Canadian Prairies Group
NEWSLETTER
of Chartered Engineers
Winter 2006

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Roger Frayne
Chairman CPGCE

IN THIS NEWSLETTER

Dear Members

We are fast approaching the end of the 2006 year and can look back on a successful program of technical presentations organised by your committee. Since February we have received presentations on water resources and climate change; oil and gas technologies; submarines and underwater propulsion systems as well as gasification technologies and modern electric power plants – a wide range of topics you must agree. Many of our speakers had considerable knowledge and experience in their respective fields and attendees were certainly able to learn much about the subjects of these presentations. One would think that with such a diverse and interesting program as this we would have been able to attract a larger number of our members to come out and attend at least one or two such events throughout the year. Sadly, this was not the case and on most evenings attendances ranged from twenty to thirty members and guests and many of them attending our meetings on a regular basis.

Currently, the Canadian Prairies Group of Chartered Engineers (CPGCE) records indicate that over 400 members reside in the Provinces of Alberta and Saskatchewan as well as The North West Territories. I understand that all of these members do not live in Alberta, let alone in the Calgary area, however, we currently have approximately 120 members and guests who receive the email message sent out before each technical meeting. So our "success" ratio, so to speak, in encouraging members to make the effort to come out and attend technical meetings is

Everyone is welcome to attend the Calgary Technical Presentations.

We meet at the Danish Canadian Club, 727 11th Ave SW at 6:30 pm on the second Wednesday of every month.

Spouses and guests are always welcome.

More details on www.cpgce.org

about 20% - not a very good success rate by any standard. All too often we hear complaints that members receive little or no value for the annual subscriptions paid each year to their respective institutions in the UK. Of course, one can probably hear similar complaints from members who actually reside in the UK, and yet many of their regions or branches suffer from the same apathy with relatively poor turnouts for many of their meetings.

In the case of the CPGCE, which is unique in that we represent members of six different institutions in the UK, the situation we face is all too common, for example, regarding publicity about upcoming technical presentations, there will be those who argue that notification of any presentation only a few days before any such meeting is to take place is too short. That may be true in today's busy world of meetings and deadlines in business but in fact the CPGCE website at www.cpgce.org generally advertises the program of proposed technical presentations for three months in advance which could therefore allow prospective attendees an opportunity to adjust their schedules so that they can attend presentations of particular interest to them.

Another criticism that is sometimes heard is that the CPGCE program of technical presentations does not contain any of specific interest to the particular individual. My response to this is that your committee is always willing to entertain proposals for presentations on any technical subject and would recommend, in fact encourage, members with ideas about a specific topic or speaker to contact one of the committee with their ideas.

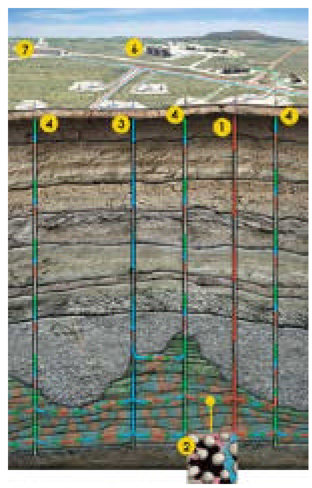
In closing, I wish to thank all committee members for their work and efforts throughout the year and to wish all members the best of the holiday season.

Finally, I look forward to seeing many of you at our Annual General Meeting and Dinner which this year is scheduled for Saturday, February 3rd 2007 at the Officers' Mess at Fort Calgary. Come on out and enjoy an evening of fellowship and good food, meet with old friends and acquaintances, and perhaps, become emboldened to take a more active role in the life of your own institution's activities by attending some of the CPGCE's technical presentations.

Roger Frayne

CO_2 Recovery and Utilization for Enhanced Oil Recovery in the United Arab Emirates

Doug MacDonald: Principal Consultant, Studies and Developmental Projects, Chemicals and Petroleum Division, SNC-Lavalin Inc.



SNC-Lavalin was retained by the Abu Dhabi National Oil Company (ADNOC) to undertake a study on the recovery of carbon dioxide for enhanced oil recovery (EOR). Currently the company is injecting natural gas to improve oil recovery rates but wished to explore alternative methods to free

Annual General Meeting and Dinner

Saturday 3rd February 2007

6.30 pm Reception , 7.30 pm Buffet Dinner

The AGM will follow Dinner at approx. 9.30 and lasts for about 30 mins.

Cost $35 per person

Book your place by contacting

Pam Meadowcroft via Telephone 403-251-7158

or email agm@cpgce.org

Payment must be made in advance by cash or cheque (payable to CPGCE)by 26th January 2007. Non receipt of payment by this date will result in cancellation of booking.

FORT CALGARY

Officers' Mess
750 9th Avenue SE,
Calgary, Alberta
T2P 2M5

up natural gas for other uses, protect the environment and allow the enhancement of urea production. The sources of carbon dioxide that are commonly available include, as a by product of ammonia production: producer gas both associated and non-associated; flue gas streams from combustion turbines, fired heaters, incinerators, boilers and steam methane reformers.

A number of features about the source gas included a low pressure, a relatively low CO_2 content (9% by volume), a high temperature, the presence of oxygen as well as the contaminants SO_X and NOx. A number of processes currently available for recovery of carbon dioxide were included in the initial review of technologies and these included gas separation, gas absorption membranes, physical absorption, cryogenic separation, adsorption and chemical absorption.

The client placed some constraints on the study by stating that any process selected had to be commercially viable by 2009, that it must have an expected reasonable cost and that the existing process configurations remain undisturbed. These constraints resulted in SNC-Lavalin choosing a chemical amine absorption process as the basis for the study although membrane technology did offer some promise.

The process design basis document for the study established the following major parameters:

- 100 mm SCFD of carbon dioxide equivalent to 5600 tonnes per day would be required,
- 3 sources, all of which were to be 99% pure,
- The use of condensing steam turbines for large rotating equipment drives
- The 100 km long pipeline, from the separation plant to the injection point, was to operate in the dense phase, i.e. above the critical point.

Among the critical issues that had to be addressed in the study were water availability, water temperature and plot plan space. Selection of two licensors was based upon three key criteria, capability, capital costs and operating costs including utility and chemical consumption. The selection process of the licensor's proposals was based upon the actual packages, a technical analysis, normalization of the proposals and design analysis.

An important set of criteria related to reservoir performance that was assessed and the major factors that emerged were as follows:

The UAE field required 1.45 MMSCFD of CO_2 as against the 1 MMSCFD of the natural gas currently used for EOR purposes

The density advantages of CO_2

CO_2 solubility - it dissolves in water

Time for EOR response – in North American gas fields this is usually 1 to 2 years but for the UAE field it was predicted to be 5 to 6 years

The magnitude of the EOR response

CO_2 break though and recycle

The study estimated that capital costs of the project would be of the order of US$300 million in 2nd quarter 2004 with the pipeline alone costing US$60 million and that the cost of the carbon dioxide was between US$28 to 31 per tonne or US$1.43 to 1.67 per MCF.

The conclusions reached from this study were that the project was technically viable and that it would be the largest flue gas amine carbon dioxide recovery project ever attempted. The follow up steps to the study include a re-evaluation at current oil and natural gas prices, reassessment of alternative carbon dioxide sources and assessment of the impact of Kyoto treaty compliance.

Moving? Moved in the last 3 months?
If so, please let Bill Meadowcroft know at
membership@cpgce.org
(It can take a considerable time before the institutions notify your local branch.)

2007 Technical Program

Wednesday, February 14th

"The U of C's Formula Student (SAE) Car Project"

by members of the project team.

The Formula Student (Formula SAE in the USA) car project, sponsored in part by the IMechE and IET, is an annual event in which university students are challenged to design, build and operate a small racing car based upon a set of predetermined specifications. Entries are judged on a number of factors including cost, design, presentation, acceleration, skid pad performance, endurance and fuel economy. The University of Calgary submitted its first entry in 2006 and did reasonably well but the University of Toronto team has been a winner in each of the past three years.

A MAJOR NEW INTERNATIONAL JOURNAL FOR 2007 FROM THE INSTITUTION OF CIVIL ENGINEERS

FIRST ANNOUNCEMENT AND CALL FOR PAPERS

Proceedings of the Institution of Civil Engineers

Energy

Energy will provide authoritative, stimulating and informative papers on all aspects of the planning, design, construction, maintenance, operation and decommissioning of projects for the generation, conservation, distribution and more efficient use of energy. The scope includes development of sustainable energy policy and technology, renewable energy sources, nuclear power, fossil fuels, electricity generation and transmission, district heating, storage schemes, energy conservation and improving energy efficiency in buildings, infrastructure and transport systems.

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Ben Ramster

Energy, Institution of Civil Engineers, 1 Heron Quay, London E14 4JD, UK

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Wednesday, March 14th

DATE CHANGE - WAS 14th February 2007

"Environmental and Permitting Processes for the Mackenzie Valley Pipeline"

by Brian Zytaruk, AMEC.

This presentation will discuss the complicated and lengthy environmental and permitting processes that have been undertaken for the first proposed major gas pipeline from Canada's Arctic regions to southern markets.

Wednesday, April 11th

"Environmental Control Technologies and Options"

by Kurt Hansen, M.Sc., P.Eng
President, Green Inc.

In today's world there are increasing pressures to either eliminate or significantly reduce emissions from industrial processes to very low levels. Emissions such as volatile organic compounds (VOCs) and oxides of nitrogen (NOx) are among those that are required to be controlled to extremely low levels and the presentation will discuss methods by which such reductions can be attained.

2006 Social Program

6th April - Morpheus Theatre Presentation of HMS Pinafore with Trial by Jury

26th May - Buffet Supper to meet ICE, IMechE and IStructE visitors

24th June—Summer BBQ and Pot Luck at the home of Alan and Anne Rhodes

All the meetings were reasonably supported particularly the May meeting. A full report of the meeting was contained in the Spring Newsletter.

Our thanks go to the organizers / hosts of these events.

NOTE - The formal social program was abandoned at the beginning of 2006 due to the poor attendance at some of the organized events. You will appreciate that this was very discouraging for the organizers who showed little or no enthusiasm for continuing . It was decided, therefore, that those members who were proposing to attend or were holding a function should issue an open invitation to all members in the immediate vicinity to join in.

In total, 3 events were held during 2006, all of which were reasonably attended thus confirming that this might be the answer to the poor showing in 2005.

"Genesee 3 Canada's - First Supercritical Power Plant"

by Dave Conlin, Director,
Generating Plant Development, EPCOR

Project background

A presentation on Genesee 3, Canada's first supercritical power plant was made in November 2006 by Dave Conlin, Director, Generating Plant Development, EPCOR. Dave was responsible for negotiating and managing the main engineer, procure and construct contract between EPCOR and Hitachi Inc. Hitachi Inc. supported by affiliates and other suppliers were contracted by EPCOR to build a 450 MW (net) output coal fired power plant on EPCOR's existing site at Genesee which already had two existing, smaller, drum fired, sub-critical units in operation. At a late stage in the development process TransAlta entered into an arrangement whereby they became owners of a 50% interest in a joint venture with EPCOR and had the rights to 50% of the unit's output. The selected plant size was determined by a number of factors including the relative size of the Alberta system and units already in successful operation. Although there are units in Japan utilizing similar technology with outputs of 1000 MW there are also a number of 500 MW output units in service and one of these was selected as reference design in order to speed up the development process. Overall the process took approximately five years to complete with the associated environmental and regulatory hearings and with a relatively short construction period of three years.

Fuel supply and preparation

Genesee is a mine mouth plant and the coal contains between 15% and 20% ash, 0.2% to 0.3% sulphur and has a moisture content of about 20%. The ash content has caused erosion problems in the boilers of the older sub-critical units on site and with Genesee 3 project there was a determined effort to control and minimize this problem. Coal from the stockpile is conveyed to the unit where it is pulverized into a fine dust by five of the six installed units before being stored in hoppers and fed into the boiler. There is a design storage capacity of 8 hours fuel supply in the hoppers at maximum continuous unit output.

Boiler design

In conventional steam fired power plants there are three basic choices when it comes to boiler selection. The first choice is a natural circulation, drum type, design, the second is a once through, universal pressure, design, and the third option is a once through, Benson boiler design. Natural circulation, drum type, designs only operate at sub-critical steam conditions whereas universal pressure boiler designs can operate at either sub or super critical conditions with the aid of mixing bottles and Benson boiler designs with the option of using mixing bottles operate at only supercritical steam conditions. The Benson boiler design is suitable for variable water and steam flow rates and was selected for the project with the optional mixing bottles. The original Benson boiler was developed by Siemens in the 1920's and current designs utilize spiral water wall tubing with internal ribbing, this feature allowing for water to be continually kept to the outside of the individual tubes and the steam to pass through the centre. Steam is generated in the boiler at a pressure of 26 MPa and a temperature of 566^0 C. In this particular plant a re-heat steam cycle is used and so the steam is re-heated to the same temperature for re-heat re-injection. Some plants in Japan operate at temperatures of 600^0 C and this is the current limit based upon today's metallurgy.

In a somewhat unusual approach to availability and reliability, single unit, axial fans with variable pitch blades were selected for the forced draft, primary air and induced draft duties. With power requirements of between 2005 kW (forced draft fan) to 8904 kW (induced draft fan) these represent significant parasitic power used by the plant and not insignificant capital costs. The air pre-heater is of a tri-sector design and is designed to warm incoming air with a design temperature of 27^0 C with furnace discharge air at 370^0 C. This preheating has the effect of cooling the exhaust gas discharged to the exhaust stack to 130^0 C, well above the dew point of sulphur dioxide, to eliminate corrosion.

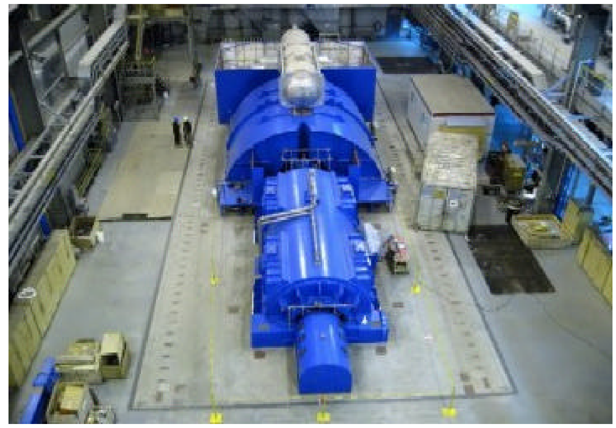
Three boiler feed pumps, each sized at 50% duty, are installed along with 3 circulation water pumps, each sized at 100% duty, to provide for variations between summer and winter loads, and two condensate pumps, each sized at 100% duty.

Steam turbine and generator

The steam turbine is of the conventional reheat design with high, intermediate and low pressure sections with the blades on the low pressure section at a maximum length of approximately 1 meter. The steam turbine is directly coupled to 2 pole, (3600) rpm hydrogen cooled, generator set. The cranes and lifting devices in the generator hall were designed on a maintenance only basis and so, as a result, a special lifting device was used to lift and locate the complete generator onto its foundation.

Exhaust gas emissions and efficiencies

Genesee 3 has a much improved net thermal efficiency of 39.28% compared with the 35.45% for the older, sub-critical steam cycle units on site, an improvement of 10.8% .



For Genesee 3 particular attention has been paid to reducing emissions of particulates, oxides of nitrogen and sulphur dioxide to meet current environmental regulations. The installation of a conventional bag house with 11,600 bags and encompassing over 34,000 square metres in 12 compartments has led to significant reductions in the level of particulates released into the atmosphere and the installation of a lime based, spray dryer scrubber has resulted in significant reductions in the levels of sulphur dioxide emissions.

When compared to the existing Units 1 and 2 on site, Genesee 3 has particulate emissions of 0.06 tons per hour as compared with 0.18 tons per hour per unit of the older units.

The Genesee 3 unit uses twenty four low NO_X burners in the boiler which results in emission levels of NOx of 0.3 tons per hour, well below the regulated level of 0.53 tons per hour and the 1.05 tons per hour per unit rates generated by Units 1 and 2.

With respect to sulphur dioxide, Genesee 3 emits this pollutant at a rate of 0.32 tons per hour; once again, well below the regulated level of 0.76 tons per hour and the 1.9 tons per hour per unit emission rate of Units 1 and 2.

Carbon dioxide emissions, which are a major contributor to green house gases (GHG) and global warming, have also been reduced. Whereas Units 1 and 2 have CO_2 emission rates of 1019 kg/MWh, the Genesee 3 unit has CO_2 emissions of only 887 kg/MWh which, with allowances for improved efficiency and with purchased offsets, reduces the effective emissions of this unit's GHGs to 418kg/MWh.

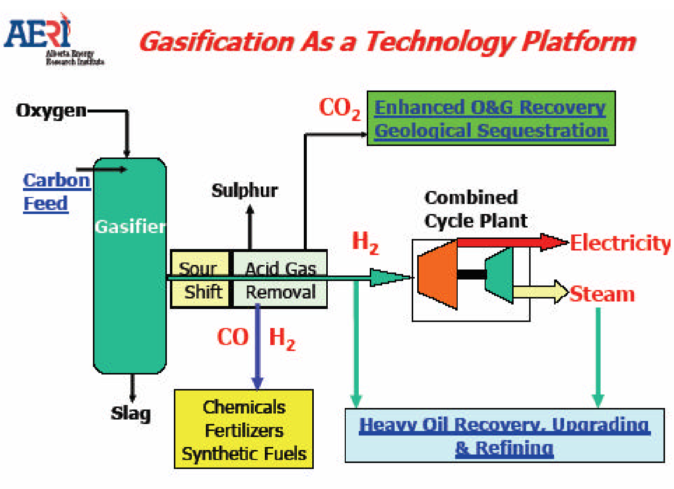
If all the older coal fired power plants currently operating in Alberta were to be replaced with Genesee 3 type units, or equal, there would be a net reduction of 17% in the total green house gases produced by electric power generation in the province.

Gasification Technologies and Applications in Canada

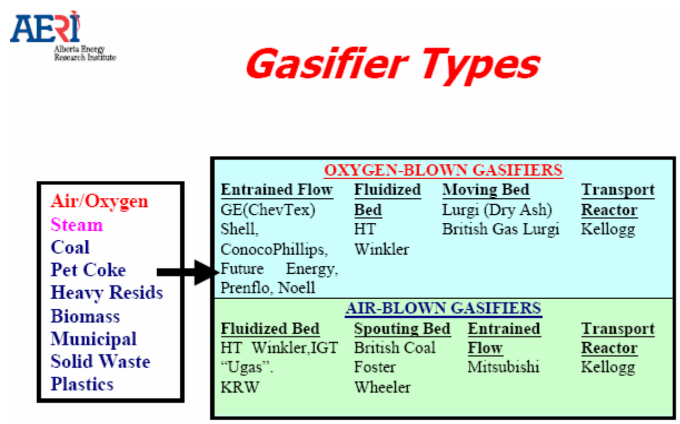
by Duke du Plessis Alberta Energy Research Institute/Alberta Economic Development

Duke du Plessis gave a comprehensive presentation on what is probably the most important technological issue in Alberta at this time, gasification of Alberta's high carbon assets(coke and coal). Alberta's energy reserves at this time are made up of 3% conventional oil, 6% gas, 25% oil sands bitumen and 66% coal. Currently all development of Alberta's energy resources is based on upgrading the tar sands which use large quantities of natural gas and reject large quantities of carbon(coke). The latter is typically put back into the mine site. To continue its role as a world energy supplier Alberta has to move forward on gasification of the rejected carbon (coke) from heavy oil upgrading and develop its coal resources. One major project at this time has integrated this technology: OPTI-Nexen Long Lake Project .

The basic technology platform exists in many well proven forms. The block diagram shows the key elements of the process. Carbon/heavy hydrocarbon is gasified in a converter, and the produced gas is



cleaned and used to make electricity/steam, provide hydrogen and other gases as required. There are two classes of gasifiers, one uses pure oxygen and the other is able to function with the oxygen contained within air. For the oxygen fed processes an oxygen separation plant is required. The Long Lake Project is one of the largest single train units in the world. The feed-stocks and the technology licensors available are listed in the Gasifier Types table. At this time there are no carbon/coal gasifiers in operation in Alberta. One is under construction and that will be discussed later. There are few similar processes implemented elsewhere in the world. The existing operations are focussed on heavy petroleum feeds rather than low rank solid feeds.

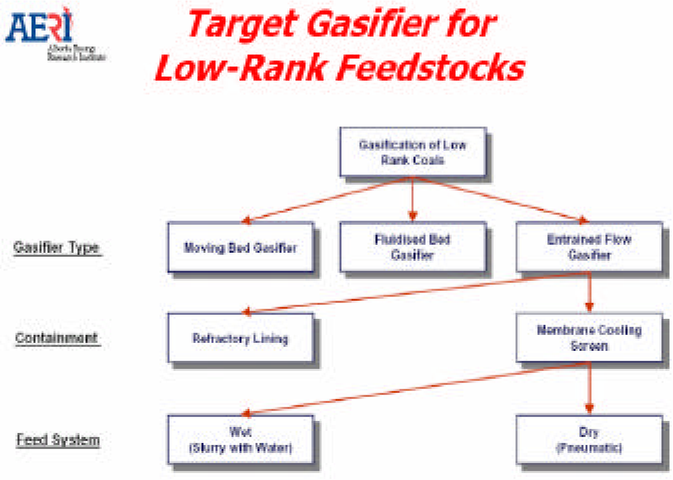


A lot of research and development work is being undertaken in Alberta to identify the best applicable processes for the Province's needs. This is a critical task since there will still need to be extensive development work once a process is selected. Alberta sub-bitumous coal is at the low end of the scale for gasifier feedstocks. There are issues of large quantities of ash, sulphur removal and CO_2 capture all of which have to be incorporated and optimised in the gasification process.

It is obviously critical that the gasifier selected matches the properties of the feedstock available. These include:

- Carbon content, which is reflected in heating value
- Ash content and mineral composition which impacts its
    - Heat sink properties
    - Slagging characteristics
- Oxygen content which reduces oxygen consumption
- Water content in feed
    - Drying required for dry-feed systems
    - Slurry feeding introduces excess water and increases oxygen consumption.

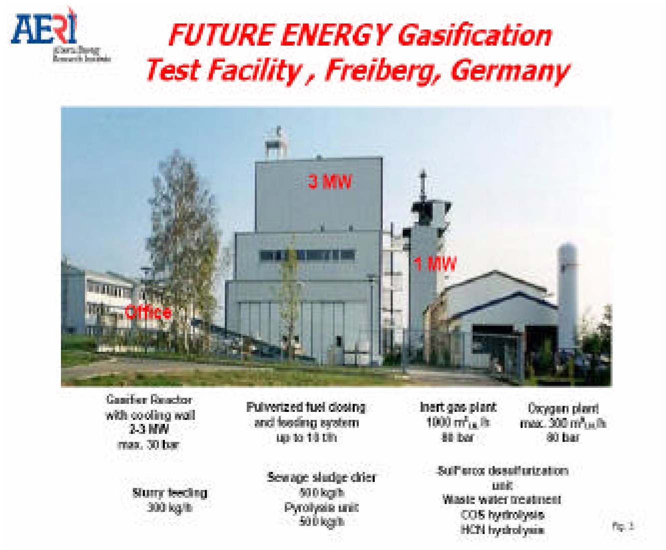
The key steps in evaluating the optimal process are outlined below. Case studies have been carried out for gasifier units and the current projected Cold Gas Efficiency for a lignite coal feedstock is 68% as against 82% for petroleum coke. There are many Joint



AERI/Industry projects ongoing. One of the most widely supported is the Canadian Clean Power Coalition (CCPC) which has a website http://www.canadiancleanpower-coalition.com/. The CCPC started a clean coal demonstration project with CO_2 capture in 2000. The technologies evaluated were British Gas Lurgi, Conoco/ Phillips, Eagle, Future Energy, GE Energy, High Temperature Winkler, Sasol-Lurgi, Shell and KBR Transport Gasifier (red highlight- denotes selected for development of performance and cost estimates). CO_2 capture technologies evaluated are gasification, amine scrubbing and oxyfuel combustion with emissions approaching similar levels to NGCC plants. Future Energy Gasification has a unique facility in Freiburg Germany which allows actual feedstocks to be tested and Alberta coals have been used in the plant.

There are ongoing technology developments which will benefit low rank coals. These include Dry feeding, slurry feeding, improved longer life refractory materials, high efficiency syngas coolers with quench cooling, ion transport membranes and posimetric dry coal feeders.

The main advantage of gasification technology is that low value fuels are converted into high value clean products. Competitiveness has improved over the last



quarter century. There is little experience with low rank Canadian coals and the high initial cost and perceived low reliability have hampered implementation in the past. However with the rising price of natural gas there is unique opportunity to implement this technology.

OPTI-Nexen Long Lake Project, of which phase 1 is due to be commissioned in late 2007, will be the first integrated heavy oil extraction (SAGD)/Upgrader which will utilize the rejected carbon to produce electricity and steam and so will require minimal natural gas. This will be the first such plant built in Alberta. It uses existing proven process units linked in a unique process chain. This is the first application of the developing gasification technologies in Alberta.

We would prefer to send your CPGCE Newsletter via e-mail, if possible. Please send your email address to Bill Meadowcroft at wmeadow@telusplanet.net

Privacy

The CPGCE maintains computer records of its membership. The information that is held consists of the following:

Name, Address, Telephone Numbers, Email Address & Institution Membership

This information is kept in strict confidence by the Executive Committee and is used solely to enable contact with the membership. The information is not used for any other purpose and is not made available to any third parties.

If you have any concerns about security of this information please contact a member of the Executive Committee.

Comments, Questions, or Concerns?

Please contact Bill Meadowcroft at: wmeadow@telusplanet.net