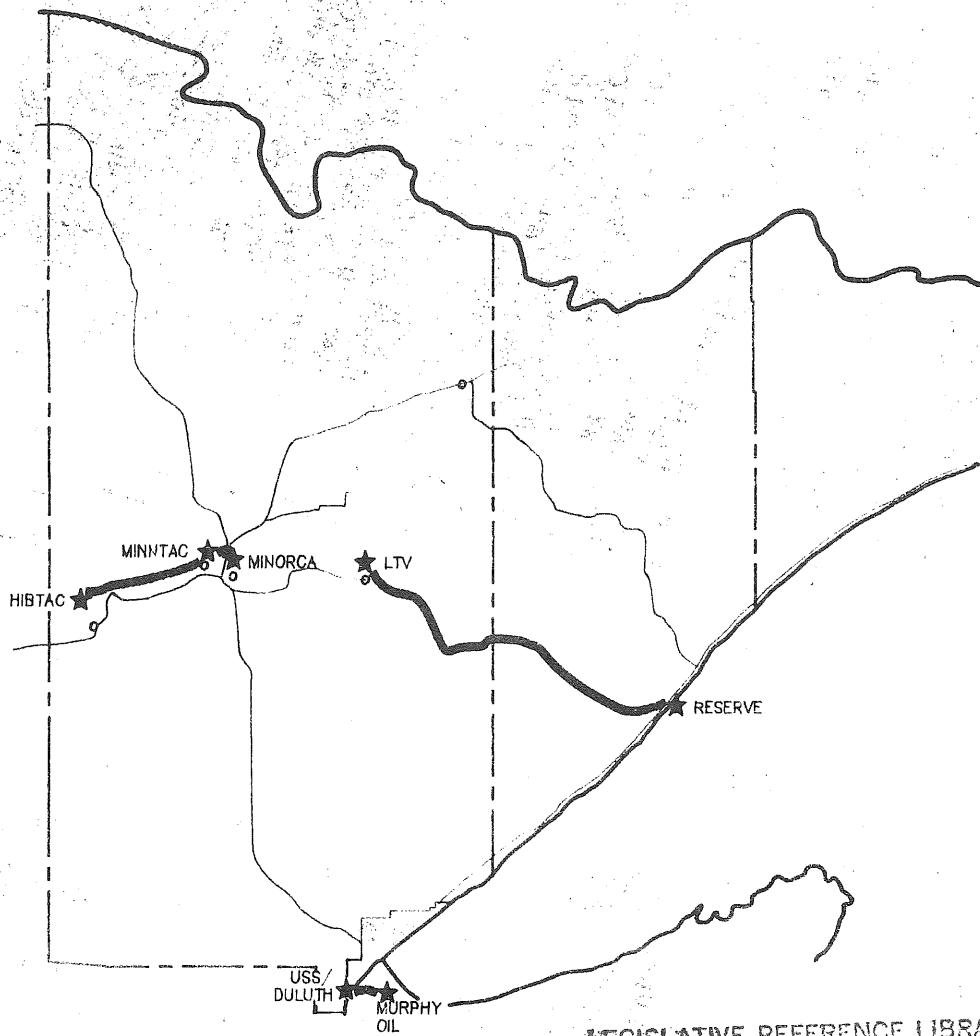




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GAS DISTRIBUTION STUDY COREX PROJECT

DEPARTMENT OF NATURAL RESOURCES STATE OF MINNESOTA



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MAY, 1988

AWM PROJECT NO. M-100

AUG 5 1988

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GAS DISTRIBUTION STUDY
COREX PROJECT
Department of Natural Resources
State of Minnesota

May, 1988

AWM Project No. M-100

Prepared By
A. W. Mathews Engineering Company
Division of AWM Corporation
555 West 27th Street
Hibbing, Minnesota 55746

AUG 5 1988

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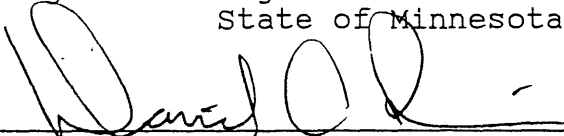
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Certification Page

Gas Distribution Study
Corex Project
AWM Project No. M-100

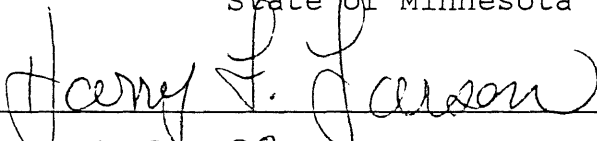
Project Manager:

I hereby certify that this plan, specification
or report was prepared by me or under my
direct supervision and that I am a duly
Registered Engineer under the laws of the
State of Minnesota


Date 6-28-88 Registration No. 9241

Mechanical Engineer:

I hereby certify that this plan, specification
or report was prepared by me or under my
direct supervision and that I am a duly
Registered Engineer under the laws of the
State of Minnesota


Date 6-28-88 Registration No. 15515

1.0 PURPOSE OF STUDY

The purpose of this study was to complete a preliminary analysis of potential waste gas distribution from the proposed Corex Plant at four alternate locations which could be used along with other data to assist in siting the Corex Plant.

Work included developing a preliminary design (size and routing) for the gas distribution system from the Corex Plant at each of four sites to potential customers and preliminary cost estimates for the distribution system and required compressor stations.

The data developed during the study was organized in a computer spreadsheet template which can provide a comparison of data for varying conditions for individual site/customer(s) or for various combinations of site/customer.

Included in this report is a summary of our investigations, cost estimate summaries, routing sketches and information on the computer spreadsheet template.

2.0 SUMMARY OF INFORMATION

2.1 Data was developed for four potential Corex Plant sites:

1. Minntac - Next to step 3.
2. Silver Bay on Reserve Property
3. LTV Mining
4. USS Steel Plant Site - West Duluth

2.2 Gas Requirements for Each Site:

| <u>Corex Plant Site</u> | <u>Offsite Customer</u> | <u>Demand</u> <u>MMBTU/hr.</u> | <u>MCFH</u> |
|-------------------------|------------------------------|-----------------------------------|-------------|
| Minntac | Minorca | 190 | 931 |
| Minntac | Hib Tac | 257 | 1260 |
| Reserve | LTV | 513 | 2515 |
| LTV | Reserve | 228 | 1118 |
| USS/Duluth | Murphy Refining/ Superior | 1012 | 5000 |

2.3 Preliminary Design/Estimate Data

A preliminary design was developed for each Corex Plant site and its respective potential offsite customer(s).

Routing of pipe lines is shown on the maps in Appendix B.

Design data for selected pipe sizes is shown in Table 1 which also includes the cost and other data developed for each design. Cost estimate summaries for these designs are included in Appendix C.

2.4 Computer Analysis

The design data for each site and customer along with cost and other data was entered in a computer spread sheet template.

The run number is first entered, then when the Corex Plant location and customer name is entered, customer data including gas demand, pressure and length of distribution pipe is displayed. Entering pipe size will display the following data:

1. Initial Pressure Required
2. Compressor Station Required (Y/N)
3. Total Horsepower
4. Cost of Pipe Line
5. Cost of Compressor Station
6. Total Capital Cost
7. Annualized Capital Cost (12 year straight line)
8. Annual Power Cost
9. Annual Maintenance Cost
10. Total Annual Operating Cost
11. Cost per MCF

Using a spread sheet macro command, the displayed data (up to 5 runs) can be saved and printed for comparison.

A copy of the computer printout for a typical series of runs is shown in Table 2.

TABLE 1
PRELIMINARY DESIGN/ESTIMATE DATA

| | | | | | |
|--------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| A. Site/Customer | Minntac/Minorca | Minntac/HibTac | Minntac/HibTac | Reserve/LTV | LTV/Reserve |
| B. Distribution System Length | 31,000 Ft. | 116,000 Ft. | 116,000 Ft. | 300,000 Ft. | 300,000 Ft. |
| C. Delivery Pressure | 20 PSIG | 20 PSIG | 20 PSIG | 20 PSIG | 20 PSIG |
| D. Pipe Size | 10" | 16" | 20" | 24" | 18" |
| E. Initial Pressure | 200 PSIG | 2,000 PSIG | 75 PSIG | 150 PSIG | 150 PSIG |
| F. Compressor Required/HP | Yes/1,800 HP | Yes/2,000 HP | No/-- | Yes/4,400 HP | Yes/2,000 HP |
| G. Estimated Cost-Pipeline | \$3,723,000.00 | \$18,692,000.00 | \$21,000,000.00 | \$84,962,000.00 | \$52,890,000.00 |
| H. Estimated Cost-Compressor Station | \$671,000.00 | \$671,000.00 | ----- | \$1,463,000.00 | \$671,000.00 |
| I. Total Capital Cost | \$4,394,000.00 | \$19,363,000.00 | \$21,000,000.00 | \$86,425,000.00 | \$53,561,000.00 |
| J. Cost-Pipeline (\$/Inch Dia./Mile) | \$63,411.00 | \$53,175.00 | \$47,793.00 | \$62,305.00 | \$51,714.00 |

TABLE 2
COMPUTER PRINTOUT

A W MATHEWS ENGINEERING DIVISION AWM CORPORATION DATE PRINTED: 27-Jun-88

GAS DISTRIBUTION STUDY
DNR COREY PROJECT
AWM PROJECT No. M-100

| | RUN NO.1 | RUN NO.2 | RUN NO.3 | RUN NO.4 | RUN NO.5 |
|----------------------------------|-------------|-------------|--------------|--------------|--------------|
| COREY PLANT LOCATION*****: | MINNTAC | MINNTAC | MINNTAC | MINNTAC | MINNTAC |
| WASTE GAS CUSTOMER DATA**: | | | | | |
| NAME: | MINORCA | MINORCA | HIBTAC | HIBTAC | HIBTAC |
| GAS REQUIREMENT(MCFH): | 931 | 931 | 1260 | 1260 | 1260 |
| PRESSURE(PSIG): | 20 | 20 | 20 | 20 | 20 |
| DISTRIBUTION(FEET): | 31000 | 31000 | 116000 | 116000 | 116000 |
| NOMINAL PIPE DIA.(IN)/ID(IN): | 16 | 10 | 14 | 16 | 20 |
| INITIAL PRESSURE REQUIRED(PSIG): | 45.66 | 165.37 | 208.83 | 139.31 | 68.97 |
| COMPRESSOR STATION REQUIRED: | NO | YES | YES | YES | YES |
| TOTAL HORSEPOWER: | 1564 | 1564 | 2117 | 2117 | 2117 |
| COST OF PIPELINE: | \$5,166,667 | \$3,229,167 | \$16,916,667 | \$19,333,333 | \$24,166,667 |
| COST OF COMPRESSOR STATION: | \$0 | \$547,428 | \$740,880 | \$740,880 | \$740,880 |
| *****TOTAL CAPITAL COST***** | \$5,166,667 | \$3,776,595 | \$17,657,547 | \$20,074,213 | \$24,907,547 |
| ANNUAL COST (12 YR SL): | \$430,556 | \$314,716 | \$1,471,462 | \$1,672,851 | \$2,075,629 |
| ANNUAL POWER COST: | \$0 | \$492,452 | \$841,632 | \$561,465 | \$277,972 |
| ANNUAL MAINTENANCE COST: | \$25,833 | \$18,883 | \$88,288 | \$100,371 | \$124,538 |
| ***TOTAL ANNUAL OPERATING COST** | \$480,556 | \$857,168 | \$2,401,382 | \$2,334,687 | \$2,478,139 |
| *****COST PER MCF***** | \$0.06 | \$0.12 | \$0.24 | \$0.23 | \$0.25 |

3.0 DESIGN CRITERIA

The preliminary design of the gas distribution system included routing of pipelines, pipe sizing, compressor station design, selection of materials and development of other information necessary to prepare preliminary cost estimates.

The system to distribute the gas would be designed to conform to the Pipeline Safety Regulations and would be considered a gas transmission system. Cathodic protection is included as required.

Pipe sizes were calculated using the Weymouth formula.

Steel pipe would be used, plastic coated through 20 inch diameter, coated and wrapped for larger diameters.

Based on the gas composition by percent volume information supplied, the following data was calculated:

| | |
|----------------------|------------------------|
| Specific Gravity | 1.018 |
| Higher Heating Value | 204 BTU per cubic foot |

Gas pressure requirements at customer sites were assumed to be 20 psig.

Compressor stations when required would be located at the Corex Plant. The compressors were selected for 60 to 200 psig which is a common pressure range and requires only single stage compressors. For pressure requirements over 200 psig a 60 to 400 psig, 2 stage compressor would be used. Electric motor driven compressors were selected based on vendor information indicating that the gas would not be suitable for turbine drive.

The following data was used in the computer analysis:

1. Pipeline cost on the basis of preliminary estimates and a weighted average cost of \$55,000.00/inch diameter/mile.
2. Horsepower requirements for single stage compression (60 to 200 psig) of 70 HP per 1000 MCF per day.
3. Horsepower requirements for 2 stage compression (60 to 400 psig) of 118 HP per 1000 MCF per day.
4. Cost for compressor station with single stage compression (60 to 200 psig) of \$350.00 per horsepower.
5. Cost for compressor station with 2 stage compression (60 to 400 psig) of \$450.00 per horsepower.

4.0 OPERATING COSTS

Annual power costs were developed for compressor stations utilizing an operating schedule of 8000 hours per year and a power cost of \$.06/KWH.

Maintenance cost were assumed to be 1/2 of 1% of the capital cost of the system or a minimum of \$50,000.00 per year based on utilizing one person for maintenance, repair, monitoring and operation of the system.

APPENDIX A

TYPICAL COMPUTER RUNS

GAS DISTRIBUTION STUDY
 DNR COREX PROJECT
 AWM PROJECT No. M-100

```

=====
                RUN NO.1      RUN NO.2      RUN NO.3      RUN NO.4      RUN NO.5
COREX PLANT LOCATION*****:  MINNTAC      MINNTAC      LTV           RESERVE       DULUTH

WASTE GAS CUSTOMER DATA**:
      NAME: MINORCA      HIBTAC      RESERVE      LTV           MURPHY OIL
GAS REQUIREMENT(MCFH):      931          1260          1118          2515          5000
  PRESSURE(PSIG):           20           20            20            20            20
  DISTRIBUTION(FEET):       31000        116000        300000        300000        60000

NOMINAL PIPE DIA.(IN)/ID(IN):      10           14            16            22            22
INITIAL PRESSURE REQUIRED(PSIG):     165.37      208.83        204.57        189.01        166.54

COMPRESSOR STATION REQUIRED: YES      YES           YES           YES           YES
  TOTAL HORSEPOWER:           1564         2117          1878          4225          8400
  COST OF PIPELINE: $3,229,167 $16,916,667 $50,000,000 $68,750,000 $13,750,000

COST OF COMPRESSOR STATION: $547,428 $740,880 $657,384 $1,478,820 $2,940,000

*****TOTAL CAPITAL COST***** $3,776,595 $17,657,547 $50,657,384 $70,228,820 $16,690,000

ANNUAL COST (12 YR SL): $314,716 $1,471,462 $4,221,449 $5,852,402 $1,390,833
  ANNUAL POWER COST: $492,452 $841,632 $731,539 $1,520,469 $2,663,429
  ANNUAL MAINTENANCE COST: $18,883 $88,288 $253,287 $351,144 $83,450

***TOTAL ANNUAL OPERATING COST** $857,168 $2,401,382 $5,206,274 $7,724,015 $4,137,712

*****COST PER MCF***** $0.12 $0.24 $0.58 $0.38 $0.10
  
```

GAS DISTRIBUTION STUDY
 DNR COREX PROJECT
 AWM PROJECT No. M-100

| | RUN NO.1 | RUN NO.2 | RUN NO.3 | RUN NO.4 | RUN NO.5 |
|-----------------------------------|-------------|-------------|-------------|-------------|-------------|
| COREX PLANT LOCATION*****: | MINNTAC | MINNTAC | MINNTAC | MINNTAC | MINNTAC |
| WASTE GAS CUSTOMER DATA**: | | | | | |
| NAME: | MINORCA | MINORCA | MINORCA | MINORCA | MINORCA |
| GAS REQUIREMENT(MCFH): | 931 | 931 | 931 | 931 | 931 |
| PRESSURE(P SIG): | 20 | 20 | 20 | 20 | 20 |
| DISTRIBUTION(FEET): | 31000 | 31000 | 31000 | 31000 | 31000 |
| NOMINAL PIPE DIA. (IN)/ID(IN): | 10 | 12 | 14 | 16 | 18 |
| INITIAL PRESSURE REQUIRED(P SIG): | 165.37 | 117.91 | 71.74 | 45.66 | 29.94 |
| COMPRESSOR STATION REQUIRED: | YES | YES | YES | NO | NO |
| TOTAL HORSEPOWER: | 1564 | 1564 | 1564 | 1564 | 1564 |
| COST OF PIPELINE: | \$3,229,167 | \$3,875,000 | \$4,520,833 | \$5,166,667 | \$5,812,500 |
| COST OF COMPRESSOR STATION: | \$547,428 | \$547,428 | \$547,428 | \$0 | \$0 |
| *****TOTAL CAPITAL COST***** | \$3,776,595 | \$4,422,428 | \$5,068,261 | \$5,166,667 | \$5,812,500 |
| ANNUAL COST (12 YR SL): | \$314,716 | \$368,536 | \$422,355 | \$430,556 | \$484,375 |
| ANNUAL POWER COST: | \$492,452 | \$351,115 | \$213,639 | \$0 | \$0 |
| ANNUAL MAINTENANCE COST: | \$18,883 | \$22,112 | \$25,341 | \$25,833 | \$29,063 |
| ***TOTAL ANNUAL OPERATING COST** | \$857,168 | \$769,650 | \$685,994 | \$480,556 | \$534,375 |
| *****COST PER MCF***** | \$0.12 | \$0.10 | \$0.09 | \$0.06 | \$0.07 |

GAS DISTRIBUTION STUDY
 DNR COREX PROJECT
 AWM PROJECT No. M-100

| | RUN NO.1 | RUN NO.2 | RUN NO.3 | RUN NO.4 | RUN NO.5 |
|----------------------------------|--------------|--------------|--------------|--------------|--------------|
| COREX PLANT LOCATION*****: | MINNTAC | MINNTAC | MINNTAC | MINNTAC | MINNTAC |
| WASTE GAS CUSTOMER DATA**: | | | | | |
| NAME: | HIBTAC | HIBTAC | HIBTAC | HIBTAC | HIBTAC |
| GAS REQUIREMENT(MCPH): | 1260 | 1260 | 1260 | 1260 | 1260 |
| PRESSURE(PSIG): | 20 | 20 | 20 | 20 | 20 |
| DISTRIBUTION(FEET): | 116000 | 116000 | 116000 | 116000 | 116000 |
| NOMINAL PIPE DIA. (IN)/ID(IN): | 12 | 14 | 16 | 18 | 20 |
| INITIAL PRESSURE REQUIRED(PSIG): | 330.68 | 208.83 | 139.31 | 96.64 | 68.97 |
| COMPRESSOR STATION REQUIRED: | YES | YES | YES | YES | YES |
| TOTAL HORSEPOWER: | 3568 | 2117 | 2117 | 2117 | 2117 |
| COST OF PIPELINE: | \$14,500,000 | \$16,916,667 | \$19,333,333 | \$21,750,000 | \$24,166,667 |
| COST OF COMPRESSOR STATION: | \$1,605,744 | \$740,880 | \$740,880 | \$740,880 | \$740,880 |
| *****TOTAL CAPITAL COST***** | \$16,105,744 | \$17,657,547 | \$20,074,213 | \$22,490,880 | \$24,907,547 |
| ANNUAL COST (12 YR SL): | \$1,342,145 | \$1,471,462 | \$1,672,851 | \$1,874,240 | \$2,075,629 |
| ANNUAL POWER COST: | \$2,246,578 | \$841,632 | \$561,465 | \$389,485 | \$277,972 |
| ANNUAL MAINTENANCE COST: | \$80,529 | \$88,288 | \$100,371 | \$112,454 | \$124,538 |
| ***TOTAL ANNUAL OPERATING COST** | \$3,669,252 | \$2,401,382 | \$2,334,687 | \$2,376,179 | \$2,478,139 |
| *****COST PER MCP***** | \$0.36 | \$0.24 | \$0.23 | \$0.24 | \$0.25 |

GAS DISTRIBUTION STUDY
 DNR COREX PROJECT
 AWM PROJECT No. M-100

| | RUN NO.1 | RUN NO.2 | RUN NO.3 | RUN NO.4 | RUN NO.5 |
|-----------------------------------|---------------|--------------|--------------|--------------|--------------|
| COREX PLANT LOCATION*****: | LTV | LTV | LTV | LTV | LTV |
| WASTE GAS CUSTOMER DATA**: | | | | | |
| | NAME: RESERVE | RESERVE | RESERVE | RESERVE | RESERVE |
| GAS REQUIREMENT(MCFH): | 1118 | 1118 | 1118 | 1118 | 1118 |
| PRESSURE(P SIG): | 20 | 20 | 20 | 20 | 20 |
| DISTRIBUTION(FEET): | 300000 | 300000 | 300000 | 300000 | 300000 |
| NOMINAL PIPE DIA.(IN)/ID(IN): | 16 | 18 | 20 | 22 | 24 |
| INITIAL PRESSURE REQUIRED(P SIG): | 204.57 | 143.48 | 103.76 | 76.79 | 57.85 |
| COMPRESSOR STATION REQUIRED: YES | YES | YES | YES | YES | NO |
| TOTAL HORSEPOWER: | 1878 | 1878 | 1878 | 1878 | 1878 |
| COST OF PIPELINE: \$50,000,000 | \$56,250,000 | \$62,500,000 | \$68,750,000 | \$75,000,000 | |
| COST OF COMPRESSOR STATION: | \$657,384 | \$657,384 | \$657,384 | \$657,384 | \$0 |
| *****TOTAL CAPITAL COST***** | \$50,657,384 | \$56,907,384 | \$63,157,384 | \$69,407,384 | \$75,000,000 |
| ANNUAL COST (12 YR SL): | \$4,221,449 | \$4,742,282 | \$5,263,115 | \$5,783,949 | \$6,250,000 |
| ANNUAL POWER COST: | \$731,539 | \$513,087 | \$371,055 | \$274,619 | \$0 |
| ANNUAL MAINTENANCE COST: | \$253,287 | \$284,537 | \$315,787 | \$347,037 | \$375,000 |
| ***TOTAL ANNUAL OPERATING COST** | \$5,206,274 | \$5,539,906 | \$5,949,957 | \$6,405,605 | \$6,625,000 |
| *****COST PER MCF***** | \$0.58 | \$0.62 | \$0.67 | \$0.72 | \$0.74 |

GAS DISTRIBUTION STUDY
DNR COREX PROJECT
AWM PROJECT No. M-100

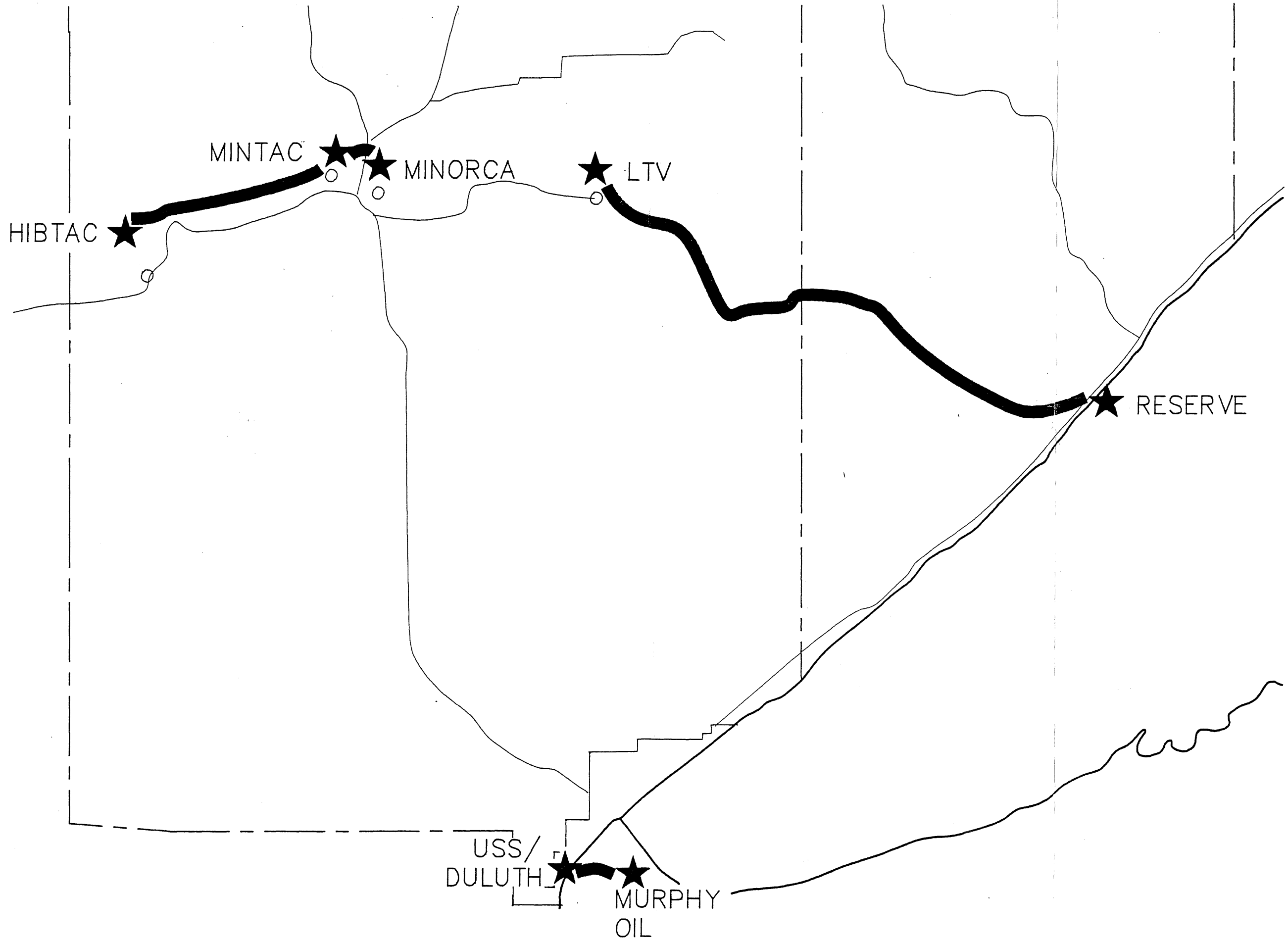
| | RUN NO.1 | RUN NO.2 | RUN NO.3 | RUN NO.4 | RUN NO.5 |
|-----------------------------------|--------------|--------------|--------------|--------------|--------------|
| COREX PLANT LOCATION*****: | RESERVE | RESERVE | RESERVE | RESERVE | RESERVE |
| WASTE GAS CUSTOMER DATA**: | | | | | |
| NAME: LTV | LTV | LTV | LTV | LTV | LTV |
| GAS REQUIREMENT(MCFH): | 2515 | 2515 | 2515 | 2515 | 2515 |
| PRESSURE(P SIG): | 20 | 20 | 20 | 20 | 20 |
| DISTRIBUTION(FEET): | 300000 | 300000 | 300000 | 300000 | 300000 |
| NOMINAL PIPE DIA.(IN)/ID(IN): | 18 | 20 | 22 | 24 | 30 |
| INITIAL PRESSURE REQUIRED(P SIG): | 339.93 | 250.17 | 189.01 | 145.82 | 73.19 |
| COMPRESSOR STATION REQUIRED: YES | YES | YES | YES | YES | YES |
| TOTAL HORSEPOWER: | 7122 | 7122 | 4225 | 4225 | 4225 |
| COST OF PIPELINE: \$ | \$56,250,000 | \$62,500,000 | \$68,750,000 | \$75,000,000 | \$93,750,000 |
| COST OF COMPRESSOR STATION: \$ | \$3,205,116 | \$3,205,116 | \$1,478,820 | \$1,478,820 | \$1,478,820 |
| *****TOTAL CAPITAL COST***** | \$59,455,116 | \$65,705,116 | \$70,228,820 | \$76,478,820 | \$95,228,820 |
| ANNUAL COST (12 YR SL): \$ | \$4,954,593 | \$5,475,426 | \$5,852,402 | \$6,373,235 | \$7,935,735 |
| ANNUAL POWER COST: \$ | \$4,609,692 | \$3,392,412 | \$1,520,469 | \$1,173,030 | \$588,785 |
| ANNUAL MAINTENANCE COST: \$ | \$297,276 | \$328,526 | \$351,144 | \$382,394 | \$476,144 |
| ***TOTAL ANNUAL OPERATING COST** | \$9,861,561 | \$9,196,364 | \$7,724,015 | \$7,928,659 | \$9,000,665 |
| *****COST PER MCF***** | \$0.49 | \$0.46 | \$0.38 | \$0.39 | \$0.45 |

GAS DISTRIBUTION STUDY
 DNR COREX PROJECT
 AWM PROJECT No. M-100

| | RUN NO.1 | RUN NO.2 | RUN NO.3 | RUN NO.4 | RUN NO.5 |
|-----------------------------------|------------------|--------------|--------------|--------------|--------------|
| COREX PLANT LOCATION*****: | DULUTH | DULUTH | DULUTH | DULUTH | DULUTH |
| WASTE GAS CUSTOMER DATA**: | | | | | |
| | NAME: MURPHY OIL | MURPHY OIL | MURPHY OIL | MURPHY OIL | MURPHY OIL |
| GAS REQUIREMENT(MCFH): | 5000 | 5000 | 5000 | 5000 | 5000 |
| PRESSURE(P SIG): | 20 | 20 | 20 | 20 | 20 |
| DISTRIBUTION(FEET): | 60000 | 60000 | 60000 | 60000 | 60000 |
| NOMINAL PIPE DIA.(IN)/ID(IN): | 16 | 18 | 20 | 22 | 24 |
| INITIAL PRESSURE REQUIRED(P SIG): | 423.14 | 300.67 | 220.88 | 166.54 | 128.17 |
| COMPRESSOR STATION REQUIRED: | YES | YES | YES | YES | YES |
| TOTAL HORSEPOWER: | 14160 | 14160 | 14160 | 8400 | 8400 |
| COST OF PIPELINE: | \$10,000,000 | \$11,250,000 | \$12,500,000 | \$13,750,000 | \$15,000,000 |
| COST OF COMPRESSOR STATION: | \$6,372,000 | \$6,372,000 | \$6,372,000 | \$2,940,000 | \$2,940,000 |
| *****TOTAL CAPITAL COST***** | \$16,372,000 | \$17,622,000 | \$18,872,000 | \$16,690,000 | \$17,940,000 |
| ANNUAL COST (12 YR SL): | \$1,364,333 | \$1,468,500 | \$1,572,667 | \$1,390,833 | \$1,495,000 |
| ANNUAL POWER COST: | \$11,407,551 | \$8,105,900 | \$5,954,918 | \$2,663,429 | \$2,049,842 |
| ANNUAL MAINTENANCE COST: | \$81,860 | \$88,110 | \$94,360 | \$83,450 | \$89,700 |
| ***TOTAL ANNUAL OPERATING COST** | \$12,853,745 | \$9,662,510 | \$7,621,945 | \$4,137,712 | \$3,634,542 |
| *****COST PER MCF***** | \$0.32 | \$0.24 | \$0.19 | \$0.10 | \$0.09 |

APPENDIX B

PIPELINE ROUTING



APPENDIX C

COST ESTIMATE SUMMARIES



ABE W. MATHEWS ENGINEERING CO.

555 WEST 27th STREET

HIBBING, MINN. 55746

PHONE (218)-262-3465

CUSTOMER

DNR

JOB DESCRIPTION GAS DIV. STUDY

ESTIMATE NO. PROPOSAL NO.

JOB NO. M-100

DIRECT COST ESTIMATE

DATE 3/25/83

PAGE 1 OF 1

| Acc't | Description | Unit | Qty. | MATERIAL | | LABOR | | | | Sub Contractor | Total |
|------------------|---|------|-------|-----------|-----------|---------------|-----------|------------------|-----------|----------------|-----------|
| | | | | Unit Cost | Sub Total | Hrs. Per Unit | Man Hours | Rate | Sub Total | | |
| 10" Ø | | | | | | | | | | | |
| | PIPE - SCH 40, ASTM A 53, ERW, BLACK STL. 10" Ø (6 mi.) | LF | 31000 | | 806 000 | | | ① | | | 806 000 |
| | POLYETHYLENE COATING | LF | 31000 | | 34000 | | 38000 | 45 ⁰⁰ | 1,716,000 | | 1 716 000 |
| | TRENCHING-EXCAVATION-Common | CY | 14000 | | - | | | | | 112 000 | 112 000 |
| | EXCAVATION-ROCK ② | CY | 14000 | | - | | | | | 700 000 | 700 000 |
| | PIPE BEDDING | CY | 3000 | | - | | | | | 60 000 | 60 000 |
| | BACKFILL | CY | 23000 | | - | | | | | 138 000 | 138 000 |
| | ROAD CROSSING - 2 LANE | EA | 1 | | - | | | | | 32 000 | 32 000 |
| | 4 LANE DIV. | EA | 1 | | - | | | | | 50 000 | 50 000 |
| | RAILROAD CROSSING | EA | 1 | | - | | | | | 32 000 | 32 000 |
| | ALLOWANCE FOR DEWATERING | LOT | | | | | | | | 16 000 | 16 000 |
| | CATHODIC PROTECTION | MILS | 6 | | | | | | | 27 000 | 27 000 |
| | Sub Totals | | | | 840 000 | | | | 1 716 000 | 1 167 000 | |

- ① RATES INCL. CONST. EQUIP., INSURANCE, OHS&P
- ② ASSUME 1/3 OF THE EXCAVATION WILL BE ROCK

Flow No. _____ Total 3 722 000



ABE W. MATHEWS ENGINEERING CO.

555 WEST 27th STREET HIBBING, MINN. 55746

PHONE (218)-262-3465

CUSTOMER

DNR

JOB DESCRIPTION

6A'S DIST. STUDY

ESTIMATE NO. PROPOSAL NO.

JOB NO.

M-100

DIRECT COST ESTIMATE

DATE

3/25/98

PAGE

1 OF 1

| Acc't | Description | Unit | Qty. | MATERIAL | | LABOR | | | | Sub Contractor | Total |
|--------------|---|------|--------|-----------|-----------|---------------|-----------|------------------|-----------|----------------|---------|
| | | | | Unit Cost | Sub Total | Hrs. Per Unit | Man Hours | Rate | Sub Total | | |
| <u>16" Ø</u> | | | | | | | | | | | |
| | PIPE - SCH. 40, ASTM A 53, FLOW, BK STEEL 16" Ø (22 mi) | LF | 116000 | | 3712000 | | | | | | 3712000 |
| | | | | | | | 204000 | 45 ⁰⁰ | 9180000 | | 9180000 |
| | POLYETHYLENE COATING | LF | 116000 | | 186000 | | | | | | 186000 |
| | TRENCHING - EXCAVATION - Common | CY | 70000 | | - | | - | | - | 520000 | 520000 |
| | EXCAVATION - ROCK ② | CY | 70000 | | - | | - | | - | 3500000 | 3500000 |
| | PIPE BEDDING | CY | 9000 | | | | | | | 180000 | 180000 |
| | BACKFILL | CY | 130000 | | | | | | | 780000 | 780000 |
| | ROAD CROSSING - 2 LANE | EA | 6 | | | | | | | 270000 | 270000 |
| | RIVER CROSSING | EA | 3 | | | | | | | 195000 | 195000 |
| | CUT & REPAIR ROAD CROSSING | EA | 2 | | | | | | | 40000 | 40000 |
| | ALLOWANCE FOR DEWATERING | LF | 116000 | | | | | | | 60000 | 60000 |
| | CATHODIC PROTECTION | MIAS | 6 | | | | | | | 29000 | 29000 |
| | Sub Totals | | | | 3894000 | | | | 9180000 | 5614000 | |

① RATES INCL. CONS. EQUIP., INSURANCE, O.H. & P.

② ASSUME 1/2 OF THE EXCAVATION WILL BE ROCK

Flow No.

Total

18692000



ABE W. MATHEWS ENGINEERING CO.

555 WEST 27th STREET HIBBING, MINN. 55746

PHONE (218)-262-3465

CUSTOMER DNR

JOB DESCRIPTION Gas Dist. Study

ESTIMATE NO. _____
PROPOSAL NO. _____

JOB NO. M-100

DIRECT COST ESTIMATE

DATE 3/25/88

PAGE 1 OF 1

| Acc't | Description | Unit | Qty. | MATERIAL | | LABOR | | | | Sub Contractor | Total |
|--------------|--|-------|---------|-----------|------------|---------------|-----------|------------------|------------|----------------|------------|
| | | | | Unit Cost | Sub Total | Hrs. Per Unit | Man Hours | Rate | Sub Total | | |
| <u>18" Ø</u> | | | | | | | | | | | |
| | PIPE - SCH 40, ASTM A-53, ERW, BLK STL. 18 Ø (57 mi) | LF | 300,000 | | 12,900,000 | | | | | | 12,900,000 |
| | POLYETHYLENE COATING | LF | 300,000 | | 561,000 | | 537,000 | 45 ⁰⁰ | 24,165,000 | | 24,165,000 |
| | TRENCHING - EXCAVATION - Common | CY | 180,000 | | | | | | | 1,440,000 | 1,440,000 |
| | EXCAVATION - ROCK ② | CY | 180,000 | | | | | | | 9,000,000 | 9,000,000 |
| | PIPE BEDDING | CY | 23,000 | | | | | | | 460,000 | 460,000 |
| | BORE HOLE | CY | 318,000 | | | | | | | 1,908,000 | 1,908,000 |
| | ROAD CROSSINGS 2 LANE | EA | 5 | | - | | | | | 340,000 | 340,000 |
| | RAILROAD CROSSINGS | EA | 3 | | - | | | | | 204,000 | 204,000 |
| | RIVER CROSSINGS | EA | 22 | | - | | | | | 1,496,000 | 1,496,000 |
| | CUT & REPAIR ROAD CROSSING | EA | 9 | | - | | | | | 180,000 | 180,000 |
| | ALLOWANCE FOR DEWATERING | LF | 300,000 | | - | | | | | 150,000 | 150,000 |
| | CATHODIC PROTECTION | MILES | 57 | | | | | | | 86,000 | 86,000 |
| | Sub Totals | | | | 13,461,000 | | | | 24,165,000 | 15,269,000 | |

① RATES INCL. CONST. EQUIP, INDIAN, & HSP

② ASSUME 1/2 THE EXCAVATION WILL BE ROCK

Flow No. _____ Total 52,890,000



ABE W. MATHEWS ENGINEERING CO.

555 WEST 27th STREET HIBBING, MINN. 55746

PHONE (218)-262-3465

CUSTOMER DNR

JOB DESCRIPTION SAS DIST. STUDY

ESTIMATE NO. _____
PROPOSAL NO. _____

JOB NO. M-100

DIRECT COST ESTIMATE

DATE 3/25/08

PAGE 1 OF 1

| Acc't | Description | Unit | Qty. | MATERIAL | | LABOR | | | | Sub Contractor | Total |
|--------------|---|-------|--------|-----------|-----------|---------------|-----------|------------------|-----------|----------------|---------|
| | | | | Unit Cost | Sub Total | Hrs. Per Unit | Man Hours | Rate | Sub Total | | |
| <u>20" Ø</u> | | | | | | | | | | | |
| | PIPE - SCH. 40 ASTM A53 F.W. BLK. STE. 20" Ø (22 mi.) | LF | 116000 | | 5452000 | | | ① | | | 5452000 |
| | POLYETHYLENE COATING | LF | 116000 | | 246000 | | 211000 | 45 ⁰⁰ | 9495000 | | 9495000 |
| | TRENCHING EXCAVATION - COMMON | CY | 84000 | | - | | | | | 672000 | 672000 |
| | EXCAVATION - ROCK ③ | CY | 84000 | | - | | | | | 4200000 | 4200000 |
| | PIPE BEDDING | CY | 13000 | | - | | | | | 260000 | 260000 |
| | BACKFILL | CY | | | | | | | | | |
| | ROAD CROSSINGS 2 LANE | EA | 6 | | - | | | | | 414000 | 414000 |
| | RIVER CROSSINGS | EA | 3 | | - | | | | | 207000 | 207000 |
| | CUT & REPAIR ROAD CROSSING | EA | 2 | | - | | | | | 40000 | 40000 |
| | ALLOWANCE FOR DEWATERING | LF | 116000 | | - | | | | | 60000 | 60000 |
| | CATHODIC PROTECTION | MILES | 22 | | | | | | | 54000 | 54000 |
| | Sub Totals | | | | 5698000 | | 211000 | | 9495000 | 5,907,000 | |

① RATES INCL. CONST. EQUIP., INDEMN., O & P

② ASSUME 1/2 THE EXCAVATION WILL BE ROCK

Flow No. _____ Total 2,100,000



ABE W. MATHEWS ENGINEERING CO.

555 WEST 27th STREET HIBBING, MINN. 55746

PHONE (218)-262-3465

CUSTOMER DNR

JOB DESCRIPTION GAS DIST. STUDY

ESTIMATE NO. PROPOSAL NO.

JOB NO. M-100

DIRECT COST ESTIMATE

DATE 3/25/88

PAGE 1 OF 1

| Acc't | Description | Unit | Qty. | MATERIAL | | LABOR | | | | Sub Contractor | Total |
|--------------|---|-------|--------|-----------|-----------|---------------|-----------|------------------|-----------|----------------|----------|
| | | | | Unit Cost | Sub Total | Hrs. Per Unit | Man Hours | Rate | Sub Total | | |
| <u>24" Ø</u> | | | | | | | | | | | |
| | PIPE - SCH. 40 ASTM A 53, ERW. BLK. STL, COATED & WRAPPED X" (57MM) | LF | 300000 | | 32400000 | | 762000 | 45 ⁰⁰ | 34290000 | | 66690000 |
| | TRENCHING - EXCAVATION - COMMON | CY | 216000 | | - | | | | | 1728000 | 1728000 |
| | EXCAVATION - ROCK ③ | CY | 216000 | | - | | | | | 10800000 | 10800000 |
| | PIPE BENDING | CY | 34000 | | - | | | | | 680000 | 680000 |
| | BACKFILL | CY | 363000 | | - | | | | | 2178000 | 2178000 |
| | ROAD CROSSINGS 2 LANE | EA | 5 | | - | | | | | 410000 | 410000 |
| | RAILROAD CROSSINGS | EA | 3 | | - | | | | | 246000 | 246000 |
| | RIVER CROSSINGS | EA | 22 | | - | | | | | 1804000 | 1804000 |
| | CUT & REPAIR ROAD CROSSINGS | EA | 9 | | - | | | | | 180000 | 180000 |
| | ALLOWANCE FOR DEVIATIONS | LF | 300000 | | - | | | | | 150000 | 150000 |
| | CATHODIC PROTECTION | MILES | 57 | | - | | | | | 96000 | 96000 |
| | Sub Totals | | | | 32400000 | | 762000 | | 34290000 | 18270000 | |

① RATES INCL. CONST. CHRG., INSURANCE, O.H. & P.

② ASSUME 1/2 THE EXCAVATION WILL BE ROCK.

Flow No. _____ Total 84962000



ABE W. MATHEWS ENGINEERING CO. 555 WEST 27th STREET HIBBING, MINN. 55746

PHONE (218)-262-3465

CUSTOMER DEPT. OF NATURAL RESOURCES JOB DESCRIPTION GAS STUDY

ESTIMATE NO. _____
PROPOSAL NO. _____

JOB NO. M-100

COMPRESSOR STATION, 1000 MCF/HR

DIRECT COST ESTIMATE

DATE APRIL 5, 1988

PAGE 1 OF 1

| Acc't | Description | Unit | Qty. | MATERIAL | | LABOR | | | Sub Contractor | Total |
|-------|--|------|------|-----------|----------------|---------------|-----------|------|----------------|----------------|
| | | | | Unit Cost | Sub Total | Hrs. Per Unit | Man Hours | Rate | | |
| | GAS COMPRESSOR, 1000 MCF/HR, ONE UNIT, 1800HP, 60-200PSIG, 100,000 LBS, 30' LG x 11' WIDE. | EA | 1 | | 460,000* | | | | 27,000 | 487,000 |
| | CONCRETE FTGS, PIERS & GRADE WALL COMPLETE INCL. EARTHWORK | CY | 133 | | 18,000 | | | | 36,000 | 54,000 |
| | PREFABRICATED BUILDING, 40' x 20' x 10' HIGH, INCLUDING LIGHTING AND HEATING & VENT. | SF | 800 | | 34,000 | | | | 22,000 | 56,000 |
| | TAX | CG | | | 31,000 | | | | - | 31,000 |
| | SUB TOTAL | | | | 543,000 | | | | 85,000 | 628,000 |
| | ELECTRICAL POWER | LOT | | | | | | | 43,000 | 43,000 |
| | Sub Totals | | | | 543,000 | | | | 85,000 | 43,000 |

146

* INCLUDES FREIGHT (\$10,000) BUT NOT TAX.

Total 671,000



ABE W. MATHEWS ENGINEERING CO. 555 WEST 27th STREET HIBBING, MINN. 55746

PHONE (218)-262-3465

CUSTOMER DEPT. OF NATURAL RESOURCES JOB DESCRIPTION GAS STUDY

ESTIMATE NO. _____
PROPOSAL NO. _____

JOB NO. M-100

COMPRESSOR STATION, 2600 MCF/HR

DIRECT COST ESTIMATE

DATE APRIL 5, 1988

PAGE 1 OF 1

| Acc't | Description | Unit | Qty. | MATERIAL | | LABOR | | | | Sub Contractor | Total |
|-------|--|------|------|-----------|------------|---------------|-----------|------|-----------|----------------|---------|
| | | | | Unit Cost | Sub Total | Hrs. Per Unit | Man Hours | Rate | Sub Total | | |
| | GAS COMPRESSOR, 2600 MCF/HR, TWO UNITS, 4400 TOTAL HP, 60-200PSIG, 100,000 LBS/UNIT, 30' LG x 11' W EACH UNIT | EA | 2 | | 1,120,000* | | | | | 36000 | 1156000 |
| | CONCRETE FTGS., PAVED & GRADE WORK COMPLETE INCL. EARTH WORK | CY | 264 | | 34000 | | | | | 58000 | 92000 |
| | PREFABRICATED BUILDING, 40' L x 40' W x 10' H, INCLUDING LIGHTING, AND HEATING & VENT. | SF | 1600 | | 53000 | | | | | 34000 | 89000 |
| | TAX | | | | 72000 | | | | | | 72000 |
| | SUB TOTAL | | | | 1281000 | | | | | 1280000 | 1409017 |
| | ELECTRICAL POWER | Lor | | | - | | | | | 54000 | 54000 |
| | Sub Totals | | | | 1281000 | | | | | 1280000 | 54000 |

* INCLUDES FREIGHT (\$20,000) BUT NO TAX.

Total 1463000



CUSTOMER DEPT. OF NATURAL RESOURCES JOB DESCRIPTION GAS STUDY

ESTIMATE NO.
PROPOSAL NO.

JOB NO. M-100

COMPRESSOR STATION, 5000 MCF/HR

DIRECT COST ESTIMATE

DATE APRIL 5, 1988

PAGE 1 OF 1

| Acc't | Description | Unit | Qty. | MATERIAL | | LABOR | | | | Sub Contractor | Total |
|-------|---|------------|-------------|-----------|------------------|---------------|-----------|------|---------------|----------------|----------------|
| | | | | Unit Cost | Sub Total | Hrs. Per Unit | Man Hours | Rate | Sub Total | | |
| | <u>GAS COMPRESSOR, 5000 MCF/HR</u> <u>FOUR UNITS, 8400 TOTAL HP,</u> <u>60" COOP SIG, 100,000 LBS/UNIT,</u> <u>30' L X 11' W EACH.</u> | <u>EA</u> | <u>4</u> | | <u>2140,000*</u> | | | | <u>72000</u> | | <u>2212000</u> |
| | <u>CONCRETE FTGS., PER FOUNDATION WALLS</u> <u>COMPLETE INCL. EARTHWORK</u> | <u>CY</u> | <u>467</u> | | <u>58000</u> | | | | <u>94000</u> | | <u>152000</u> |
| | <u>PREFABRICATED BUILDING, 10W*</u> <u>70' L X 10' H, INCLUDING</u> <u>LIGHTING AND HEATING & VENT.</u> | <u>SF</u> | <u>2800</u> | | <u>86000</u> | | | | <u>55000</u> | | <u>141000</u> |
| | <u>TAX</u> | <u>62</u> | | | <u>137000</u> | | | | | | <u>137000</u> |
| | <u>SUB TOTAL</u> | | | | <u>2421000</u> | | | | <u>221000</u> | | <u>2642000</u> |
| | <u>ELECTRICAL POWER</u> | <u>Lor</u> | | | <u>-</u> | | | | <u>-</u> | <u>84000</u> | <u>84000</u> |
| | <u>Sub Totals</u> | | | | <u>2421000</u> | | | | <u>221000</u> | <u>84000</u> | |

¹⁴⁶ *INCLUDES FREIGHT (\$40,000) BUT NO TAX.

Total 2,726,000

