mncoalgasplant.com

BEFORE THE MINNESOTA PUBLIC UTILITIES COMMISSION

DIRECT TESTIMONY OF RONALD R. RICH

I. INTRODUCTION

Q: Please state your name, occupation, and business address.

Ronald R. Rich, President
Atmosphere Recovery, Inc.
15800 32nd Avenue North, Suite 110
Plymouth, MN 55447

Q: What is your education and professional background?

I have a B.S.E. degree in Aerospace and Mechanical Engineering from Princeton University, and a M.S.E. degree in Environmental Engineering from Stanford University. I am President of Atmosphere Recovery, Inc., a company I founded 11 years ago that develops advanced process gas monitoring and control technologies that enhance industrial and energy production efficiency for and reduce emissions at Fortune 1000 companies. During my career, I have designed, developed, managed and assessed hundreds of advanced energy production (both conventional and alternative), energy conservation, and environmental mitigation and remediation projects and have attached my C.V. My most recent expertise is in the area of efficient gas reaction process measurement and control and, control, prevention and mitigation of air emissions. However, I also have expertise in industrial and utility water and wastewater treatment and solid and hazardous waste generation reduction and disposal.

Q: On whose behalf are you testifying?

A: I'm testifying on behalf of mncoalgasplant.com.

Q: What are your major issues of concern and recommendations regarding Excelsior's Mesaba Project?

A: Many issues concern me about this project, which I believe is not in the public interest, but in this docket addressing public interest and cost, my primary concerns are that there are cost associated with aspects of this project that must be carefully taken into account, specifically:

- Cost of Carbon Dioxide Emissions and Sequestration
- Air Emissions from Proposed Flares – Cost of Control and Mitigation
- Costs of Plant and Off-Site Safety
- Evaporative Cooling Tower and ZLD Air Emissions – Cost of Control and Mitigation
- Cooling Water Blowdown ZLD – Cost of Control and Mitigation
- Costs of Cumulative Impacts in Conjunction with the MSI project
- Overstated Economic Benefits and Costs not Addressed

I. COST OF CARBON DIOXIDE EMISSIONS AND SEQUESTRATION

Q: What are your concerns about the carbon dioxide emissions and sequestration costs?

A: In the Power Purchase Agreement Petition and accompanying report, Excelsior claims that "[t]he Mesaba Project will significantly reduce emissions of carbon dioxide." Petition, para. 23; Report, Section I, 4; Section II, pps. 3-11; etc.

Since CO2 capture requirements within the design lifetime of the facility are acknowledged in the application, the cost of design, installation and operation of CO2 capture and sequestration equipment should be required by the PUC. This must include costs incurred from point of generation and attachment to the Mesaba plant to the point of sequestration and maintenance of sequestration.

Further, where CO2 capture is required, capturing only 1/3 of the CO2 is not a reasonable mitigation plan, because that rate of capture will almost certainly not meet such capture requirements; most announced plans for future DOE backed IGCC plants assume a 90% CO2 capture requirement. Therefore, the proposed CO2 capture cost amount is inadequate – planning and cost assumptions should be targeted at the 90% capture level.

Inclusion of the costs of CO_2 capture and sequestration is necessary because CO_2 capture and sequestration was used to justify the proposed facility's substantially higher cost of electricity, reasonable under a strict regulatory regime. Not only costs must be considered, but these features must be included in the design and construction plans because to forgo inclusion of the additional equipment and its cost, that is assumed to be required in the near term, imposes unknown, but even higher costs per KWh on Minnesota ratepayers than those imposed if this facility is constructed to capture and sequester CO_2. The PUC is obligated to consider complete facility costs prior to approval, both in a typical Power Purchase Agreement and public interest context, and also under the provisions of the Mesaba legislation.

Q: What is the impact of carbon capture on the plant's efficiency?

A: Capturing and compressing CO_2 would require a significant portion of the plant's energy output, reducing net electrical output and further increasing ratepayer costs. Most DOE estimates for carbon capture range from 10-40% of the net output of an IGCC plant and do not include the additional energy required for CO_2 transportation and sequestration. If the net power reduction is known by Excelsior Energy and not disclosed (likely given the decision to design for only a 33% capture of their CO_2 emissions), this section of the application as well as all net power output and per KWh emissions presented elsewhere in the report are purposefully misleading and need to be revised. If they are not known by Excelsior Energy the document language should state the anticipated performance penalties based on best available information. The PUC should require these disclosures and their related economics. Even under the assumption the discharged combustion gas is relatively clean of "criteria" and "hazardous" air pollutants, costly steps must be taken to capture the CO_2 in an acceptable form for transportation to the sequestration site:

1. The combustion gas discharge stacks must be equipped with a damper or valve assembly and appropriate residual heat removal equipment, ducting and blowers (likely) to safely move the gas to the facility CO_2 capture area. This equipment cost has not been disclosed.

2. The water produced as a result of combustion with air (or oxygen if modified), nitrogen, and excess oxygen remaining must be removed from the cooled combustion gas in a potentially capital intensive and high operating cost process yet to be disclosed.
3. The remaining gas phase CO2 would need to be converted to a liquid or solid to allow economic transportation to a permanent sequestration site. Any such phase change, whether mechanical (such as compression) or thermal (such as refrigeration) would involve even more significant capital and operating not yet disclosed.
4. Because both proposed sites are located very far, in excess of 450 miles and more likely at least 1000 miles, from a suitable sequestration site, additional capital cost would be required for CO2 storage and the onsite equipment to transfer the captured CO2 to a high pressure, 700 psi or greater, pipeline or pressured or refrigerated railroad tank or bulk carrier cars. This cost has not been disclosed.
5. Assuming 90% capture, the volume and the weight of the CO2 to be transported from the facility would exceed three times that of the coal or natural gas supplied to the facility. Either a long and very expensive additional 450+ mile pipeline would need to be constructed, or a large quantity of specialized CO2 rail cars purchased. The costs of this additional infrastructure have not been disclosed. The costs of operating the transportation system would also be expensive given the shipping distances involved and the energy expenses required to move the CO2.
6. CO2 asphyxiates animals and humans at concentrations in excess of 20,000 ppm. In addition, the density of CO2 causes it to displace air upward when spilled. To prepare for both accidents and potential terrorism as a result of the hazard, additional undefined and undisclosed additional capital costs would be incurred.
7. Finally, it is likely that the costs of sequestration, including site preparation, unloading and injection equipment, perpetual monitoring, and storage failure and remediation, even if subsidized by the Federal government, will be the most significant cost of the entire CO2

capture and sequestration process. No such costs, not even an attempt at per ton disposal rates, are disclosed.

Taken together, these seven components represent a very significant additional cost of electricity from this facility. If the reduced net output of the plant as a result of CO2 capture is considered, the per KWh price is even higher, but still undisclosed by Exclesior. Because of the potential for significant cost and shift in the economic feasibility of this project, Excelsior must disclose this information and the Commission must consider this range of costs.

Q: What experience and studies address whether carbon capture and sequestration is feasible?

A: Carbon capture and sequestration has not been accomplished in a power plant of this configuration, this distance, or in a commercial context – there is no prior experience to draw from. Carbon capture and sequestration a distance from source has been begun in a pilot study, but this scheme is not under consideration for the Mesaba project, so the Applications state. However, the Mesaba legislation requires Excelsior to make best efforts to secure Department of Energy funding for sequestration study, and this has been done. In its Siting application, Excelsior states:

> Additionally, the Applicant has contracted with the University of North Dakota Energy and Environmental Research Center ("EERC") to assess CO2 management options for Mesaba One and Mesaba Two. This work is part of the Plains CO2 Reduction Partnership…Phase II efforts EERC is conducting for DOE to validate the most promising sequestration technologies and infrastructure concepts identified during Phase I of the Program. Sink-source pairs, specific to the composition of CO2 gas streams that can be removed from the syngas produced by Mesaba One and Mesaba Two, will be identified and ranked according to engineering, economic, and public-acceptance considerations.

Siting Application, Section 3.1.5.3.5 Potential Carbon Capture Benefit.

Q: In light of your knowledge of carbon capture and sequestration, do you have comments about this plan??

A: Yes, I have comments on the Excelsior plan to research carbon sequestration:

1. A review of this research indicates that the carbon sequestration method of most interest to Excelsior Energy is based on the amount of excess CO_2 that can be captured by natural CO_2 absorption in the land or water (with a wetland focus). Even if such sequestration had significant potential, IGCC CO_2 capture potential is not needed for this approach, since all atmospheric CO_2 (including that from conventional PC coal plants) would equally benefit.
2. Since the global CO_2 concentration is rising faster very year, it is clear that natural "sinks" for CO_2 have been unable to absorb the massive worldwide volumes of CO_2 emitted. Permanent underground or under ocean storage of CO_2 in liquid or solid form is the only currently known method that has any prospect of maintaining atmospheric CO_2 levels at acceptable concentrations.
3. The volume of CO_2 captured by the plant (even at only 33% much less 90%) would far exceed the volume of coal shipped to the plant.
4. The proposed West Range location lies approximately 450 miles east-southeast from the nearest remotely feasible underground sequestration area (South-Central Saskatchewan). A large capacity, high pressure pipeline would need to serve that nearest area even if sufficient capacity existed.
5. Higher capacity, more viable sequestration locations with sufficient potential capacity exceed 1000 miles from the West Range plant site.
6. The East Range plant site is closer to Lake Superior which might be used for transshipment of captured CO_2 in tankers.
7. Given the energy, cost and danger of liquid or solid CO_2 transportation over the long distances both proposed sites are inappropriate for anticipated future CO_2 sequestration requirements.

Q: Do you have any recommendations?

A: Yes, I have recommendations. The PUC should require that both proposed site evaluations include the estimated energy consumption and economics of CO2 transportation and sequestration using appropriate permanent sequestration approaches in making its public interest determination. In addition, to indicate the financial penalty caused by the mandated siting, the PUC should also consider an economic evaluation of two alternate reference sites, one for a generating plant near a coal mine-mouth and another one near a permanent CO2 sequestration location, and ideally a third, that of a generating plant near a coal mine-mouth that is also near a permanent CO2 sequestration location.

2. Cost of Control and Mitigation of Air Emissions from Proposed Flares

Q: Have you reviewed the air emissions data provided in Excelsior's proposal?

A: Yes, I have reviewed air emissions data provided in Excelsior's proposal, and I am particularly concerned about the air emissions from proposed flares and the costs of containment.

Q: What are your concerns about flare air emissions:

A: My concerns focus on air emissions from flares and associated costs. Excelsior states in its Siting Application application:

> The elevated flares for Mesaba One and Mesaba Two will be designed for a minimum 99 percent destruction efficiency for carbon monoxide and hydrogen sulfide." and that the flares are normally used only to oxidize treated syngas and natural gas combustion products during gasifier startup operations.

Siting Application, 3.4.1.1.3 Flares - Pages 183-184, et seq.:

However it also states that:

> The flares will also be available to safely dispose of emergency releases from the IGCC Power Station during unplanned upset events or outages. The estimated maximum short-term and annual emission rates, based on agency guidance and equipment supplier specifications, are shown in Table 3.4-8.

Id. Here is that table, cited above:

Table 3.4-8 Flare Short-Term Emission Rates (Phase I and II)

Operating Mode	**Emission Rate (Lb/Hr)**				
	NOX	SO2	CO	PM10	VOC
Normal operation1	0.3	0.01	2.2	0.03	0.02
Normal startup operation2	230	370	5,350	28	21
Maximum flaring operation3	478	2,080	11,360	60	45
Emission Rate (Tons/Year)					
Maximum Annual4	26.8	24.6	572	3.4	2.6

1 Natural gas pilot, only.
2 Startup flaring of syngas for two gasifiers and two flares.
3 Maximum flaring capacity for two flares, based on flaring syngas production from two gasifiers for each flare and a worst case upset sulfur content of 400 ppmv in syngas.
4 Maximum annual emission based on combustion of approximately 700 billion Btu of syngas and 136 billion Btu of natural gas during startup, plant upsets, and normal operating conditions.

Q: What are your concerns regarding air emissions during flare operation?

A: My concerns about air emissions during flare operation are as follows:

1. The E-Gas process and the syngas it forms is similar to many existing processes that use flares for "startup", "plant upsets" (i.e. problems and emergencies) and "normal operating conditions".
2. As indicated in Table 3.1.3 the anticipated syngas formula (30-40% H_2; 35-50% CO; 13-26% CO_2; 1-5% CH_4; 2-3% N_2 and Ar) at one atmosphere pressure is nearly identical to specialized heat treating and steel reducing atmospheres for which my company makes monitoring and control devices and that I have personally monitored and controlled.
3. Flares are often the single larges contributor to air emissions from such processes and the assumptions made on their use make very large differences in anticipated criteria air emissions from such processes.
4. The data presented in Table 3.4-8 indicates that the gasifier flares have the potential to be the most significant source of air emissions from the facility.

5. If the flare pilot is extinguished during an emergency or caused by an operator error the short term air emissions from the 185 foot stack may be significantly higher than indicated and could cause onsite health effects or fires and possibly offsite heath risks too.

6. The air emission assumptions made are questionable and/or misleading, and in addition:

   a. No maximum syngas flow rates through the flares are indicated during "upsets and emergencies" however the diameter of each syngas flare would apparently be 5.5 feet, capable of large flow rates. Maximum startup and emergency flow rates should be specified.

   b. Only two gasifiers are assumed to be operating at any one time. However, if there is a problem with one of the two, flaring will likely occur in from the third during its startup. Two or three flares could be simultaneously operating in high emission startup or emergency modes.

   c. Normal operation is assumed to emit only the combustion products of the natural gas pilot. This assumes zero flow. The proposed E-Gas reactors will operate at 400+ psi and likely will release a portion of syngas through the flare at all times. During partial power operation can be assumed (as other in other syngas systems) that an unused fraction of the gas will be vented through flare

   d. During an emergency or a syngas vessel valve failure, large amounts of syngas could vent through the flare. According to Excelsior Energy, during emergencies, the scrubber system would not operate and non-combustible air emissions, including selenium, arsenic and mercury, would vent directly to the atmosphere without reduction or control. If the flare is extinguished, no control or limitation of any emission would take place.

   e. A "minimum 99% destruction efficiency" for CO and H2S is stated. Therefore CO in the syngas would range from maximums of 3,500-5,000 ppm and an undisclosed amount of H2S would be emitted. Flare monitoring data that I have measured would indicate emissions of CO would approximate 10,000 to 35,000 ppm through smaller diameter flares. There seems no basis for the "99% reduction" assumed; if there is, such data should be provided, as well as the cost of achieving this "99% reduction."

f. The majority of the facility HAPs are indicated as coming through the flares. No assumptions other than table footnotes are provided.

Q: Do you have any recommendations regarding air emissions of flares?

A: Yes. My recommendation is that Excelsior must include a much more detailed assessment of syngas flare operations, performance, flow rates, planned and unanticipated syngas upsets, emergency conditions and assumed frequency, component reliability, and on and offsite effects. Each of these has a significant impact on air emissions and must be considered in the overall evaluation of emissions and more to the point in this proceeding, the significant cost impacts of controlling and/or mitigating emissions during these planned and unavoidable flare occurrences. Excelsior must provide cost estimates of flare impacts and control and mitigation, and these must be considered by the Commission in its public interest determination.

3. Costs of Plant Site and Off-Site Safety

Q: Do you have concerns about the extent of costs for Plant Site and Off-Site Safety?

A: Plant operating safety and its potential for human and environmental impact has not been adequately considered in the application. With one exception, the applicant has included only standard ("boilerplate") references to safety permits, construction issues, generic training and related material safety data sheets along with one reference to the CMP public access closure for "safety reasons. The exceptional reference is "Flaring of untreated syngas or other streams within the plant will only (Siting Application, Section 3.1.6.5 Flare). In one location, IGCC technology combines all the safety risks and potential repair, remediation, and liability costs associated with: 1, coal transport and storage; 2, natural gas fired combustion turbine-electric power plants; 3, steam turbine-electric power plants; and 4, forced evaporative cooling systems. Problems with or failures in each of these components of an IGCC plant pose relatively known safety risks both on the plant site and to the surrounding community and environment. None of these safety risks are addressed by Excelsior Energy.

In addition, IGCC technology inherently adds three significant but relatively unknown additional safety risks:

1. High pressure gasifiers employing both natural gas and coal slurry as fuel and pure oxygen;

2. Use of low and variable energy content syngas as a feedstock to the gas turbines; and

3. Extreme technological complexity with a high probability of operational accidents.

Of these three, the syngas gasifiers would appear to cause the greatest safety risk both on and off site.

Normal Operation Gasifier Risk - The proposed IGCC intends to inject pure oxygen and coal slurry directly into two of three high pressure vessels at more than 400 psig during "normal" operation at a scale much larger than has been tried before. Gas valve control or sealing failures could result in a non-explosive but sudden increase in pressure that would either blow out undisclosed but probable "rupture disks" or cracking the vessel or its piping. This "normal operation" risk would result in a sudden, high volume air emission of the most contents of the gasifier including the "normal" contents (30-40% H_2; 35-50% CO; 13-26% CO_2; 1-5% CH_4; 2-3% N_2 and Ar), most of the hazardous pollutants including mercury, and any additional combustion products from the pressure increase. The volume released could far exceed 30 times the actual volume of the gasifier, depending on the pressure relief setpoint, and pose a serious on-site asphyxiation and fire hazard. Residents downwind of the facility would also be at risk, especially since the release would occur at ground level.

Startup Gasifier Risk – During startup, natural gas would apparently be used to heat the gasifier until it reaches appropriate temperatures and pressures. If the temperature in the vessel is below a critical value, at ambient pressure about 1200 Deg. F, and if the natural gas and oxygen valve set or ignition system fails in certain ways during the heat up, unburned combustible gas can accumulate in the gasifiers that can suddenly explode. Such explosions occur often in the auto industry in heat treating furnaces that use similar, but less explosive, gas mixtures. However, because they do not operate at elevated pressures, less damage occurs. An explosion at elevated pressures in a gasifier vessel generally cannot be relieved by rupturing of a component. In this case the gasifier can potentially fracture the vessel into a number of pieces that can travel significant distances from their original location. Clearly there is significant on-site risk both to workers and other IGCC equipment. It is conceivable that smaller pieces, like bomb shrapnel, put offsite individuals and property at risk.

Emergency Gasifier Risk – It is not specified by Excelsior Energy what constitutes an "emergency". However, because Excelsior Energy chooses to address only this risk in the joint application there must be other situations or combinations of situations more serious than that described above for which "Flaring of untreated syngas or other streams within the plant will only occur as an emergency safety measure during unplanned plant upsets or equipment failures." In any event, such emergencies may or may not be served by flaring untreated syngas, especially if a flare or its associated valving is itself part of the failure.

This is one example of the kind of risk assessment that should be part of the EIS. Others should also be included. According to the IGCC industry itself:

• The most unpredictable startup activities concern shakedown of [the syngas] gasifier and gas processing systems and initial operation of the gas turbines on syngas. Early ASU startup and startup of the power block on natural gas ensure they stay off the critical patch (sic - intended word path?).

• The integrated plant controls including the gasifier safety shutdown and control systems must be thoroughly checked prior to first syngas production. Small programming glitches can significantly delay startup because of the time needed to prepare for each gasifier light-off.

Rich Exhibit ____, IGCC - The Challenges of Integration, Robert F. Geosits and Lee A. Schmoe Bechtel Corporation, Proceedings of GT2005, ASME Turbo Expo 2005: Power for Land, Sea and Air, June 6-9, 2005 Reno-Tahoe, Nevada, USA.

ConocoPhilips, Fluor and Siemens, the same team that is supposed to provide design, construction and operational expertise to the Mesaba Power facility attended an IGCC "risk" symposium sponsored by the DOE in 2004. A presentation in this symposium compared the IGCC technological, regulatory and economic risks to those posed by nuclear power and concluded that electric power utilities believed nuclear power plants posed less risk than IGCC. Rich Exhibit ___, Climate VISION Risk Framework for Advanced Clean Coal Plants Risks & Challenges, David Berg, Chief Advisor, DOE Policy Office, Presentation to Roundtable on Deploying Advanced Clean Coal Plants, July 29, 2004, Washington, DC.

This document provides a framework to address safety and economic risk issues and could be used by Excelsior Energy to properly evaluate the missing safety and risk information. The Commission must use this as its framework to assist in addressing the public interest and cost issues of safety and risk.

Q: Do you have recommendations for consideration of the cost and public interest implications of safety, environmental and economic risks of IGCC?

A: Recommendation for the EIS: The PUC should consider both known and potential safety and related environmental risks of the proposed plant in the EIS. Particularly, the EIS should reflect the potential safety and environmental risks posed by the three proposed syngas gasifiers and all proposed safety measures to mitigate their potential problems. Site selection criteria should favor that location with the least potential for accidental harm to the surrounding people and property and the least over all on and off-site environmental impact. As above, the Commission should add the framework presented in the DOE's Climate VISION Risk Framework for Advanced Clean Coal Plants Risks & Challenges when it considers costs and public interest.

4. Costs of Evaporative (Wet) Cooling Tower and ZLD Air Emissions

Excelsior Energy proposes to discharge water vapor and chemicals to the air through its use of evaporative (wet) cooling towers and evaporation from its ZLD system(s). Based on the inconsistent and incomplete data provided in the following tables:

Table 3.6-6
Water Appropriation Requirements

Phase	West Range IGCC Power Station: Average Annual Appropriation (GPM)	West Range IGCC Power Station: Peak Appropriation (GPM)	East Range IGCC Power Station: Average Annual Appropriation (GPM)	East Range IGCC Power Station: Peak Appropriation (GPM)
Mesaba One	4,000[a]-4,400[b]	6,500	3,700[a]	5,000
Mesaba One & Two	8,800[b]-10,300[c]	15,200	7,400[a]	10,000

[a]Based on 8 COC in the gasification island and the power block cooling towers
[b]Based on 5 COC in the gasification island and the power block cooling towers
[c]Based on 3 COC in the gasification island and the power block cooling towers

Page 271

Table 2.7-4 Quantitative Comparison of Environmental-Related Attributes at West and East Range Sites

	Mesaba One and Mesaba Two Air Emissions[1] (Tons Per Year; Hg in lbs/yr)				lbs/MWh (gross)	Class I Visibility (Days >10% Impact BWCA)[4]	Protected Waters Crossed: Preferred HVTL	Protected Waters Crossed: Proposed Natural Gas Pipeline	Protected Waters Crossed: Water Pipelines	Average Water Appropriation (GPM)[5]	Cooling Tower Blowdown Discharge (GPM)[6]	[illegible] (TPY)[7]
	SO_2	NO_x	PM_{10}	Hg[2]	CO_2[3]							
West Range	1390	2872	493	54	2016(SB) 1831(B)	25	1	2	2	4400(I) 10300(II)	390(I) 3500(II)	[illegible] GI
East Range	1390	2872	709	54	>2016(SB) >1831(B)	69	20	12	5	7,400	0	~6800 GI ~2400 PB

1 Figures provided represent stack and fugitive emissions of criteria pollutants assuming 100% capacity factor (sulfur dioxide, nitrogen oxides, volatile organic compounds, and particulate matter are included in totals). See Application for Part 70/New Source Review Construction Authorization attached as Appendix B for basis of estimate.
2 Mercury emissions from stack emission points represent peak annual emissions accepted as permit limit.
3 SB= Subbituminous Coal; B= Bituminous Coal; East Range Site with ZLD will have lower efficiency and higher emissions per MWh.
4 Visibility based on Calpuff Method 2, 1992 Met Data.
5 I = Phase I; II= Phase I + II.
6 I = Phase I; II= Phase I + II; East Range ZLD eliminates discharge of cooling tower blowdown.
7 Fuel dependent; GI = Gasification Island; PB = Power Block (i.e., eliminating cooling tower blowdown).

Page 134

Table 3.4-17
Estimated Wastewater Discharge Rates To West Range Site Receiving Waters

	Cycles of Concentration	Peak Discharge (GPM)	Average Annual Discharge (GPM)
I	5	1,300	550-900
I and II	3	5,140	2,200-3,500

Page 208

Table 3.4-18 Wastewater Discharge Rate From Systems In The Phase I IGCC Power Station

Wastewater Component	Cycles of Conc.	Expected Discharge (GPM)	
		Ann. Avg.	Peak
Power Block Cooling Tower Blowdown	8	335	498
HRSG Demineralizer/RO Reject Water*	8	15	15
HRSG Blowdown*	8	17	17
Gasifier/ASU Cooling Tower Blowdown	8	140	209
Plant Service Water	8	45	45
Mixed Bed Polisher Regen./Backwash	8	15	15
Power Block Cooling Tower Blowdown	5	585	873
HRSG Demineralizer/RO Reject Water*	5	15	15
HRSG Blowdown*	5	17	17
Gasifier/ASU Cooling Tower Blowdown	5	245	366
Plant Service Water	5	45	45
Mixed Bed Polisher Regen./Backwash	5	15	15
Power Block Cooling Tower Blowdown	3	1,180	1,750
HRSG Demineralizer/RO Reject Water*	3	15	15
HRSG Blowdown*	3	17	17
Gasifier/ASU Cooling Tower Blowdown	3	494	732
Plant Service Water	3	45	45
Mixed Bed Polisher Regen./Backwash	3	15	15

*The HRSG Demineralizer/RO Reject Water stream and HRSG Blowdown stream both discharge directly to the Power Block Cooling Tower and, therefore, would be reflected in the discharge from the Power Block Cooling Tower. For example, the average annual discharge from the IGCC Power Station assuming 8 cycles of concentration would be 535 gpm (335+140+45+15), not 567 (335+15+17+140+45+15).

Page 210

The Mesaba I and II combined facility proposes to evaporate somewhere between 5,000 and 10,000 gallons of water per day. The vast majority of the evaporation is assumed to be through the "gasifier/ASU" and "power block" evaporative cooling towers.

Especially during cold winters, but also occurring year round during more humid periods, the water vapor often forms a significant continuous cloud of water vapor and mist that can continue downwind of the cooling tower for several miles. Within a mile or two of the facility, the evaporated water can also produce a ground fog at the ground level and extending upward for several hundred feet.

In addition to the obstruction of view this water vapor causes, this cloud can condense and form a slippery layer that in the winter can freeze and build up ice on homes, walkways and streets and pose a danger to nearby residences.

Evaporative cooling towers always emit more than water. The upward flow of the air inside these towers mix pick up (entrain) small droplets of water containing any of the chemicals and organisms that are added to or come from the water source being used or form as a result of chemical or biological reactions in the tower. An example chemical is chlorine. An example organism that forms in warm weather causes "legionnaires' disease". As the droplets evaporate, there diameter reduces, they are carried further and they can penetrate far into lungs. This tendency increases health risks of individuals several miles downwind of the discharge point. These particles also can significantly add to the facility's PM_{10} and $PM_{2.5}$ air emissions. These emissions do not appear to have been considered by Excelsior Energy. In fact none of the cooling tower emission, health and visual obstruction concerns or the costs of controlling and mitigating them seems to have been considered at all.

Excelsior proposes to consume the following chemicals that may evaporate or become entrained in the as a cooling tower air emission:

Table 3.4-19 Chemical Additives Used Per Year (Phase I and II)

Chemical	Point(s) Of Introduction	Estimated Usage (lbs/Year)	Estimated Residual In Discharge	Basis, % In Discharge
Scale Dispersant	Cooling Towers	75,000	750	1%
Corrosion Inhibitor	Cooling Towers	300,000	3000	1%
Dechlorination – Sodium bisulfite	Cooling Tower Blowdown Sump, Reverse Osmosis System	15,000 7500	150 75	1%
Oxygen Scavenger	Boiler Feed Water	6600	66	1%
Condensate Corrosion Inhibitor-Neutralizing Amine	Boiler Feed Water	2200	22	1%
Chlorination - Sodium Hypochlorite	Cooling Towers	300,000	1500	0.5%
pH control-93% Sulfuric acid	Cooling Towers, Reverse Osmosis, Mixed Bed	18,000 3000 11,000	36 6 22	0.2%
Sodium Hydroxide	Mixed Bed regeneration	11,000	0	(totally neutralized)
Scale and Corrosion inhibitor	Boiler/HRSG	13,000	130	1%
Anti-Scalant	Reverse Osmosis, Deionizer	150 200	2 2	1%
Non-Oxidizing Biocide	Cooling Towers	11,000	22	0.2%

Page 211

The majority of the water would be used in the cooling towers, and a significant fraction could be discharged to the air in vapor or mist form. The chemicals include significant quantities of unspecified "non-oxidizing biocide", "corrosion inhibitor", and "scale dispersant" as well as sodium hypochlorite (bleach) and sulfuric acid. The table indicates that only 1% or less of these chemicals will be discharged in wastewater. The remaining portions would therefore leave the facility as hazardous or solid waste or as an undisclosed air emission. No mention is made of the fraction of dissolved solids in the naturally occurring water that would also be discharged. This information is not disclosed, nor are effects or the costs of prevention, control and mitigation considered.

There are alternative cooling technologies (such as use of a mine pit heat exchanger, dry cooling towers, natural draft evaporative towers and combination cooling systems) that can mitigate this risk. Some are even more energy efficient and may be more cost effective than the proposed cooling approach.

Q: Do you have recommendations for the Commission to consider in its cost and public interest analysis of Cooling Tower and ZLD Air Emissions?

A: Yes. It is crucial to quantify and evaluate the air emissions, visual impairment, and health effects from the proposed cooling tower systems and ZLD system(s) and the costs of prevention, control and mitigation. The Commission should consider costs of various cooling alternatives and require ones that have less environmental and health impacts even if they have somewhat higher capital costs.

5. Cooling Water Blowdown ZLD

Q: Have you reviewed the Cooling Water Blowdown ZLD and found cost and public interest concerns?

A: Yes, there are design problems that require Zero Liquid Discharge (ZLD) but Excelsior has not planned on ZLD for both sites. Excelsior must integrate ZLD into the West site plan, and the cost of this necessary addition must be considered.

For example, regarding the East site, Excelsior states:

> Stringent conditions applying to discharges of mercury in the Lake Superior Basin watershed make it necessary for the East Range IGCC Power Station to eliminate all direct wastewater discharges to receiving waters…

Siting App., 3.1.6.3.2 Elimination of Cooling Tower Blowdown: East Range Site – Page 158

In addition, the Siting Application states:

> The allowable quantity and concentration of chemical species in wastewater discharges from the IGCC Power Station are dependent in large part

> on the characteristics of potential receiving waters in the Project's vicinity. In the case of the West Range and East Range Sites, the receiving waters are located in different watershed basins that have greatly different water quality criteria. Importantly with respect to wastewater discharges, the East Range Site is located within the Lake Superior Basin watershed, and the standards that apply to discharges of bioaccumulative chemicals of concern ("BCCs") in that basin effectively preclude discharges of cooling tower blowdown from Mesaba One and Mesaba Two. The reason for such discharge prohibitions is that mercury – a BCC – is found in the source waters for the East Range Site at concentrations nearly equal to the water quality criteria standard applied to end-of-the-pipe discharges. Siting Application, 3.4.2 Water Effluents – Pages 199-200

It appears that a primary reason the West Range "Greenfield" site is favored over the East Range "Brownfield" site is that the high surface water mercury levels at the East Range Site require a ZLD and the West Range site does not -- the cost and power efficiency loss supposedly caused by addition of a ZLD system is too great. The application does not consider that the mercury removal technology, such as reverse osmosis, ion exchange and activated carbon among others, can reduce the high surface water mercury levels before use possibly eliminating the need for the ZLD. The application also does not acknowledge that there is a strong likelihood that mercury, selenium and arsenic wastewater discharge limits will be reduced in the region of the West Range site in the near future, nor does it consider that the belief that a ZLD system is not needed for the West Range site is not correct. Excelsior's proposal does not address the prohibition of the "impaired waters" status of the Mississippi and Swan Rivers, and its inability to discharge and further impair these waters.

Not considering mercury removal technology for the East Range site or a ZLD system for the West Range site is limiting, shortsighted and inappropriately and unfairly skews the site location decision. Given the low flows likely available to dilute these discharges (see Cumulative Impacts), a ZLD system will likely be required for the West Range site anyway. In addition (see cooling tower air

Emissions comments), alternative, closed loop cooling systems are available that may have less impact on both the operating cost and the ZLD need.

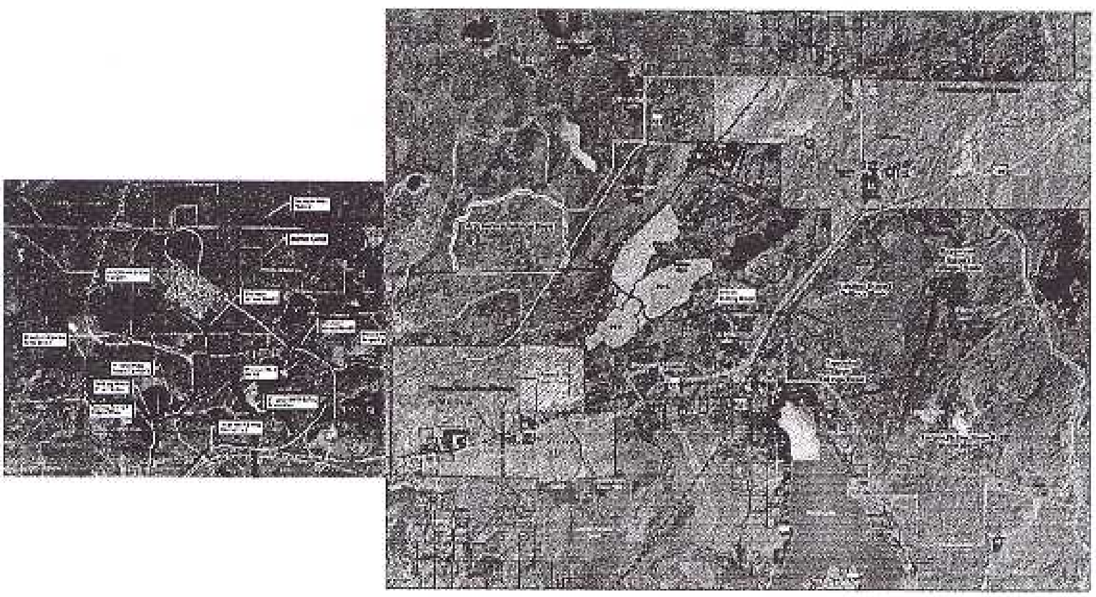
Q: Do you have recommendations that the commission consider regarding a ZLD system and the cost of incorporating ZLD into both sites and the potential cost if it is not included?

A: The Commission must evaluate alternative feed water mercury removal technologies, consider alternative condensate cooling options and/or require that a ZLD be installed at the West Range site. The costs and public interest value of this system must be considered.

6. Cumulative Effects of Mesaba Power and Minnesota Steel

A: Neither Excelsior Energy nor Minnesota Steel Industries (MSI) has considered the combined costs of both proposals and the impact of these two projects in tandem if the West Range site is selected by for the Mesaba Power facility. While both companies claim to be aware of each other and even though MSI is further ahead in their permitting and financing, Excelsior has not mentioned MSI environmental or resource use issues and cost distribution in any of its submittals. If both projects go forward, there may not be sufficient resources for both projects at any cost, and to construct both in the West Greenfield site may be cost prohibitive due to infrastructure costs.

A map showing both proposed facilities and their boundaries would look about like this:



MSP proposed to construct a large steel-making facility that uses conventional and "commercially available" mining, ore, and metals processing technologies. Their unfortunate but professed intent to use "proven" technologies all but assures significant air, water and solid waste discharge impacts and significant costs of prevention, control, and mitigation that make many of Excelsior's cost assessments invalid.

Most chemicals proposed for discharge to the air and water by MSI are identical to those proposed by Mesaba Power for the West Range site. Both proposed projects will also discharge to the same regional ambient air, and require significant revision of the West Site portion of the application. If Excelsior locates Mesaba Power at the West Range site, also in the same watershed, there can be no question that the surface and ground water resource availability, quality and impact assumptions used by Excelsior in its application for the West Range site are incorrect and need to be completely revised.

Excelsior mentions MSI only in conjunction with shared roads and natural gas pipelines, and only mentions these where cost savings may be realized. Infrastructure costs are deemed a "Trade Secret" by Excelsior. Yet the eastern boundary of Mesaba West Site and the western boundary of Minnesota Steel as currently proposed nearly join north of Marble.

Q: Do you have recommendations for the Commission regarding consideration of MSI and the impacts of tandem projects in its cost and public interest analysis of Excelsior?

A: Yes. I recommend that the Commission require revision of all of Excelsior's assumed air and water quality, surface and ground water resources and infrastructure calculations to include cumulative cost benefits and costs incurred based on the assumption that the MSI is constructed as proposed. Then, require revaluation of the proposed West Range site overall costs and operating economics to reflect the MSI presence. If the Commission does not complete this analysis, it should remove the West Range site from further consideration.

Q: Do you have concerns about statements regarding economic benefits and costs?

A: Yes, I am concerned that economic benefits are overstated and that costs are not addressed.

In preparation for this testimony, I searched for studies regarding economic development costs and benefits and found a study of the specific project at issue which does not seem to have been entered in the record. This study, also by Labovitz School, addresses "economic impact" of the Mesaba project on Itasca County. It is problematic, in the same ways the Labovitz study produced by Excelsior is, and the findings and conclusions are suspect as the information it is based on comes from those interested in the development. Exhibit ___ (Rich 4), The Economic Impact of Constructing and Operating An Intergrated Gasification Combined-Cycle Power-Generation Facility on Itasca County, Labovitz School, University of Minnesota-Duluth (2006). There are no negatives addressed, no costs addressed, costs such as loss of tourism, local health impacts, loss of water supplies, etc., and does not address environmental costs not borne by the developer, or alternatives to the development that would be more beneficial.

The modeling assumptions are limited. Some are provided by U.S. government economic databases, and it is unclear to me who determines what the percentage of labor, equipment and materials that would be procured inside Minnesota or the particular region being evaluated. This is a key assumption in the model and should be addressed to be credible. Also, another key to determining indirect economic impact, the indirect employment, services and materials multiplier ratios, are not disclosed, and are hidden in the computer model. This is important because indirect economic impact comprises the bulk of the claimed economic benefits.

I worked with a similar state model at the former Minnesota Energy Agency. That model determines the future economic effects only if all the assumptions used never change, all the assumptions are corrected for physical, not economic constraints. All negative impacts are also considered. There does not even appear to an attempt to include a "low", "medium", and "high" range or probability given the uncertainty of the global prices of energy, raw materials and other commodities that can cause the projects to fail. In addition, UMD only includes few disclaimers – especially disappointing since this developer driven type of study is suspect because it would also have shown grand numbers for the Hibbing chopsticks factory and the Cohasset biotech facility.

While I understand the developer interest in using studies that support their project, they should not be given great weight by the Commission. The Labovitz studies don't even disclose or disclaim the potential economic risk these projects can pose. There is no impartiality and the results are not credible.

Q: **Does this conclude your testimony?**

A: Yes, it does.