Prepared for Presentation at
The 2006 Gasification Technologies Conference
Washington D.C., USA

October 1-4, 2006
Unpublished

Agrium's Kenai Blue Sky Project

Repowering an Ammonia/Urea Complex with Coal Gasification

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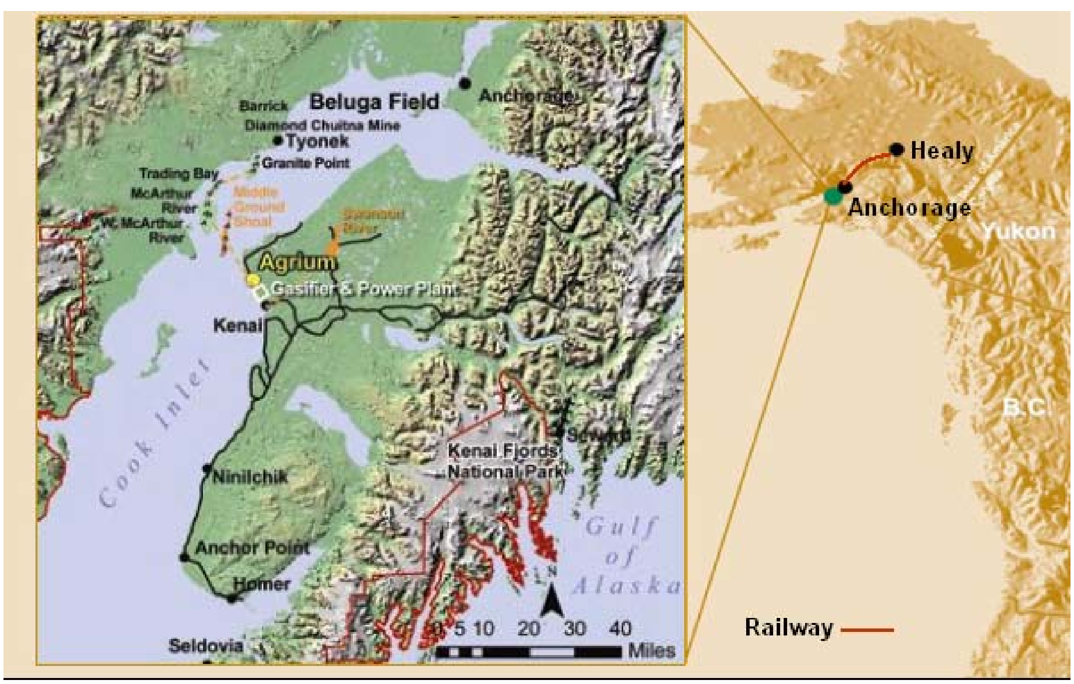
The Cook Inlet region of Alaska has a variety of established industries that were built around an abundance of low cost natural gas. The natural gas supply is vanishing, forcing these industries to either cease operations or to pass on the increased cost of fuel to utilities and consumers. Agrium U.S. Inc. has been working with Black & Veatch and Uhde to investigate the feasibility of using coal gasification to provide a long-term commercially viable alternative to natural gas. The objective of the Kenai Blue Sky Project is to construct a gasification block and power generation plant adjacent to Agrium's Kenai Nitrogen Operations (KNO) facility, both capable of efficiently utilizing indigenous sub-bituminous Alaskan coal. Startup is scheduled for 2011. A single gasifier train would produce the hydrogen (H_2), nitrogen (N_2) steam and carbon dioxide (CO_2) required by the nitrogen complex. If determined to be economically attractive, the project would also provide low cost coal-based power for sale into the Alaskan market, and supply excess CO_2 to recover up to 300 million barrels of oil from local oil fields through Enhanced Oil Recovery.

With almost 40 years of Alaskan experience, the KNO facility has traditionally been able to successfully compete in the export fertilizer market. Based on the abundant supply of Alaskan coal, this project will effectively mitigate the volatility associated with traditional natural gas based fertilizer producers and assure a long-term supply of gas feedstocks to KNO. Nearby coal reserves are projected to provide well in excess of 100 years of economic development. The abundant low-cost feedstock opportunity offered by coal gasification transforms KNO from an asset with significant leverage potential, depending upon feedstock arrangement, into a long-term asset.

Figure 1- Location of Kenai Blue Sky Project



Kenai Blue Sky Project Evolution

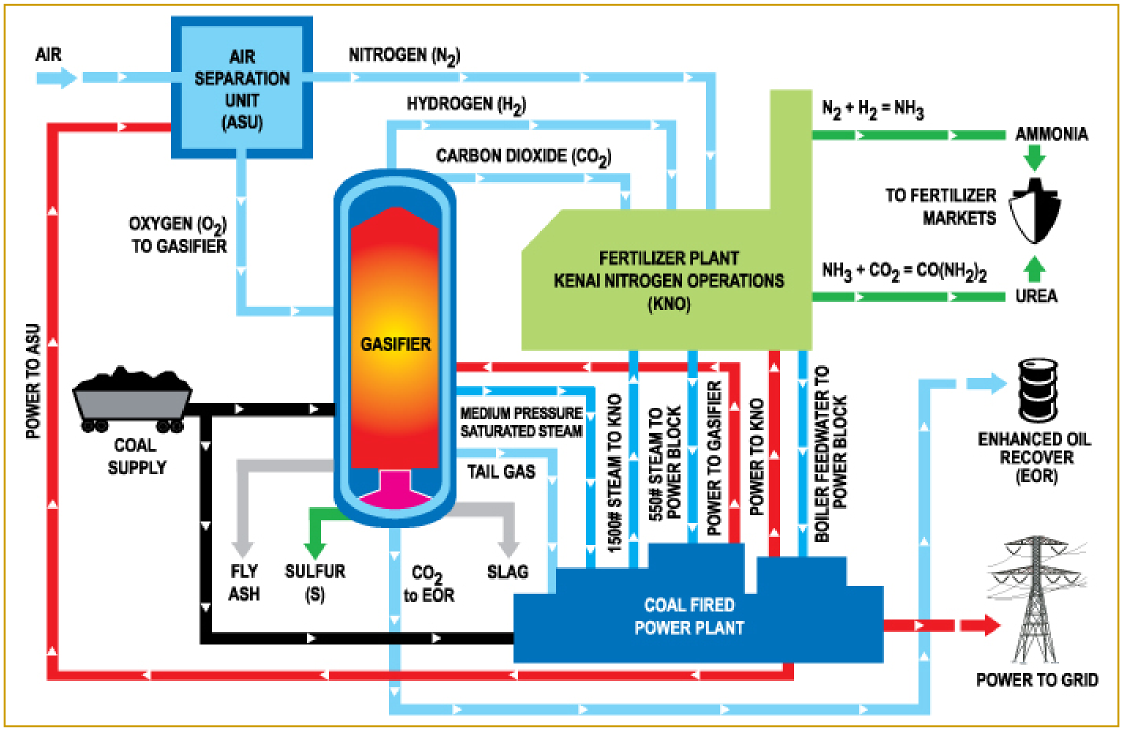
The Kenai Blue Sky project began in the fall of 2004 with the idea of using coal gasification to supply hydrogen to the Agrium KNO facility. In the Spring of 2005 an initial study was undertaken which examined the feasibility of using coal gasification to supply hydrogen to KNO and syngas to fire gas turbines. The combined cycle units were to provide the power for the proposed and existing KNO facilities while supplying the surplus for power sales into the Alaska Railbelt grid. Agrium's pro forma analyses using the results of the initial Kenai Blue Sky Phase 1(a) feasibility study determined that power production using coal gasification would not be economically feasible due to high capital and operating costs. However, the analysis did conclude that an alternate configuration using coal gasification to provide the hydrogen and a traditional Pulverized Coal (PC) Power Plant to provide the power and steam for gasification would have an attractive return.

The initial design basis for the second feasibility study was to use two gasifiers in the Gasification Block and two PC boilers in the Power Plant to provide for 4,000 metric tpd of ammonia production and 255 MW of export electrical power, with a high degree of reliability. This assessment also included investigations of alternatives to the base case design in terms of gasifier redundancy, PC boiler redundancy, ammonia production capacity, urea production capacity, power export, etc. Coal consumption for this case was 7,300 metric tpd for the gasifiers and 7,100 metric tpd for the PC Plant.

Analysis of the boiler heat duties conducted in this part of the study found the boiler needed to be oversized due to the fact that more coal was required because of the high internal steam consumption in the gasifier and fertilizer plant. As a design basis, Agrium also concluded that a maximum of 70 MW of power could be reasonably sold based on present grid restrictions on the Kenai Peninsula. Based on these results, the associated pro forma analyses established that the two-gasifier, two-boiler design should not be pursued based on the needs of the Alaskan power grid and the power pricing. Furthermore, for the high syngas and ammonia capabilities envisaged, a part of the existing equipment could not be reused, leading to additional capital costs.

Additional cases were analyzed at the extremes of the project design to find the economic optimum. These analyses found that with inert free ammonia syngas from gasification, the KNO ammonia plants were capable of producing more ammonia than the 4,000 metric ton per day base case, and this would also allow for the construction of a new 3,250 metric tpd urea plant. Opposite the mega production case, an alternative case was tested using one gasifier and one boiler to produce enough ammonia to maximize existing KNO urea production capability without adding further urea capacity. The results of these investigations indicates that the maximum value creation comes from optimizing the contribution of installed KNO equipment, especially the existing KNO urea capacity, since nearly twice the amount of urea is produced per ton of coal.

Kenai Blue Sky Project Description



The most attractive design from the feasibility study uses a single gasifier and a Power Plant comprising a single PC boiler adjacent to the KNO facility to supply enough hydrogen for approximately 2,600 metric tpd of ammonia production, which is mostly converted to and sold as urea.

Coal Supply

At the above production rates, the Project consumes 2.5 million tons of coal per year. The long-term nature, volume and location requirements support the development of new coal opportunities in Alaska. The Project includes evaluation of options associated with utilization of coal from Healy and other coalfields, and evaluation of ways to transport coal to the Kenai Blue Sky facility. The initial design activities contemplated for Phase 2 of the project will continue to develop on this and will narrow the scope to identify the most viable strategic option and final plant configuration.

KNO Nitrogen Plant

Agrium's KNO facility is the second largest nitrogen manufacturing complex in North America. KNO is located on 130 acres and the main complex consists of two ammonia/urea trains. One train was built in 1968 and the other was completed in 1977. The plant also contains its own power and steam plants, process and storage tank flare systems, a docking terminal for loading cargo ships, and significant maintenance and support facilities. KNO benefits from excellent transportation logistics. Essentially all products produced at KNO are transported via ship or barge. KNO will take hydrogen from the gasifier and pure nitrogen from the air separation unit to produce ammonia syngas. Ammonia (NH_3) synthesized in the ammonia converters is sent to the urea facilities to produce urea (NH_2CONH_2) by reaction with carbon dioxide (CO_2) in high-pressure reactors or the ammonia is refrigerated and sold as liquid product.

Gasifier Block

The gasification process dries and pulverizes as-received coal and thereafter conveys it to the gasifier where the coal reacts with sub-stoichiometric amounts of high purity oxygen to form a gas stream rich in carbon monoxide and hydrogen (syngas). This gas is reacted with water in shift converters where the carbon monoxide (CO) is shifted into carbon dioxide (CO_2) and hydrogen (H_2). The CO_2 is then removed from the syngas along with sulfur and other impurities. The hydrogen stream is purified in existing methanators and is combined with pure nitrogen from the air separation unit, then sent to the ammonia converters. In order to reduce capital and operating costs, the existing shift converters and MDEA equipment will be reused.

Power Block

Agrium plans to build a sub-critical PC Power Plant to supply power and steam to the Project with the surplus power sold to the Railbelt grid. The Kenai Blue Sky Project will require approximately 120 MW of power and 975,000 lb/hr of high-pressure steam. The project will generate approximately 70 MW of power for sale into the grid. The project anticipates using emissions control that is considered BACT.

Air Separation Unit

The gasifier block requires high purity oxygen to process the coal, all of which is supplied by a single air separation unit (ASU). The ASU processes air directly from the atmosphere to generate the 2,200 metric tpd of oxygen required by the gasification block. At 43 MW, the ASU is by far the largest energy consumer in the complex due to the large compressors required to liquefy and separate pure oxygen and nitrogen from the air.

Enhanced Oil Recovery

As a future enhancement, CO_2 generated by Agrium could be injected into the aging Cook Inlet oil fields to produce up to 300 million barrels of additional crude oil. The use of pressurized CO_2 to enhance the recovery of oil from existing fields has been proven in many fields across North America. The unique properties of CO_2 allow this gas to dissolve into the remaining oil in the reservoir and enhance the oil's flow characteristics. The result is that more oil is able to flow from the reservoir and be recovered. The Department of Energy has sponsored two recent studies that have identified the high potential for such enhanced oil recovery methods in the Cook Inlet oil fields.

Project

The feasibility work and associated economic analyses appear to indicate that a viable project can be developed that uses coal instead of natural gas to make hydrogen for fertilizer production. It overcomes the unavailability of feedstock due to dwindling natural gas supplies as well as meets current coal, fertilizer and power generation needs while leaving flexibility for future expansions. The projected coal consumption matches the estimated coal production capacity from an expansion of the existing Healy coal mine. All components of this project utilize existing, proven technology in a unique configuration to produce multiple benefits for Agrium.

Environmental Feasibility

The key environmental issues and permits are the Prevention of Significant Deterioration (PSD) Permit, the National Environmental Policy Act (NEPA) process, mercury emissions and the Clean Air Mercury Rule (CAMR), and solid byproduct disposal. No environmental fatal flaws were found and initial response from state and federal agencies has been positive.

Kenai Blue Sky Business Structure

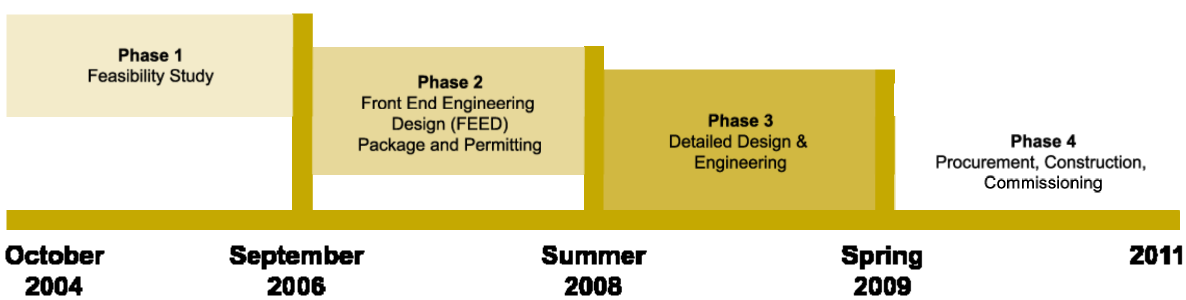
The project derives significant synergies from the integration of the nitrogen facility, power plant, air separation unit, coal mine, other feedstock alternatives and gasifier.

The current model of Kenai Blue Sky envisions that the ultimate structure will include several strategic partners with an interest in individual project components with strong contractual ties. Agrium brings nitrogen production experience, marketing capability, and market network to maximize value for the fertilizer product. The proven experience of Agrium combined with the excellent operating performance of the Kenai Nitrogen Operations team is a strong foundation on which to build Kenai Blue Sky. Other strategic partners will be integrated to enhance this foundation into a thriving long-term operation.

Government Support

To date the Project has been awarded grant support from the State of Alaska ($5.0 million) and the Denali Commission ($2.0 million). The National Energy Technology Laboratory (NETL) conducted an evaluation of gasification to supply the Agrium KNO facility. The results of this study will be posted on the NETL web site.

Project Timeline



Project Phase 2 FEED Package

During the initial activities of Phase 2, the 2,600 metric tpd design will be honed to the final design case and the level of detail in the estimate will be greatly increased over the cost estimates developed as part of the feasibility investigations. The detail of the design completed to date is highly specific and has resulted in greater definition of the project, but is not sufficient for the final design and construction of a facility. The Phase 2 Front End Engineering Design (FEED) will reduce the uncertainty around final project cost and will allow for a better overall design by providing greater definition.

The FEED package will establish engineering definition sufficient to support an EPC offering for the final design and construction of the project. The FEED phase will also begin the environmental permitting and establish the corporate structure and financing and commercial agreements to advance the project through commissioning.