ABB Project Summary Report

	LIGNITE VISION 21 PROJECT			
Title:	**PHASE II TRANSMISSION SYSTEM IMPACT STUDY SUMMARY REPORT**	Department ESC	Date Feb 6, 2001 Rev. 2-23-01	Page 1

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Summary:

Electric Systems Consulting (ESC) of ABB Power T&D Company, Inc., has been contracted by the Lignite Energy Council to study the transmission system requirements for seven potential sites for a new 500-MW coal-fired generating unit in North Dakota. This study developed one to three alternatives for each site with one main alternative for exporting the power from North Dakota to the Minneapolis / St. Paul area. This is only one of many potential alternatives that could be developed and analysis of this alternative was limited to the technical performance to meet MAPP criteria. The evaluation did not consider contractual obligations, prior requests for transmission capacity, analysis of any potential SSR problems, or other commercial and environmental aspects.

This report is a summary of the results of the studies for each of the sites plus the common facilities for all of the sites to export power from North Dakota. For each of the seven sites in North Dakota, alternatives were developed for exporting power from North Dakota to the Minneapolis / St. Paul area. A common set of system upgrades and additions were identified for the sites for increasing the North Dakota Export (NDEX) and transferring the power to the Minneapolis / St. Paul area. The seven sites are shown in the attached diagram and described below by the nearest power system feature.

Site #1 – Beulah Mine near Coyote Station
Site #2 – Center Mine near Milton Young Station
Site #3 – Falkirk Mine near Coal Creek Station
Site #4 – Freedom Mine near Antelope Valley Station
Site #5 – Great Northern Properties near Belfield Substation
Site #6 – Gascoyne Mine near Hettinger Substation
Site #7 – LUSCAR near Tioga Substation

Initially studies were made for identifying the common facilities required to export 2,450 MW from North Dakota with the new Lignite Vision 21 500-MW power plant. Studies were also made for identifying the facilities required to export 2,800 MW from North Dakota with the new Lignite Vision 21 500-MW power plant plus an additional 350 MW in transmission reservations. The transmission facilities common to all sites for increasing the NDEX to 2450 MW and transmitting the power to Minneapolis/St. Paul are listed as follows:

- Upgrade the operation of the Antelope Valley-Broadland 345 kV line to 500 kV and continue the line to Split Rock. This results in a 409-mile, 500 kV line from Antelope Valley to Split Rock, 299 miles of this 500 kV line will be the result of upgrading the existing A. Valley to Broadland line, which was built for 500 kV, but is currently operated at 345 kV. The remaining 110 miles will be new construction.
- The new 500 kV line is 88% shunt compensated (350 Mvar line shunts at each end of the line using existing 225 Mvar reactors plus new 125 Mvar reactors) to prevent excessive overvoltages during load rejection and energization.
- One 345/500 kV autotransformer (approximately 1,200 MVA) at Antelope Valley and Split Rock.
- A 70-mile, 345 kV circuit between Split Rock and Lakefield Junction.
- For high NDEX transfer scenarios (i.e., the Summer Off-Peak case), a 50-Mvar shunt capacitor at the Groton 345 kV station (to support voltages at that station following outage of the Antelope Valley to Split Rock 500 kV circuit).

Upgrading the Antelope Valley-Broadland 345 kV line to 500 kV and extending it to Split Rock is required to increase the transmission capacity for higher exports and to increase the system stability. Adding a line from Split Rock to Lakefield is required to provide a second 345 kV line to carry power out of the Split Rock (Sioux Falls) area. Without this line, an outage of the Split Rock-Sioux City 345 kV line results in overloads on the 230 kV system. These new lines are shown in the attached map of the electrical system. The new 500 kV line addition from Broadland to Split Rock is colored orange and in bold and the new Split Rock-Lakefield 345 kV line is red and in bold.

The transmission facilities required for increasing the NDEX to 2,800 MW (with generator tripping of the LV21 unit upon outages involving the A.Valley-Split Rock 500 kV line) and transmitting the power to Minneapolis / St. Paul are listed below. Only those facilities that are in addition to or modify the facilities listed above for the 2,450 MW NDEX are listed below (ie. this list is for the incremental facilities).

- 35% series compensation of the Antelope Valley-Split Rock 500 kV line
- 25% series compensation of the Leland Olds-Groton-Split Rock 345 kV line
- 220 Mvars in additional shunt compensation along the Leland Olds to Split Rock 345 kV line.
- A Broadland 500 kV station with a 1,000-MVA 500 / 230 kV transformer
- Line reactor compensation of the proposed 500 kV line is modified to the existing 225-Mvar reactors at Antelope Valley and Broadland

The transmission facilities required for increasing the NDEX to 2,800 MW without generator tripping of the LV21 unit requires additional series capacitors as listed below.

- 35% series compensation of the Antelope Valley-Split Rock 500 kV line
- 65% series compensation of the Leland Olds-Groton-Split Rock 345 kV line
- 65% series compensation of the Leland Olds-Ft. Thompson 345 kV line

The cost estimates for the common facilities to increase the NDEX to 2,450 MW and to 2,800 MW are listed as follows:

Costs for NDEX Upgrade to 2,450 MW	$130,529,000
Costs for NDEX Upgrade to 2,800 MW With Generator Tripping	$153,039,000
Costs for NDEX Upgrade to 2,800 MW Without Generator Tripping	$162,039,000

The confidential site reports identify the facility additions or modifications required for each specific site in addition to those common facilities listed above. These facilities insure that power can be transmitted from the nearby power system station identified in the site list above to the common facilities for a NDEX of 2,450 MW.

Since the three main EHV lines that export power from North Dakota emanate from the Antelope Valley and Leland Olds Stations, the closer the sites are to Antelope Valley and Leland Olds the less miles of transmission lines that need to be built or reinforced to export the power. In general it is required to transmit the power to Antelope Valley and / or Leland Olds Stations or to one of the 345 kV lines that ties into these stations in order to export the power. For some of the sites, alternatives were evaluated for connecting to the local 345 kV or 230 kV systems and enhancing the system to export the power versus building a 345 kV line directly from the site to the Antelope Valley and / or Leland Olds Stations.

Another consideration is the isolation between the generating stations in central North Dakota. The Coal Creek power plant and station is electrically isolated from the Antelope Valley and Leland Olds transmission system. The Coyote and Milton R. Young power plants and stations are also electrically isolated from the Antelope Valley and Leland Olds transmission system. Connecting these systems together generally has an adverse impact on system stability. Alternatives that connect these systems in general will need to increase the system stability by additional enhancements such as series capacitors. Some alternatives also included an Inter-phase Power Controller (IPC) to transmit power between these stations. The IPC transmits power but still results in the station being de-coupled for system faults, that is the IPC does not transmit fault current. This keeps the systems isolated so faults on one system do not excessively impact the other system and therefore do not adversely impact the system stability.

Some of the transmission alternatives for the sites required additional series compensation in the Antelope Valley-Split Rock 500 kV line and / or the Leland Olds-Groton-Split Rock 345 kV line. These alternatives would leave less flexibility to expand the transmission system for future increases in the NDEX. The site studies did identify the total system requirements for each site to insure that each site will meet the MAPP system requirements for steady-state and stability performance.

Conclusions:

Facilities were identified for each site which result in all sites having the capability to export 2,450 MW. The common facilities for increasing the export level to 2,450 MW and to 2,800 MW have been identified for transfers to the Minneapolis / St. Paul area. For these common facilities an estimated cost has been provided. The individual site reports contain the facilities required for each specific site.

Figure 1: Site Locations Map

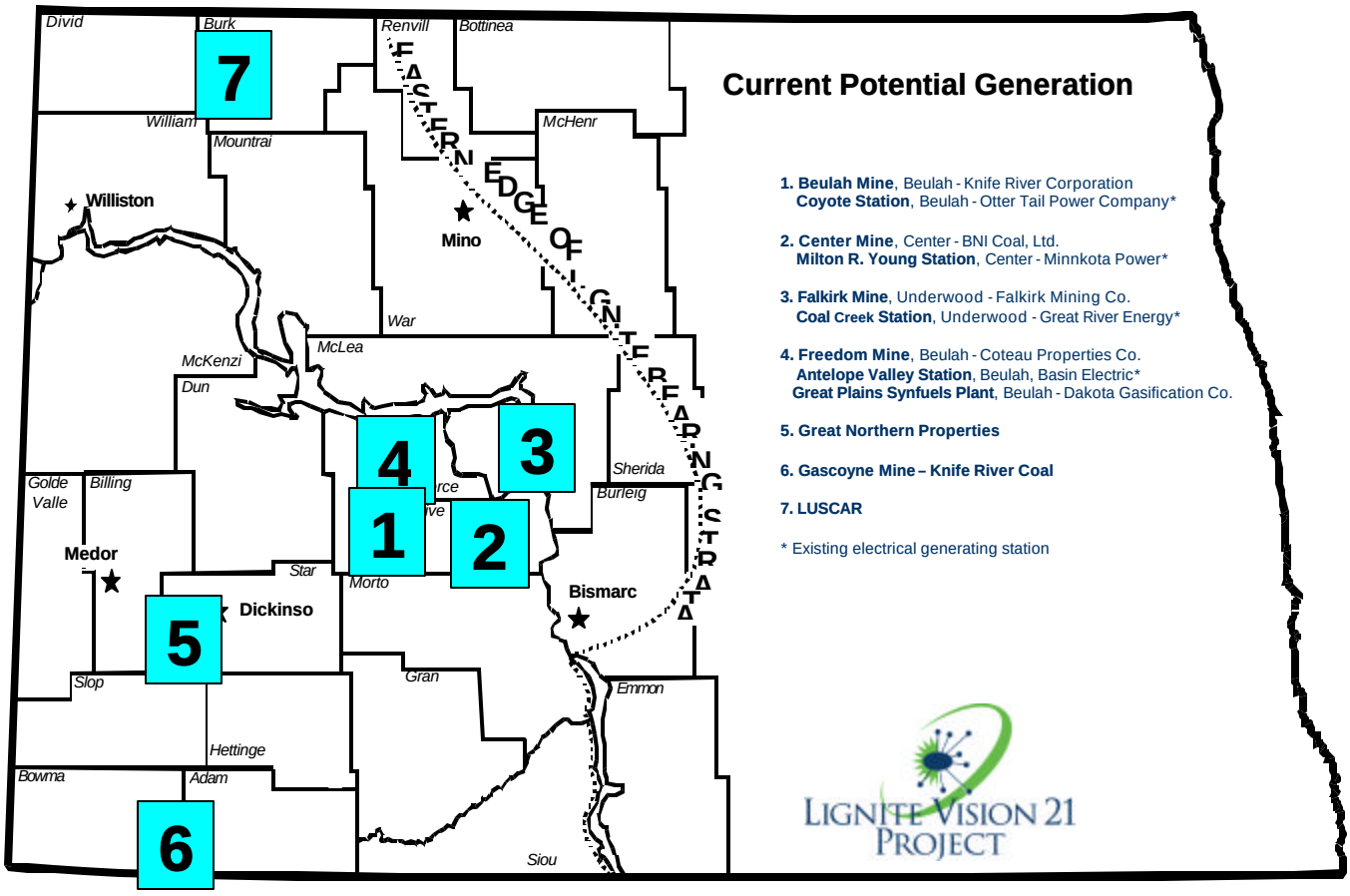

Figure 2: Transmission Route Map