Grant Application
for a
North Dakota Partnership
in the
Canadian Clean Power Coalition

Presented to:
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North Dakota Industrial Commission
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Submitted by:
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Funds Requested from
The North Dakota
Industrial Commission
$75,000

September 30, 2004

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ABSTRACT

The Lignite Energy Council's (LEC) Integrated Gasification Combined Cycle (IGCC) Task Force members seek to become partners with the Canadian Clean Power Coalition (CCPC). The CCPC (table below) is a partnership of utilities, producers and government agencies designed to accelerate the development and demonstration of clean coal technology in Canada. The CCPC represents over 90% of Canadian coal-based utilities. Leadership of the CCPC is provided by the industry lead partnership via a technical committee that provides direction to the program.

Canadian Clean Power Coalition

Canadian Industry	Canadian Government
ATCO Power Canada EPCOR Utilies Inc. IEA Greenhouse Gas Luscar Ltd. Nova Scotia Power Inc. Ontario Power Generation Saskatchewan Power Corp. TranAlta Utilities Corporation	Natural Resources Canada Alberta Energy Research Institute Saskatchewan Industry & Resources

The CCPC project was initiated in 2001 to accelerate the development and demonstration of clean coal technology in Canada. The multistage objectives are to demonstrate all future environmental issues, including carbon dioxide (CO_2), for a retrofit technology by 2008 and a Greenfield plant by the 2010-2012 timeframe.

The multistage plan consists of the following:

Phase I: Feasibility Studies, Jul 2001 – Jul 2003

Phase II: Optimization Studies and Business Case development, Dec 2003 – June 2005

Phase III: Demonstration plant Design & Construction, Oct 2005 – June 2011

Phase IV: Demonstration Plant operation, start July 2012

The $5 million Phase I work commenced in mid-2001 and was completed in July 2003. The scope of this initial phase was:

- To evaluate clean coal technologies to control all emissions, including CO_2 to the lowest possible levels.
- To evaluate technologies to control all emissions, excluding CO_2, to the lowest possible levels. This would allow the net cost of CO_2 capture to be evaluated.
- To evaluate amine scrubbing and CO_2/O_2 combustion as retrofit and new power plant technologies.
- To evaluate gasification as a new generation plant technology.

Phase II scope: The technology focus includes reduced emissions and CO_2 capture:

- Gasification of low rank coals (polygeneration concept) leading to technology selection for demonstration plant.
- Evaluation of retrofit CO_2 removal for existing plants with amine scrubbing identified in Phase I as most likely to be the most appropriate retrofit technology.
- Identification of CO_2 sequestration storage options.

The LEC and the IGCC Task Force, comprised of lignite industry generators and producers, have been evaluating advanced gasification reactors for power generation with tests in the "Transport Reactor" gasifier at the Department of Energy's Power System Development Facility (PSDF), located in Wilsonville, Alabama. The DOE advanced gasifier offers significant advantages (high system efficiency, low emissions) for repowering and Greenfield applications for low rank lignite coal. With the current interest of the IGCC task force in lignite gasification as a "next" technology for new power plant development or repowering existing plants, the CCPC project research will greatly enhanced the knowledge of gasification, advanced

combustion and new plant and retrofit CO_2, capture technology. Also the identification of effective retrofit technology for CO_2 capture and identifying possible CO_2 sinks for existing plants will benefit the North Dakota lignite industry in a possible future CO_2 controlled environment. Fort Union lignite, common to both Saskatchewan and North Dakota, has similar characteristics, so the knowledge gained by the CCPC project would be useful to both organizations.

Coal gasification is the latest advanced technology being researched and developed to demonstrate that coal can be used as a fuel in electric generation in an environmentally enhanced manner. The advanced Integrated Gasification Combined Cycle (IGCC) system is designed to gasify coal, use the synthetic gas (syngas) produced to fuel a gas generation turbine. The captured waste heat from the gas turbine goes through a heat exchanger to produce steam, which in turn drives a steam generation turbine. This advanced process improves the plant efficiency while reducing plant emissions significantly.

PROJECT SUMMARY

A Canadian partnership of utilities, government agencies and producers has initiated a program to accelerate the development and demonstration of clean coal technology in Canada. The CCPC represents a national association of coal producers and over 90% of Canadian coal-based utilities. A technical committee provides leadership to the CCPC in the industry-lead partnership. Canadian participants and potential USA industry participants are show in the table below.

Canadian Industry	**Canadian Government**	**USA Industry**
ATCO Power Canada EPCOR Utilities Inc. IEA Greenhouse Gas Luscar Ltd. Nova Scotia Power Inc. Ontario Power Generation Saskatchewan Power Corp. TransAlta Utilities Corp.	Natural Resources Canada Alberta Energy Research Institute Saskatchewan Industry & Research	Electric Power Reach Institute (EPRI) ND Industrial Commission Lignite Energy Council & IGCC Task Force: Basin Electric Dakota Gasification Co. Great Northern Power Devel. Great River Energy Coop. Montana-Dakota Utilities Otter Tail Power Co. Westmoreland Coal Co.

An important emphasis of the CCPC program is to examine CO_2 capture in existing plants and to determine the best technology for future electric generation plants with CO_2 capture ability. Phase I has directed the CCPC towards more research on coal gasification technology. The IGCC team has a similar interest and believes that the CCPC research would be a coordinated effort on advancing lignite gasification technology research.

Today coal currently provides over 50% of the electricity consumed in the United States and

will remain a necessary part of our energy mix for some time to come. One of the technologies being developed for advanced coal-based electric power-generating systems is an IGCC system. The IGCC process converts coal to a combustible gas, cleans the pollutants from the gas, and combusts it in a gas turbine to generate electricity. The exhaust from the gas turbine is used to generate steam to generate more electricity in a steam turbine.

Exploring how lignite coal performs in an advanced gasification process could have a significant economic impact on the North Dakota power industry. The construction of new power plants and the re-powering of existing North Dakota plants using this advanced gasification process could lead to new development of cost-competitive, environmentally acceptable coal-based power generation in the state.

A number of factors make the CCPC study a very timely project:

- There is a growing realization that natural gas supplies in Canada are unlikely to allow electric power production in western Canada to switch to gas from coal.
- Reserves of low rank coal in western Canada and North Dakota are sufficient to last for hundreds of years.
- Power generation technologies used in the past are not going to be acceptable in the future because of growing concerns about emissions.
- With the agreement by Canada to accept the Kyoto treaty, CO_2 capture technologies for Canadian power plants must be developed if coal is to be used over the long term.
- There is a fortunate association of the proximity of the Western Sedimentary Basin with the need to store or use CO_2 from power plants that provides an opportunity to use the CO_2 if it can be captured at a price competitive with users needs.

- There is increasing pressure from environmental groups in the United States to pass Federal legislation or regulation on CO_2 emissions.

Starting around 1985, many of the organizations funding the present work have studied gasification of coal, CO_2 capture, coal bed methane and other potential uses for the CO_2, storage in depleted reservoirs and in deep highly saline aquifers. Recently in 2003, the Energy & Environmental Research Center (EERC) was awarded one of the seven DOE contracts to form a regional carbon sequestration partnership. The EERC's "Plains CO_2 Reduction Partnership" (PCOR) will form the core of a nationwide network to help determine the best approaches of CO_2 sequestration technologies in the northern Upper Great Plains. The region includes nine states and two Canadian Provinces, including North Dakota, Minnesota and Saskatchewan. Results from the PCOR study, which includes several members of the IGCC Task Force team, will benefit and complement the CCPC study.

Based on the CCPC studies, while many of the conventional (non-CO_2) emissions have been shown to be economically controllable, CO_2 has been a challenge. With Canada signing the Kyoto treaty additional stimulus has been provided to make this happen. Very little of what is being done elsewhere in gasification-based power generation is directly transferable to the high moisture and ash content in Saskatchewan and North Dakota lignite. This presents a great challenge to gasification process developers. With the focus of the CCPC largely on low-rank coals, the goal is to conduct an economic/business evaluation to determine the best approach to demonstrate a first-of-a-kind commercial scale project. Retrofit CO_2 capture applications for existing lignite-based power plants will be analyzed as well as a probable IGCC demonstration.

PROJECT DESCRIPTION

Work Plan

The results of both Phase I and Phase II of the CCPC project will be made available to the IGCC task force members once accepted into the coalition. If the IGCC members become a partner with the CCPC project, they would be entitled to have a seat on the CCPC Technical Committee. After completing Phase II, IGCC members will have the opportunity to determine whether to remain part of the coalition in Phase III and IV. As in Phase I, consultants, who will be selected after competitive bidding, will carry out the work.

The tasks to be carried out in Phase II are:

Phase I Technology Gap Analysis. This will review the Phase I reports and make recommendations to the CCPC Technical Committee on areas of the technology where more development effort is required. It will also assess which of the technologies studied is most appropriate for use in retrofit and Greenfield demonstration projects using low rank coals. The results of this task will allow the Phase II scope to be better focused by e.g. possibly eliminating one of the technologies or the addition of gasification tests on low-rank coals.

Gasification technology and feedstock evaluation. The focus on low-rank coal makes this work unique. This work will review available gasification technologies (see Figure 1, Page 12), and near-term process improvements. In particular, processes such as E-Gas, which was not available for analysis in Phase I (the technology having just been bought by ConocoPhillips), will be included. Earlier studies, such as the 1991 Coal Association of Canada Feasibility Study for IGCC, has reviewed other gasification processes such as Lurgi and found them unsuitable for electricity generation from low-rank western Canadian coals. A major issue is how to attain acceptable performance and costs using low rank coals, particularly lignite as feedstock. Technology options and emerging process, such as low-rank coal upgrading (moisture and ash

reduction), will be sought to achieve this. Other technology options, such as membrane air separation will be investigated. A recent Air Products paper predicts the technology could reduce electricity costs for gasification by 7%. This technology is reported to be ready for large-scale demonstration by 2010.

CO_2 Uses Study. A major goal of the project is to determine viable use or storage options in provinces that use coal for power generation. The CO_2 economic assessment for use in EOR projects in the Western Sedimentary Basin will be determined by working with oil companies with interests in EOR. A recently awarded DOE contract to the EERC entitled, "Plains CO_2 Reduction Partnership (PCOR)", will identify cost-effective CO_2 sequestration systems in the northern Great Plains region that will supplement the CCPC evaluations. Options for CO_2 use or disposal in saline aquifers and enhanced coal bed methane recovery will also be examined. Finally, potential safety issues resulting from pipeline leakage or ruptures will be examined.

Amine Extraction Optimization. (See Figure 2, Page 13). The objective is to identify process economics to minimize efficiency and cost impacts on plant generation efficiencies. This will examine two key aspects of the design. In the Phase I study, the Econamine (owned by Fluor) process for capturing the CO_2 was used as the basis. The optimization study will review other leading processes, such as Mitsubishi Heavy Industries, Ltd. (MHI's), state-of-the-art Advanced SuperCritical Rankine cycle technology being developed and used in Europe and Japan will be included. This uses higher temperature and pressure steam conditions to give greater efficiency from the power cycle. The required quality of the extracted CO_2 will be further evaluated. The impact of co-removal of hydrogen sulfide (H_2S) and sulfur dioxide (SO_2) from the CO_2 product stream verses injecting the gases with the CO_2 will be determined. Significant cost reductions may be achieved with this approach. The work carried out in Phase I using low-rank coal fuels will then be re-evaluated using the results of the previous two items and the impacts on costs and performance determined.

CO_2/Oxygen Combustion (Oxyfuel) Optimization. (See Figure 3, Page 14) Concerns about the large parasitic energy requirements for air separation require that the competitive potential of this technology be validated. Three important issues will be addressed. As in the gasification case with the H_2S, the benefits of leaving the SO_2 (all or in part), and possibly other flue gas constituents, in the extracted CO_2 and pipelining the gas mixture for use in EOR or to storage in geological will be evaluated. Also, as in the amine case, data from state-of-the-art Advanced SuperCritical Rankine cycle technology being developed and used in Europe and Japan will be included. Finally, performance, operational and economic impacts of deleting air-firing capability from the design will be evaluated. With the benefit of this new information, the work carried out in Phase I using lignite will be refined, and a sub-bituminous coal case evaluated. The designs will include modifications to the product recovery train process, including concepts developed at the CANMET Energy Technology Centre's oxyfuel pilot plant facility.

Demo Site Selection and Business Case Development. An important task for this Phase will be to evaluate the business case for proceeding to a first-of-a-kind commercial scale project as opposed to a limited life, minimum scale technology demonstration project. Two cases will be evaluated, the first a retrofit, and the second a Greenfield case. During the study, a preferred case will be selected for a single demonstration.

Figure 1:

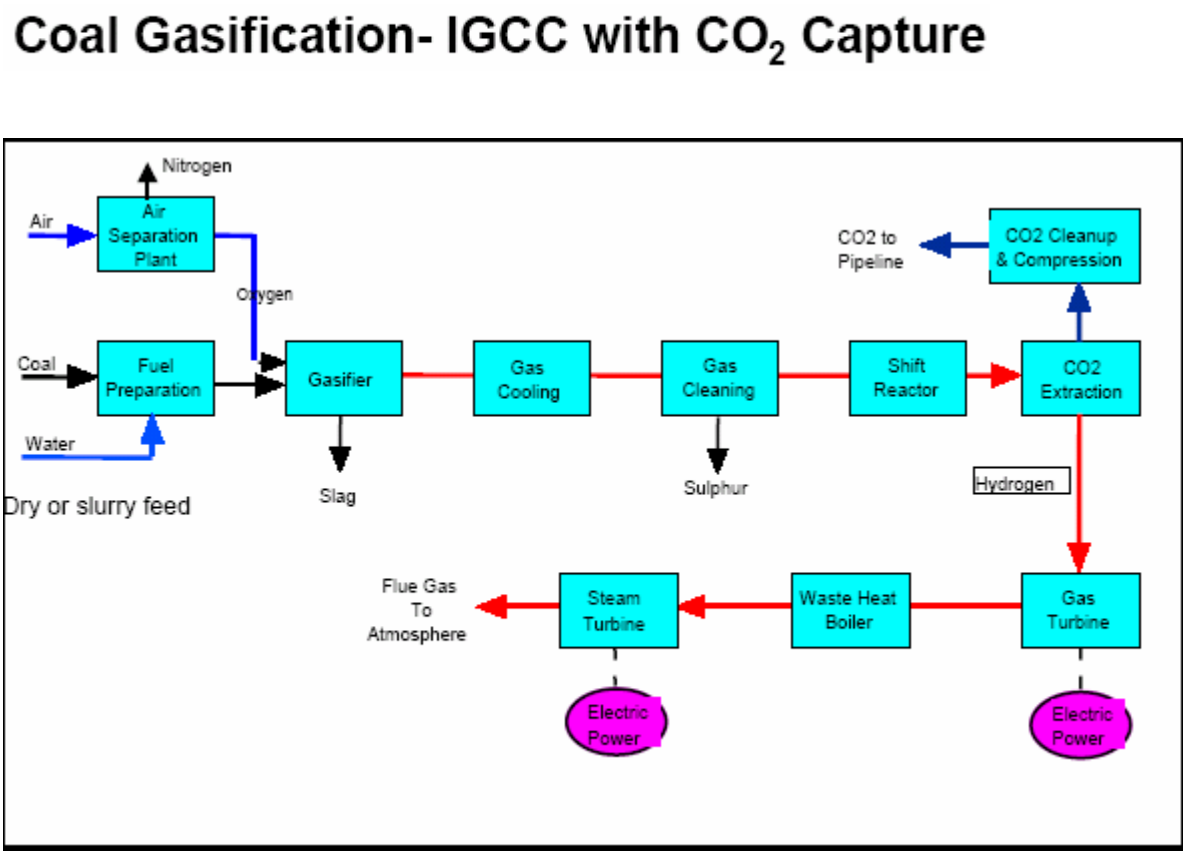

Coal Gasification- IGCC with CO_2 Capture
Nitrogen
Air
Air Separation Plant
Oxygen
Coal
Fuel Preparation
Water
Dry or slurry feed
Gasifier
Slag
Gas Cooling
Gas Cleaning
Sulphur
Shift Reactor
CO2 Extraction
CO2 Cleanup & Compression
CO2 to Pipeline
Hydrogen
Gas Turbine
Waste Heat Boiler
Steam Turbine
Flue Gas To Atmosphere
Electric Power
Electric Power

Figure 2:

Flue Gas Amine Scrubbing

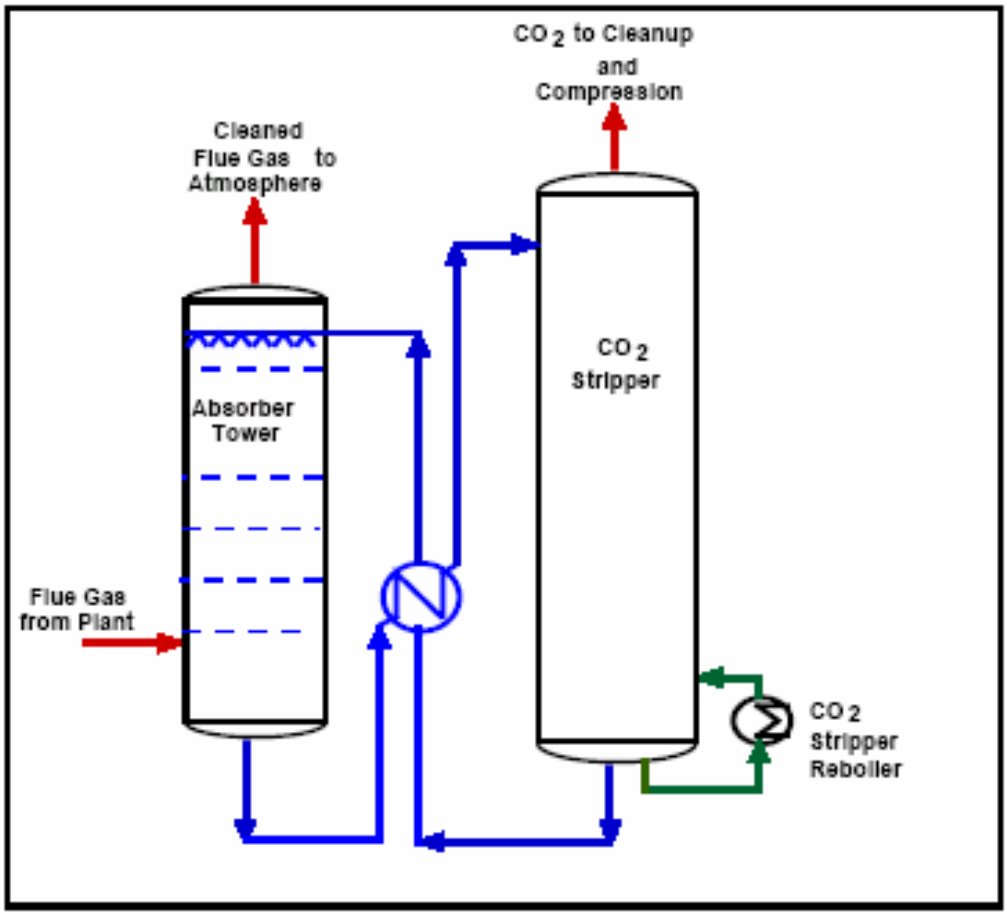
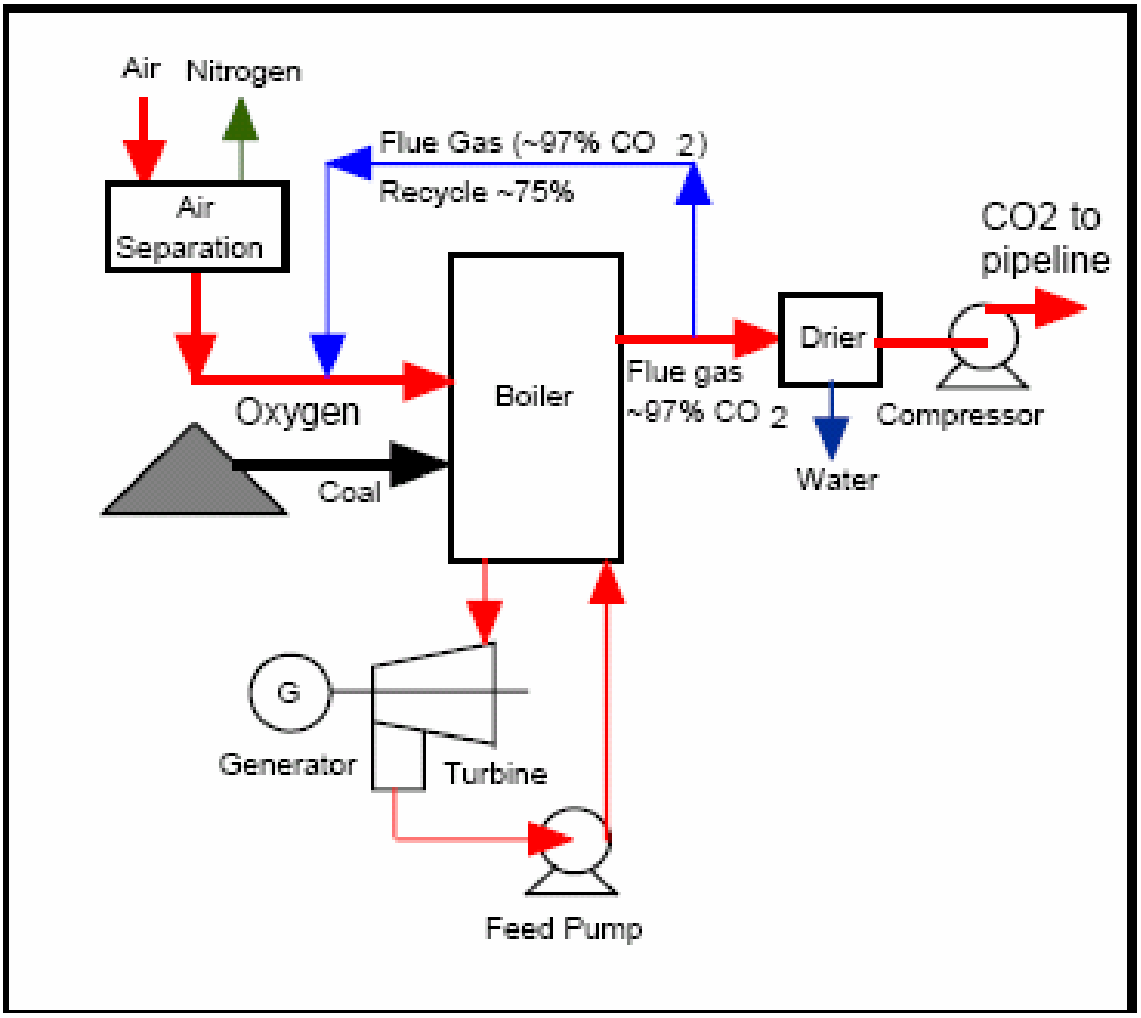


Figure 3:

CO_2/ O_2 Combustion



Standards of Success

The overall success of the CCPC program will be determined through the successful implementation of a Phase III first-of-a-kind commercial scale plant in Canada that demonstrates an advanced Clean Coal Technology generation plant (e.g., IGCC, advanced generation) with priority pollutant emissions equal to or less than 10% of New Source Performance Standards (NSPS) and capable of CO_2 capture. A major technology challenge is to maintain the ability of the plant design to operate at high availability to ensure economic viability.

Alternatively, the success of the CCPC program will be further determined through the successful identification of retrofit CO_2 technology for existing plants and implementation of geological sequestration of CO_2 for long-term storage or as a valuable by-product for use in enhanced Coal Bed Methane (CBM) recovery or Enhanced Oil Recovery EOR.

The success to the North Dakota lignite industry would be the integration of the CCPC information into the existing operations ranging from retrofit CO_2 capture for existing plants, sequestration and/or technical information supporting construction of an advanced IGCC technology with or without CO_2 sequestration.

The successful use of lignite in an IGCC system will benefit North Dakota lignite industry by demonstrating the technical and economic viability of lignite fuel in a high efficiency gasification power plant. The CCPC technology evaluations, combined with the current North Dakota activities (Leland Olds Station repowering, lignite upgrading projects, lignite gasification test in

advanced DOE gasification facilities, PCOR sequestration partnership) could provide lignite-based options for new generation plants as for re-powering existing plants.

Identification of economical, efficient and effective retrofit technologies that can addressed CO_2 removal from existing plants and identifying possible CO_2 sinks will also benefit the North Dakota lignite industry by providing an option for continued operations if regulation or legislation mandate CO_2 control.

The overall success requires identifying appropriate candidate opportunities and cooperative participation of lignite industry operators and producers to address and solve technical, economic and regulatory concerns. Communications among the program participants will be essential.

Background

Neill & Gunter and ADA Environmental Solutions evaluated a range of advanced emission control technologies. For each of the coal types (eastern bituminous, western sub-bituminous, and Saskatchewan lignite) technologies to control SO_2, nitrogen oxides (NOx), particulates and mercury were studied. The emission control targets were much more taxing than currently regulated levels.

A series of major studies was carried out by Fluor. These covered the viable CO_2 capture technologies. For conventional Rankine cycle power plants, amine scrubbing and CO_2/Oxygen recycle combustion, a technology pioneered by the US DOE Argonne Labs, were considered. A more advanced coal utilization technology, Integrated Gasification Combined Cycle was evaluated, principally for new plants. In this technology coal is first gasified with oxygen and the resulting gas, once cleaned of impurities, is burned in a gas turbine and the exhaust waste heat used to generate steam, which in turn generates more power in a steam turbine. This technology allows the CO_2 to be easily removed from the fuel gas prior to burning.

These studies provided a consistent basis of cost evaluation of the options for the production of clean electricity with CO_2 capture. The results of the studies showed that technology is commercially available to control conventional air emissions (NOx, SO_2, particulates, mercury) to levels approaching that of natural gas power generation. However, costs to do so were high, ranging from $250 million - $350 million for capital and resulting in additional operating costs ranging from $4/MWhr - $22/MWhr.

Among the CO_2 capture technology options studied, gasification with low-rank coal provides the lowest cost of electricity. Further improvements in cost may be expected with a fully optimized gasification process for low rank coals. Other gaseous emissions are equivalent to the levels

from gas-fired power plants. Key areas for technology improvement were also identified. The Technology Gap Analysis will further refine the needs for Phase II scope.

The Western Sedimentary Basin provides storage capacity for a vast amount of CO_2 in B.C., Alberta and Saskatchewan. CO_2 is currently being used for enhanced oil recovery in Saskatchewan and has been successfully used for many years in Texas. However, costs of these technologies are currently high and further work was identified as being required to optimize the designs and to develop a good business case.

Several issues were identified during the Phase I feasibility studies. These were:

Gasification Case: One major developer (E-Gas) was not able to provide support to the study as the technology was in the process of being sold. This is now owned by ConocoPhillips and will be fully evaluated in Phase II.

Amine Case: Significant energy efficiencies of 20% were achieved with an improved process, and an additional 11% due to effective integration with the power plant. However, a competing process developed by MHI could not be evaluated. This is planned for Phase II.

CO_2/O_2 Combustion: In spite of great efforts by the contractors in developing new designs, the high cost and performance penalties imposed by the large-scale air separation required could not be overcome.

The following results achieved in Phase I met the goals of the CCPC:

Retrofit: Technologies were identified to control all non-CO_2 emissions, CO_2 removal options were compared with estimates prepared for costs and performance. Amine scrubbing was identified as likely to be the most appropriate retrofit technology. However, a leading amine capture technology was not studied and could provide some benefits.

Greenfield: Gasification appeared to offer the best prospects for new plants by combining relatively simple processes to control conventional emissions with simple CO_2 capture

processes. However, not all gasification technologies could be studied, and it became apparent that for low-rank coals, considerable uncertainty exists in regard to costs and performance. Also, the most advanced supercritical Rankine cycle technology was not reviewed, and cost reduction strategies such as simplification of the design could not be applied to the CO_2/O_2 combustion option.

Costs: The results indicated that gasification with 90% CO_2 extraction, and with very low conventional emissions using Alberta sub-bituminous coal could provide a cost of power at around $95/MWhr. The scope of the Phase II work plan is aimed at finding ways to reduce this.

Technology Selection: The original work plan was to select the technologies for the demonstration projects at the end of Phase I. While gasification and amine scrubbing appear to be the best choices for new and retrofit plants respectively, before making that selection final the project wishes to clarify several uncertainties:

- Could advanced supercritical Rankine with amine scrubbing be competitive?
- Are there other gasification processes that might be better (than Texaco or Shell) with low-rank coals?
- Are there other process enhancements such as membrane air separation, which might improve gasification?
- Could process simplification plus advanced supercritical Rankine allow CO_2/O_2 combustion to be competitive?

The project focus will be on advancing the development of the technologies being studied to provide solutions for the particular needs of Canadian coals. Process improvements will be sought from process developers. With gasification using high-pressure gasifiers requiring the coal to be fed as a water based slurry, the challenge will be to obtain higher solids loading to improve efficiency. Other innovative approaches will be considered, such as slurrying the coal in supercritical CO_2. Another concern is the ash and moisture content of the low rank coals.

Coal drying or cleaning to reduce the mineral content will be evaluated to improve quality prior to feeding the coal to the gasifier.

In the case of amine scrubbing the Phase I study contractor developed an improved Econamine process providing significant energy savings. Further reductions are believed possible. Another approach is to use improved amines which require less energy for regeneration or which are more effective CO_2 absorbers, such as the MHI process. Because of the need to use large quantities of low-grade steam for amine regeneration, integration of the amine system with the plant steam system is critical to obtaining more efficient use of the energy. Phase I showed significant improvements in this area.

For CO_2 /O_2 Combustion with its large requirement for oxygen, the challenge will be in reducing the energy needs. Developments in advanced air separation technology will be investigated (which would also benefit the gasification case). Other key process areas to examine include simplification of gas cleanup needs and operating requirements such as the assumption that plant operation on air is required.

Qualification

Canadian Clean Power Coalition

The CCPC comprises seven founding member companies representing over 90% of Canada's coal-based electrical generation capacity. Members of the CCPC include: ATCO Power, EPCOR, IEA Coal Research, IEA Greenhouse Gas, Luscar Ltd, SaskPower, Ontario Power Generation, TransAlta, and Nova Scotia Power. Recently, the California-based Electric Power Reach Institute (EPRI) joined the coalition as a participant.

The Government of Canada, through Natural Resources Canada, is a partner in the CCPC project. The Alberta government through the Alberta Energy Research Institute and the Saskatchewan government through the Saskatchewan Industry and Resources are members of the CCPC project. "Cutting-edge technology to burn coal cleanly is an important step in decreasing greenhouse gas emissions, as outlined in our Climate Change Plan for Canada," said the Honorable Herb Dhaliwal, Minister of Natural Resources Canada. "By finding a cleaner way to use an economical and abundant sources of energy, we are contributing to a better quality of life for all Canadians through healthier communities and greater economic prosperity."

"By working together with the Government of Canada, the CCPC is one step closer to making the first generation of clean coal technology a reality," said Jim Dinning, CCPC Chair. "Coal is our country's most abundant fossil fuel resource and an essential part of Canada's clean energy future.

Implementation of the CCPC program, Phase II will consist of the Technical Committee competitively selecting contractors with experience and expertise in advanced combustion and gasification generation technology, and advanced environmental control processes, including

CO_2 capture from advanced and existing generation systems. The contractors will review Phase I results, conduct discussions with the CCPC Team and identify goals and objective to further pursue. It is anticipated that detailed engineering perspective will be required with respect to integrating various environmental processes into the advanced generation concepts and retrofit of the existing fleet.

Basin Electric Power Cooperative

Basin Electric Power Cooperative (Basin Electric) is a consumer-owned, regional cooperative headquartered in Bismarck, North Dakota. We produce clean energy for a healthy economy, based on the Ecowatts® concept. Our history as an electric cooperative is rooted in the beginnings of the electrification of rural America.

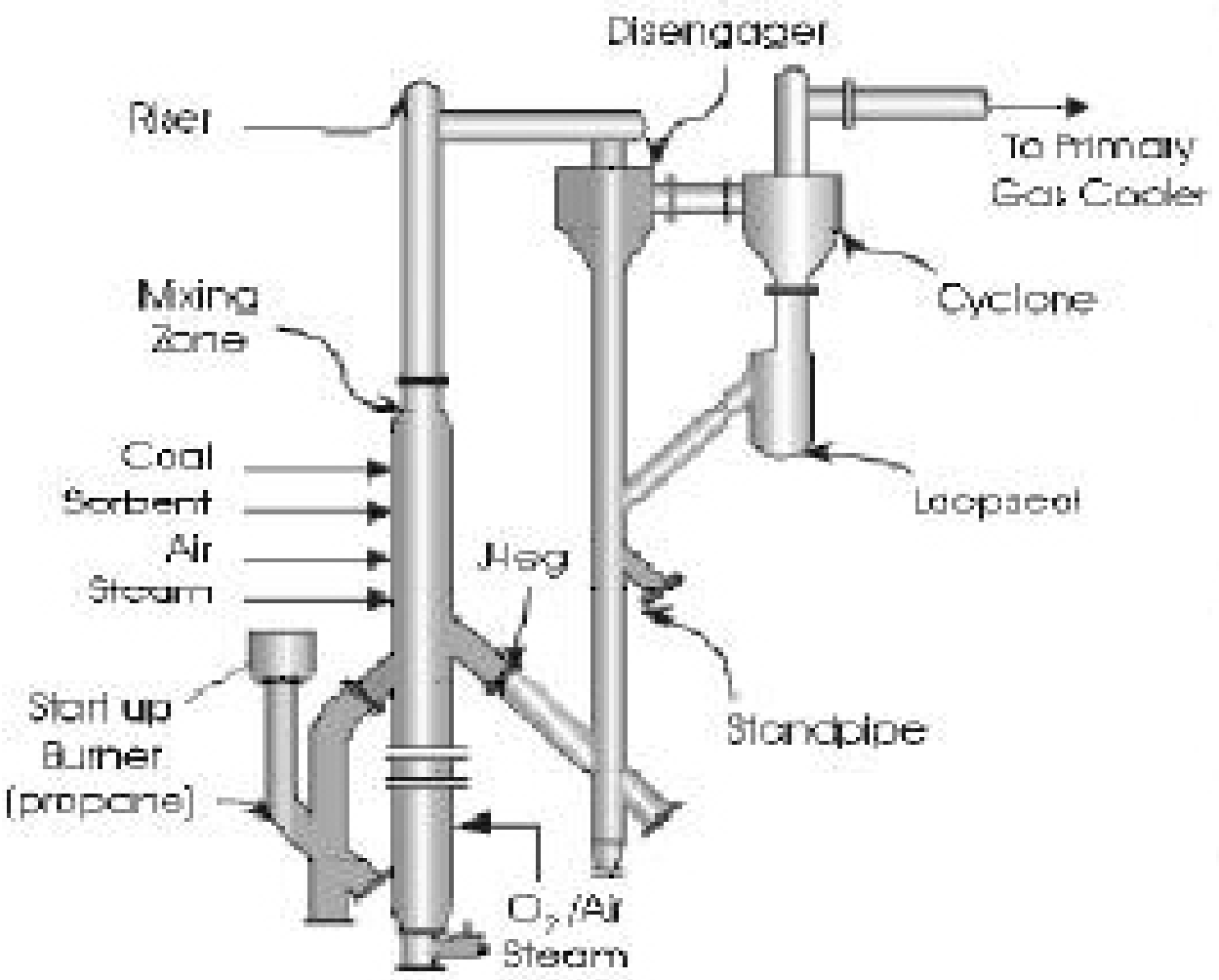
Basin Electric operates electricity-generating power plants with a total capacity of 3,373 megawatts. We serve 124 rural electric member cooperative systems that in turn serve approximately 1.8 million consumers in the nine states of North Dakota, South Dakota, Montana, Wyoming, Minnesota, Nebraska, Iowa, Colorado and New Mexico.

Basin Electric has several subsidiaries, including Dakota Gasification Company, which produces natural gas from the coal gasification process and products such as chemicals and fertilizers; Dakota Coal Company, which purchases lignite for our power plants and owns a lime processing plant. Basin Electric and its subsidiaries employ about 1,700 people.

Basin Electric and members of the IGCC Task Force Team have provided Ft. Union lignite coal to the DOE's Power System Development Facility (PSDF) which is operated by Southern Company Services, Inc and located in Wilsonville, AL. The facility operates an emerging gasifier called the Transport Reactor Integrated Gasifier (TRIG) that is capable of higher efficiencies using a high ash, high moisture low-Btu lignite. A schematic of the TRIG advanced

gasifier is shown below in Figure 4. The TRIG is a low-temperature (~ 1800°F) reactor that consists of a riser reactor with an expanded mixing zone at the bottom, a two disengager cyclones and a standpipe. The standpipe collects solids from the disengager and returns fine coal particles to the mixing zone. Syngas and entrained fly ash from the disengager cyclones is delivered to a high-temperature (1,000°F) particulate control device containing metallic candle filters. Syngas exiting the particulate control device is combusted in a combustion can. In addition to two 500 ton gasification tests, the IGCC Team will provide two additional 500 tons batches for testing, followed by a 3,000 ton, (1,000 hr) test schedule for early 2005. Results from these tests will be available to the CCPC program.

Figure 4. Transport Reactor Integrated Gasifier



Value To North Dakota

The CCPC successful use of low-rank coals, including lignite, in a commercial IGCC system will benefit North Dakota lignite industry by demonstrating the technical and economic viability of lignite fuel in a high-efficient gasification power plant. The high reactivity of the lignite provides a market advantage against other coals for this IGCC technology, and the impact of high moisture is minimized. Clearly, this technology could provide lignite-based options for new generation plants, as well as for re-powering existing plants.

These coal gasification systems also offer the best potential competition to natural gas-based generation and the future vision of coal-based generation. IGCC systems are also being developed and promoted under DOE's Vision 21 program, which should help facilitate market acceptance.

Identification of an efficient, effective retrofit technology that addresses CO_2 removal from existing plants and identifying possible CO_2 sinks will also benefit the North Dakota lignite industry by providing an option for continued operations if federal regulation or legislation mandate CO_2 control. A substantial study of how North Dakota could use carbon dioxide for Enhanced Oil Recovery or Enhanced Coal Bed Methane Recovery would augment the state's energy production potential.

Management

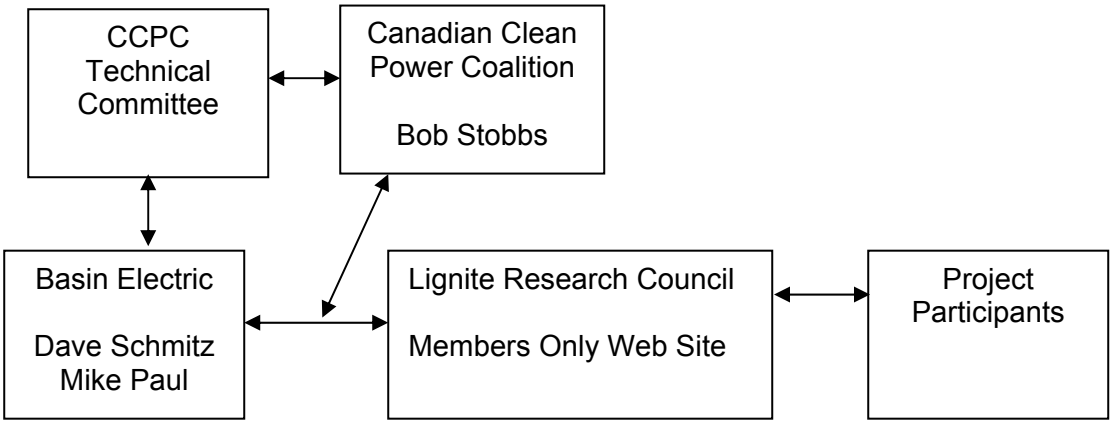
Dave Schmitz will coordinate participation of the IGCC Task Force Team with respect to the CCPC Program. Mr. Schmitz is a registered Professional Engineer in the State of North Dakota with over 32 years of electric utility experience. He is the vice-president of engineering and constructions for Basin Electric and has extensive experience and knowledge of new plant development.

Additionally, Mike Paul will provide technical support for the project. Mr. Paul is a registered Professional Engineer in the State of North Dakota with over 25 years of electric utility experience. He is also project manager for the Leland Olds re-powering study. Mr. Paul has the responsibility for the technical review of projects related to the gasification technology performance and determining if the IGCC technology is applicable to a re-powering effort.

Communication:

Communications are essential for a successful project. In an effort to accommodate project participants with planning, scheduling and facilitating project discussions, the following communication flow will be followed. The LEC will schedule periodic IGCC Task Force Team meetings. Meeting minutes and CCPC reports will be posted on a Members Only web site.

Communications Flow:



Timetable

The overall project Phase II activities were initiated in December 2003. Request for proposals (RFPs) have and will be issued to ensure a competitive evaluation and selection of contractors for Phase II studies and analyses. All studies will be completed by December 31, 2005.

Phase II Deliverables & Schedule

- Gasification Study Report - Draft — June 1, 2005
- Advanced Combustion Report - Draft — October 1, 2005
    - Includes Amine Scrubbing Processes.
- Fuel Selection & Site Location – Draft — December 1, 2005
    - Business Plan Analysis.
- Final Reports — December 31, 2005

Phase I Deliverable & Schedule

Phase I studies have been completed and will be made available to the LEC when membership dues are paid to the CCPC Program, estimated to be mid-December, 2004.

Budget

The estimated cost of the Phase II work plan is currently $2.8 million (Canadian funds). Each industrial participant's share is $200,000 (Canadian funds) or ≅ $150,000 (U.S. funds) spread over 2004 and 2005.

Expenditure Schedule:

- Gasification Study Report - Draft $ 1,500,000
- Advanced Combustion Report - Draft $ 400,000
    - Includes Amine Scrubbing Processes.
- Fuel Selection & Site Location – Draft $ 500,000
    - Business Plan Analysis.
- Administrative Support $ 300,000
- Completion of Phase I Gap Analysis $ 100,000

No computer or capital equipment will be purchased.

Matching Funds

Total project value is $150,000. Basin Electric Power Cooperative and the IGCC Task Force Team requests $75,000 from the North Dakota Industrial Commission Lignite Research & Development Program. The IGCC Task Force Team would provide industrial matching cost share of $75,000 with written commitments following funding approval by the North Dakota Industrial Commission.

Matching funds commitment are subject to Board of Directors approval of the participating organizations (as required). Industry members of the IGCC Task Force Team members include: Basin Electric, Dakota Gasification Company, Great River Energy Cooperative, Great Northern Power Development L.P., Montana-Dakota Utilities, Otter Tail Power Company and Westmoreland Coal Company.

Tax Liability

I, Clifton T. Hudgins, certify that Basin Electric Power Cooperative does not have any outstanding tax liability owed to the State of North Dakota or any of its political subdivisions.

_____ _____

Clifton T. Hudgins
Senior Vice President
Chief Financial Official

Date

Confidential Information

All non-confidential data will be placed in the public domain as part of the industry sponsored lignite gasification tests. The final report summarizing the project and its findings will be public information.

References

1. From the Canadian Clean Power Coalition website:

   www.canadiancleanpowercoalition.com

2. Department of Energy Fossil Energy Website at http://fossil.energy.gov

3. Power System Development Facility http://psdf.southernco.com

APPENDIX A

Resumes of Key Personnel

DAVID P. SCHMITZ, P.E.
Basin Electric Power Cooperative
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Bismarck, N.D. 58503-0564
(701) 355-5701
dpschmitz@bepc.com

Qualifications

- B.S., Mechanical Engineering, North Dakota State University
- Registered Professional Engineer, North Dakota
- Member of National Society of Professional Engineers
- Over 32 years of electric utility experience

Professional Experience

May 2001 to Present
Basin Electric Power Cooperative, Headquarters, Bismarck, ND
Vice President, Engineering & Construction

Manage and direct the Engineering & Construction Division to continue providing a broad range of design engineering, technical, construction coordination, capital projects planning and administration, facility life assessment, and economic evaluation support for existing generation, transmission and lime production facilities. Continue to administer existing and negotiate new microwave, fiber optic and mobile radio system agreements and licenses. Responsibilities also include direct and indirect support for planning, project coordination, engineering and construction of major new generation, transmission and telecommunications facilities.

October 1985 to April 2001
Basin Electric Power Cooperative, Headquarters, Bismarck, ND
Manager of Engineering

Responsible for combining and downsizing the previous Production Department engineering staff and the previous Engineering Department (responsible for transmission design, construction, and maintenance) engineering staff. Managed the new Engineering Division to provide a broad range of design engineering, technical, operational performance, construction coordination, capital projects planning and administration, facility life assessment, and economic evaluation support for essentially all areas of the Cooperative. This included varying levels of involvement with DGC starting with its acquisition. It also included negotiation and administration of the microwave and mobile radio system agreements and licenses.

October 1978 to September 1985
Basin Electric Power Cooperative, Headquarters, Bismarck, ND
Manager of Design

Managed and supervised the new Design Division with responsibilities for overseeing and directing design engineering projects for new generation projects and modifications to existing generation facilities. This included the remaining project coordinator duties for LRS and also picked up project coordinator responsibilities for the remainder of the 900 MW Antelope Valley Station project until its completion.

June 1977 to September 1978

Basin Electric Power Cooperative, Headquarters, Bismarck, ND
Project Coordinator – LRS

Responsible for supervising project engineering staff and for coordinating, monitoring, and guiding all day-to-day activities of internal departments/divisions, consultants, and other parties involved in the design and construction of the Laramie River Station and the Grayrocks Dam.

October 1975 to May 1977

Basin Electric Power Cooperative, Headquarters, Bismarck, ND
Project Engineer – LRS

Worked as a project design engineer on the 1650 MW Missouri Basin Power Project. This involved working with engineering consultants Burns & McDonnell on design of the Laramie River Station and Banner Associates on design of the Grayrocks Dam. It also involved working with REA (now RUS) for contract specifications and administration.

March 1974 to September 1975

Basin Electric Power Cooperative, Leland Olds Station, Stanton, ND
Results Engineer

Responsible for monitoring and guiding overall plant performance, supervising plant engineering staff, and supervision of the instrument maintenance group, the water and coal lab technicians, and the coal handling crew.

February 1972 to February 1974

Basin Electric Power Cooperative, Leland Olds Station, Stanton, ND
Mechanical Engineer

Conducted tests, monitored plant performance and designed smaller plant modifications

Professional Memberships, Certifications, Organizations

- Registered Professional Engineer, North Dakota
- National Society of Professional Engineers

MICHAEL W. PAUL, P.E.
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Bismarck, N.D. 58503-0564
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Qualifications

- B.S., Mechanical Engineering, University of North Dakota
- Registered Professional Engineer, North Dakota
- Over 25 years of electrical utility experience with six years stationed at three coal-based power plants

Professional Experience

May 2001 to present

Basin Electric Power Cooperative, Headquarters Office, Bismarck, ND
Manager, Mechanical and Performance Engineering

Manage the Mechanical and Performance Section of the Generation Department, Engineering and Construction Division to provide professional engineering support for Basin Electric's existing operating facilities, members, and subsidiaries. Also conduct studies and planning for future generation resources as well as options for meeting future needs at existing facilities. Served as Project Coordinator for the Wyoming Distributed Generation Project and currently assigned as Project Coordinator for the Leland Olds Station Repowering Project Study.

March 1987 to May 2001

Basin Electric Power Cooperative, Headquarters Office, Bismarck, ND
Mechanical/Performance Engineering Supervisor

Supervised the Mechanical/Performance Section of the Operations & Engineering Department, Engineering Division to provide professional, cost-effective and timely mechanical design and performance engineering activities for each of our coal-fired plants, as well as for our members and subsidiaries. Activities focused on coal-based power plant operations, performance, and maintenance activities to help ensure safe, reliable, and efficient operation. Assigned as Project Engineer for the Wyoming Distributed Generation project and was actively involved in the future coal-based generation and Leland Olds Station future options studies.

January 1986 to March 1987

Minnkota Power Cooperative, Milton R. Young Station, Center, ND
Engineering Superintendent

Managed the overall generation engineering needs of Minnkota including supervision of professional staff and employees represented by a bargaining agreement. Established and directed the overall plant performance program, coordinated design changes and procurement of equipment and systems, monitored plant water management and chemistry programs, conducted economic and technical feasibility studies, provided technical support and recommendations on plant operations, prepared budgets, and directed plant documentation and drafting efforts. Responsibilities also included working with Minnkota headquarters departments and the other Square Butte project participant.

August 1983 to January 1986

Basin Electric Power Cooperative, Antelope Valley Station, Beulah, ND
Results Engineer

Monitored and reported performance of plant equipment and systems, ensured proper chemistry control of all plant systems, directed plant water management including environmental concerns, supervised lab technicians, assisted in design and operational modifications of plant equipment and systems, and monitored coal quality.

September 1982 to August 1983

Basin Electric Power Cooperative, Antelope Valley Station, Beulah, ND
Mechanical Engineer

Involved with initial Unit 1 start-up, including design changes, supervised boil-out and boiler chemical cleaning, prepared and supervised equipment testing for a full American Society of Mechanical Engineers turbine test, participated in water balance and vibration monitoring, and provided technical support to plant operations and maintenance. Worked closely with design, construction, and start-up groups.

October 1979 to September 1982

Basin Electric Power Cooperative, Production/Design Division, Bismarck, ND
Mechanical Design Engineer

Monitored and directed the design and purchase of mechanical equipment and systems for the Antelope Valley and Laramie River Stations.

May 1978 to October 1979

Basin Electric Power Cooperative, Wm. J. Neal Station, Velva, ND
Mechanical Engineer

Engineering and supervision of a plant upgrade to 50 MW, compliance testing of retrofit precipitators, monitored progress of a Babcock & Wilcox pilot dry scrubber, engineering and initial test burns of sunflower hulls in the main boilers, and operating plant engineering and supervision as required.

September 1977 to May 1978

Engineering Experiment Station, University of North Dakota, Grand Forks, ND
Student Engineer

Involved in the engineering of several solar energy and heat pump projects.

June 1977 to August 1977

Clark Equipment Company, Melroe Division, Gwinner, ND
Summer Engineer

Quality control for welding, fabricating, machining, and assembling various models of the Bobcat skid steer loader.

Professional Memberships, Certifications, Organizations

- American Society of Mechanical Engineers
- Registered Professional Engineer in the State of North Dakota
- North Dakota State Department of Health, Certification as a Class II Water Treatment Plant Operator
- Energy Generation Conference Executive Committee – five years

Robert A. Stobbs, P. Eng.

SaskPower
2901 Powerhouse Drive
Regina, Sask.
S4N 0A1
Tel: (306) 566-3326

Education

1969 - 1973 **University of Saskatchewan**
Saskatoon, Saskatchewan

Bachelor of Science in Chemical Engineering

Work experience

2004 - present **Canadian Clean Power Coalition**
Regina, Saskatchewan

Executive Director – Seconded from SaskPower to the Canadian Clean Power Coalition (CCPC) to manage the second phase of feasibility studies on clean coal technologies. Responsible for all activities to implement the approved work plan within prescribed budget and schedule. Negotiate and execute contracts with engineering firms for the required studies.

2001 - 2003 **SaskPower**
Regina, Saskatchewan

Project Leader, Operations Support – Coordinated the environmental issues and clean coal activities for the Power Production Business Unit. Represented the Corporation on several committees and groups who were developing and promoting clean coal technologies.

1999 - 2000 **SaskPower**
Regina, Saskatchewan

Project Leader, Power Production Business Unit – Coordinated the data conversion and creation activities within Power Production to meet the requirements of the Delta Project. Provided direction and training to staff in five locations to ensure the data converted and created met the requirements of SAP.

1998 **SaskPower**
Regina, Saskatchewan

Team Lead, Process and System Integrity, Delta Project - Developed the business process design to ensure adequate risk-based controls were integrated into the new business processes. Developed the policies and procedures necessary to maintain authorized access and set the appropriate parameters to reflect the Corporation's risk assessment.

1995 - 1998 **SaskPower**
Regina, Saskatchewan

Senior Auditor, Internal Audit - Conducted programs of operational audits to improve the competitiveness of the Corporation's business units by reviewing business processes from the perspective of economy, efficiency, effectiveness and control. Administered corporate environmental audit program.

1996 - 1997 **SaskPower International**
Regina, Saskatchewan and Zelenodolsk, Ukraine

Technical Specialist for chemical and environmental issues on a CIDA technical assistance project in southeastern Ukraine. The project required the rehabilitation of three units of a ten unit power station. The scope of work was to provide guidance to the plant staff on project management techniques and the preparation of technical specifications. These specifications were necessary for bidding in the international market to meet the requirements for World Bank funding.

1994 - 1995 **SaskPower**
Regina, Saskatchewan

Member of Business Unit Implementation Phase 1 Team which reviewed the Corporation for reengineering opportunities. Subsequently, team leader of the Capital/Project Management team on Phase 2 of the Business Unit Implementation which developed recommendations for reducing the current level of capital expenditures, establishing a ranking criteria for capital projects and restructuring engineering and support to match the capital program.

1992 - 1994 **Environment Canada**
Ottawa, Ontario

Senior Advisor, Greenhouse Gas Program - Administered consulting contracts for studies related to the objectives of the Greenhouse Gas Program - to develop and maintain comprehensive inventories of greenhouse gas emissions and, in partnerships with stakeholders, to assess actions to reduce greenhouse gas emissions.

1981 - 1992,
1994 - 1995 **SaskPower**
Regina, Saskatchewan

Chemical & Environmental Engineer - Reporting to the Director of Generation Engineering, designed and developed cost estimates of chemical and environmental related systems for new generating projects and power station improvements, developed engineering standards for these systems and ensured environmental controls were incorporated in the design of major capital projects.

In particular, managed the design of the zero discharge water and waste water treatment facilities for the Shand project, implemented environmental monitoring for the Shand project; managed corrosion investigation and implemented surface and ground water quality monitoring programs for the Nipawin Hydroelectric Project.

1984 **Project Manager, Meadow Lake Gas Turbine Project** - managed and controlled the cost, schedule, public information and interfaces between participating divisions.

1986 - 1988 **Project Manager, Boundary Dam Supplementary Water Supply Project** - managed and controlled the cost, schedule, public liaison and overall coordination of the project.

1979 - 1981 **SaskPower**
Regina, Saskatchewan

Chemical Engineer - Reported to the Project Manager of the Poplar River Project, managed the design of the condensate polishing plant and stack gas monitoring system, and implemented surface and ground water quality monitoring programs for the project.

1977 - 1979

Whiteshell Nuclear Research Establishment, Atomic Energy of Canada Limited
Pinawa, Manitoba

Reactor Operations Engineer - Assisted in supervision of daily operation of an organic cooled nuclear reactor. Conducted daily checks of safety control devices, issued work permits for maintenance work and studied the various systems of the nuclear plant which led to check-out in operation of the reactor.

1973 - 1977 **SaskPower**
Regina, Saskatchewan

Environmental Surveillance Engineer - Conducted environmental surveys of operating power plants, including pollutant emissions from stacks, ambient ground level concentrations of air quality, and water quality sampling and analysis; prepared progress reports of environmental studies on power stations; prepared calculations of pollutant emissions and ground level concentrations for future power generating projects.

Professional memberships

Association of Professional Engineers & Geoscientists of Saskatchewan

National Association of Corrosion Engineers

Air and Waste Management Association

Technical committees

1979 - 1990	Environmental Requirements Subsection, Thermal and Nuclear Power Section, Canadian Electrical Association
1982 - 1986	Advisory Panel on Flue Gas Desulphurization, Canadian Electrical Association
1986 – 1987	Chairman of Flue Gas Emission Control Advisory Panel, Canadian Electrical Association
2001 to present	Chair, Technical Committee of the Canadian Clean Power Coalition