

C O P Y

8748 N 912

THIS AGREEMENT, Made and entered into this 3rd day of February, A. D. 1916, between the GREAT FALLS POWER COMPANY, a corporation, organized under the laws of the State of Montana, party of the first part, hereinafter for convenience referred to as the Power Company, and the CHICAGO, MILWAUKEE & ST. PAUL RAILWAY COMPANY, a corporation organized under the laws of the State of Wisconsin, for convenience hereinafter referred to as the Railway Company, party of the second part, WITNESSETH:

WHEREAS, heretofore, by contract of date November 25, 1912, the above named Power Company and the Chicago, Milwaukee & Puget Sound Railway Company, a corporation organized under the laws of the State of Washington, and the predecessor in interest of the Railway Company, party of the second part hereto, entered into a certain contract; and,

WHEREAS, the Railway Company, party of the second part hereto, has succeeded to the rights of the said Chicago, Milwaukee & Puget Sound Railway Company under the said contract, and has taken the place of said Puget Sound Railway Company in and under said contract; and,

WHEREAS, by said contract it is agreed that the line of railway of said Railway Company between the stations of Harlowton and Deer Lodge, in the State of Montana, should be equipped with apparatus so that the same should be operated by electric power furnished by said Power Company; and

WHEREAS, under said contract it was agreed that the said Power Company should provide the necessary equipment for measuring the said power so to be delivered, at five points on the said division between Harlowton and Deer Lodge, which said points have been selected by the said Railway Company and agreed upon as follows: At Two Dot, Josephine, Piedmont, Journey and Morel; and,

WHEREAS, under said contract heretofore entered into and referred to, it is provided among other things, as follows:

"It is agreed that the power herein contracted for shall be measured at each agreed point of delivery by curve-writing wattmeters operated synchronously and integrating watt-hour meters, or such approved instruments for the measurement of electric current as may be agreed upon by the parties hereto."

"It is agreed that the measurement of the said power shall at all times be under the control and direction of the said Power Company, but that the said Railway Company and its duly designated agents shall, at all times, possess the right to make full inspection of the methods employed and the instruments and apparatus used for recording such measurements and to make any tests or examinations which may be necessary to enable the said Railway Company and its agents to determine the accuracy and reliability of such methods as may be pursued and such instruments and apparatus as may be used for the recording and measuring of the electric power furnished."

In order to carry out the terms and provisions of said contract of November 25, 1912, and not for the purpose of changing, modifying or amending the same, or any provision thereof, in any way, it is deemed desirable by the parties hereto to provide by agreement for the installation and operation of a power limiting and indicating system, as hereinafter set forth;

NOW, THEREFORE, in consideration of the premises and the mutual agreements of the parties hereto, this contract WITNESSETH:

1. The Railway Company shall, at its own initial cost and expense, install, or cause to be installed, a power limiting and indicating system upon its said line of railway between said stations of Harlowton and Deer Lodge above mentioned, the type of system so to be installed to be in general as outlined in a proposition made by the General Electric Company of Schenectady, New York, to the Chicago, Milwaukee & St. Paul Railway Company, under date of March 25, 1915, a copy of which said proposal is attached hereto marked Exhibit A, and made a part hereof.

2. The said Power Company and the said Railway Company shall each bear one-half the total cost installed, of such of the said apparatus as is located in the Dispatcher's office of said Railway Company, and of the circuit required for connecting this apparatus with suitable local 2300 volt power supply. (44000 Ryne Used)

3. Each of the parties hereto shall bear one-half of the total cost installed, of the circuit connecting the power limiting and indicating apparatus in the Dispatcher's office, with that in the sub-stations, the cost of this circuit to include wire, insulators, pins, cross-arms and hardware, and also all labor required for installing this circuit; this circuit to extend from the Railway Company's sub-station at Two Dot, Montana, to a point at or near Deer Lodge, Montana, and to be run on the Railway Company's trolley and feeder poles.

4. Each party shall bear one-half the actual cost installed, of the sub-station apparatus required for the power indicating portion of the system, and the Railway Company shall bear the actual cost installed, of such additional portions of the sub-station apparatus as are required only for the power limiting feature of the system.

5. The Power Company shall reimburse the Railway Company in accordance with the annual bills to be furnished by the latter for its proportion of taxes and insurance chargeable to the power limiting and indicating apparatus and necessary circuits, said charges to be reckoned on basis of 1 1/2% of the Power Company's proportion of original investment and subsequent additions and improvements properly chargeable to the cost of the plant, excepting the actual cost of such additional portion of substation apparatus required only for the power limiting feature of the system.

6. Each party shall bear one-half of the charges for maintenance and operation of the system and bills therefor shall be rendered by the Railway Company monthly for the proportion due from the Power Company.

7. The said apparatus installed hereunder shall be operated by the employees of the Railway Company, but under the control and direction of the Power Company as regards the measuring and recording features of the system, subject, however, to inspection and tests by the Railway Company, as outlined in contract dated November 25, 1912, hereinbefore referred to.

8. The Railway Company hereby reserves the right, upon reasonable notice in writing to the Power Company, to assume complete ownership of the entire system to be installed hereunder, and in case the Railway Company shall assume such complete ownership, it shall reimburse the Power Company in an amount equal to its original investment in such system, less a proper depreciation on such apparatus.

IT IS EXPRESSLY UNDERSTOOD AND AGREED, that this contract is made and entered into for the purpose of conveniently carrying out the terms and provisions of the said contract of date November 25, 1912, herein referred to, and not for the purpose of changing, modifying or amending in any particular any term, feature or provision of said contract of November 25, 1912, and if there be, or should prove to be, any conflict or inconsistency between this contract or any of its provisions or terms,

and any provision or term of said contract of November 25, 1912, or any of its terms or provisions, then the said contract of November 25, 1912, and its terms and provisions shall control and shall be held to abrogate any such term or provision of this contract as shall conflict therewith.

This contract shall be and remain in full force and effect for the same period that the said contract of November 25, 1912, shall be in force and effect.

It is agreed that the terms and provisions of this contract shall inure to the benefit of, and its obligations shall be binding upon, the successors and assigns of the respective parties hereto.

IN WITNESS WHEREOF, the respective parties hereto have caused these presents to be executed by their officers, thereunto duly authorized, the day and year herein first above written.

GREAT FALLS POWER COMPANY,

By JOHN D. RYAN,
Its President.

(Seal)

Attest:

WALTER DUTTON,
Its Secretary.

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY COMPANY,

By E. D. SEWALL,
Vice President.

(Seal)

Attest:

E. W. ADAMS,
Its Secretary.

Approved:
As to Form H. H. Field,
General Solicitor.

C. A. Goodnow.

EXHIBIT A.

POWER LIMITING AND INDICATING SYSTEM PROPOSED FOR

ROCKY MOUNTAIN ELECTRIFICATION

FOR CHICAGO, MILWAUKEE & ST. PAUL RY.

This system was developed to meet requirement that equipment must be provided to indicate to the train dispatcher the total amount of power used on his division with some means by which the maximum power could be automatically limited at the will of the dispatcher. The system outlined below accomplishes the following results.

1st. Indicates direct to the train dispatcher the total amount of energy being delivered to his division at any instant with permanent record for future study and record.

2nd. Automatically limits the amount of power supplied to the division so that the maximum peak load on the system cannot exceed a certain pre-determined maximum. This maximum can be changed easily and directly by the dispatcher at any time without necessity of notifying sub-station operators.

3rd. If an excessive amount of power is required near one sub-station, the voltage of the nearest sub-station is automatically lowered without affecting the voltage of the other sub-stations, so that the total load is automatically divided between the nearest sub-station and the sub-stations on either side.

The system consists of a pilot wire circuit connecting in series all of the sub-stations and the train dispatcher's office. A constant source of direct current potential is applied across the two ends of the pilot wire loop at the dispatcher's office, power being obtained by means of a small motor generator set with voltage held constant by a voltage regulator. The voltage applied to the pilot wire is determined by the length of the division, size and resistance of the pilot wire, and number of sub-stations. If copper is used for the pilot wire with two-wire circuit or one-wire circuit with ground return, it is estimated that the maximum voltage required across the pilot wire loop will not exceed 1200 volts direct current.

The equipment at the dispatcher's office consists of a milli-ammeter calibrated in kilowatts, a curve drawing ammeter, also calibrated in kilowatts to give a permanent record, and a suitable indicating instrument, etc., to control the motor generator set supplying power. The motor generator set consists of two .5 kw., 600 volt generators connected in series for 1200 volts direct connected to a 2 h.p., 1800 r.p.m., 110 volt induction motor. A rheostat is inserted in the pilot wire circuit in the dispatcher's office so that the resistance of the complete pilot wire can be adjusted when necessary to take care of change in temperature conditions. The adjustable resistances used with the wattmeters at feeding-in points in the sub-station are automatically short circuited by means of polarized relays as shown on drawing M-1674858 when train dispatcher adjusts the trolley wire resistance. This adjustment is accomplished by reversing current in the pilot wire by a double pole double throw switch the dispatcher's office as shown on drawing just mentioned.

The motor generator set, indicating and recording instruments and adjusting resistance are connected in series with the pilot wire circuit, as shown on drawing M-1674858.

The equipment for each sub-station at which power is supplied is exactly the same, the wattmeter equipment being omitted in the other sub-stations.

Each sub-station, with an incoming power line, contains a pilot wire rheostat and contact making ammeter connected in series with the pilot wire circuit. The amount of resistance inserted in the pilot wire by the pilot wire rheostat is controlled by a special contact making A. C. wattmeter so arranged that resistance is cut out or inserted in the pilot wire circuit proportionately to the alternating current input. If the substation load increases, resistance is cut out of the pilot wire which causes the current to increase with corresponding indication on the meters in the dispatcher's office. The resistance used in connection with the wattmeters is inserted in series with the pilot wire at each of the incoming power sub-stations so that the total ampere increase in the pilot wire due to load is proportional to the kilowatt input. The system will be so arranged that the amount of current in the pilot wire will not exceed $1\frac{1}{2}$ amp. with maximum kilowatt input.

The ameters used as wattmeters in the dispatcher's office will have to be calibrated for kilowatts after the installation of the apparatus. These ameters will be arranged to compensate so that the correct power will be indicated or recorded irrespective of the voltage used on the pilot wire. That is, if the original adjustment is so arranged as to indicate the correct power at 1200 volts, the voltage can be increased or decreased a certain amount and the meters will still indicate the correct power.

The power limiting scheme in connection with the indicating equipment consists of a contact making ammeter for each substation with its coil connected in series with the pilot wire circuit so that when the current in the pilot wire exceeds a certain predetermined point, contact is made and resistance inserted in the exciter circuit supplying excitation to the separately excited direct current generators by means of a motor operated rheostat clutch mechanism driving a rheostat similar to that used with BR regulators. When contact is made by the contact making ammeter, the voltage of the sub-station is thereby decreased and the A. C. input reduced until the power supplied is below the predetermined setting when the motor operated rheostat will be shut down by the contact making ammeter and as soon as the load is decreased, the contact making ammeter will make contact on the other side and bring the voltage of the sub-station back to normal. A secondary current coil is used on the contact making ammeter supplied with current from a direct current shunt in the grounded side of the sub-station main circuit so that the heavily loaded sub-stations have their voltage decreased before those with light loads, giving good voltage over parts of the system not heavily loaded, unless the total A. C. input is beyond that covered by the power contract, or amount determined by the train dispatcher when the voltage of all of the sub-stations will be decreased until the total alternating current input reaches the amount decided upon.

The maximum kilowatt input can be changed at any time by the train dispatcher by simply varying the voltage across the pilot wire which will change the maximum peak load obtainable. Raising the voltage will decrease the maximum power which it is possible to obtain with the automatic apparatus and lowering the voltage will cause the automatic apparatus to remain inactive until the load reaches a higher amount.

The system is automatically arranged so as to deduct the power regenerated. If some locomotives are taking power from the system and others regenerating power, the indications on the meters in the dispatcher's office will be the difference between the two.

The apparatus it is proposed to furnish will be arranged for indicating a maximum kilowatt input at any incoming line point of 7500 or 15000 kw., depending on the connections of the current transformers. There will be five incoming line points for the electrification between Harlowton and Deer Lodge. Therefore the system can be arranged to indicate a total maximum input of 75000 kw. at any one instant. For the initial installation it is understood that two of the incoming line points will be provided for a maximum input of 15000 kw. each and the other three points for a maximum kilowatt input of 7500 kw. each. The maximum power indication possible on the initial installation will, therefore, be 52,500 kw.

The accuracy of the indications is affected by the large range in power indications which is desired. For this reason it is desired that the maximum possible indication be made as low as possible.

The electrification from Harlowton to Deer Lodge covers a distance of 226.4 miles. The end sub-stations will be located at Two Dot and Morel, the distance between these two sub-stations is 197.3 miles. Adding 10% to the distance to allow for sag and the extra amount required to go through the sub-stations and doubling the same gives a total length of pilot wire of 434 miles. It is recommended that #8 B&S wire be used, which gives a total pilot wire resistance of 2441 ohms at 75 deg. F.

Inasmuch as one side of the pilot wire is continuous from one end of the division to the other without additional resistance, meter, coils, contact-making ammeter coils, etc., it is believed that one wire could be saved by the use of deep well grounds similar to those used in several places in Europe, thereby cutting down the whole resistance of the pilot wire circuit appreciably, saving in voltage at the dispatcher's office and perhaps making it possible to use iron instead of copper wire.

It is believed that it is desirable to segregate the apparatus required for power indicating and power limiting.

If only power indicating is desired, there is required the following apparatus.

DISPATCHER'S OFFICE.

- 1- 1 kw. motor generator set.
- 2- 1 kva. transformers
- 1- pilot circuit adjusting rheostat
- 1- switchboard as covered by Spec. 63687-B, items 1 to 6 inclusive.

SUBSTATION APPARATUS

- 5 pilot wire rheostats, one each for Morel, Janney, Piedmont, Josephine and Two Dot Sub-Stations.
- Item 8, Switchboard Spec. 63687-B.
- Part of the material under item 9, Subd. Spec. 63687-B, as follows:
 - 1- special polyphase contact-making wattmeter.
 - 2- single pole special D. C. circuit closing relays.
 - 1- double pole polarized relay
 - 1- 50/100 amp., Form K-14 current transformer.

Item 2, Swbd. Spec. 67033-A.

Part of the material under item 3 of Swbd. Spec. 67033-A as follows:

- 1- special polyphase contact-making wattmeter
- 2- single pole special D. C. circuit closing relays.
- 1- double pole polarized relay
- 1- 50/100 amp. Form K-14 current transformer.

Item 10, Swbd. Spec. 63687-B

Item 11, " " "

Item 4, " " 67033-A

Item 5, " " "

If power limiting is desired in addition to power indicating there is required the following additional apparatus,

SUB-STATION APPARATUS.

1- motor operated voltage regulating rheostats, one each per sub-station.

Item 7, Swbd. Spec. 63687-B.

Part of the material under item 9 of Swbd. Spec. 63687-B as follows:

- 1- special D.C. contact-making ammeter with 4000 amp. main negative shunt.
- 1- D.C. overload relay.

Item 9-A, Swbd. Spec. 63687-B.

Item 1, " " 67033-A.

Part of the material under item 3, Swbd. Spec. 67033-A, as follows:

- 1- special D.C. contact-making ammeter with 4000 amp. main negative shunt.
- 1- D.C. overload relay.

Item 3-A, Swbd. Spec. 67033-A.

If only power limiting is desired, all of the apparatus listed above for both power limiting and power indicating is required.

If it is desired to allocate the cost of the apparatus for power limiting and power indicating, it is believed that the cost of the apparatus listed for power indicating only should be equally divided between the two and that the cost of the apparatus listed as additional apparatus required for power limiting should be charged to the power limiting cost.

The following apparatus is required for the electrification from Harlowton to Deer Lodge.

DISPATCHER'S OFFICE

- 1- 1 kw. motor generator set
- 2- 60 cycle, 1 kva., 2300-110 V. oil cooled transformers.
- 2- pilot circuit adjusting rheostat
- 1- switchboard in accordance with Swbd. Spec. 63687-B, Items 1 to 6 incl.

SUBSTATION APPARATUS

- 7- motor operated voltage regulating rheostats.
- 5- motor operated pilot wire rheostats, one each
for Morel, Jamney, Piedmont, Josephine
and Two Dot Sub-stations
- 4- switchboards in accordance with Swbd. Proposal
63687-B, items 7 to 12 incl.
- 3- switchboards in accordance with Swbd. Proposal
67033-A, items 1 to 5 incl.

Copies of switchboard specifications and wiring diagram attached.

E. S. JOHNSON

ESJ/k

RAILWAY & TRACTION ENGINEERING DEPT.

March 25, 1915.

SPECIFICATIONS FOR SWITCHBOARD

- F O R -

CHICAGO, MILWAUKEE & ST. PAUL RY. COMPANY,

CHICAGO, ILL.

SPECIFICATION NO. 63667-B

The switchboard included in these specifications has been designed to be used in connection with Proposal #66938.

The Company will furnish one (1) fuse to go with each single-pole fuse-holder included in these specifications.

Material of panels will be Natural Black Slate.
Instruments will have a dull black finish.
Panels will be mounted on pipe framework.
switches will be provided with cardholders where necessary.

SWITCHBOARD WILL CONTROL:

Pilot wire system for power limiting and indicating system.

In Dispatcher's Office:

- 1- Induction Motor- Generator Set, consisting of:
 - 1- 110 volt, 3-phase Induction Motor, 1 kw., 60 cycle.
 - 2- 600 volt DC Generators, connected in series to give 1200 volt with common connection grounded.
 - 1- 2300/110 volt, 2 kw., 3 phase 60 cycle transformer.
 - 1- 2300 volt, 3 phase incoming line.
 - 2- 1200 volt, DC lines (1 incoming and 1 outgoing).

In Sub-Stations:

- 1- 110 volt, 3 phase Motor for driving Generator rheostat for each of 4 sub-stations.
- 2- 1200 V. DC lines (incoming and outgoing) for each of 4 sub-stations.
- 1- 110 volt, 3 phase motor for driving pilot wire rheostats for each of 3 sub-stations, Moral, Janney Piedmont.

63667-B

SWITCHBOARD WILL CONSIST OF:

DISPATCHER'S OFFICE:

- | | | |
|----------|-----|-------------------------------------|
| Item No. | 1. | 1- instrument panel. |
| | 2. | 1- motor generator panel. |
| | 2A. | 1- TD voltage regulator. |
| | 2B. | 2- DC lightning arresters. |
| | 3. | 1- instrument and base. |
| | 4. | 3- expulsion fuses and hook. |
| | 4A. | 3- disconnecting switches and hook. |
| | 5. | 1- AC lightning arrester |
| | 6. | 3- choke coils. |

SUB-STATIONS:

- | | | |
|--|-----|--|
| | 7. | 4- lever switches (1 for each of 4 substations). |
| | 8. | 3- lever switches (1 for each- Moral- Janney- Piedmont sub-stations) |
| | 9. | 3- instrument panels (1 each for Moral- Janney- Piedmont sub-stations) |
| | 9A. | 1- instrument panel (for Rustic Sub-station) |
| | 10. | 8- DC lightning arresters (2 for each of 4 sub-stations) |
| | 11. | 3- DC lightning arresters (1 for each - Moral, Janney - Piedmont sub-stations) |

SPECIFICATIONS FOR SWITCHBOARD

Apparatus to be mounted in Dispatcher's Office

- Item #1: One (1) Instrument panel.
(Top section 31 x 16 x 1-1/2"
Size (Middle " 31 x 16 x 1-1/2"
(Bottom " 28 x 16 x 1-1/2"
on 90" supports.

EQUIPMENT:

- 1- 1200 volt curve drawing kw. recorder with special adjustable shunt mounted on front of panel including reroll attachment, and time marker.
- 1- 1200 volt curve drawing voltmeter mounted on front of panel including reroll attachment, time marker, and resistance.
- 1- 3 hole plug rack, front of panel.
Insulating caps.

- Item #2 One (1) Motor generator panel.
Capacity- 110 volts, AC 1200 volts DC 1 kw.
(Top section 31 x 24 x 1-1/2"
Size (Middle " 31 x 24 x 1-1/2"
(Bottom " 28 x 24 x 1-1/2"
on 90" supports.

EQUIPMENT:

- 1- Special D-7 milli-ammeter with insulating cover.
- 1- 750 volt D-7 voltmeter with 1500 volt scale, insulating cover and 2 to 1 multiplier.
- 1- D-7 milli-ammeter for indicating ground
- 1- handwheel and mounting for field rheostat.
- 2- Sp DT 100 amp. plug switches with 2 plugs.
- 2- 1200 volt 1 amp. NE CS fuses with blocks mounted back of panel.
- 1- TP ST 250 volt 30 amp. D-12 lever switch with NE CS fuses on front of panel.
Insulating caps.

Item #2A:

- 1- set of brackets for mounting at side of panel.
- 1- Special TD voltage regulator.
- 1- condenser section.

Item #2B:

- 2- 600 volt DC aluminum cell lightning arresters (outdoor type, Cat. #77160)

- Item #3: One (1) Natural Black Slate base,
without supports,

MOUNTINGS:

- 1- Special DC indicating kw. instrument with special adjustable shunt.
(Above to be mounted by purchaser at dispatcher's desk.)

Item #4:

- 3- SP 2500 volt 100 amp. TD-3 expulsion fuse blocks and holders with fuses on Blue Vermont Marble bases. Cat. #59443 (for incoming line 2300 V. 3 phase)
- 1- operating hook - Cat. 45229.

Item #4A: 3- SP 2500 volt 300 amp. disconnecting switches on Blue Vermont Marble bases, for lightning arrester (not mounted)

1- 4 foot operating hook - Cat. 65849.

A. C. Lightning Protective Apparatus.

Item #5: 1- 3 phase TP Multigap graded shunt resistance lightning arrester equipment Cat. #149754 for 2300 volt incoming line.

Item #6: 3- 25 amp. choke coils Cat. 76339 on steel bracket.

Apparatus to be Installed in the Various Sub-stations

Item #7: 4- TP ST 250 volt 100 amp. D-12 lever switches with NE CS fuses mounted on front of panel.
(1 for each of 4 sub-stations, to be mounted on Local Power Panel) for generator rheostat motor circuit.

Item #8: 3- TP ST 250 volt 100 amp. D-12 lever switches with NE CS fuses for mounting on front of panel for pilot wire rheostat motor circuit.
(1 for each of three sub-stations, Morel, Jarney, and Piedmont.)

Item #9: Three (3) instrument Panels (one each for Morel, Jarney, and Piedmont Sub-stations)
Size- (Top section 31 x 16 x 1-1/2"
(Middle " 31 x 16 x 1-1/2"
(Bottom " 28 x 16 x 1-1/2"
on 90" supports.

EQUIPMENT PER PANEL:

1- Special DC contact making ammeter with 1- 4000 amp. main negative shunt, (shunt not mounted by SWBD.Dept)
1- DC overload relay (not mounted on panel) used with above.

1- 110 volt 5 amp. special polyphase contact making wattmeter to be geared by rack or worm, to pilot wire rheostat (may not be mounted on panel).

2- SP Special DC relays circuit closing, excited by above wattmeter contacts.

1- DP polarized relay in series with 1200 volt line with 125 volt separate excitation (for short circuiting pilot wire rheostat).

1- 50/100 amp. form K-14 current transformer (to be used in connection with Power Co.'s Transformers for above wattmeter)

Insulating caps

Item #9A:

One (1) Instrument Panel (for Eustis Substation)
(Top section 31 x 16 x 1-1/2"
Size (Middle " 31 x 16 x 1-1/2"
(Bottom " 28 x 16 x 1-1/2"
on 90" supports

EQUIPMENT:

1- Special DC contact making ammeter with 1- 4000 amp.
main negative shunt (shunt not mounted by Swbd.Dept.)

1- DC overload relay (not mounted on Panel) used with
above.

Insulating caps.

LIGHTNING PROTECTIVE APPARATUS.

Item #10: 8- 600 volt DC Aluminum cell lightning arresters.
(Outdoor type) Cat. #77160.
(2 for each of 4 sub-stations.

Item #11: 3- 60 volt DC Vacuum tube lightning arresters
(indoor type) (1 for each of 3 sub-stations for
protecting pilot wire rheostats) Cat.#148057.

SPECIFICATIONS FOR SWITCHBOARD

- F O R -

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY CO.

CHICAGO - ILLINOIS.

SPECIFICATION NO. 67033-A.

- - - - -

The switchboard included in these specifications has been designed to be used in connection with Proposal #66969-A.

The Company will furnish one (1) fuse to go with each single-pole fuse-holder included in these specifications.

Material of panels will be Natural Black Slate.
Instruments will have a dull black finish.
Panels will be mounted on pipe framework.
Switches will be provided with cardholders where necessary.

SWITCHBOARD WILL CONTROL:

Pilot wire system for Power Limiting and Indicating System.

In Sub-stations:

- 1- 110 volt 3 phase motor for driving generator rheostats for each of 3 sub-stations.
- 2- 1200 V. DC lines (incoming and outgoing) for each of 3 sub-stations.
- 1- 110 volt 3 phase motor for driving pilot wire rheostats for each of 2 substations- (Josephine and Two Dot.)

SWITCHBOARD WILL CONSIST OF:

- Item #1. 3- Lever switches (1 for each of 3 sub-stations)
2. 2- Lever switches (1 for Josephine and 1 for Two Dot Sub-Station)
3. 2- Instrument panels (1 for Josephine and 1 for Two Dot Sub-Stations)
3A. 1- Instrument panel (for Summit Sub-station)
4. 6- DC lightning arresters (2 for each of 3 sub-stations)
5. 2- DC lightning arresters (1 for Josephine and 1 for Two Dot Sub-stations)
- Item #1. 3- TP ST 250 volt 100 amp. D-12 lever switches with NE CS fuses mounted on front of panel.
(1 for each of 3 sub-stations, to be mounted on Local Power Panel) for generator rheostat motor circuit.
- Item #2. 2- TP ST 250 volt 100 amp. D-12 lever switches with NE CS fuses for mounting on front of panel (1 for Josephine and 1 for Two Dot Sub-stations) for pilot wire rheostat motor circuit.
- Item #3. Two (2) Instrument Panels (1 for Josephine and 1 for Two Dot Sub-stations)
(Top Section 31 x 16 x 1-1/2"
Size-(Middle " 31 x 16 x 1-1/2"
(Bottom " 28 x 16 x 1-1/2"
on 90" supports.

EQUIPMENT PER PANEL:

- 1- Special DC contact making ammeter with 1- 4000 amp. main negative shunt, (shunt not mounted by Swbd. Dept.)
- 1- DC overload relay (not mounted on panel) used with above.
- 1- 110 volt 5 amp. Special polyphase contact making wattmeter to be geared by rack or worm, to pilot wire rheostat (may not be mounted on panel).
- 2- SP Special DC relays circuit closing, excited by above wattmeter contacts.
- 1- DC polarized relay in series with 1200 volt line with 125 volt separate excitation (for short circuiting pilot wire rheostat)
- 1- 50/100 amp. form K-14 current transformer (to be used in connection with Power Co.'s transformers for above wattmeter).

Insulating caps.

Item #3A: One (1) Instrument panel (for Summit Sub-station).
(Top section 31 x 16 x 1-1/2"
Size-(Middle " 31 x 16 x 1-1/2"
(Bottom " 28 x 16 x 1-1/2"
on 90" supports

EQUIPMENT:

- 1- Special DC contact making ammeter with 1- 4000 amp. main negative shunt (shunt not mounted by Swbd. Dept.)
- 1- DC overload relay (not mounted on panel) used with the above.

Insulating caps.

LIGHTNING PROTECTIVE APPARATUS.

Item #4: 6- 600 volt DC aluminum cell lightning arresters, (outdoor type) Cat. 77160.

(2 for each of 3 sub-stations)

Item #5: 2- 60 volt DC vacuum tube lightning arresters (indoor type) for protecting pilot wire rheostat (one for Josephine and one for Two Dot Sub-Stations) Cat. #148057.