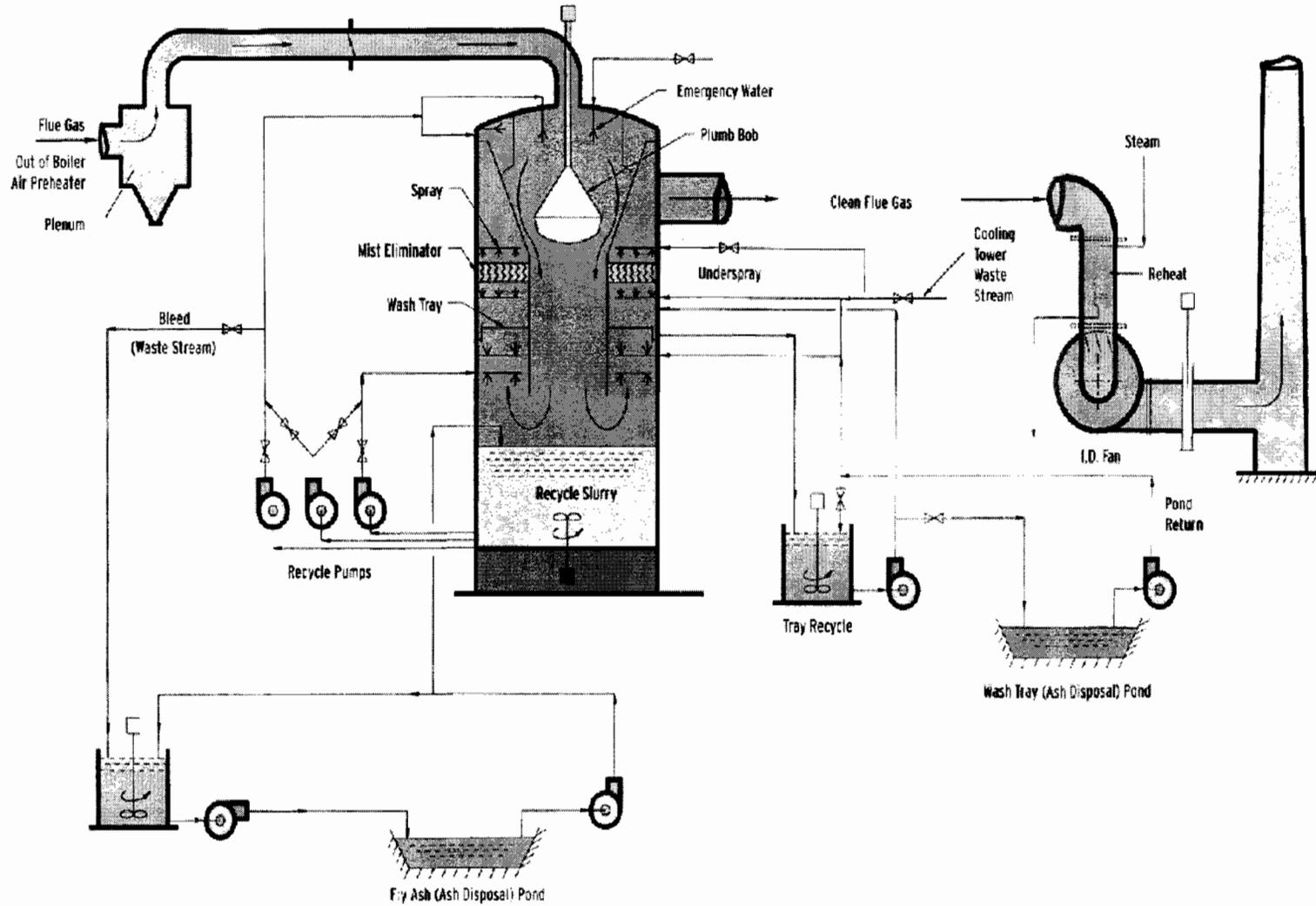
Generator



Transmission Capacity



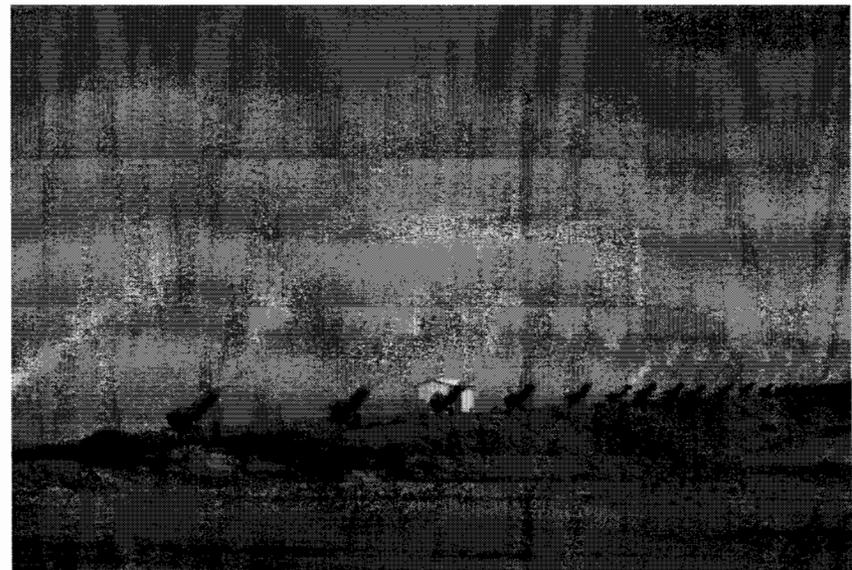
Simplified Flow Diagram Scrubbers



Groundwater Protection



- Colstrip is a zero-discharge facility
- Wet scrubbers use surface impoundments for final disposal
- Ponds lined with clay, synthetic liners, or concrete wall
- Over 800 monitoring wells to help ensure protection of groundwater
- Current strategy to protect groundwater (~\$34 million)
 - Paste disposal process (90% reduction in seepage potential)
 - Double-lined clearwater ponds with leachate collection
 - Forced evaporation/wastewater treatment



SO2 Control



- Units 1&2 – limit of 1.2 lb/mmbtu
 - Normal control efficiency of 65-75%
 - Normal emission rate of 0.35 lb/mmbtu
 - 38th cleanest coal-fired power plant in country (~350 plants)

- Units 3&4 – limit of 0.10 lb/mmbtu
 - Normal control efficiency of 95%
 - Normal emission rate of 0.08 lb/mmbtu
 - In 2006, 9th lowest SO2 emissions from US coal-fired plants

Particulate Control

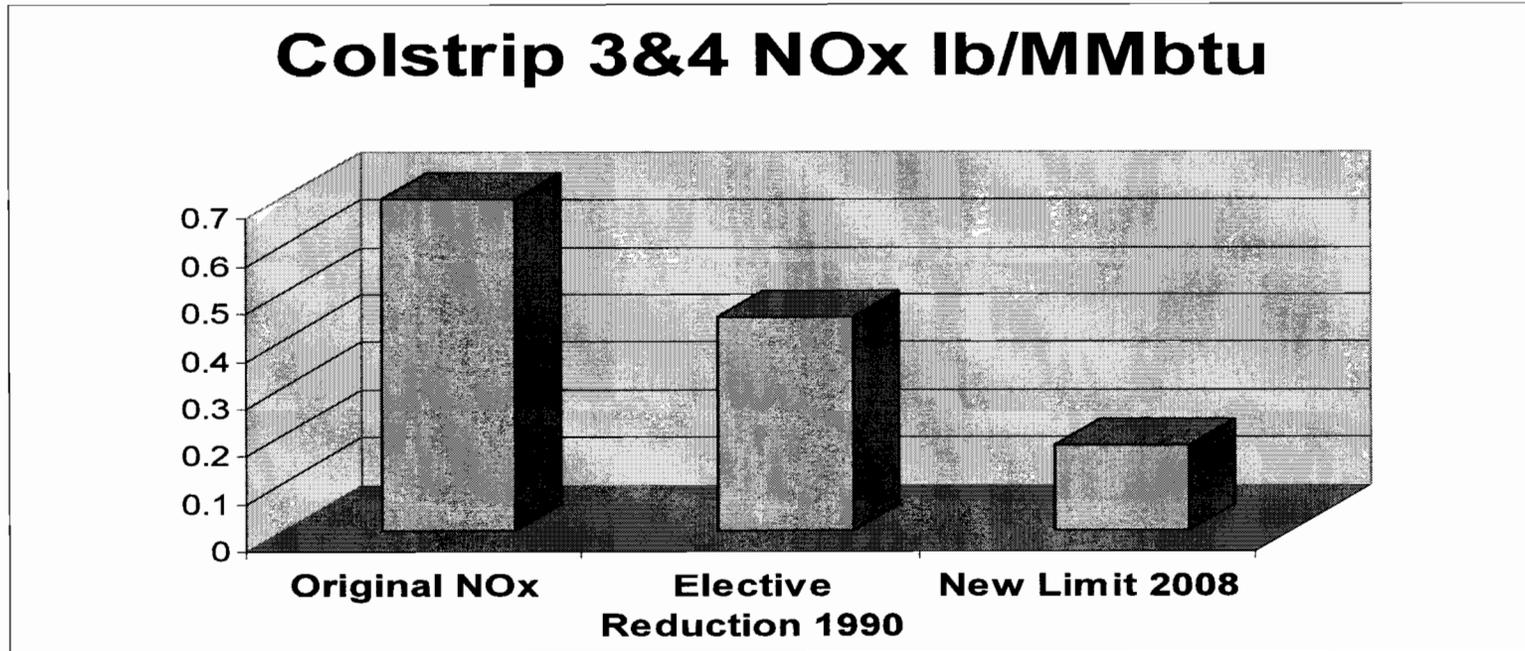


- Units 1&2 particulate emission limit of 0.10 lb/mmbtu
 - Normal removal efficiency of 99.5%
 - Normal emission rate of 0.04 lb/mmbtu

- Units 3&4 particulate emission limit of 0.05 lb/mmbtu
 - Normal removal efficiency of 99.5%
 - Normal emission rate of 0.03 lb/mmbtu

- Continuous monitoring of Opacity to help ensure compliance with particulate emissions at all times

NOx Control



- 75% NOx reduction
- Low-NOx burners with a SOFA, \$20 million
- Unit 3 in 2007, Unit 4 in 2009
- 3&4 will rank ~60th out of 350 coal-fired power plants for NOx

Mercury Control

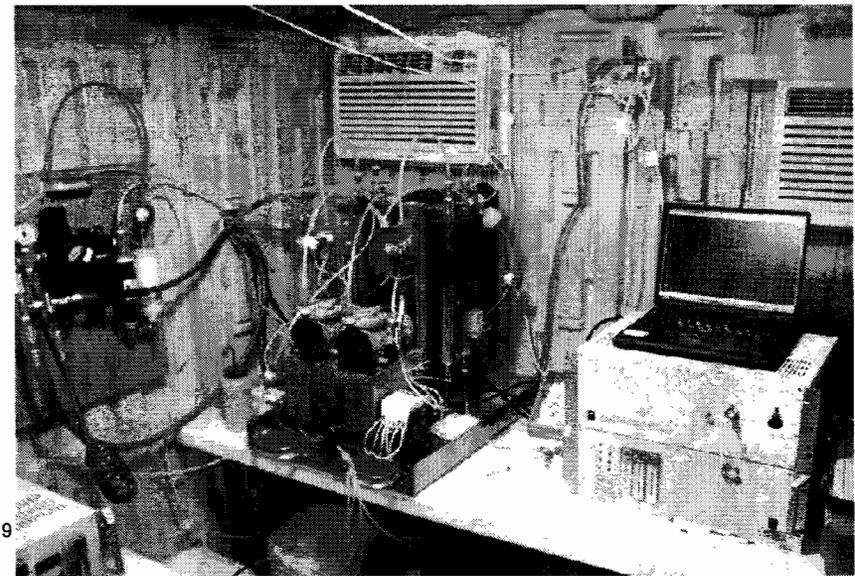
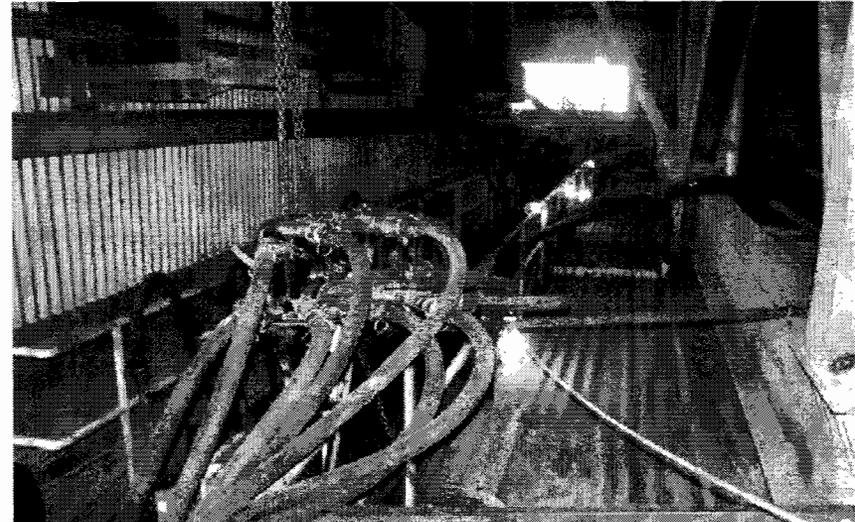


- EPA federal rule required 20% reduction by 2010 and 80% reduction by 2018
- 17 states have promulgated/proposed stricter limits than EPA Federal Rule
 - MT has second strictest rule (0.9 lb/Tbtu, 85-90% reduction by 2010)
- ~1% of mercury deposited in Montana is from Montana power plants, based on EPA models
- Colstrip currently emits 6-8 lb/Tbtu (use Astrodome analogy)
- Mercury control technology installed by 2010, ~\$16 million capital, ~\$4.5 million/yr O&M

Recent Mercury Control Testing on Unit 3



- In September, conducted tests involving addition of calcium bromide and treated activated carbon to remove mercury
- Preliminary results are encouraging
 - Achieved about 90% reduction and an emission rate of about 1 lb/Tbtu
- Additional testing in 2008 to fine tune process and evaluate balance of plant impacts



PPL Climate Change Strategy



✎ PPL generated 39 percent of its electricity from non-fossil fuel power plants in 2006.

✎ PPL participates in the beneficial reuse of ash which offsets greenhouse gas emissions from the cement industry.

✎ PPL is decommissioning two coal-fired power plants in 2007, which will reduce annual carbon dioxide emissions by about 1.3 million tons.

✎ PPL has developed 12 megawatts of renewable energy projects; plans to invest at least \$100 million in renewable energy projects over the next five years.

✎ PPL plans to expand generating capacity at existing nuclear and hydro plants

PPL Climate Change Strategy



✍ PPL is a member of the FutureGen Industrial Alliance, which is developing a near-zero emission power plant that can capture carbon dioxide for sequestration.

✍ PPL is a member of Big Sky Carbon Sequestration Partnership

✍ PPL participates in the Montana Governor's Climate Change Advisory Committee.

✍ PPL plans to participate in EPRI (Electric Power Research Institute) to evaluate technology options as they are developed, then support demonstration projects as appropriate at Colstrip

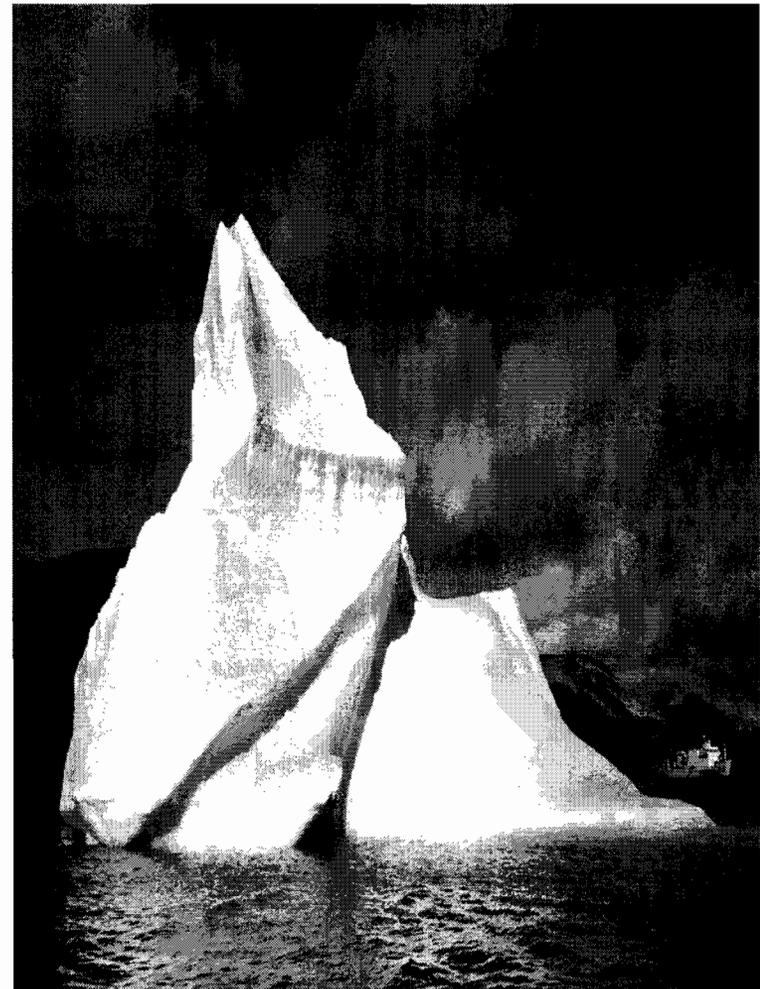
Colstrip CO2 Control – Opportunities?



- Colstrip SES emits ~18 million tons CO₂/yr
 - 18th largest power plant, rank ~50th for CO₂ emissions

- Current technologies are in developmental stage

- Possible control technologies
 - Amine scrubber w/sequestration
 - Chilled ammonia w/sequestration
 - GreenFuel's Algae-to-Biofuel



Amine Scrubber Process



- Basis:
 - Carbon capture from flue gas and geologic sequestration
 - Current status 1200 tpd, Colstrip 40,000 tpd
 - Study conducted on Wyodak power plant by Idaho National Laboratory, scaled up for Colstrip 1-4
 - Current technology, no improvements
 - Target 90% capture of CO₂

- Following cost estimates are ballpark
 - Capital Cost: \$430 Million
 - O&M Annual Cost: \$900 Million
 - Includes “Energy Penalty” of 30% (625 MW)
 - CO₂ removal and sequestration cost per ton: \$53

Chilled Ammonia Process



■ Basis:

- Carbon capture from flue gas and geologic sequestration
- ALSTOM's 5mw pilot test at Pleasant Prairie
- Scaled up for Colstrip 1-4 (2276 mw)
- Target 90% capture of CO₂

■ Following cost estimates are ballpark

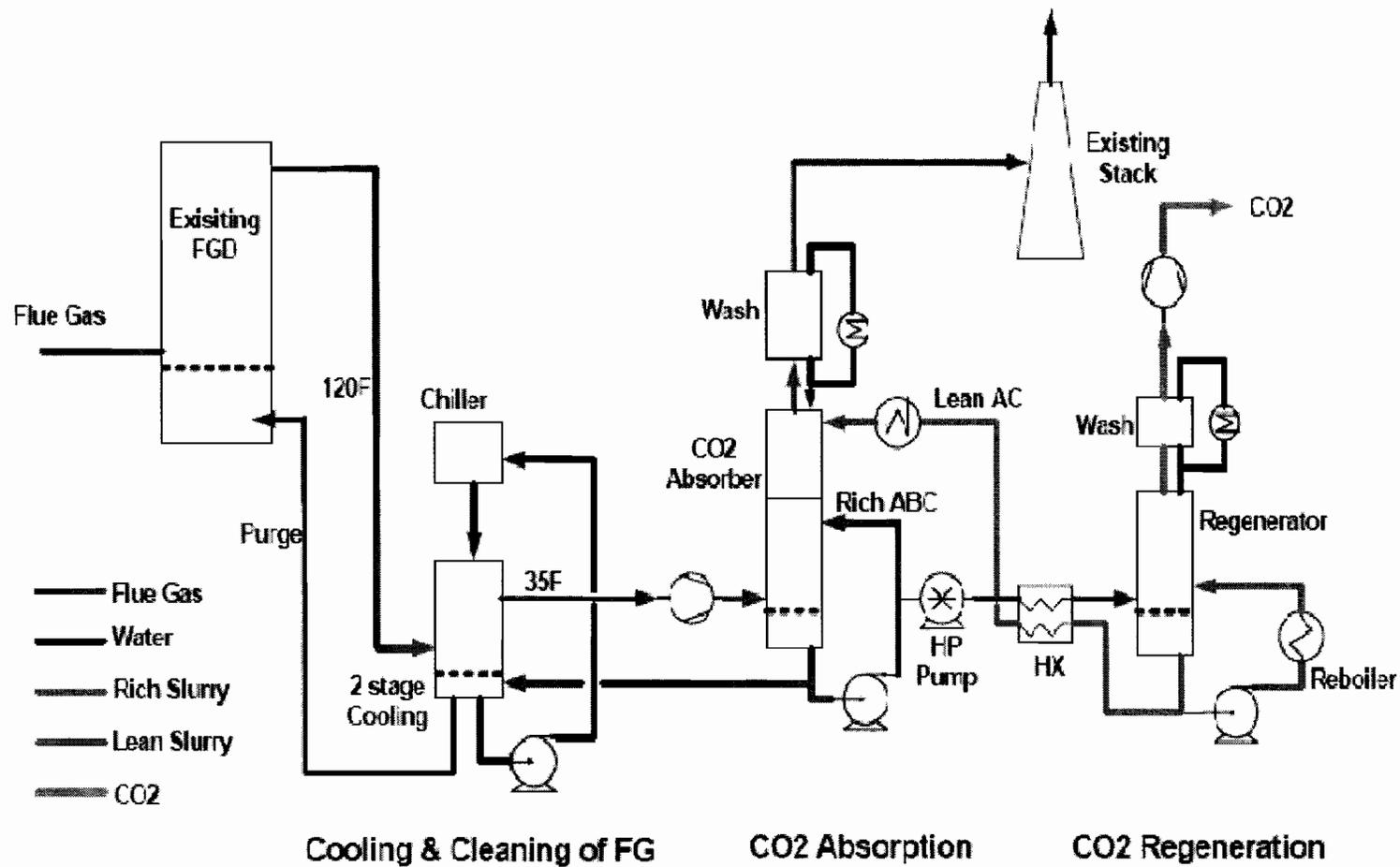
- Capital Cost: \$430 Million
- O&M Cost: \$650 Million
 - Includes "Energy Penalty" of 9% (189 MW)
 - CO₂ removal and sequestration cost per ton: \$39

Source: Alstom Power, November, 2007

Chilled Ammonia Process



Schematic of commercial Ammonia-based CO2 capture system retrofitted downstream of the FGD



Green Fuels Algae-to-Biofuel



- Basis:
 - Flue gas to 'feed' algae, then convert to bio-fuel
 - Use of Existing Technology without improvements
 - 40% capture of CO₂
 - Scaled up for Colstrip 1-4, 26 sq. miles of algae fields

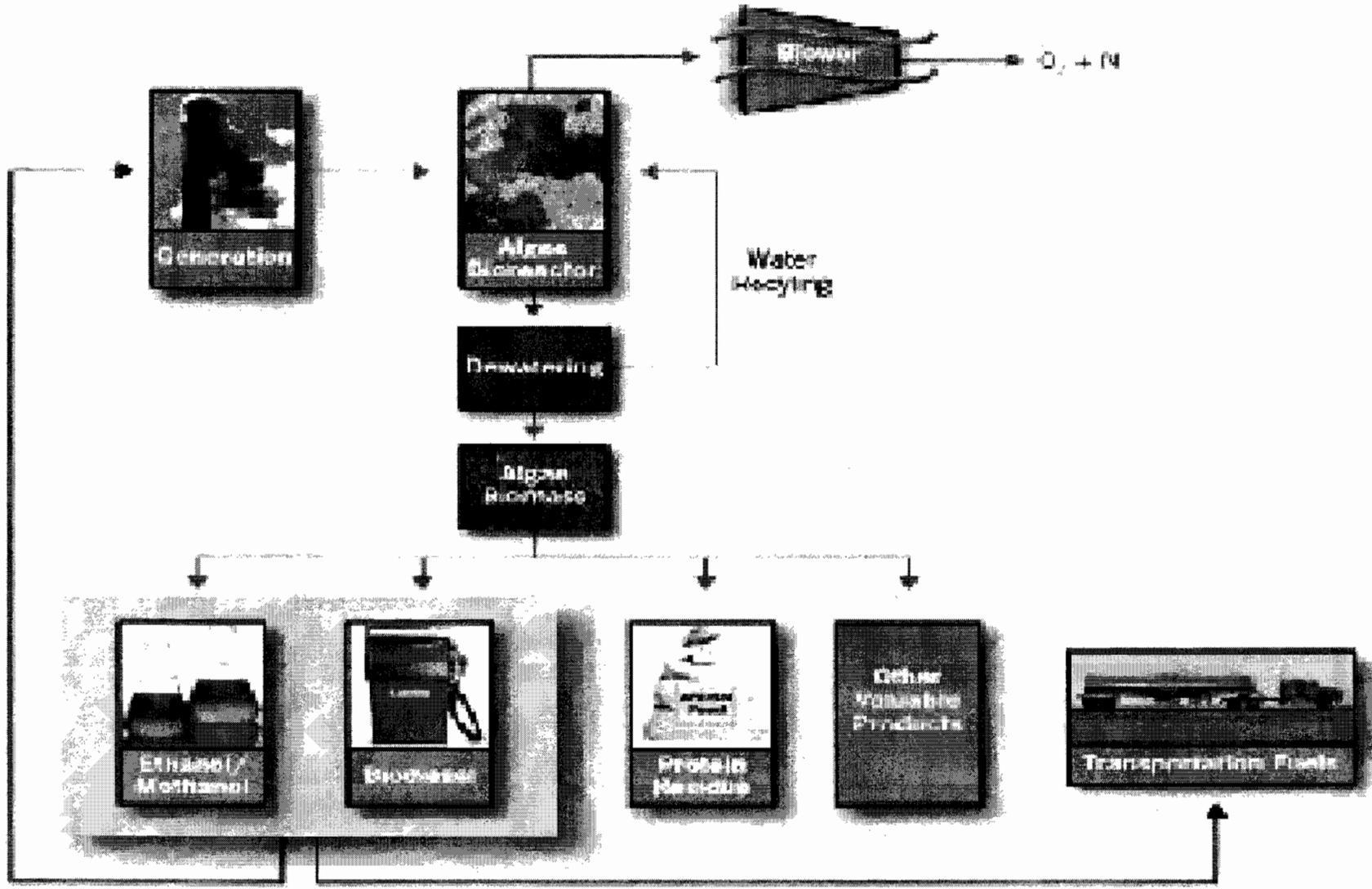
- Following cost estimates are ballpark
 - Capital Cost: \$1.7 Billion
 - O&M Cost: \$417 Million
 - Revenue Potential is \$750 million

- Recent setback w/bioreactor system results in layoff of half the 50 person staff

Green Fuels Algae to Biofuel



Process Flow



QUESTIONS?

