NorthWestern™ Energy

Cascade County

May 25, 2001 Application

Facilities Study

September 2, 2004

Electric Transmission Planning

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Executive Summary

NorthWestern Energy ("NWE") has completed a Facilities Study for interconnecting the 280 MW Interconnection Customer's Project at the Great Falls 230 kV Switchyard located near Great Falls, MT. The Facilities Study considers the facilities required to physically and electrically interconnect the generator high side bus with NWE's electric transmission system in accordance with the conclusions of the System Impact Study and in accordance with Good Utility Practice. The study considers the proposed generation project in conjunction with all the Generation Interconnection projects prior to the Interconnection Customer Project in the NWE queue.

The System Impact Study found that the Interconnection Customer Project could be connected to the 230 kV bus at the Great Falls 230 kV Switchyard described in the study prepared for Interconnection Customer by NWE on April 16, 2002.

This report provides a summary of the Facilities Study results. NWE is responsible for maintaining acceptable system reliability, and we must be certain that any degradation of system reliability as a result of connecting the Interconnection Customer Project is within the tolerances of NWE and regional performance criteria.

The Facilities Study is intended to provide the preliminary design layout, transmission system upgrade and construction routing information, major equipment specifications, and clear delineation of responsibility for facilities installation; an estimate of the cost to install the Transmission Provider Interconnection Facilities and Interconnection System Upgrades; and an estimate of the schedule to complete the installation of the Transmission Provider Interconnection Facilities and Interconnection System Upgrades.

Any deviation from the generator design or interconnection specifications provided to NorthWestern Energy may cause the results of this analysis to become inaccurate. If any Generation Interconnection projects senior to the Interconnection Customer Project in the NWE queue choose to drop from the queue, the results of this analysis may become inaccurate. Additional studies may have to be completed to address items not covered in the Coexisting System Impact Study and this Facilities Study.

This Facilities Study does not constitute a request for transmission service. This study examines the physical interconnection of the Interconnection Customer generator to the electrical system and does not imply that Interconnection Customer will receive any transmission required to deliver the generation output to the load. Interconnection Customer must follow the procedures described in the transmission tariff available on NWE's OASIS site (www.nwoasis.org) to request and/or reserve transmission service. Interconnection Customer is responsible for ensuring all WECC criteria, policy, and guidelines are satisfied.

Interconnection Data

The basic proposed generator and interconnection information used in these studies includes:

- **Project Name** – Cascade Count, May 25, 2001 Application
- **Size** (Rating) – 280 MW Nameplate Rating
- **Generator Type –** 2 – 84 MW Gas fired Combustion Turbines and 1 – 112 MW Steam Turbine
- **Fuel –** Natural Gas
- **Location** – Two miles north of Great Falls, MT along Highway 87 on the east side
- **Proposed Facilities Ready Date** – March 1, 2005
- **Proposed In Service Date** – June 1, 2005
- **Power Factor –** .85 leading - .85 lagging
- **Excitation System –** EXAC2
- **Power System Stabilizer –** Not Available
- **Transformer –** Generator Step-Up, 3- Three-phase, Wye Connected, 60 Hertz
- **Point of Change of Ownership –**the point on the Interconnection Customer side of the Tie Air Break Switch located at the NWE Great Falls 230 kV Switchyard where the Interconnection Customer 230 kV transmission line meets the air break switch insulator. Interconnection Customer is to install and own the 230 kV transmission line and the facilities at the Interconnection Customer Step-up Substation.
- **Point of Interconnection –** the point where the jumpers for the Interconnection Customer tap meet the 230 kV bus within the Great Falls 230 kV Switchyard

Interconnection Substation Facilities

Network Upgrades:

- **LAND:**
  - There are no additional land requirements at the Great Falls 230 kV Switchyard. The land required to complete the project as proposed, is already owned by NorthWestern.

- **RIGHT OF WAY (EASEMENTS):**
  - There will be no easements obtained for NorthWestern Energy's work at the Switchyard.

- **SURVEY:**
  - The surveying associated with NorthWestern Energy's Substation facilities will be done internally. NorthWestern Energy has on staff a licensed professional land surveyor.

- **FENCE:**
  - The existing fence on the north boundary will be moved north 64 feet. This will result in 660 linear feet of new fence to be installed. There will be 532'-6" of fence removed.
  - The existing fence will require upgrades to meet current codes since alterations are taking place.
  - The existing fence is tied to the ground mat in accordance with NorthWestern Energy's Substation Design Standards.

- **CONTROL HOUSE:**

- The existing control house is adequate, and meets NESC requirements, for the additional panels that will be installed by the Relay Department.

- **YARD WORK:**

  - It will be necessary to haul off excess materials and to gravel the sections of the yard that are disturbed during construction.

  - A Geotechnical Evaluation will have to be made. There is no current report on file.

  - The access road exists to the site and no additional work is required.

  - The site drainage exists and will not require additional work.

  - Oil Containment is not an issue for this project. The equipment additions associated with this project have little or no impact on the oil volume at this location.

  - There is adequate lighting in the existing facility. The additional expansion of the yard to the north will require that yard lighting be added on the 660 linear feet of new fence.

- **FOUNDATIONS:**

  - The total concrete volumes associated with this project are estimated at 244.56 cu. Yards. The breakdown is as follows:

    - Spread Footings associated with two dead-end towers – Dwg. 19424-B. NorthWestern Energy will own these foundations. NorthWestern Energy will design and install the foundations.

    - Spread Footings associated with two dead-end towers – Dwg. 40070-C1. NorthWestern Energy will own these foundations. NorthWestern Energy will design and install the foundations.

    - Flat pad with piers underneath associated with two 242 kV power circuit breakers - Dwg. 40078-C2. NorthWestern Energy will own these foundations. NorthWestern Energy will design and install the foundations.

    - Spread footings associated with 21 bus support towers - Dwg. 40076-B3. NorthWestern Energy will own these footings.

- Spread footings associated with 4 air break switch structures - Dwg. 19752-A. The footings associated these air break switches will be owned by NorthWestern Energy. NorthWestern will design and install the air break switch foundations.

- Spread footings associated with Coupling Capacitors - Dwg. 40076-B3. NorthWestern Energy will own these footings. NorthWestern Energy will design and install the foundations.

- Auger footings associated with 2 – N Towers that are used for the static wire protection over the substation – Dwg. 19548-A. NorthWestern Energy will own the footings. NorthWestern Energy will design and install the foundations.

- Spread footings associated with 6 hold down structures – Dwg. 40076-B3. NorthWestern Energy will own these foundations. NorthWestern Energy will design and install the foundations.

- **STRUCTURES:**

  - The total steel required for this project is 105,833 lbs. The structure details are as follows:

    - There will be two 230 kV, 45 foot dead-end towers owned by NorthWestern Energy. The design parameters of the tower are as follows:

      - Maximum Tension per phase is 10000#.

      - Maximum Tension per static is 4000#.

      - Maximum # of phases is 3.

      - Maximum # of static lines is 2.

      - Maximum angle on the tower is 0 degrees.

      - Height of phase conductors at attachment is 45 feet.

      - Height of static conductors at attachment is 55 feet.

      - The phase spacing of the conductors is 12 feet and is horizontal.

      - The static spacing, if two are used, is 45 feet.

      - The NorthWestern Dwg. # is 19560-C.

- NorthWestern Energy will design and install the tower.

- There will be two 230 kV, 32 foot dead-end towers owned by NorthWestern Energy. The design parameters of the tower are as follows:
  - Maximum Tension per phase is 10000#.
  - Maximum Tension per static is 4000#.
  - Maximum # of phases is 3.
  - Maximum # of static lines is 2.
  - Maximum angle on the tower is 6 degrees.
  - Height of phase conductors at attachment is 32 feet.
  - Height of static conductors at attachment is 42 feet.
  - The phase spacing of the conductors is 11 feet and is horizontal.
  - The static spacing, if two are used, is 42 feet.
  - The NorthWestern Dwg. # is 40006-C8.
  - NorthWestern Energy will design and install the towers.
- There will be four Air Break Switch structures. The height of the structures will be 12 feet. The NorthWestern Dwg. # is 40006-C7. NorthWestern Energy will own the air break switch towers. NorthWestern Energy will design and install all the air break switch structures.
- There will be 21 Insulator Support Towers. The tower heights will be 12'-6". The NorthWestern Energy Dwg. # is 20141-A. NorthWestern Energy will own all the insulator support towers. NorthWestern Energy will design and install all the air break switch structures.
- There will be 3 towers to hold the Coupling Capacitors. The towers will be approximately 8' tall and will have mounting plates on top to hold the CCVT's. The NorthWestern Energy Dwg. # is 40063-B1 and B26. NorthWestern Energy will own the towers associated with the coupling capacitors. NorthWestern Energy will design and install the towers.

- **ELECTRICAL EQUIPMENT:**
  - **Power Circuit Breakers**

- There will be two 242 kV rated Power Circuit Breakers installed.
- The breaker will be rated 1200 amp.
- The breaker will have the capability to interrupt a 40,000-amp fault.
- NorthWestern Energy will purchase and install the breakers.

- **Gang Operated Air Break Switches**
  - These switches can be swing handle operated.
  - The switches will be rated at 1200 amps.
  - The switches will have a BIL rating of 550 kV.
  - The switches will be Vertical Break – 3 Insulator type.
  - The switches will have TR 304 insulators.
  - NorthWestern Energy will purchase and install all the air break switches.
- **Instrument Transformers**
  - There will be 3 Coupling Capacitors with carrier provisions.
  - The coupling capacitors will be installed in the breaker and one half bay. The coupling capacitor voltage transformers will be used for relay purposes. The carrier provisions will allow for communications changes in the future.
  - NorthWestern Energy will purchase and install the instrument transformers.

- **BUS WORK:**
  - The bus will be rated, and capable of carrying, 1200 amps.
    - The bus will be 2" SPS 6063-T6 Aluminum pipe and 1272 MCM ACSR.
    - The station post insulators will be standard strength TR304 insulators.
    - The rigid pipe bus will be attached to the insulators using 2" pipe bus supports (slip fits).
    - The dead-end tower will have 3 composite standard strength insulators. The insulators will have Y-clevis-clevis end fittings.

- All bus work internal to the 230 kV Switchyard will be designed and built by NorthWestern Energy.

- **CONDUIT:**
  - Conduit will be installed from the electrical equipment to the control house. The conduit will be 3" schedule 40 PVC.
  - There will be conduit installed from the control house to the air break switch structure installed outside of the switchyard. This conduit will bring signal back to the control for indication on the status of the air break switch.
  - NorthWestern Energy will purchase and install all the conduit.

- **GROUND MAT:**
  - The ground mat will be added as necessary to provide proper grounding for all electrical equipment and steel structures.
    - The ground grid is comprised of 4/0 copper interior to the substation and 1/0 copper as a perimeter ground around the outside of the fence.
    - All equipment is tied to the interior ground mat with 4/0 copper.
    - All steel structures are tied to the interior ground mat with a loop of 1/0 copper.
    - The fence is tied, at every fourth post, to the ground mat with 1/0 copper. As part of the fence grounding, the 3-strand barbed wire top is tied integrally to the ground mat.
    - Ground rods will be added as needed in an effort to reach a total ground mat resistance of 1 ohm.
    - All switches will have a grounded switching platform, for operator protection, at the operating point.

- **ENGINEERING & SUPERVISION:**
  - The engineering associated with all additions inside of NorthWestern Energy's property will be done internally, or by a NorthWestern Energy consultant, and reviewed and approved by an engineer licensed in the State of Montana.

- **CONSTRUCTION:**

    - The construction of all facilities inside of NorthWestern Energy's property will be done internally or by a NorthWestern Energy contractor. NorthWestern Energy personnel will do supervision of construction.

Interconnection Relaying Facilities

- **Line Relaying Required**
  - Interconnection Customer Substation to Great Falls 230 kV Switchyard - Primary Relaying
    - The line relaying shall be fully redundant line differential relaying or equivalent.
    - Interconnection Customer will be responsible for the installation of the line relaying in the Interconnection Customer Substation. NWE will review the line protection package to insure that it is compatible with the line protection package in the Great Falls 230 kV Switchyard.
    - NWE will install the line relaying in the Great Falls 230 kV Switchyard.
    - NWE will wire from the existing Ovando line terminal (new Interconnection Customer line terminal) breaker wall terminations to the new Interconnection Customer relaying panel in the Great Falls 230 kV Switchyard.
  - Interconnection Customer Substation to Great Falls 230 kV Switchyard - Backup Relaying
    - The backup line relaying shall consist of step-distance relaying utilizing the phase and ground time over current elements of the primary relays.
  - Ovando to Great Falls 230 kV Switchyard Line Relaying
    - NWE will wire from the new Ovando line terminal breakers to the wall terminations in the Great Falls 230 kV Switchyard.
    - NWE will wire from the new Ovando line terminal breaker wall terminations to the existing Ovando relaying panel in the Great Falls 230 kV Switchyard.
  - Reclosing Philosophy
    - Automatic reclosing will not be allowed on the Interconnection Customer 230 kV line breaker.
    - Automatic reclosing of the NWE 230 kV line breakers will be allowed for 'Hot Bus / Dead Line' conditions only.

- Synch Check
  - Not required in the Great Falls 230 kV Switchyard on the Interconnection Customer 230 kV line.

- Polarizing Source
  - Three phase 230 kV potential transformers will be required on the Interconnection Customer 230 kV line terminal at the Great Falls 230 kV Switchyard and at the Interconnection Customer Substation. The potential transformers shall be wire-wound.
  - Interconnection Customer will be responsible for the installation of the potential transformers at the Interconnection Customer Substation.
  - NWE will install the potential transformers at the Great Falls 230 kV Switchyard.
- Communications
  - Interconnection Customer shall provide a communications channel between the Great Falls 230 kV Switchyard and Interconnection Customer for each line differential relay set.
  - Dedicated fiber optic pairs are the preferred communications media choice.
  - OPGW is preferred over ADSS due to the lower probability of damage.

- **Substation Relaying Required**
  - Bus Differential
    - NWE will incorporate the 230 kV PCBs associated with the Interconnection Customer 230 kV line terminal at the Great Falls 230 kV Switchyard into the existing substation relay schemes, as required.
  - Breaker Failure
    - Interconnection Customer shall provide a breaker failure trip from a Lockout Relay to Great Falls 230 kV Switchyard 230 kV PCBs for the failure of Interconnection Customer's 230 kV line breaker. This signal will activate an electrical reset "Transfer Trip Received" Lockout Relay (TTX LOR) which will trip and lockout NWE's 230 kV line breakers. This TTX LOR will be

automatically reset when the Breaker Failure LOR at the Interconnection Customer substation is reset.

- NWE shall provide a breaker failure trip from a Lockout Relay to Interconnection Customer's 230 kV line breaker for the failure of either of NWE's Great Falls 230 kV Switchyard 230 kV PCBs.

- **Generation Relaying Required**
  - NWE will review the generation protection package and verify that it contains the following protection devices:
    - Phase/Ground Overcurrent
    - Over/Under Frequency
    - Over/Under Voltage
    - Phase Sequence/Under Voltage

- **Special Protection Schemes Required**
  - Remedial Action Schemes (Stability/Voltage)
    - None required.
  - Overload Management Schemes (Thermal)
    - None required.

- **Supervisory Control and Data Acquisition**
  - RTU Upgrade
    - NWE will replace the existing RTU chassis in the Great Falls 230 kV Switchyard with a new RTU chassis capable of being expanded.
  - SEL 2030 Addition
    - NWE will install a new SEL 2030 in the Great Falls 230 kV Switchyard.

- Line Breaker Control/Indication

  - NWE's Great Falls 230 kV Switchyard 230 kV PCBs may be tripped, test closed or closed by supervisory control.

- Analog Quantities

  - A, B and C phase currents, megawatts, megavars and kilovolts are to be reported on the Interconnection Customer 230 kV line terminal at the Great Falls 230 kV Switchyard.

- Alarms

  - NWE will install a new 32-point alarm chassis in the Great Falls 230 kV Switchyard.

  - Interconnection Customer shall provide the appropriate alarms for Interconnection Customer's 230 kV breaker, primary and backup line relaying, 230 kV potential and communications.

  - Interconnection Customer shall provide any other alarms from their substation or equipment associated with the 230 kV line between Interconnection Customer and NWE's Great Falls 230 kV Switchyard.

- **Tie Point RTU**

  - NWE will be responsible for the installation of the Tie Point RTU located in the Interconnection Customer Substation.

  - NWE will provide the existing SCADA RTU chassis from the Great Falls 230 kV Switchyard for the new Tie Point RTU.

  - Generator Breaker Indication

    - Interconnection Customer shall provide switch status of each generator-synchronizing breaker to NWE.

  - Line Breaker Indication

    - Interconnection Customer shall provide switch status of Interconnection Customer's 230 kV line breaker to NWE.

  - Generator Analog Quantities

        - Kwh to NorthWestern Energy
        - Kwh from NorthWestern Energy
        - Instantaneous megawatts
        - Instantaneous megavars

- **Control House**
    - No additions to the Great Falls 230 kV Switchyard control house will be required.
    - Panel and cubicle additions will match existing relay panel/cubicle construction size and type.

- **Miscellaneous**
    - Relay Protective Zone Diagram
        - See attached drawing.
    - Coordination of Relay Settings Process
        - NWE will work with Interconnection Customer or its consultant to coordinate the settings and requirements for the 230 kV line differential, breaker failure and generator backup relaying.

Interconnection Metering Equipment

- **Meter Form, Voltage, & Class:**
    - This project will require one Form 9S, 120 Volt, billing revenue class watthour meter.
- **Meter Type/Manufacturer:**
    - Siemens type 2510 MaxSys multi-function meter or equivalent.
- **Meter Communication Requirements:**
    - Telemetered Data:
        - Data from the meter to the control house will be transmitted between two fiber optic "Line Powered" modems using RS232.
            - NWE will install fiber optic cable.
            - Interconnection Customer is to install two 2-inch Schedule 40 PVC conduits from the control house to the metering enclosure with a pulling tape installed inside the conduits.
            - Two optical modems will be required.
                - Optical modems will be supplied by NWE.
                - Optical modems need to convert RS232 from the meter into optical signals and then convert the optical signals at the other end of the fiber back to RS232.
                - Optical modems must be "Line Powered".
        - Data transmission from the optical modem (located inside the meter enclosure) to all downstream points will be determined by the metering/relay departments of NWE.
        - The RS232 port on the meter is strictly for internal NWE use.
        - MODBUS protocol will be used for data transmission on the RS232 port of the revenue meter.

        - Metered metrics extracted from the revenue meter are limited to:
            - Delivered & Received MWH, Instantaneous ± MW, Instantaneous ± Mvar, Instantaneous Phase "A" Volts & Amps, Instantaneous Phase "B" Volts & Amps and Instantaneous Phase "C" Volts & Amps.
                - Depending upon timing issues the instantaneous amps might not be included in the telemetered data.
    - Phone Modem Data:
        - The revenue meter will be equipped with an internal dial-up phone modem.
            - Appropriate phone communication conductors will be required to the meter and are to be supplied by the Interconnection Customer
        - A dial-up modem and a MSU (modem sharing unit) may be required at the Interconnection Customer Step-up Substation control house and is to be installed by Interconnection Customer.

- **Special Programming Requirements:**
    - Bi-directional metering will be required at the billing metering point.
    - Transformer loss compensation will not be required.

- **Auxiliary Power Requirements (Meter Only):**
    - DC auxiliary power will be required on the revenue meter.
        - If DC is not available, then AC may be used in conjunction with a backup UPS.
            - The UPS will be installed inside the meter enclosure.

- **Meter Location – Physical:**

  Distance from the CT's

        - As close to the revenue meter as possible. In the event that the total secondary circuit length exceeds fifty feet per phase, greater than # 10 AWG copper will have to be used. Actual size will be dependant upon the circuit length.

    - Distance from the PT's

        - Same requirements as for the CT's.

    - Enclosure requirements:

        - The standard meter enclosure built by NWE will be used at the meter site.

    - Mounting Structure:

        - Interconnection Customer is to provide a structure that meets the above requirements on which the meter enclosure will be mounted.

- **Meter Location – Electrical:**

    - The metering point will be on the high side of each GSU.

- **Meter Connectivity:**

    - Cabling requirements for instrument transformers:

        - Current Transformers:

            - Four # 10 AWG or larger, copper conductors.

                - Actual size dependant upon overall circuit length.

        - Voltage Transformers (PT's):

            - Four # 10 AWG or larger, copper conductors.

                - Actual size dependant upon overall circuit length.

        - Auxiliary DC Power: (Auxiliary power for the revenue meters).

            - Two # 12 AWG or larger copper conductors.

        - Heater and AC Power to the meter enclosure:
            - One three-wire 240-volt circuit of at least # 10 AWG or greater, copper conductors.
    - Cabling requirements for Telemetered data, modem, KYZ, EOI & other
        - Phone Modem:
            - Two #24 AWG or larger, twisted pairs - one pair to be designated as "spare"
                - Standard Cat 5 cabling works well.
        - Optical modem requirements:
            - Four fibers - two to be designated as "spares"
        - Optional pulse output cabling for KYZ, EOI or other: IF REQUIRED
            - Sixteen #18 AWG or greater stranded copper conductors - eight to be designated as "spares". Conductors must have a minimum insulation rating of at least 120 Vac.

- **Meter Testing:**
    - The revenue meter will be fully tested prior to installation and will be re-certified for accuracy on an annual basis. The Generation Owners will be responsible for all costs associated with the annual re-certification. A typical re-certification meter test, at 2002 levels, would cost approximately $235.00

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- **Instrument Transformer Requirements:**
    - Voltage Transformers (PT's)
        - Manufacturer & Type:
            - Unspecified at this time.
        - The metering VT's/PT's should be of sufficient ratio to supply 120 VAC to the potential metering circuits inside the watthour meter.

- A secondary winding dedicated to revenue metering only.
- Accuracy class to be at least 0.3 %
    - If 0.15% transformers are available they should be used.
- The "Burden" rating should be ZZ with a thermal rating of at least 2 kVA.
- The BIL to be determined by substation design.

- Current Transformers (CT's)
    - Manufacturer & type
        - Unspecified at this time.
    - Current ratio:
        - To be of sufficient ratio to supply at least 5 amps of secondary current to the metering elements when the generator is operating at its normal capacity.
    - Accuracy class to be at least 0.3 % thru a Burden of 1.8 Ω.
        - During periods of reverse flow, when the plant is receiving power from the grid, the current passing through the current transformers will be minimal. It is therefore imperative that the most accurate instrument transformers are employed. If 0.15% transformers are available they should be used.
            - If 0.15% instruments are found they may be de-rated to a Burden of 0.9 Ω but should have a rating of at least 0.3% accuracy @ 5% rated current.
    - The BIL to be determined by substation design.

- Instrument Transformer Testing:
    - All instrument transformers will be fully tested at NorthWestern Energy meter shop prior to installation.
        - If preferred, NWE can test the instrument transformers "On Site" using NWE's "Mobile Metering Lab" (MML). The cost for the MML per hour is $360.00 and does <u>not</u> include

labor or other equipment. This testing normally requires a four-man crew and a bucket truck. If the instrument transformers are not connected and sitting on the ground then testing may only require a two man crew and a ladder.

- All instrument transformers will be tested "On Site" at two-year intervals. The Generation Owners will be responsible for all costs associated with these tests.
    - Depending upon the amount of disconnection and reconnection, a typical re-certification instrument transformer test, at 2002 levels, would cost approximately $3,550.00 to $5,100.00.
- Further Considerations - Instrument Transformer Testing – Installation of bypasses.
    - It may be prudent to design and install operational bypasses on all instrument transformers.
        - "On-Site" instrument transformer testing using NorthWestern's MML will be required at two year intervals. Prior to testing, all instrument transformers must be isolated and disconnected from the circuit with the appropriate clearances taken. If circuit bypasses are not installed, shutdowns may be required that could result in lost revenue. The average "shut down" is approximately six hours.
            - If the instrument transformers are to be located inside NWE's substation, the design and construction of the circuit bypasses would be the responsibility of NWE but all costs would be born by the Generation Owners.

- **Metering Costs: Estimate of the cost to install metering:**
    - Metering installation <u>from</u> the secondary taps on the instrument transformers, <u>to</u> the output of the optical modem located inside the control house; the estimated metering cost is $10,250.00. This would include the meter, enclosure, modems, cable/wire/fiber and labor to install.

        - This estimate does not include the cost of the instrument transformers or their installation. Interconnection Customer is to purchase and install the instrument transformers. Ownership of the instrument transformers will be transferred to NorthWestern Energy on the date of Commercial Operation

        - This estimate does not include installation of underground conduits and other related hardware for the control, secondary, heating, and auxiliary circuits.

- **Metering Installation Time Table**:

    - Order and receipt of the revenue meter:

        - Allow sixteen weeks from the time NWE places the meter order with the factory to its arrival at NWE's meter shop.

            - Allow two weeks from the arrival of the revenue meter at NWE's meter shop to the completion of all necessary meter testing.

    - Metering enclosure:

        - Allow seventeen weeks for the construction of the metering enclosure. This time is necessary to order and receive all the necessary components of the enclosure. Actual construction can be done in two working days.

    - Modems, MSU and miscellaneous metering communication equipment:

        - Allow eight weeks from order date to their receipt.

    - Site preparation:

        - The installation of the instrument transformers, and all conduits for control cables and secondary circuits must be installed prior to the installation of the meter enclosure and meter.

        - All control cables, fiber (optional), heating circuits, auxiliary circuits, and secondary circuits must be properly installed prior to the installation of the meter enclosure and meter.

    - Actual meter installation:

        - After the site preparation has been completed allow four working days for meter installation.

- Installation includes mounting and wiring the metering enclosure.

- Connecting and testing all control, communication, heating, auxiliary and secondary circuits.

- Programming and commissioning the revenue meter, instrument transformers and associated secondary wiring.

- **Ownership & Responsibilities:**

    - Interconnection Customer will be responsible for the purchase and delivery of the instrument transformers to the meter shop for testing and then for their transportation to the metering site.

        - The Generation Owners will pay for the cost of the instrument transformers and their installation.

            - Nothing other than the billing meter will be connected to the secondary windings dedicated to the revenue metering.

    - Interconnection Customer will transfer ownership of all instrument transformers to NorthWestern Energy on the date of Commercial Operation.

        - NWE will provide maintenance and testing of all instrument transformers.

            - All maintenance and testing to be paid for by the Generation Owners.

    - NorthWestern Energy will own, operate, and maintain all metering hardware from the Primary terminals of the instrument transformers.

        - The cost of the metering hardware and its installation, including but not limited to the meters, instrument transformers, enclosures, communication devices, and wiring will be the responsibility of the Generation Owners.

Interconnection Communication Facilities

- Interconnection Customer is to install an Optical Ground wire as the static on the 230kV inter-tie transmission line between the dead-end structure at the Great Falls 230kV Switchyard and the Interconnection Customer Plant. NorthWestern Energy will provide a forward-looking communications medium, which will support a wide variety of protective relay equipment as well as the communications for data and voice requirements.

- Interconnection Customer Responsibilities - Plant:

    - Provide space for 19" Communications equipment rack in the switchgear building. Switchgear building will contain fiber terminations, relays and phone circuit interconnections to the plant.

    - Insure station battery will accommodate DC loading of communications equipment.

    - Design and install station battery voltage from DC breaker panel to communication rack.

    - Design and install DC filter and fuse panels in communications rack in order to supply filtered and fused DC voltage to individual communications equipment in 19" rack.

    - Specify, design and install fiber optic and conduit between switchgear building and dead-end structure.

    - Design and install adequate fiber optic enclosure on outside of switchgear building to allow for entry of fiber cable into building. Enclosure needs to accommodate at least 50 feet of extra-coiled fiber cable.

    - Design and install protective routing of fiber cable from entry point inside of the switchgear building to the 19" communications rack. (Coil a minimum of 96" of fiber cable at the top of rack).

    - Arrange for local telephone service for the plant to accommodate both local and long distance telephone. Also provide a telephone cable between the switchgear building and the plant in order to accommodate a ring-down telephone.

    - Contract for testing of ADSS cable before installation.

- Contract for splicing of ADSS cable to fiber termination chassis in communications rack in switchgear building as well as fiber terminations.

- Contract for splicing of ADSS cable to OPGW cable at the Plant dead-end structure. Fiber contractor will furnish splicing hardware.

- Contract for fiber end to end testing between the Plant switchgear building and the 230kv switchyard control house after completion of all fiber splicing and terminating.

- Interconnection Customer Responsibilities – 230KV Line:

  - Specify and order optical ground wire (OPGW) and associated mounting hardware between the Plant and 230kv switchyard dead-end structures. This includes specifying, ordering and installing bulletproof splice enclosures at each dead-end structure at both the Plant and 230kv switchyard.

  - Contract for testing of the OPGW fiber cable before installation.

  - Agreement for maintenance and/or restoration of all fiber optic cable between the Plant communications rack and 230kv switchyard communications rack.

- NorthWestern Energy Telecommunications Department Responsibilities:

  - Design and installation of 19" communications rack in switchyard control house.

  - Insure station battery accommodates DC loading by new communications equipment.

  - Design and install station battery voltage from DC breaker panel to communications rack.

  - Design and install DC filter and fuse panels in communications rack in order to supply filtered and fused DC voltage to individual communications equipment in 19" rack.

  - Specify, design and installation of ADSS fiber cable and conduit between 230kv switchyard dead-end structure and the control house.

  - Design and installation of fiber optic enclosure on the outside of the 230kv switchyard control house.

- Design and install protective routing of fiber cable from entry point inside of the 230kv switchyard control house to the 19" communications rack. (Coil a minimum of 96" of fiber cable at the top of rack).

- Design and installation of 19" communications rack in 230kv switchyard control house.

- Specify, design and install fiber end equipment including fiber termination equipment both at the switchgear building and 230kv switchyard in order to carry the following information:

    - NorthWestern Energy's Energy Management System (EMS) data requirements.

    - Ring-down telephone between Plant and NorthWestern Energy SOCC.

    - Metering at 230kv switchyard and Plant to SOCC.

    - Teleprotection circuits for relaying Plant to 230kv switchyard.

    - Any additional circuits identified

- Communications agreement between NorthWestern Energy and Interconnection Customer for providing circuits required to NorthWestern Energy's SOCC.

- Communications agreement between NorthWestern Energy and Interconnection Customer for maintenance of communications end equipment at Plant and 230kv switchyard.

- Arrange for splicing of ADSS and OPGW at the 230kv switchyard dead-end facility.

- Arrange for splicing and termination of fiber at the 19" communications rack in the 230kv switchyard control house.

- Perform final testing of all communications circuits originating at the Plant and terminating at the 230kv switchyard and/or SOCC. Also final testing of all pertinent circuits originating at the 230kv switchyard and terminating a SOCC.

- Contract to reroute/move both TA fiber cable and Three Rivers fiber cable to allow for 230kv switchyard expansion

o Cost Estimates (Based on 2003 dollars)

- Total NorthWestern Energy communications installed cost estimate: $53,211

- Cost estimate for reroute/move of TA fiber: $26,000
- Cost estimate for reroute/move of Three River fiber: $21,000

Interconnection Transmission Facilities

- **Transmission Line Survey:**

    - Surveying for the new Interconnection Customer tie air-break switch and the Ovando-Great Falls 230 kV Transmission Line reroute into the Great Falls 230 kV Switchyard will be completed by NorthWestern Energy crews, including plan and profile survey and map preparation, location of existing structures and features and new structure staking.

- **Transmission Line Design:**

    - Design of the new Interconnection Customer tie air-break switch and the Ovando-Great Falls 230 kV Transmission Line reroute into the Great Falls 230 kV Switchyard will be completed by NorthWestern Energy staff.

- **Transmission Line Construction:**

    - Construction of the new Interconnection Customer tie air-break switch and supporting structure and the reroute of the Ovando-Great Falls 230 kV line will be completed by one or a combination of the following resources:

        - NorthWestern Energy in-house crews

        - Contract line crews defined by NorthWestern Energy

- **Transmission Line Ownership:**

    - NorthWestern Energy will maintain ownership of the existing transmission line facilities in the area, the new tie air-break switch and supporting structure, the existing Ovando-Great Falls 230 kV Line segment from the dead-end tower in the Great Falls 230 kV Switchyard up to the new air-break switch dead-end structure and the new Ovando-Great Falls 230 kV Line reroute into the Great Falls 230 kV Switchyard.

- The existing Ovando-Great Falls 230 kV Line from the new air-break switch dead-end structure to the point where the existing line route turns north (Structure 105-2 on Drawing Number 18,400-C Sheet 51) will be owned by Interconnection Customer.

- **Transmission Line Right-of-Way:**

  - The right-of-way easement for the portion of the Ovando-Great Falls 230 kV Line that will be transferred to Interconnection Customer will be assigned to Interconnection Customer.

  - The right-of-way easements for the new 230 kV line to serve Interconnection Customer and the new Ovando-Great Falls 230 kV Line reroute into the Great Falls 230 kV Switchyard have been previously reserved by Special Warranty Deed, Exhibit C,I. Easements B. Item 19.

  - A reservation for communications lines is provided by Special Warranty Deed, Exhibit C, I. Easements C. Item 2.

  - Both previously mentioned line easements are subject to a Lewis & Clark Heritage Greenway Deed of Conservation Easement, filed on Reel 327 on Document 810. This gives the Montana Department of Fish, Wildlife and Parks "The right to review and comment on the quality of the visual resource as may be impacted by the Grantor's exercise of the right retained herein", which requires an advance written notification and allows a 30 day comment period by the Montana Department of Fish, Wildlife and Parks.

Transmission Line Design Objectives:

- **Transmission Line Terminations:**

  - The Interconnection Customer tie line termination, at the customer end, will be on the west side of the new tie air-break switch dead-end structure, located west of the Great Falls 230 kV Switchyard in the existing Ovando-Great Falls 230 kV Line.

  - NorthWestern Energy will provide transmission line terminations (deadends) at the new Interconnection Customer tie air-break switch facilities except for termination of any overhead fiber optic ground wire. These will be provided by Interconnection Customer.

- **Transmission Line Information:**

    - Interconnection Customer will be responsible for securing new right-of-way easements for the tie line throughout it's entire length for any areas not covered in the section of this document titled "Transmission Line Right-of-Way" under the Transmission Line Work Plan heading.

    - Interconnection Customer will be responsible for all phases of survey, design and construction of the 230 kV tie line from structure 105-2 on the existing Ovando-Great Falls 230 kV Line to it's termination at the Interconnection Customer Site.

    - Interconnection Customer will be responsible for inspection and maintenance of the portion of the existing Ovando-Great Falls 230 kV Line that will be become a segment of the new 230 kV tie line, to assure that it is in good operating condition and exceeds the current National Electric Safety Code at replacement values.

    - NorthWestern Energy will remove the existing conductor and static wire, on the Ovando-Great Falls 230 kV Line, from structure number 105-2 to the start of the new 230 kV line reroute into the Great Falls 230 kV Switchyard.

    - Interconnection Customer will be responsible for modifying or removing Ovando-Great Falls 230 kV Line structure number 105-2 to fit the design parameters of the new 230 kV tie line.

    - Transmission line conductors on the existing Ovando-Great Falls 230 kV Line are 1272 mcm ACSR, 45/7 Strand "Bittern".

        - Maximum tension limits are 50% of conductor ultimate strength under the maximum design condition, 19% of conductor ultimate strength at 30 degrees F, Initial and 17% of conductor ultimate strength at 30 degrees F, Final.

    - Transmission line static wires on the existing Ovando-Great Falls 230 kV Line are 3/8" HS Steel 7-Strand.

        - Maximum tension limits are 50% of conductor ultimate strength under the maximum design condition, 19% of conductor ultimate strength at 30 degrees F, Initial and 17% of conductor ultimate strength at 30 degrees F, Final.

- Transmission line static wires on the new Ovando-Great Falls 230 kV Line reroute will be 3/8" HS Steel 7-Strand.

    - Maximum tension limits are 50% of conductor ultimate strength under the maximum design condition, 19% of conductor ultimate strength at 30 degrees F, Initial and 17% of conductor ultimate strength at 30 degrees F, Final.

- Transmission Line conductors on the new Ovando-Great Falls 230 kV Line reroute will be 1272 mcm ACSR, 45/7 Strand "Bittern".

    - Maximum tension limits are 50% of conductor ultimate strength under the maximum design condition, 19% of conductor ultimate strength at 30 degrees F, Initial and 17% of conductor ultimate strength at 30 degrees F, Final.

- Conductor and static wire tension limits and transmission line ruling span on the new 230 kV tie line to the Interconnection Customer site shall be the same as exists on the Ovando-Great Falls 230 kV Line or an adequate dead-end structure must be installed at structure location 105-2 to accommodate the necessary wire tension and ruling span differences. This will be the responsibility of Interconnection Customer.

    - The new dead-end structure, if installed, shall adhere to the current National Electric Safety Code for strength and clearance requirements.

- Installation of any required overhead fiber optic ground wire on the 230 kV tie line, or underground communication cable will be the responsibility of Interconnection Customer.

    - The overhead fiber optic ground wire will be installed from the Interconnection Customer Plant to the tie air-break switch structure and dead-ended.

    - The communication cable will be installed from the tie air-break switch structure to the control house in the Great Falls 230 kV Switchyard in an underground conduit.

    - A ⅜" HS Steel 7-Strand overhead guy will be installed from the tie air-break switch structure to the existing dead-end tower in the Great Falls 230 kV Switchyard, for the Interconnection Customer 230 kV Line terminal, to support tension from the overhead fiber optic ground wire.

- Correct phasing between the Interconnection Customer Plant and the Great Falls 230 kV Switchyard will be the responsibility of Interconnection Customer.

- The tie air-break switch structure will be a custom five-pole structure (the structure drawing will be produced at the time this project is approved for construction).

    - The line dead-end portion of the air-break switch structure will be modeled after NorthWestern Energy drawing numbers 230-2A-03 (for pole spacing and cross-arm bracing) and 161-2D-01 (for conductor and static dead-ending).

    - The air-break switch portion of the structure will consist of mounting the switch on steel cross-arms, similar to NorthWestern Energy drawing number 100-2F-03, and attaching the cross-arms to three short poles, that will allow the base of the air-break switch to be installed 25 feet above the ground.

    - The three air-break switch poles will be tied to the two dead-end structure poles with X-braces installed in two directions from each dead-end structure pole.

    - The phase conductors will be jumpered down to the air-break switch from both sides of the dead-end structure.

    - 230 kV horizontal post phase isolation insulators will be installed on the dead-end structure for the jumpers from the west side of the dead-end structure.

    - All materials used will adhere to NorthWestern Energy approved 230 kV construction practices.

- The switch structure will be grounded according to the NorthWestern Energy drawing number 100-2F-03.

- Guy material and installation will be consistent with that shown on NorthWestern Energy three-pole dead-end structure drawing number 230-3C-02.

- **Switch Considerations:**

    - The air-break switch will only be operated when the tie line is de-energized.

- The switch will be rated at 1200 amps.

- The air-break switch will not be provided with Load Sectionalizer Interrupters, vacuum interrupters or motor operators.

- The air-break switch will not be supervisory controlled.

- **Material Procurement:**

  - NorthWestern Energy will procure all material necessary for new facilities defined as NorthWestern Energy ownership.

- **Cost Estimate:**

  - The cost estimate for all new NorthWestern Energy transmission facilities defined above is $143,398.48. Reference the cost spreadsheet for transmission facilities found in the appendix.

- **Transmission Facility Time Line:**

  - The lead-time necessary for survey, design, material procurement, delivery and installation of the transmission facilities is 24 weeks.

NorthWestern Energy Cost Summary

TRANSMISSION PROVIDER INTERCONNECTION FACILITIES

NWE Substation	$ 0
NWE Relaying	$ 83,650
NWE Metering	$ 10,250
NWE Communications	$ 53,211
NWE SOCC EMS Interface	$ 15,000
NWE Transmission	$ 69,626
SUBTOTAL	**$ 231,737**

NETWORK UPGRADES

NWE Substation	$ 1,044,939
NWE Relaying	$ 62,650
NWE Metering	$ 0
NWE Communications	$ 47,000
NWE SOCC EMS Interface	$ 0
NWE Transmission	$ 73,772
SUBTOTAL	**$1,228,361**
TOTAL	**$ 1,460,098**

Appendix Listing

Appendix A: Interconnection Drawings

Great Falls 230 kV Switchyard One Line Diagram

Great Falls 230 kV Switchyard Plan View

(Available in Hard Copy Only)

REVISIONS							MICROFILM NUMBER	
REV.	DESCRIPTION/NETWORK #	PROF. ENGR.	DEPT. MGR.	DIRECTOR	DESIGNED	DRAWN	ROLL	FRAME
0	NEW DRAWING ISSUED						–	
							DATE	

230 KV TO OVANDO

2005 CONSTRUCTION

#24B — 230/24 — #24L — #25X — 230/25 — #25Y

230 KV TO CONRAD

*#22B * — 230/22 — *#22L — *#23L — * 230/23 — *#23B

SEL 321

SEL 221

230 KV TO [redacted] STEAM PLANT

TIE ABSW

230 KV TO BROADVIEW

#75B — 230/75 — #75L — X — #76X — 230/76 — #76Y — #26L — 230/26 — #26B

2005 CONSTRUCTION

OPEN BUS HERE

#233 1200 AMP

SEL 587,501

60 MVA

BANK #2
60, 80, 100 MVA
MPC #60,000-G

TO PCB 100/129 ON SHEET 1

#232

SEL 587,501
51T

60 MVA

3 PT'S

1E

5E

BANK #1
60, 80, 100 MVA
230/105 KV
TERT. 13.8 KV
MPC #60,000-E

TO PCB 100/103 ON SHEET 1

LEGEND

- TWO WINDING POWER TRANSFORMER
- AUTOTRANSFORMER
- AUTOTRANSFORMER WITH TERTIARY
- COUPLING CAPACITOR POTENTIAL DEVICE
- VOLTAGE OR STATION POWER TRANSFORMER
- WAVE TRAP
- CURRENT TRANSFORMER EXTERNAL TYPE
- CURRENT TRANSFORMER BUSHING TYPE
- POWER CIRCUIT BREAKER OR RECLOSER
- AIR BREAK SWITCH MANUAL OPERATED (NORMALLY CLOSED POSITION)
- FUSED DISCONNECT SWITCH OR POWER FUSE (NORMALLY CLOSED POSITION)
- ARC GAP
- SURGE ARRESTER

* WAPA OWNERSHIP

THIS DOCUMENT IS TO BE REVISED BY NORTHWESTERN UTILITY ONLY !!!

USE ONLY AS REFERENCE !!!!!!

POWER WIRING DIAGRAM	12634-C
REFERENCE DRAWING	DRAWING NUMBER

NorthWestern Energy

X GREAT FALLS 230KV SWITCHYARD ONE LINE DIAGRAM X

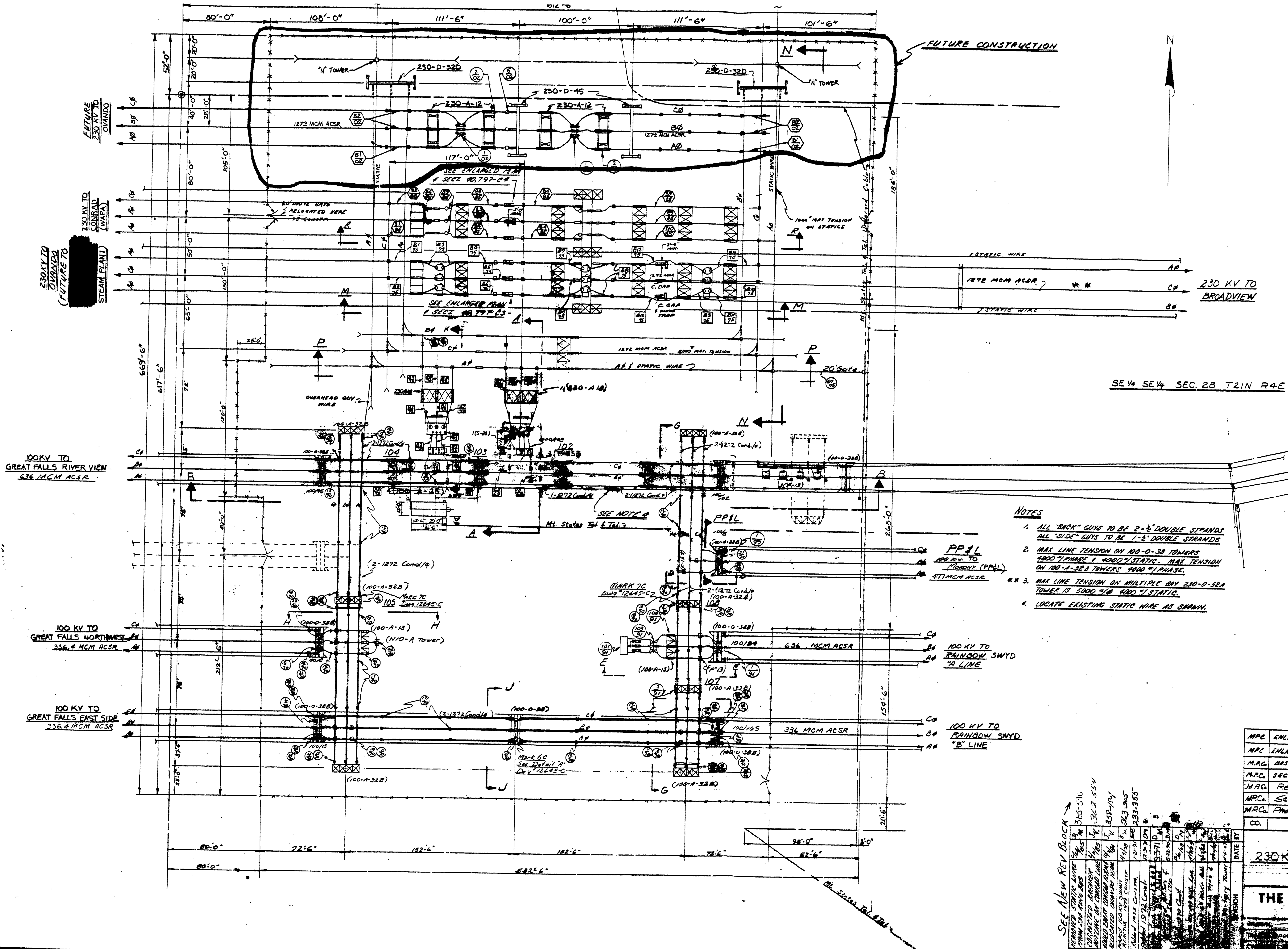
PROF. ENGR.	DATE
DEPT. MGR.	
DIRECTOR	
ENG./TECH.	
DRAWN	

SIZE D | DWG. NO. 12117-C

SCALE NONE | SHT 2 OF 2

34" x 22" ACAD 2004

12117-C-2-0-WHEELER



NOTES

1. ALL "BACK" GUYS TO BE 2-½" DOUBLE STRANDS. ALL "SIDE" GUYS TO BE 1-½" DOUBLE STRANDS
2. MAX LINE TENSION ON 100-0-38 TOWERS 4800 #/PHASE & 4000 #/STATIC. MAX TENSION ON 100-A-32B TOWERS 4000 #/PHASE.
3. ** MAX LINE TENSION ON MULTIPLE BAY 230-0-52A TOWER IS 5000 #/⌀ 4000 #/STATIC.
4. LOCATE EXISTING STATIC WIRE AS SHOWN.

REVISION	DRAFTER	DFTG. SUPV.	DESIGN ENGR.	DEPT. MGR.	PROF. ENGR.	MICROFILM NUMBER ROLL / FRAME
14						567-878
W.O. 19-19315 19314						2-28-91
RELOCATED REACTOR W.O. 19-19314. ADDED RING BUS TOWER & ABSW. AND 100 KV TOWER & EQUIP. TO RAINBOW SWYD. 19-19315. & CHANGE 100 KV A.B.SW. No's IN RING BUS.						
15						6/12/98
33-10225						642-867
REMOVED LA'S FROM 100KV RING BUS						
16						647-553
W.O. 33-10371						5-10-99
ADDED ABB MOCT SENSING UNIT TO MORONY LINE TERM.						
17						648-158
33-10371						6-21-1999
ADDED PP&L OWNERSHIP						
18	JW					—
20018240						
ADD NEW OVANDO BAY, FUTURE CONSTRUCTION						

SEE NEW REV BLOCK →

NO.	REVISION	DATE	BY	
13	REMOVED STATIC WIRE FROM 230 RING BUS	4/4/85	D.M.	365-510
12	CORRECTED BREAKER POSITIONS ON CONRAD LINE	2/5/85	J.V.	362-554
11	ADDED 230KV CONRAD TOWER RELOCATED OVANDO TOWER	10/4/84	J.V.	357-454
10	Added 100KV SHUNT REACTOR 1979 CONSTR.	1/4/80	B.S.	323-365
9	Added 1975 Const PR.	1-21-76		233-355
8	Added 1972 Const.	12-3-7?	DM	
[illegible]	[illegible]	9-3-71	D.M.	
[illegible]	[illegible]	6-22-70	DM	
[illegible]	[illegible]	[illegible]	DM	

CO.	REFERENCE DRAWINGS, TITLE	DRWG.NO.
MPC	ENLARGED PLAN & SECT. CONRAD LINE	40,797-C4
MPC	ENLARGED PLAN & SECT. OVANDO LINE	40,797-C3
M.P.Co.	BUS DETAILS (75 CONSTRUCTION	12607-B
M.P.Co.	SECTIONS H-H, R-R, E-E, G-G	12629-C
M.P.Co.	Ref. Drawing List	12600-F
M.P.Co.	Section Views A-A, B-B, C-C, D.D	12629-C
M.P.Co.	Phase Dia. - Ovando - Great Falls	18048-F

Great Falls
230Kv Switchyard
Plan View

THE MONTANA POWER CO.
BUTTE, MONTANA

DRAWN: A. Neill | SCALE: 1" = 40'
TRACED: Bodevinac-DuCharme | DATE: Feb. 21, 1967
CHECKED: [illegible] | DRAWING NUMBER: 12628-C
APPROVED: [illegible]

40797

168-287

Appendix B: Substation Equipment & Costs

(Available in Hard Copy Only)

Substation Budget Estimate Report

Great Falls Area: [redacted] 230 kV Interconnect

Thursday, February 05, 2004

Project Estimator: Greg Darkenwald

WBS	*WBS Element Description* / *Quantity*	*WBS Detail*			*Company Labor*	*Material*	*Auto/ Travel/ Living*	*Contract*	*Total*
03	Survey								
		Survey Labor (2 Surveyors - Party Chief & Instrument Man)			2,800	0	520	0	3,320
20	Substation Fence								
		Chain Link Fence	*Total*	660.00 Lin. Feet					
				660.00 Lin. Feet	0	0	0	16,500	16,500
22	Substation Site Work								
		Normal Yardwork (Grading, Gravel, Etc…) (Contract Rate/Sq. Ft)							
		Geotechnical Evaluation		34,112.00 Sqr Feet	0	0	0	17,056	17,056
		Major Site Preparation (Pad Work)			0	0	0	5,000	5,000
	6	Yard Lights			0	0	0	20,000	20,000
					3,000	900	0	0	3,900
23	Substation Foundations								
			Total	244.56 Cubic Yard	146,736	24,456	0	0	171,192
	2	N Tower Auger Footing (Dwg. 19548-A)		4.40 Cubic Yard					
	4	230-D-45 Tower Foundation (Dwg. 19424-B)		91.60 Cubic Yard					
	3	242 kV Inst. Trans. Spread Footing 5' x 5' Pad (Depth D = 6'-0") (Dwg. 40076-B3)		5.40 Cubic Yard					
	4	230-D-32D Tower Foundation (Dwg. 40070-C1)		60.40 Cubic Yard					
	21	Standard Column Footing 5'-0" x 5'-0" Pad (Depth D = 6'-0") (Dwg. 40076-B3)		37.80 Cubic Yard					
	6	230 kV Hold Down Tower Foundation 5' x 5' Pad (Depth D = 6'-0") (Dwg. 40076-B3)		10.80 Cubic Yard					
	8	230-A-?? Var. Hgt. Vertical Break ABSW Tower Spread Footing (Dwg. 19752-A) (2 req/tower)		24.80 Cubic Yard					
	2	242 kV ABB PMR40 SF6 Power Circuit Breaker Foundation (Depth D = 6'-0") (Dwg. 40078-C2)		9.36 Cubic Yard					

Substation Budget Estimate Report

Great Falls Area: [redacted] 230 kV Interconnect *Thursday, February 05, 2004*

Project Estimator: Greg Darkenwald

WBS	*WBS Element Description* / *Quantity* *WBS Detail*			*Company Labor*	*Material*	*Auto/ Travel/ Living*	*Contract*	*Total*
24	Substation Structures							
	Total	105,833.00	Pounds	105,833	105,833	0	0	211,666
4	230-A-12 Variable Height Vertical Air Break Switch Tower (Height H = 12'-0") (Dwg. 40006-C7)	16,134.00	Pounds					
2	230-D-45 Dead End Tower (10000 # Phase Tension) (Dwg. 19560-C)	42,581.40	Pounds					
2	230-D-32D Dead End Tower (Dwg. 40006-C8)	33,135.80	Pounds					
3	Single Phase Inst. Trans. Mounting Plate (50 kV - 230 kV) (30" x 36") (Dwg. 40063-B26)	537.90	Pounds					
21	230-S-12.5 Insulator Support Tower (Height H = 12'-6") (Dwg. 20141-A)	9,689.40	Pounds					
6	230 kV Hold Down Tower (Height H = 12'-6") (Dwg. 20146-A)	2,680.80	Pounds					
3	230 kV Inst. Trans. Support Tower Leg (Length L = 8'-0") (Dwg. 40063-B1)	1,073.70	Pounds					
25	Substation Electrical Equipment							
3	230 kV Coupling Capacitor, Single Phase			7,500	18,000	0	0	25,500
4	230 kV Vertical Break Air Break Switch			38,000	32,000	0	0	70,000
2	242 kV SF6 Power Circuit Breaker			45,000	160,000	0	0	205,000
26	Substation Bus Work							
2000	1272 MCM ACSR 45/7			60,000	2,920	0	0	62,920
18	230 kV Composite Dead-End Insulators			3,600	5,400	0	0	9,000
12	2" Pipe Bus Supports for 2" SPS Aluminum to 5" Bolt Circle			600	600	0	0	1,200
9	Single Cable Support for 1272 MCM ACSR to 5" Bolt Circle			450	450	0	0	900
120	2" Aluminum Pipe SPS 6063-T6			750	420	0	0	1,170
21	230 kV Station Post Insulators			5,250	13,125	0	0	18,375
1	Miscellaneous (Wire, Connectors, Expansion Joints, etc...) (10% of Bus Work Total)			4,678	4,678	0	0	9,356

Substation Budget Estimate Report

Great Falls Area: [redacted] 230 kV Interconnect

Thursday, February 05, 2004

Project Estimator: Greg Darkenwald

WBS	*WBS Element Description* / *Quantity* *WBS Detail*			*Company Labor*	*Material*	*Auto/ Travel/ Living*	*Contract*	*Total*
28	Substation Conduit							
	Substation Conduit (3" Schedule 40 PVC)	5,100.00	Lin. Feet	43,350	12,750	0	0	56,100
29	Substation Ground Mat	34,112.00	Sqr Feet	28,995	13,645	0	0	42,640
44	Engineering & Supervision							
	Substation Engineering (10.0% of Total Estimate)			94,144	0	0	0	94,144
	Project Totals:			590,686	395,177	520	58,556	**1,044,939**

Appendix C: Relaying Equipment and Costs

G.F. 230KV SUBSTATION (INTERCONNECTION CUSTOMER LINE)
TOTALS

2004	Material	Labor	Contract	Travel/Living	Total
Gf 230 KV Substation Substation	$44,400	$92,400		$9,500	**$146,300**
Total					**$146,300**

G.F. SUBSTATION

(loaded)

	Engineering/Drafting		Material	Shop Labor		Field Labor		Travel/Living	Total
	M/W	$$	$$	M/W	$$	M/W	$$	$$	
MFM 230kV Line Relay Panel	3.0	$7,200	$21,850	6.0	$14,400	3.0	$7,200	$1,500	$52,150
Supv Expansion	2.0	$4,800	$8,050	1.0	$2,400	2.0	$4,800	$1,000	$21,050
Tie Point RTU	1.0	$2,400	$5,500	2.0	$4,800	2.0	$4,800	$1,000	$18,500
Bus Differential	0.5	$1,200	$0	0.0	$0	1.0	$2,400	$500	$4,100
Wire 2 ea New 230 kV PCB's	0.0	$0	$0	0.0	$0	2.0	$4,800	$1,000	$5,800
Re-wire 2 ea Existing 230 kV PCB's	0.5	$1,200	$0	0.0	$0	1.0	$2,400	$500	$4,100
Wire 1 ea Main Line ABSW	0.5	$1,200	$6,000	0.0	$0	2.0	$4,800	$1,000	$13,000
Communications Interface to MFM	0.5	$1,200	$0	2.0	$4,800	3.0	$7,200	$1,500	$14,700
Misc Control House Wiring	0.5	$1,200	$2,500	0.0	$0	3.0	$7,200	$1,500	$12,400
	0.0	$0	$0	0.0	$0	0.0	$0	$0	$0
	0.0	$0	$0	0.0	$0	0.0	$0	$0	$0
	0.0	$0	$0	0.0	$0	0.0	$0	$0	$0
	0.0	$0	$0	0.0	$0	0.0	$0	$0	$0
	0.0	$0	$0	0.0	$0	0.0	$0	$0	$0
	0.0	$0	$500	0.0	$0	0.0	$0	$0	$500
TOTALS	**8.5**	**$20,400**	**$44,400**	**11.0**	**$26,400**	**19.0**	**$45,600**	**$9,500**	**$146,300**

G.F. 230KV Sub Material

MFM Line Relay Panel	**$21,850**	SEL311L	$6,200
		Redundant 311L	$6,200
		CIM	$2,000
		Terminals	$1,250
		Cubicle	$1,700
		FMS-14 Sw	$750
		TT LOR	$1,000
		BF LOR	$750
		FMS-14 (2 EA.)	$750
		Misc	$1,250
Supv Expansion	$8,050	Expansion Chassis	$1,000
		SEL2030	$3,600
		32 PT Annun	$1,200
		Supv Boards	$2,250
Tie Point RTU	$5,500		
PT Junct Box	$1,500		

Appendix D: Transmission Equipment and Costs

SURVEY AND STRUCTURE STAKING

QTY	UNITS	DESCRIPTION	COST	
60	HRS	NWE - LABOR AND OVERHEADS	$4,860.00	
1	EA	NWE -TRAVEL AND EXPENSES	$1,510.00	
		TOTAL SURVEY COSTS		**$6,370.00**

ENVIRONMENTAL & PERMITTING

QTY	UNITS	DESCRIPTION	COST	
80	HRS	NWE - LABOR AND OVERHEADS	$5,040.00	
1	EA	NWE -TRAVEL AND EXPENSES	$760.00	
		TOTAL ENVIRONMENTAL AND PERMITTING COSTS		**$5,800.00**

TRANSMISSION - TYPE "M" 230 kV STRUCTURE (Angle Double Dead-end)

QTY	UNITS	DESCRIPTION	COST	
1	EA	COMPLETE "M" STRUCTURE, MATERIALS	$9,562.55	
8.5	PCT	WAREHOUSE UNION LABOR-HANDLING MATERIAL	$812.82	
		TOTAL "M" STRUCTURE - MATERIAL		**$10,375.37**
27	FT	DIGGING POLE HOLES	$1,620.00	
1	EA	ERECT 65' POLE	$1,050.00	
1	EA	ERECT 70' POLE	$1,110.00	
1	EA	ERECT 75' POLE	$1,200.00	
1	EA	FRAME TYPE "M" STRUCTURE	$4,000.00	
10	EA	INSTALL AND TEST ANCHORS	$5,000.00	
6	EA	INSTALL LANDING	$1,800.00	
6	EA	REMOVE LANDING	$900.00	
		TOTAL "M" STRUCTURE - CONTRACT LABOR		**$16,680.00**

TRANSMISSION - TYPE H2XHC-HD--ABSW STRUCTURE

QTY	UNITS	DESCRIPTION	COST	
1	EA	COMPLETE "H2XHC-HD--ABSW", MATERIALS	$16,286.73	
8.5	PCT	WAREHOUSE UNION LABOR-HANDLING MATERIAL	$2,064.37	
1	EA	230 kV AIR BREAK SWITCH	$8,000.00	
		TOTAL ABSW STRUCTURE - MATERIAL		**$26,351.10**
35	FT	DIGGING POLE HOLES	$2,100.00	
2	EA	ERECT 80' POLE	$3,000.00	
3	EA	ERECT 30' POLE	$2,070.00	
1	EA	FRAME TYPE "H2XHC-HD--ABSW" STRUCTURE	$3,550.00	
1	EA	INSTALL AND ADJUST 230 kV ABSW	$3,000.00	
3	EA	INSTALL JUMPERS & CONNECTORS	$2,500.00	
		TOTAL ABSW STRUCTURE - CONTRACT LABOR		**$16,220.00**

OVANDO-GREAT FALLS 230 kV REROUTE--CONDUCTOR RELATED ITEMS

QTY	UNITS	DESCRIPTION	COST	
4100	LB	1272 mcm ACSR 45/7 CONDUCTOR	$5,535.00	
2000	FT	3/8" HS STEEL 7-STRAND STATIC	$5,509.55	
1	ST	ABSW JUMPER COMPRESSION FITTINGS	$646.35	
3	EA	DEAD-END TOWER LINE SIDE INSULATORS	$726.00	
3	EA	DEAD-END TOWER COMPRESSION DEAD-ENDS	$225.00	
8.5	PCT	WAREHOUSE UNION LABOR-HANDLING MATERIAL	$1,074.56	
		TOTAL WIRE STRINGING - MATERIAL		**$13,716.46**
0.17	MI	STRING, SAG & CLIP 1272 mcm ACSR 45/7 CONDUCTOR	$5,509.55	
0.17	MI	STRING, SAG & CLIP 2-3/8" HS STEEL 7-STRAND STATIC	$2,110.95	
		TOTAL WIRE STRINGING - CONTRACT LABOR		**$7,620.49**

OVANDO-GREAT FALLS 230 kV REROUTE--STRUCTURE REMOVAL

QTY	UNITS	DESCRIPTION	COST	
4	EA	REMOVE & DISPOSE OF EXISTING STRUCTURE	$1,500.00	
		TOTAL STRUCTURE REMOVAL - CONTRACT LABOR		**$1,500.00**

OVANDO-GREAT FALLS 230 kV REROUTE--CONDUCTOR REMOVAL

QTY	UNITS	DESCRIPTION	COST	
0.03	MI	REMOVE EXISTING 230 kV CONDUCTOR AND STATIC	$600.00	
		TOTAL CONDUCTOR REMOVAL - CONTRACT LABOR		**$600.00**

ENGINEERING/PROJECT MANAGEMENT

QTY	UNITS	DESCRIPTION	COST	
240	HRS	NWE - ENGINEERING LABOR AND OVERHEADS	$12,960.00	
38	HRS	NWE - DRAFTING LABOR AND OVERHEADS	$1,710.00	
250	HRS	NWE - INSPECTION LABOR & OVERHEADS	$14,850.00	
1	EA	NWE -TRAVEL AND EXPENSES	$5,155.00	
		TOTAL ENGINEERING COSTS		**$34,675.00**

***TOTAL MATERIAL AND LABOR COST = $143,398.48**

***Note: Costs do not include Supervisory Control, Relay, Communications or CIAC cost allowance. Those costs are to be defined and considered by others.**

Appendix E: Communication Equipment and Costs

Interconncetion Customer			
Equipment	**Equipment Cost**	**Qty**	**Total**
19" Rack	$260.00	1	$260.00
DC Filter/Fuse Panel	$225.00	1	$225.00
DC/DC Converter	$650.00	0	$0.00
Channel Bank	$6,500.00	1	$6,500.00
19IN 3 Tray Lynx Shelf 026-2200-0000	$173.33	1	$173.33
Lynx Patch Tray 026-0021-3000	$57.78	2	$115.56
Lynx Splice Tray 026-0010-0005	$66.67	2	$133.34
Telect Clamp Kit 055-8000-0001	$18.67	1	$18.67
Telemix Chassis 010-0000-4010	$179.17	1	$179.17
DSX-1 Module 010-4004-0000	$66.44	2	$132.88
F/O Jumpers	$22.00	10	$220.00
F/O Pigtails	$10.00	10	$100.00
F/O Barrels	$5.00	10	$50.00
Steel Enslosures 14 inch	$325.00	0	$0.00
Preformed Coyote Splice Case 8" x 28"	$480.00	0	$0.00
Preformed Coyote Tray	$38.00	0	$0.00
Preformed Coyote Green Sealant Kit	$25.00	0	$0.00
Clark Box 24" x 24"	$125.00	0	$0.00
36 Fiber OPGW	$2.28	0	$0.00
OPGW Shipping	$600.00	0	$0.00
Susp. Units SUME528/555	$45.81	0	$0.00
Susp Unit Link Plate 10 inch	$18.01	0	$0.00
Dead Ends	$166.07	0	$0.00
Downlead Clamp	$21.76	0	$0.00
Wood Pole Guide Clamp	$4.58	0	$0.00
ADSS Fiber	$0.90	0	$0.00
2" conduit plus Install	$5.50	0	$0.00
Misc Wiring			$0.00
Total Materials			**$8,107.95**
U.G. F/O & Mtl Install	$2,500.00	0	$0.00
Splice at Sub Struct.	$1,100.00	0	$0.00
Splice at Control House.	$700.00	0	$0.00
Test Fiber Facility	$650.00	1	$650.00
OPGW Reel Testing / fiber	$250.00	0	$0.00
Install Enclosures	$200.00	0	$0.00
Install Splice Assembly	$200.00	0	$0.00
Install NEMA Box Control House	$250.00	0	$0.00
Install ADSS In Conduit	$250.00	0	$0.00
Splicing at Dead End Towers	$21.00	0	$0.00
ADSS Reel Testing 10/fiber	$15.00	0	$0.00
Provisioning	$60.00	1	$60.00
Install Telect plus splicing	$500.00	1	$500.00
Total Labor			**$1,210.00**

Engineering & Doc.	
No.Eng Man Days	3
Total Engineering	**$1,500.00**
Travel/Living	
Per Deiem	160
Total Travel/Living	$800.00

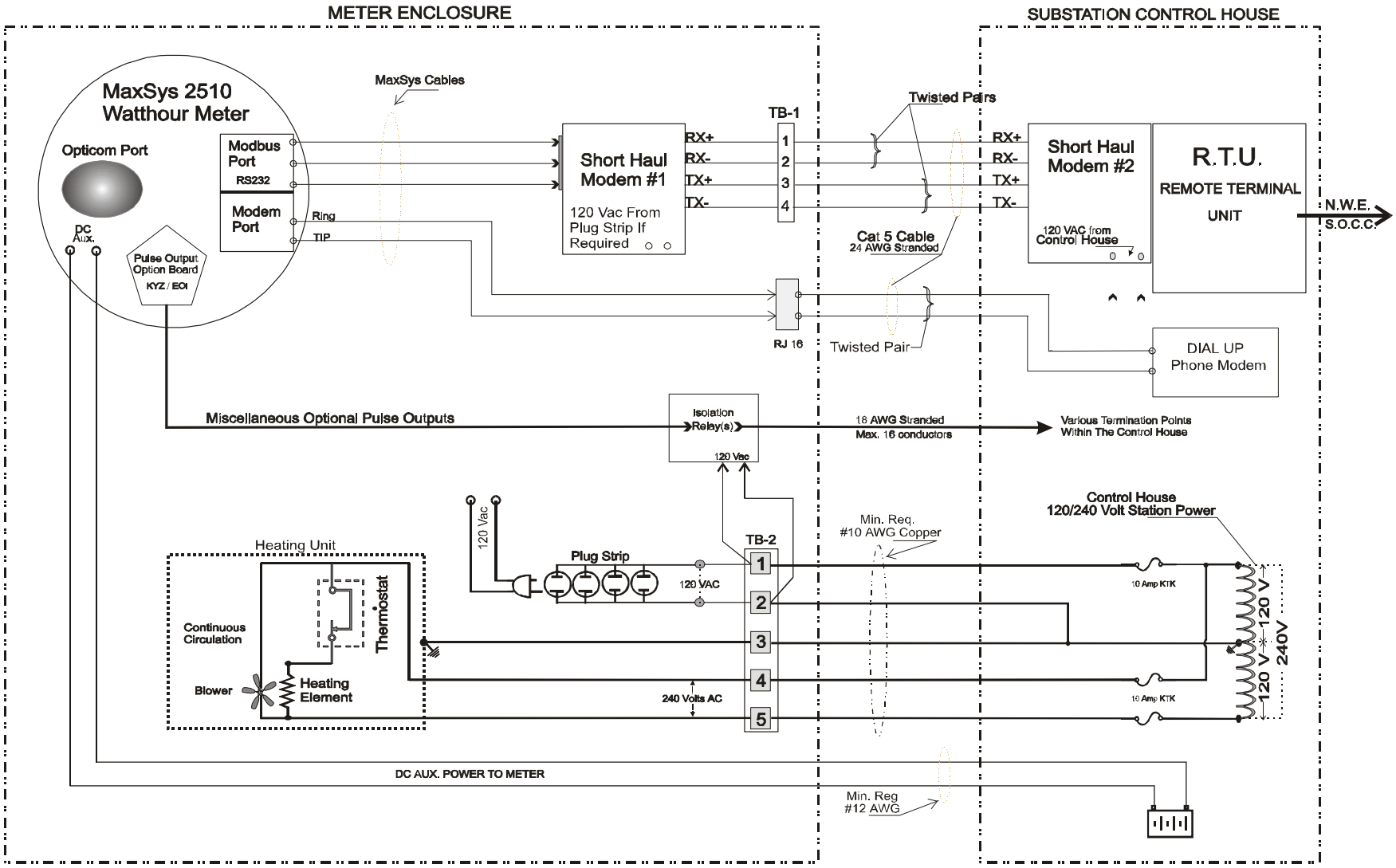
NWE 230KV Swithyard			
Equipment	**Equipment Cost**	**Qty**	**Total**
19" Rack	$260.00	1	$260.00
DC Filter/Fuse Panel	$225.00	1	$225.00
DC/DC Converter	$650.00	0	$0.00
Channel Bank	$6,500.00	1	$6,500.00
19IN 3 Tray Lynx Shelf 026-2200-0000	$173.33	1	$173.33
Lynx Patch Tray 026-0021-3000	$57.78	2	$115.56
Lynx Splice Tray 026-0010-0005	$66.67	2	$133.34
Telect Clamp Kit 055-8000-0001	$18.67	1	$18.67
Telemix Chassis 010-0000-4010	$179.17	1	$179.17
DSX-1 Module 010-4004-0000	$66.44	2	$132.88
F/O Jumpers	$22.00	10	$220.00
F/O Pigtails	$10.00	10	$100.00
F/O Barrels	$5.00	10	$50.00
Steel Enslosures 14 inch	$325.00	0	$0.00
Preformed Coyote Splice Case 8" x 28"	$480.00	1	$480.00
Preformed Coyote Tray	$38.00	2	$76.00
Preformed Coyote Green Sealant Kit	$25.00	1	$25.00
Clark Box 24" x 24"	$125.00	1	$125.00
36 Fiber OPGW	$2.28	0	$0.00
OPGW Shipping	$600.00	0	$0.00
Susp. Units SUME528/555	$45.81	0	$0.00
Susp Unit Link Plate 10 inch	$18.01	0	$0.00
Dead Ends	$166.07	0	$0.00
Downlead Clamp	$21.76	0	$0.00
Wood Pole Guide Clamp	$4.58	0	$0.00
ADSS U.G.	$0.90	100	$90.00
2" conduit plus Install	$5.50	100	$550.00
Misc Wiring			$0.00
Total			**$9,453.95**
U.G. F/O & Mtl Install	$2,500.00	1	$2,500.00
Splice at Sub Struct.	$1,100.00	1	$1,100.00
Splice at Control House.	$700.00	1	$700.00
Test Fiber Facility	$650.00	1	$650.00
OPGW Reel Testing / fiber	$250.00	1	$250.00
Install Enclosures	$200.00	1	$200.00
Install Splice Assembly	$200.00	1	$200.00
Install NEMA Box Control House	$250.00	1	$250.00
Install ADSS In Conduit	$250.00	1	$250.00
Splicing at Dead End Towers	$21.00	1	$21.00
ADSS Reel Testing 10/fiber	$15.00	1	$15.00
Provisioning	$60.00	1	$60.00
Install Telect plus splicing	$500.00	1	$500.00
			$6,696.00

Engineering & Doc.	
No.Eng Man Days	6
Total Engineering	**$3,000.00**
Travel/Living	
Per Deiem	160
Total Travel/Living	$800.00

Transmission Provider Cost: **$53,210.90**

Appendix F: Metering Schematic

SIMPLIFIED METER CONTROL CIRCUITS

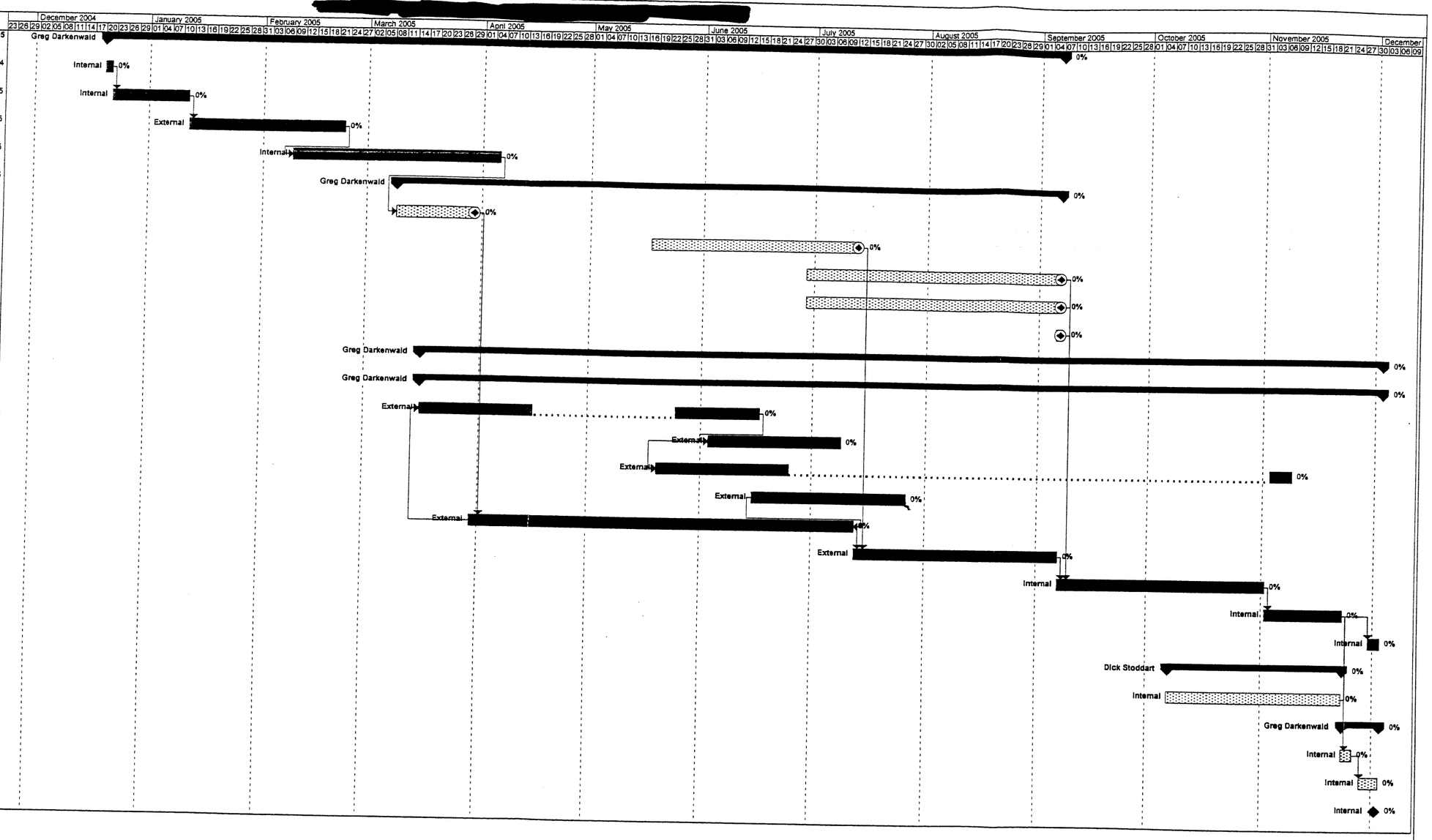


Designed & Drawn By:
R. Neil O'Donnell

Original Drawing Completed 7/27/95
Revision Number 3.1
Revision Date 10/24/02

Appendix G: NorthWestern Energy Construction Time

ID	Task Name	Duration	Start	Finish
1	**Project Design/Materials Overview**	**187 days**	**Mon 12/20/04**	**Tue 09/06/05**
2	Environmental Permitting	2 days	Mon 12/20/04	Tue 12/21/04
3	Survey	15 days	Wed 12/22/04	Tue 01/11/05
4	Geotechnical Evaluation	30 days	Wed 01/12/05	Tue 02/22/05
5	Substation Design/Drafting	40 days	Wed 02/09/05	Tue 04/05/05
6	**Material Deliveries**	**130 days**	**Wed 03/09/05**	**Tue 09/06/05**
7	Anchor Bolts	15 days	Wed 03/09/05	Tue 03/29/05
8	Steel	40 days	Wed 05/18/05	Tue 07/12/05
9	Coupling Capacitor Voltage Transfor	50 days	Wed 06/29/05	Tue 09/06/05
10	Air Break Switches	50 days	Wed 06/29/05	Tue 09/06/05
11	Power Circuit Breakers	1 day	Tue 09/06/05	Tue 09/06/05
12	**Construction Overview/Field Inspection**	**188 days**	**Wed 03/16/05**	**Fri 12/02/05**
13	**Substation Construction**	**188 days**	**Wed 03/16/05**	**Fri 12/02/05**
14	Yard Work	40 days	Wed 03/16/05	Thu 06/16/05
15	Fence	26 days	Fri 06/03/05	Fri 07/08/05
16	Ground Mat Installation	30 days	Fri 05/20/05	Tue 11/08/05
17	Conduit Installation	30 days	Wed 06/15/05	Tue 07/26/05
18	Foundations	75 days	Wed 03/30/05	Tue 07/12/05
19	Steel Erection	40 days	Wed 07/13/05	Tue 09/06/05
20	Set Electrical Equipment	40 days	Wed 09/07/05	Tue 11/01/05
21	Bus Work	15 days	Wed 11/02/05	Tue 11/22/05
22	Bank Metering	3 days	Wed 11/30/05	Fri 12/02/05
23	**Relay Construction**	**33 days**	**Fri 10/07/05**	**Tue 11/22/05**
24	Field Relay Work	33 days	Fri 10/07/05	Tue 11/22/05
25	**Substation Finalization**	**8 days**	**Wed 11/23/05**	**Fri 12/02/05**
26	Substation Energization	3 days	Wed 11/23/05	Fri 11/25/05
27	Final Testing	5 days	Mon 11/28/05	Fri 12/02/05
28	Completion	1 day	Fri 12/02/05	Fri 12/02/05



Project: Montana First Megawatts-Gre
Date: Wed 02/11/04

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | External Milestone | Deadline