

GENERAL ELECTRIC COMPANY

SCHENECTADY, N. Y.

Schenectady, N.Y., November 9th 1914.

To Chicago, Milwaukee & St. Paul Railway.

(Hereinafter called the Purchaser)

Address Chicago, Ill.

(Give full address by street number)

The General Electric Company (hereinafter called the Company) proposes to furnish apparatus as herein described, subject to the following conditions and specifications:

TO INSURE THE PURCHASER AGAINST ANY LOSS OR EXPENSE BY REASON OF ADVERSE CLAIMS UNDER PATENTS, BASED UPON THE USE OF ANY OF THE APPARATUS COVERED HEREBY, **THE COMPANY GUARANTEES THAT THE PURCHASER SHALL NOT BE DISTURBED IN THE USE OF SAID APPARATUS** BY LITIGATION BASED UPON SUCH ADVERSE CLAIMS, AND TO THAT END WILL AT ITS OWN EXPENSE DEFEND ALL SUITS OR PROCEEDINGS INSTITUTED AGAINST THE PURCHASER FOR INFRINGEMENT OF ANY PATENT BY THE USE OF SAID APPARATUS, PROVIDED SUCH INFRINGEMENT SHALL CONSIST IN THE USE BY THE PURCHASER IN THE REGULAR COURSE OF ITS BUSINESS OF SAID APPARATUS, OR PARTS THEREOF, AND PROVIDED THE PURCHASER BE NOT IN DEFAULT IN ITS PAYMENTS THEREFOR AND GIVES TO THE COMPANY IMMEDIATE NOTICE IN WRITING OF THE INSTITUTION OF THE SUIT OR PROCEEDING, AND PERMITS THE COMPANY THROUGH ITS COUNSEL TO DEFEND THE SAME, AND GIVES ALL NEEDED INFORMATION, ASSISTANCE AND AUTHORITY TO ENABLE THE COMPANY SO TO DO, AND THEREUPON IN CASE OF AN AWARD OF DAMAGES, **THE COMPANY WILL PAY SUCH AWARD** AND IN CASE OF AN INJUNCTION AGAINST THE PURCHASER **THE COMPANY WILL PAY TO THE PURCHASER ANY LOSS OR DAMAGES TO ITS BUSINESS CAUSED BY SUCH INJUNCTION.**

In consideration of the foregoing guarantee the *Purchaser* covenants not to violate or infringe any of the United States Letters Patent, relating to any of the apparatus herein specified, controlled by the *Company* or under which the *Company* has the right to manufacture or sell any of such apparatus, and also agrees that if any controllers or trolleys, or parts thereof, covered by the patents of the *Company*, or under which the *Company* is licensed, are to be included in this proposal, the *Purchaser* will not use or permit others to use such controllers or trolleys or parts of controllers or trolleys except when incorporated in and used as parts of such car equipments as it had prior to July 1st, 1896, or of such additional car equipments as it may thereafter purchase from the *Company* or from a Manufacturer duly licensed under the aforementioned patents (the license of the *Purchaser* to use such controllers or trolleys and parts thereof being expressly qualified as in this paragraph provided).

The *Company* agrees to correct any defects in the apparatus which develop under normal and proper use within ~~thirty days~~ from the starting thereof, provided the *Purchaser* gives the *Company* immediate written notice of such defects and provided further that during said period the apparatus shall not be taxed beyond its normal capacity, shall be regularly cleaned and cared for, and shall be operated normally and properly. The *Company* agrees that the installation, if made by it, shall be done in a thorough and workmanlike manner. The *Company* shall not be held responsible for work done, apparatus furnished or repairs made by others.

The *Purchaser* agrees to properly care for all apparatus and material delivered until the same is fully paid for, and to hold the *Company* harmless against the payment of any taxes assessed against the apparatus and material after it shall have been shipped. If the installation is made by the *Company*, the *Purchaser* agrees without charge to furnish for the *Company* all necessary storage, rights of way, permits and authority for the installation and operation of the plant hereunder, and to reimburse the *Company* for any loss incurred by reason of delays in starting the plant and completing the work that are not chargeable to the *Company*; to designate the location of the apparatus herein specified before the work is begun, to pay extra for any changes made in location after same has been placed, and for any work performed or apparatus or material furnished in addition to that herein specified; and, furthermore, that the apparatus, after the starting thereof, shall be operated by the *Purchaser*. The apparatus shall be considered as starting when first put in operation. The *Company* shall not in any event be held responsible or liable for any loss, damage, detention or delay caused by fire, strikes, civil or military authority, or by insurrection or riot, or by any other cause beyond its control, nor in any event for consequential damages. Receipt of the apparatus by the *Purchaser* shall constitute a waiver of any claim for loss or damage due to delay. Apparatus shall be installed by and at expense of *Purchaser* unless otherwise expressly stipulated.

To enable the *Company* to proceed with the construction of the apparatus, the *Purchaser* agrees to furnish promptly on demand by the *Company* all the necessary information as to details to be determined by the *Purchaser* and that it will not delay in the doing of any act by it to be performed. In case of delay by the *Purchaser* shipment shall be extended for a reasonable time based on period of *Purchaser's* delay and conditions at the factories of the *Company*.

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY COMPANY
PUCKET SOUND LINES.

This proposal covers the delivery to the Purchaser f.o.b. points of shipment of the following 3000 volt direct current electric locomotives and substation apparatus for the electrification of Purchaser's railway between Deer Lodge and Three Forks, Montana.

LOCOMOTIVES:

- 6- Freight locomotives without steam heater and train lighting generator.
- 5- Freight locomotives equipped with steam heater and train lighting generator.
- 3- Through passenger locomotives equipped with steam heater and train lighting generator.

SUBSTATION APPARATUS:

Morel Substation - 4000 kw. Capacity.

- 2- 2000 kw. motor generator sets.
- 2- Step down transformers, three phase 2500 K.V.A. each.
- Switchboard for control of above.
- Lightning arresters.
- Line switches - 100,000 volts.
- Fuse limiting control, etc.
- 15 foot air compressor.
- 10 K.V.A. 2500 volt three phase transformer.

Jamez Substation - 4500 Kw. Capacity.

- 3- 1500 Kw. motor generator sets.
- 3- Step down transformers, three phase 1500 K.V.A. each.
- Switchboard for control of above.
- Lightning arresters.

Line switches - 100,000 volts.
 Power limiting control, etc.
 15 foot air compressor.
 10 K.V.A. 2300 volt three phase
 transformer.

Piedmont Substation - 4500 Kw. Capacity.

2- 1500 Kw. motor generator sets.
 2- Step down transformers, three phase,
 1900 K.V.A. each.
 Switchboard for control of above.
 Lightning arresters.
 Line switches - 100,000 volts.
 Power limiting control, etc.
 15 foot air compressor.
 10 K.V.A. 2300 volt three phase transformer.

Eustis Substation - 4000 Kw. Capacity.

2- 2000 Kw. motor generator sets.
 2- Step down transformers, three phase,
 1900 K.V.A. each.
 Switchboard for control of above.
 Lightning arresters.
 Line switches - 100,000 volts.
 Power limiting control, etc.
 15 foot air compressor.
 10 K.V.A. 2300 volt three phase transformer.

LOCOMOTIVES:

The locomotives proposed are very similar to those now in successful operation upon the Butte, Anaconda and Pacific Railway except that both the voltage and capacity is somewhat greater and guiding trucks have been added to conform to the requirements of the Purchaser.

Freight Locomotives are composed of two units connected by articulated joint so that they may be separated for convenience in shipping. Each half comprises four power axles driven by twin geared motors and a four wheel guiding truck.

The freight locomotive cab is lengthened to provide space for an oil burning boiler for possible use in passenger service.

Through Passenger Locomotive is a duplicate of the freight locomotive except as to gear ratio, which will be changed to provide a maximum speed of approximately 57 m.p.h. on tangent level track with 800 tons trailing.

For local passenger service one-half of the through locomotive can be utilized; this half locomotive will haul 400 tons trailing load. It will, however, be necessary to provide this half unit with draft gear which is not covered by this contract.

Regenerative Electric Braking:- Both freight and passenger locomotives will be equipped with the necessary control apparatus to permit of regenerative electric braking on down grades and the Company guarantees successful performance as follows:-

Freight				Passenger			
Speeds	Trailing Tons	Number Locomotives	M.P.H. 2000 V.	Trailing Tons	Number Locomotives	M.P.H. 2000 V.	
1.00	2000	1	20.5	800	1	40 or 44 x	
1.20	2500	1	19.5				
1.64	2000	1	17.2	800	1	35.2	
2.00	2500	2	17.8	650	1	32.7	
	x 40 M.P.H. is with full locomotive working.						
	33	"	"	1/2	"	"	

The above speeds are based on regenerating with the number of locomotives indicated in the above table and on a supply voltage of 2000. The speeds will be increased approximately in proportion to any increase in this voltage. They are also based on a constant ratio of field and armature currents, but it will be possible to vary this ratio to a limited extent.

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which will result in a more nearly constant speed under varying train and grade conditions. Inasmuch as the purchaser objects to speeds as high as those given above for regenerative braking and especially to the increase of speed by reason of trolley voltage changes the Company will endeavor to devise a method by which the speed can be absolutely maintained at a constant value.

Substation Apparatus in general will be entirely similar to that operating in the Butte and Anaconda substations of the Butte, Anaconda and Pacific Railway except as to voltage and capacity of units.

Each substation will contain the necessary apparatus to regulate the total peak load demand of all the several substations connected to the same pilot wires and under the control of one train or power dispatcher. This apparatus will automatically refuse any peaks above the load to which it is adjusted to the extent of approximately 30%. Thus, if the pilot wires control a group of substations, the output of which it is desired to keep within 10,000 kw maximum, then the automatic device specified herein will work within a range of approximately 8000 kw. Should the load exceed 10,000 kw by say 1000 kw then the control devices will lower the substation potential by 10% and the lower train speed resulting will reduce the power demand from the momentary 11,000 kw to the 10,000 kw desired. This apparatus is not designed to operate over a greater range than from 10,000 to 13,000 kw, and proportional values of aggregate substation load and peak load demands in excess of this must remain uncorrected if the power dispatch-

er cannot co-operate with the train dispatcher to prevent such excess loads.

Substation apparatus is described in the following specifications.

Installation material is included in our proposal and will be listed in detail upon the completion of substation drawings. This material includes all bus bars, bus bar supports, cables, conduit and other material needed for electrical connections of substation apparatus.

The Company will furnish a competent engineer to superintend the installation of all apparatus specified herein.

The Company will prepare as promptly as possible, for construction purposes, and submit to the Purchaser detail substation layout drawings, showing the location of all apparatus, the arrangement of wiring connections, and the type and size of cables recommended.

A list of all locomotive and switchboard layout drawings (except construction drawings of electrical apparatus) will be submitted to the Purchaser for selection of such drawings as it wishes to approve or comment upon. Drawings to be returned by the Purchaser within ten days after receipt with approval or comments.

PRICE:

The amount to be paid by the Purchaser to the Company for such apparatus shall be the commercial cost f.o.b. cars point of shipment, as ordinarily determined in the regular and usual practice of the Company and defined as follows:-

To the actual cost of labor and material there will be added the usual factory overhead percentages which were applied to apparatus of similar character in the regular practice of the Company during the year 1913. The following percentages and charges which were the percentages of 1913 shall be added to the factory cost so obtained in order to arrive at the commercial cost.

Motor generator sets

Mechanical parts of locomotive purchased from other companies

All other apparatus manufactured by the Company

There shall be added charges for development, boxing, testing and other incidental expenses all in connection with the regular and usual practice of the Company, but no commercial percentage shall be added to these items.

The Company guarantees that the total price to the Purchaser of all apparatus furnished under this contract exclusive of the interest charge referred to under heading "Terms of Payment" shall in no event exceed \$1,963,000. This maximum price shall be increased or decreased as the Purchaser may add to or reduce the amount of apparatus herein specified.

PRESENTATION AND VERIFICATION OF BILLS:

The Company will render bills to the Purchaser based upon the contract price when and as each complete unit, consisting of a locomotive or the apparatus constituting complete substitution equipment, as provided for in this contract, is

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shipped and within three months after presentation of the final bills upon this contract the Purchaser may at its option but at its own expense verify the correctness of the bills of the Company in the following manner:-

An accounting official of the Purchaser selected by its President shall make an examination and certify to the effect that the aggregate charge as finally rendered by the Company for the whole or a part of the contract is based upon the factory costs determined in accordance with the usual and regular practice of the Company in the conduct of its business during the year 1918, and that the percentages of overhead expense and incidental expenses agreed to above have been added to the factory cost, or shall certify the amount to be deducted from or added to the bills of the Company hereunder to make the same accord with commercial costs determined in accordance with the usual and regular practice of the Company in the conduct of its business as defined above indicating the particular bill affected and the reasons for such addition or deduction. Such certificate in writing shall be mailed to both parties hereto and shall be controlling as to the contract price unless within sixty (60) days after receipt of such certificate either party shall appeal from the decision represented by such certificates to a firm of Certified Public Accountants to be mutually agreed upon by the parties hereto. The question in dispute shall be submitted to said firm of Certified Public Accountants, and the decision of such firm either affirm-

ing, over-ruling or amending said certificate shall be final and conclusive upon both parties hereto, and the expense of such Chartered Accountants to be equally borne by both parties.

The Purchaser agrees that all information received by it regarding the Company's cost of manufacturing apparatus and regarding the Company's practices of determining such cost shall be considered confidential and will not be disclosed. The Purchaser further agrees that no accounting officer in its employ who secures access to the books and records of the Company under the terms of this agreement shall be permitted to remove from the premises of the Company any copy or memorandum of such books or records.

TERMS OF PAYMENT:

The Purchaser agrees to make payment for all apparatus sold hereunder, one hundred per cent (100%) cash in New York, Boston or Chicago funds one year from date of complete shipment of all apparatus. By complete shipment is meant shipment of all apparatus and material but does not include shipment of or replacement of minor parts not essential for the successful operation of apparatus covered hereby/

The Purchaser agrees to pay to the Company interest at the current rate but not less than five per cent (5%) per annum on the amount of all bills rendered as herein before provided for from the date of such bills to the date of payment, but such interest charges shall not apply to the price of defective apparatus during the time it is not in proper condition to be operated successfully.

SHIPMENT:

The Company will begin shipment of the substation apparatus in six (6) months and complete in eight (8) months and will ship the first locomotive in ten (10) months with two locomotives each succeeding thirty (30) days thereafter until all locomotives have been shipped - all shipments to date from date of acceptance of this proposal by the Purchaser and receipt at Schenectady of full information regarding construction details.

Amended

In consideration of the sale by the Company to the Purchaser of the apparatus above described, at commercial cost, the Purchaser agrees in the event of its electrifying its line extending from Harlowton to Three Forks, Montana, and from Deer Lodge, Montana, to Avery, Idaho, that it will purchase from the Company all electric locomotives, substation apparatus, line and installation material required for such electrification at the prices and terms hereinafter set forth.

PRICE:

The amount to be paid by the Purchaser to the Company for such apparatus shall be the commercial cost, plus ten per cent (10%) f.o.b. cars points of shipment, the commercial cost to be as ordinarily determined in the regular and usual practice of the Company and defined as follows:-

To the actual cost of labor and material there will be added the usual factory overhead percentages which were applied to apparatus of similar character in the regular practice of the Company during the year 1913, provided contracts for such material are placed before January 1st, 1913. On all subsequent contracts of later date there will be applied the usual factory overhead percentages as applied in the regular practice of the Company of the date at which contract is placed. To this factory cost shall be added the following percentages to make commercial cost:-

Motor generator sets

Mechanical parts of locomotive, purchased from other companies

All other apparatus manufactured by the Company

In addition there shall be added development charges and other incidental expenses in accordance with the regular and usual practice of the Company, but no commercial percentages shall be added to these items.

In view of the uncertainty as to the size and character of the apparatus to be furnished and the cost of labor and material required for the two additional developments, it is impossible for the Company to definitely determine at this time the upset price for such additional apparatus but the Company agrees at the time the Purchaser places an order for such additional apparatus that it will protect the Purchaser with an upset price. At such time a separate contract shall be entered into by the parties hereto which shall cover all details of construction, billing payments, shipment, etc.

It is agreed that the apparatus herein specified shall be delivered by the *Company* at place of manufacture, and that it is at the risk of the *Purchaser* after its delivery on board cars at point of shipment, unless other delivery is expressly stipulated.

An extra charge will be made for iron oil barrels, carboys and wooden reels if used in shipping, but full credit will be given when returned to the factory or other point as may be designated by the *Company*, in good condition, freight prepaid.

~~1000~~

~~1000~~

~~1000~~

~~1000~~

~~1000~~

~~1000~~

Pro rata payments shall be made as shipments are made. In case shipments shall be delayed by the *Purchaser*, payments shall be made ~~by the Company~~ in accordance with the above terms, for material which the *Company* is prepared to ship.

The title to the apparatus herein sold shall not pass from the *Company* until all payments hereunder (including deferred payments, if any) shall have been fully made in cash. The *Purchaser* agrees to do all acts necessary to perfect and maintain such retention of title in the *Company*.

It is agreed that the *Company* shall insure said apparatus or plant sold hereunder against damage or loss by fire for its full selling price as above stated, until, but not after, under the contract the title to the apparatus shall have passed to the *Purchaser* hereunder for the benefit of itself and the *Purchaser*, as their interests may appear; and the *Purchaser* agrees to pay the *Company* for premium for such insurance one-fourth of one per cent on the total amount insured for each three months or fraction thereof after the delivery of said apparatus on board cars at point of shipment.

If the apparatus is to be shipped to a "prepay station," it shall be at the risk of the *Purchaser*, ~~and the Company shall not be responsible for any loss or damage to the apparatus after it has been shipped to the prepay station.~~

The foregoing proposal is subject to the approval of an executive officer of the *Company*, the Manager or Assistant Manager of its General Office Railway, Lighting, Power and Mining, or Supply Departments, or the Manager of its ~~Chicago~~ Office, and is not binding upon the *Company* until so approved and delivered to the *Purchaser*, nor in any event unless accepted by the *Purchaser* within fifteen days from date of its submission. If this printed form is altered or modified in any respect (except to abridge the time of payment), it must be approved by an executive officer, or the manager of a Commercial Department, and is not binding upon the *Company* unless it is so approved. This agreement as it exists at the date of approval by the *Company* is the agreement between the parties, and all previous communications between them, either verbal or written, are hereby abrogated and withdrawn, and this proposal when duly signed, accepted and approved constitutes in all respects the agreement between the parties hereto, and no modification thereof shall be binding upon the parties hereto or either of them unless such modification shall be in writing duly executed by the *Purchaser* and approved by a duly authorized representative of the *Company*.

GENERAL ELECTRIC COMPANY,

R. Beecher
C.A. Goodnow 11/9/14

(Signed) By A. H. Armstrong

TO GENERAL ELECTRIC COMPANY:

Your proposal as above is hereby accepted this Ninth day of November 1914

Attest:

Purchaser's Secretary

By

Chicago Milwaukee & St. Paul Railway Co.
A. J. Earling
President

Approved

Nov 24th

1914

GENERAL ELECTRIC COMPANY

By

E. W. Rice Jr.

DETAILED LOCOMOTIVE SPECIFICATIONS,

No. 1088 FREIGHT SERVICE - 3000 VOLTS D. C.

Specification for nine 44444-E-519- 8-6HZ-490-3000 Volt D. C. Locomotive.

GENERAL DESIGN:

Two similar sections each consisting of two articulated two axle trucks and one swivel guiding truck supporting a box type cab. The two sections connected by an articulated joint.

Design shown by T- 1124667.

GENERAL DIMENSIONS (Approximate)

Length inside of knuckles	112' 0"
Length over cab	106' 10"
Height over cab	15' 6"
Width overall	10' 0"
Total wheel base	103' 4"
Rigid wheel base	10' 0"
Track gauge	4' 8 1/2"
Min. radius of curvature	250'

WEIGHTS (Approximate)

Electrical equipment	\$19,700 lb.
Air brake and compressor	17,500 "
Mechanical equipment	282,000 "
Total weight	\$19,000 "
Weight on drivers	400,000 "
Weight on guiding trucks	119,000 "
Weight per driver	\$0,800 "
Dead weight per driving axle	15,300 "

In making detail design of locomotive full consideration will be given to the possibility of reducing overall length and also to equalize weights upon each driving axle.

Six freight locomotives will be furnished with above dimensions and weights which provide for space in which steam heater, water and oil tanks may be installed.

Three locomotives will be furnished equipped with heater and tanks for emergency use as passenger locomotives, and the weight of these locomotives so equipped will be approximately 282,000 lb.

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Heater will be capable of evaporating 1500 lbs. water per hour and a storage capacity will be provided for 30,000 lbs. water and 450 gallons oil. On these three locomotives will also be provided lighting generator capacity of 20 kw. to furnish current to charge the lighting storage batteries on trailing passenger cars. This generator will be direct driven by the 3000 volt motor described under locomotive auxiliaries.

RUNNING GEAR:

Consists of four two-axle power trucks connected by articulated joints and with frames of end trucks extended and attached by center plates to two axle guiding trucks. Power trucks to have outside steel side frames semi-elliptic spring support steel transoms and end frames.

SPRINGS:

The springs will be of the best cast steel tempered in oil, and each proportioned to the weight to be carried, with ample factors of safety.

DRIVING WHEELS:

Type and material	Steel tires C.S. centers
Number	16
Diameter	52"
Diameter of centers	44"
Material of tires	Open hearth steel
Width	5 1/8"
Thickness	5"
Tread and flange	MOB contour
Fastening	Shrinkage and lip.

GUIDING TRUCK WHEELS:

Type and material	Solid rolled steel
Number	8
Diameter	52"
Diameter of centers	---
Material of tires	Integral with centers
Width	5 1/8"
Thickness	5 1/8"
Tread and flange	MOB contour
Fastening	---

All wheels to be of make selected by Purchaser and sold subject to maker's guarantee.

AXLES:

Material	Hammered CR steel
Diameter between wheels	5 1/2"
Diameter motor axle bearing	5 1/8"
Diameter wheel seat	---
Diameter gear fit	Gear centers on wheel hubs.

DRIVING:

Journals	Collarless
Journals, dimensions	7 1/2" x 14"
Journal box	Cast steel

AXLES:GUIDING TRUCK:

Material	Hammered OH steel
Diameter between wheels	MCB Std.
Diameter motor axle bearing	-----
Diameter wheel seat	-----
Diameter gear fit	-----
Journals, type	MCB collar
Journals, dimensions	5 1/2" x 10"
Journal box	-----

FOUNDATION BRAKES:

The brake rigging will be properly proportioned to give a total brake shoe pressure of 65% of the weight on drivers with 50 pounds per square inch cylinder pressure.

Hand brake will be placed on each end of locomotive.

PLATFORM:

The platform framing will be built up of structural steel longitudinal and cross sills, stiffened by brace plates and a steel floor 5/8 inch thick, securely riveted.

A wooden covering floor 3/4 inch thick will be provided in the motormen's cabs overlaying the steel floor.

BUMPERS:

Cast steel attached to extended frames of end power trucks.

DRAFT GEAR:

Attached to extended frames of end power trucks.
 Type of coupler - MCB
 Height above rail 54 1/2 inches.
 Type of draw rigging - Miner friction draft gear.
 Type of buffers - Oak beams attached to truck end frames.

PILOTS AND END STEPS:

Steel pilots with foot plates will be provided.

CAB:

The sides and the ends of the cab will be built of 1/8 inch steel, the roof of No. 8 steel substantially riveted to a frame of steel angles properly braced and riveted together.

Type and dimensions of cab. Two box type cabs each 10' by 52'8" long. Outer end of each cab has compartment for motorman. The electrical train heating and air brake apparatus occupies the other portion.

Motorman's compartment will be provided with a non-inflammable heat insulating lining.

The doors and window sashes will be of wood glazed with first quality double thick glass.

Doors will be located to give access to cabs from outside and between compartments.

End doors and windows will be provided with a suitable device for clamping tightly shut.

Engineer's seats will be provided.

The necessary steps and hand rails will be provided.

TOOLS AND FIXTURES:

There will be provided a steel tool box with wrenches, hammer, chisels, packing tools, pinch bar, oil can, and flags according to the General Electric Company's standard list.

Sanders operated by air will be provided.

Bell- 2- 14 1/2" bells with air ringers will be provided.

Whistle- 2- air operated whistles will be provided.

AIR BRAKE EQUIPMENT:

Westinghouse schedule 14-KL air brake equipments will be provided.

Main reservoirs with a capacity of at least 85,000 cu. in.

Air brake cylinder - 10- cylinders 12" x 10"

Air signal will be included.

SPEED INDICATOR:

To be of make specified by Purchaser at price not exceeding \$250 and sold subject to maker's guarantee.

AIR COMPRESSOR:

There will be provided in the cabs, two air compressors having a piston displacement of 150 cubic feet each per minute when delivering air at a pressure of 130 pounds per square inch and operating at 3000 volts.

MOTOR DATA:

The locomotive will be equipped with 8- GE2-490 commutating pole box frame motors, twin geared to the driving axles and operating at 1500 volts, two permanently in series for 3000 volts. The following data applies:-

MOTOR DATA:

Number per locomotive	8
Type	GE2-490
Voltage	1500 volts
Insulated for	3000
Wheel diameter	52"
Diameter of armature	29.5"
Length core	18"
HP rating - 1 hour - A. I. E. E. as of 1913	450
Ampere rating - 1 hour - A. I. E. E. as of 1913	240
Ampere rating continuous blow	210
Cu. ft. air per minute	1750
5 Min. ampere rating 30% coefficient of adhesion	350
Copper loss - 1 hour rating	14400 watts
" " - cont.	11000 "
" " - 5 Min.	87500 "
Core loss - 1 hour	7400 "
" " - cont.	7150 "
" " - 5 Min.	5260 "

The above values for copper and core loss are approximate figures based upon calculation. They do not constitute a guarantee, and are for estimating purposes only.

Motors will be suspended on axle and truck transom and drive through spring gears.

Gears and Pinions:

Gear ratio	4-52
Gear teeth	86
Pinion teeth	19
Pinions - Forged steel, Grade "F" two per motor	
Gears - Spring forged steel Grade "F" nine and provided with spring drive.	

CONTROL EQUIPMENT:

The locomotive will be equipped with Type "M" Multiple Unit Control, with two master controllers and arranged to make the necessary connections for starting steps on resistance and series parallel grouping of the motors. The control will also provide for shunting the motors for higher speeds on level track only, and regenerative electric braking on down grades.

Two locomotives may be operated in multiple.

Rheostats of sufficient capacity for the specified service will be provided and properly secured and insulated.

Contactors of proper size to operate the power circuits will be included with Type "M" control.

Full details of control, connections, numbers of steps series and parallel, resistances and tractive effort increments will be furnished.

All control apparatus and details thereof will be in accordance with the General Electric Company's standard practice unless otherwise specified and detailed as part of the contract.

COLLECTING DEVICES:

There will be furnished two pantograph trolleys and bases suitably insulated for collecting current at 5000 volts from a trolley conductor located centrally above the track with catenary suspension and with a variation in height from 19 ft. to 25 ft.

LIGHTING AND MISCELLANEOUS EQUIPMENT:

Necessary lamps, switches, fuses and wiring for illuminating cab and gauges, and for headlights will be installed.

Headlights to meet requirements of Montana law.

One electric heater in each motorman's cab. Two motor generator blower sets to supply current for control, lights, regenerative braking, train lighting and air to cool motors.

The auxiliary apparatus upon each half unit comprises;

- 1: A motor generator set consisting of an 84 kw 5000 volt motor having two commutators in series and driving a blower to ventilate the axle motors.
- 2: A generator of 40 kw capacity having two commutators and used to excite the fields of the power motors during regenerative braking. This exciter will be directly connected to the shaft of the 5000 volt motor above.

- 3: Control generator of 8 kw capacity direct connected to the 3000 volt motor shaft and furnishing 125 V. current to operate the control, headlights and locomotive light.
- 4: Lighting generator capacity of 20 kw to supply current for train lighting batteries and driven by the 3000 volt motor (to be furnished on 3 locomotives only). If separate lighting generator is used only one outfit will be supplied on a complete locomotive.
- 5: 150 ft. air compressor with 3000 volt motor having two commutators in series and operating direct from trolley circuit and taking 50 kw at maximum pressure of 150 lbs.

SERVICE CAPACITY:

Each locomotive will successfully haul a trailing load of 2500 tons on all gradients between Deer Lodge and Harlowton of 1% or less, and with the assistance of a similar locomotive 2500 tons trailing on all gradients of 2% or less. This service performance is based upon the following values for grade, train and curve resistance.

AVERAGE TRACTIVE EFFORT LB. PER TON

	<u>Grade</u>	<u>Train</u>	<u>Curve</u>	<u>Total</u>	<u>Approx. Speed 3000 volts.</u>
Deer Lodge - Newcomb	8.9	6	0.6	15.5	18.0 m.p.h.
Newcomb - Donald	26.7	6	2.0	34.7	17.5 "
Piedmont - Donald	26.8	6	1.5	34.3	17.0 "
Lombard - Piedmont	2.62	6	0.4	9.22	22.5 "
Piedmont - Lombard	2.62	6	0.6	9.22	27.5 "
Lombard - Summit	15.0	6	1.2	21.0	16.5 "
Greveland - Summit	17.7	6	1.0	24.7	17.0 "
Harlowton - Greveland	11.0	6	0.1	17.1	18.5 "

The above approximate speeds are based upon the above values of grade, train and curve resistance and with trailing load of 2500 tons eastbound and 2000 tons westbound.

Maximum operating speed of locomotive 30 m.p.h.

Maximum emergency speed of locomotive 25 m.p.h.

PAINTING AND LETTERING:

Will be in accordance with railway company's standards.

BOLTS AND NUTS:

All bolt threads will be U.S. standard except where finer threads are necessary.

MATERIAL SPECIFICATIONS of the Railway Company will govern in the construction of mechanical parts of the locomotive and the standard specification of the General Electric Company will be followed in the construction of electrical apparatus.

ERECTOR:

The locomotive will be erected complete in running order at Schenectady subject to the Purchaser's inspection.

ACCEPTANCE TESTS:

The following tests will be made before shipment.

a. High potential test and insulation resistance test on the assembled locomotive, or on the individual parts in accordance with standard specifications of the General Electric Company and A. I. E. E. as of 1913.

b. Measurement of resistance of rheostats and wiring on the assembled locomotive to show that the connections are made in proper order.

c. General Examination in operation on a test track to test general mechanical features, operation of contactors, air brakes, and heating of bearings.

Tests will be made upon the first locomotive received upon the tracks of the Railway Company and under its direction to determine if the locomotive can fulfill guaranteed performance as to service capacity. Subject to strikes, fires, floods, or other causes beyond the control of the Railway Company, such tests shall be completed within sixty (60) days of receipt of the locomotive upon the electrified tracks and will in general be of such a nature as will conform to the motor and locomotive capacity specified herein. The successful performance of the first locomotive under the above factory and service tests will constitute its acceptance, and succeeding locomotives will be subjected to factory tests only.

DELIVERY:

The locomotive will be delivered f.o.b. tracks Company's works.

Messenger will be furnished to accompany it to destination and be responsible for delivery in proper condition. Expense of messenger will be billed to the Purchaser at cost.

Price and delivery are based on the locomotive exactly as specified above. Details of electrical or mechanical equipment not specified herein will be furnished in accordance with the General Electric Company's standard practice. Any modification of these specifications or details will entail a corresponding modification in price and delivery.

Specification prepared by A. E. Batchelder (AJW)

DETAILED LOCOMOTIVE SPECIFICATIONS

No. 1089 PASSENGER SERVICE - 3000 VOLTS D. C.

Specification for three 44444-B-564-S- GE1-490-3000 Volt D. C. Locomotives.

GENERAL DESIGN:

Two similar sections each consisting of two articulated two axle trucks and one swivel guiding truck supporting a box type cab. The two sections connected by an articulated joint.

Design shown by T- 11244657.

GENERAL DIMENSIONS (Approximate)

Length inside of trucks	112' 8"
Length over cab	104' 10"
Height over cab	15' 6"
Width over all	101' 0"
Total wheel base	103' 4"
Rigid wheel base	10' 0"
Track gauge	41' 8 1/2"
Min. radius of curvature	250'

WEIGHTS (Approximate)

Electrical equipment	222,200 lb.
Mechanical equipment	222,000 "
Train heater, tanks, water and oil	42,900 "
Air brakes and compressor	17,500 "
Total weight	544,600 "
Weight on drivers	444,400 "
Weight on guiding trucks	120,000 "
Weight per driver on 6 axles	57,500 "
Weight per driver on 2 axles	30,000 "
Dead weight per driving axle	12,500 "

In making detail design of locomotive full consideration will be given to the possibility of reducing overall length, and also to equalize weights upon each driving axle.

RUNNING GEAR:

Consists of four two-axle power trucks connected by articulated joints and with frames of end trucks extended and attached by center plates to two-axle guiding trucks. Power

trucks to have outside steel side frames semi-elliptic spring support steel transoms and end frames.

SPRINGS:

The springs will be of the best cast steel tempered in oil, and each proportioned to the weight to be carried, with ample factors of safety.

DRIVING WHEELS:

Type and material	Steel tires C.S. centers
Number	16
Diameter	32"
Diameter of centers	45"
Material of tires	Open hearth steel
Width	8 1/2"
Thickness	3"
Tread and flange	M33 contour
Fastening	Shrinkage and lip

SPIDING TRUCK WHEELS:

Type and material	Solid rolled steel
Number	8
Diameter	36"
Diameter of centers	---
Material of tires	Integral with centers
Width	8 1/2"
Thickness	2 1/2"
Tread and flange	M33 contour
Fastening	----

All wheels to be of make selected by Purchaser and sold subject to maker's guarantee.

AXLES

Material	
Diameter between wheels	
Diameter motor axle bearing	
Diameter wheel seat	
Diameter gear fit	
Journals, type	
Journals, dimensions	
Journal box	

DRIVING

Hammered OH steel
8 1/2"
8 1/2"

Gear centers on wheel hub.
Collapsible
7 1/8" x 14"
Cast steel

AXLES:

Material
 Diameter between wheels
 Diameter motor axle bearing
 Diameter wheel seat
 Diameter gear fit
 Journals, type
 Journals, dimensions
 Journal box

GUIDING TRUCK

Hammered ON steel
 MOB Std.

 MOB Collar
 5 1/2" x 10"

FOUNDATION BRAKES:

The brake rigging will be properly proportioned to give a total brake shoe pressure of 88% of the weight on drivers with 50 pounds per square inch cylinder pressure.

Hand brake will be placed on each end of locomotive.

PLATFORM:

The platform framing will be built up of structural steel longitudinal and cross sills, stiffened by brace plates and a steel floor 3/8" thick, securely riveted.

A wooden covering floor 3/4" thick will be provided in the motorman's cab overlaying the steel floor.

BUMPERS:

Cast steel attached to extended frames of end power trucks.

DRAFT GEAR:

attached to extended frames of end power trucks.
 Type of coupler - MOB
 Height above rail - 34 1/2"
 Type of draw rigging - Miner friction draft gear.
 Type of buffers - Oak beams attached to truck end frames.

PILOTS AND END STEPS:

Steel pilots with foot plates will be provided.

CAB:

The sides and the ends of the cab will be built of 1/8" steel, the roof of No. 8 steel substantially riveted to a frame of steel angles properly braced and riveted together.

20

Type and dimension of cab. Two box type cabs each 10' x 52' 8" long. Outer end of each cab has compartment for motorman. The electrical, train heating and air brake apparatus occupies the other portion.

Motorman's compartment will be provided with a non-inflammable, heat insulating lining.

The doors and window sashes will be of wood glazed with first quality double thick glass.

Doors will be located to give access to cabs from outside and between compartments.

End doors and windows will be provided with suitable devices for clamping tightly shut.

Engineer's seats will be provided.

The necessary steps and hand rails will be provided.

TOOLS AND FIXTURES:

There will be provided a steel tool box with wrenches, hammer, chisels, packing tools, pinch bar, oil cans and flags according to the General Electric Company's standard list.

Sanders operated by air will be provided.

Bell - 2- 14 1/2" bells with air ringers will be provided.

Whistle - 2- air operated whistles will be provided.

AIR BRAKE EQUIPMENT:

Westinghouse Schedule 14-EL air brake equipment will be provided.

Main reservoir with a capacity of at least 85,000 cu. in.

Air brake cylinder - 10- cylinders 12" x 10"

Air signal will be included.

SPEED INDICATOR:

To be of make specified by Purchaser at price not exceeding \$250 and sold subject to maker's guarantee.

AIR COMPRESSOR:

There will be provided in the cabs two air compressors having a piston displacement of 150 cu. ft. each per minute when delivering air at a pressure of 150 pounds per sq. in. and

operating at 3000 volts.

MOTOR DATA:

The locomotive will be equipped with 8- GE2-490 commutating pole box frame motors, twin geared to the driving axles and operating at 1500 volts, two permanently in series for 3000 volts. The following data applies:-

Number per locomotive	8
Type	GE2-490
Voltage	1500
Insulated for	3000
Wheel diameter	52"
Diameter of armature	29.5"
Length core	12"
H.P. rating - 1 hour A. I. E. E. as of 1915	420
Amps	240
Amps - continuous (1/2 hour)	210
Cu. ft. air per minute	1750
1 Min. ampere rating 80% coefficient of adhesion	570
Copper loss - 1 hour rating	14400 watts
" - cont.	11000 "
" - 1 Min.	21500 "
Core loss - 1 hour	7400 "
" - cont.	7150 "
" - 1 Min.	10700 "

The above values for copper and core loss are approximate figures based upon calculation. They do not constitute a guarantee, and are for estimating purposes only.

Motors will be suspended on axle and truck transoms and drive through spring gears.

GEARS AND PINIONS:

Gear ratio	2.50
Gear teeth	74
Pinion teeth	31
Pinions - Forged steel Grade "F" two per motor	
Gears - Spring Forged steel Grade "F" rims and provided with spring drive.	

CONTROL EQUIPMENT:

The locomotives will be equipped with type "M" multiple unit control, with two master controllers and arranged to make the necessary connections for starting steps on resistance and series parallel grouping of the motors. The control will also

20
provide for shunting the motors for higher speeds on level track only, and regenerative electric braking on down grades.

Two locomotives may be operated in multiple.

Rheostats of sufficient capacity for the specified service will be provided and properly secured and insulated.

Full details of control connections, number of steps, series and parallel, resistance and tractive effort increments will be furnished.

Contactors of proper size to operate the power circuits will be included with type "L" control.

All control apparatus and details thereof will be in accordance with the General Electric Company's standard practice unless otherwise specified and detailed as part of the contract.

COLLECTING DEVICES:

There will be furnished two pantograph trolleys and bases suitably insulated for collecting current at 3000 volts from a trolley conductor located centrally above the track with catenary suspension with a variation in height from 19 ft. to 25 ft.

LIGHTING AND MISCELLANEOUS EQUIPMENT:

Necessary lamps, switches, fuses and wiring for illuminating cab and gauges, and for headlights will be installed.

Headlights to meet requirements of Montana law.

Heating apparatus- An oil burning steam boiler capacity 1500 lb. steam per hour; water tank for 20,000 lb. water; oil tank for 450 gal. oil. Oil and water storage capacity will be so proportioned that a 500 ton local passenger train can be heated by the half locomotive containing heater. Two motor generator blower sets to supply current for control, lights, regenerative braking, train lighting and air to cool motors. Electric heater will be provided in cab.

The auxiliary apparatus upon each half unit comprises:

1. A motor generator set consisting of an 86 kw 3000 volt motor, having two commutators in series and driving a blower to ventilate the axle motors.
2. A generator of 40 kw capacity, having two commutators and used to excite the fields of the power motors during regenerative braking. This exciter will be direct connected to the shaft of the 3000 volt motor above.
3. Control generator of 4 kw capacity direct connected to the 3000 volt motor shaft and furnishing 125 V.

current to operate the control, headlights and locomotive lights.

4. Lighting generator capacity of 20 kw to supply current for train lighting batteries and driven by the 3000 volt motor. If separate lighting generator is used only one outfit will be supplied on a complete locomotive.
5. 150 ft. air compressor with 3000 volt motor, having two commutators in series and operating direct from trolley circuit and taking 30 kw at maximum pressure of 130 lbs.

SERVICE CAPACITY:

Each locomotive of 564,400 lbs. total weight will successfully haul a trailing load of 800 tons on all gradients between Deer Lodge and Harlowton, excepting the 2% ruling grade between Piedmont and Donald, westbound. The locomotive will haul unaided a trailing load of 650 tons up this grade and with the assistance of a freight helper will haul a trailing load of 1100 tons. This service performance is based upon the following values for grades, train and curve resistance.

AVERAGE TRACTIVE EFFORT LB. PER TON

	<u>Grade</u>	<u>Train</u>	<u>Curve</u>	<u>Total</u>	<u>Approx. speed 3000 volts</u>
Deer Lodge - Newcomb	8.9	6	0.6	15.5	57.5 m.p.h.
Newcomb - Donald	26.7	6	2.0	34.7	30.5 "
Piedmont - Donald	26.3	6	1.5	33.8	29.2 "
Lombard - Piedmont	8.62	8 1/2	0.6	11.72	51.8 "x
Piedmont - Lombard	8.62	9	0.6	6.98	61.0 "x
Lombard - Summit	15.8	6	1.2	21.0	34.5 "
Croveland - Summit	17.7	6	1.0	24.7	33.0 "
Harlowton - Croveland	11.0	6	0.1	17.1	36.0 "

x - based upon motor fields shunted.

The above approximate speeds are based upon the above values of grade, train and curve resistance and with trailing load of 800 tons, on all gradients except between Piedmont and Donald, where 650 tons are hauled.

Maximum operating speed of locomotive 60 m.p.h.
Maximum emergency speed of locomotive 45 m.p.h.

PAINTING AND LETTERING:

Will be in accordance with Railway Company's standards.

BOLTS AND NUTS:

All bolt threads will be U. S. standard except where fixed

threads are necessary.

MATERIAL SPECIFICATIONS:

Material specifications of the Railway Company will govern in the construction of the mechanical parts of the locomotive, and the standard specifications of the General Electric Company will be followed in the construction of the electrical apparatus.

ERECTION:

The locomotive will be erected complete in running order at Schenectady subject to the Purchaser's inspection.

ACCEPTANCE TEST:

The following tests will be made before shipment.

a. High potential test and insulation resistance test on the assembled locomotive, or on the individual parts in accordance with standard specifications of the General Electric Company and A. I. E. E. as of 1913.

b. Measurement of resistance of rheostate and wiring on the assembled locomotive to show that the connections are made in proper order.

c. General examination in operation on a test track to test general mechanical features, operation of controllers, air brakes and heating of bearings.

Tests will be made upon the first locomotive received upon the tracks of the Railway Company and under its direction to determine if the locomotive can fulfill guaranteed performance as to service capacity. Subject to strikes, fires, floods or other causes beyond the control of the Railway Company, such tests shall be completed within sixty (60) days of receipt of the locomotive upon the electrified tracks and will in general be of such a nature as will conform to the motor and locomotive capacity specified herein. The successful service tests will constitute its acceptance, and succeeding locomotives will be subjected to factory tests only.

DELIVERY:

The locomotive will be delivered f.o.b. Tracks Company's Works.

Messenger will be furnished to accompany it to destination and be responsible for delivery in proper condition. Expense of messenger will be billed to the Purchaser at cost.

Price and delivery are based on the locomotive exactly as specified above. Details of electrical or mechanical equipment not specified herein will be furnished in accordance with the General Electric Company's standard practice. Any modification of these specifications or details will entail a corresponding modification in price and delivery.

Specification prepared by A. F. Batchelder (AJW)

General Electric Company, Schenectady, N. Y.

SPECIFICATIONS FOR 3 UNIT 6 BEARING MOTOR-GENERATOR
SET WITH SYN. MOTOR AND D. C. GENERATOR
DIRECT CONNECTED EXCITER EXC. A SPEC.

For CHICAGO, MILWAUKEE & ST. PAUL R.R.Motor Spec. No. 48036-AGenerator Spec. No. 48036-A-2Date June 23, 1914.

CLASSIFICATION

	Type	Poles	Kv-a.	Kw.	Speed R.P.M.	Volts	Amp.	Field Wind'g	P-F.	No. of Phases	Cycles
Motor	ATI	12	1900	--	600	2500	478	--	.9	3	60
Generator	MCP	6		750	600	1500	500	07	-	-	-
Exciter	MP	6		13	600	125	-				
	MP	6		8	600	125					

TEMPERATURES AND HIGH POTENTIAL TESTS*

	RISE IN TEMPERATURE BY THERMOMETER DEG. C. @ <u>.9</u> P-F.						FACTORY HIGH POTENTIAL TESTS BETWEEN COILS AND FRAME A-C. VOLTAGE FOR 1 MIN.		EXCITATION REQUIRED AT OVERLOAD AND P-F. STATED†	
	Full Load Continuously <u>1 1/2</u> % Load <u>2</u> Hrs.									
	Arm.	Field	Comm.	Arm.	Field	Comm.	Field	Arm.	Volts	Kw.
Motor	<u>35</u>	<u>35</u>	<u>-</u>	<u>55</u>	<u>55</u>	<u>-</u>	<u>5000</u>	<u>5000</u>	<u>125</u>	<u>13</u>
Generator	<u>35</u>	<u>35</u>	<u>35</u>	<u>55</u>	<u>55</u>	<u>55</u>	<u>2000</u>	<u>6000</u>	<u>125</u>	<u>8</u>

The above temperature rises are based on a room temperature of 25 deg. C. and a barometric pressure of 760 mm. of mercury and will be corrected according to standards of A.I.E.E.

EFFICIENCIES AND OVERLOAD OF SET

P-F.	<u>1 1/2</u> Load	Full Load	1/2 Load	1/4 Load	Maximum Momentary Overload <u>150%</u>
.90	90.2	89.6	88.5	85.6	200%

APPROXIMATE NET WEIGHTS AND DIMENSIONS

ROTATING MEMBER		STATIONARY MEMBER		Base Bearings and Accessories	2 Exciter Complete	Weight of Set	OVERALL DIMENSIONS		
Motor	2 Generator	Motor	2 Generator				Length	Width	Height above floor
14150	22000	12000	36600	16800	1900	103450			

EFFICIENCY.—The efficiencies include bearing and windage losses and all electrical losses in both machines. Losses in field rheostat of alternating current machine not included.

Two bearing sets have rotating members mounted on single shaft, the weight of this shaft being included with generator rotating member. Sets with more than two bearings have the rotating members mounted on separate shafts connected by suitable couplings.

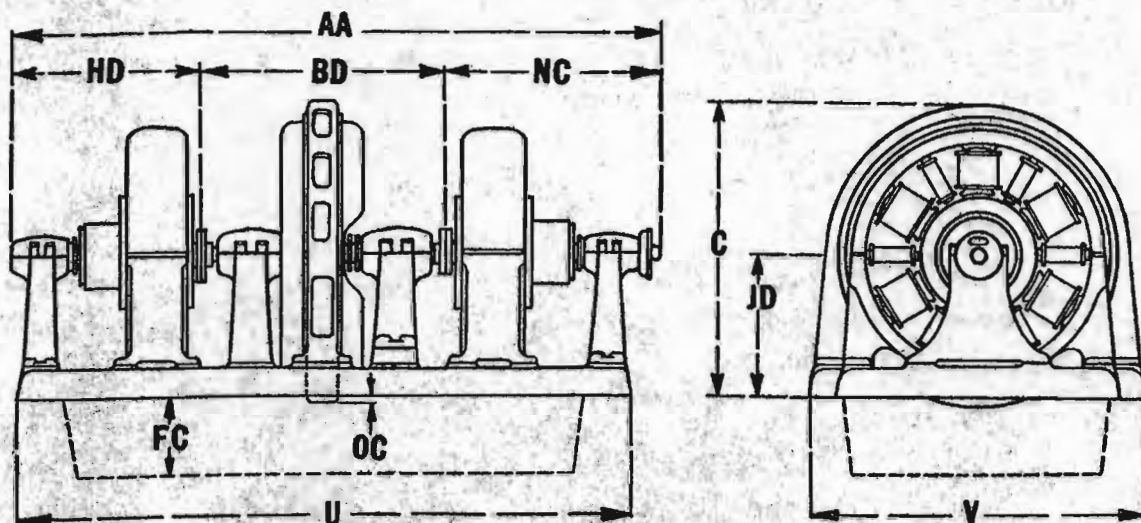
* When tests are made for heating the full load is continued until the temperatures become constant. The overload temperatures are based on making the overload run immediately following the full load run.

† The maximum exciting current required by the synchronous machine at its rated overload and p-f. is approximately equal to the normal rated current of the exciter recommended.

(2) D.C. generators operate in series for 3000 V. Pole face, series & commutating windings are connected on low side. Shunt field sep. excited from 125 V. Exciter for syn. motor to be compounded by current from the generator so that excitation at 300% load will maintain 1.0 P.F. input to motor with 15% line drop, and excitation at normal load will maintain approx. .9 P.F. leading current input at normal voltage.

GENERAL DIMENSIONS OF MOTOR-GENERATOR SETS—FOUR BEARINGS

PRELIMINARY DESIGN



MOTOR A. T. I. 12-1900-600, 2500 V.

GENERATOR M. C. F. 6-750-600, 1500 V.

"U" and "AA" include 2 exchangers

AA	BD	C	FC	HD	JD	NC	OC	U	V
314"	103-1/2"	96"	36"	85-1/2"	42"	85-1/2"	12"	210"	117"

DIMENSIONS ARE APPROXIMATE AND MUST NOT BE USED FOR CONSTRUCTION

FOR CHICAGO, MILWAUKEE & ST. PAUL RAILWAY

ENGINEERING DEPT.
GENERAL ELECTRIC COMPANY

M.C. 48056

APPROVED H. F. T. FRENCH
Per - Gandy.

Date June 25, 1914.

General Electric Company, Schenectady, N. Y.

SPECIFICATIONS FOR 3 UNIT 4 BEARING MOTOR-GENERATOR
SET WITH SYN. MOTOR AND (2) D. C. GENERATOR
with DIRECT CONNECTED EXCITER

For CHICAGO, MILWAUKEE & ST. PAUL R. R.Motor Spec. No. 48762Generator Spec. No. Aug. 1, 1914/
Date

CLASSIFICATION

	Type	Poles	Kv-a.	Kw.	Speed R.P.M.	Volts	Amp.	Field Wind'g	P-F.	No. of Phases	Cycles
Motor	ATI	14	2500	--	514	2300	628		.9	3	60
Generator (2)	MOP	8	---	1000	514	1500	667	CW			
Exciter	MP	6	---	12	514	125	96	CW			
	MP	6	---	25	514	125	200	CW			

TEMPERATURES AND HIGH POTENTIAL TESTS*

	RISE IN TEMPERATURE BY THERMOMETER DEG. C. @ <u>.9</u> P-F.						FACTORY HIGH POTENTIAL TESTS BETWEEN COILS AND FRAME A-C. VOLTAGE FOR 1 MIN.		EXCITATION REQUIRED AT OVERLOAD AND P-F. STATED	
	Full Load Continuously <u>150</u> % Load <u>2</u> Hrs.									
	Arm.	Field	Comm.	Arm.	Field	Comm.	Field	Arm.	Volts	Kw.
Motor	<u>35</u>	<u>35</u>		<u>55</u>	<u>55</u>		<u>5000</u>	<u>5000</u>	<u>125</u>	<u>25</u>
Generator	<u>35</u>	<u>35</u>	<u>35</u>	<u>55</u>	<u>55</u>	<u>55</u>	<u>2000</u>	<u>6000</u>	<u>125</u>	<u>6</u>

The above temperature rises are based on a room temperature of 25 deg. C. and a barometric pressure of 760 mm. of mercury and will be corrected according to standards of A.I.E.E.

EFFICIENCIES AND OVERLOAD OF SET

P-F.	<u>1 1/2</u> Load	Full Load	$\frac{1}{2}$ Load	$\frac{1}{4}$ Load	<u>5</u> Maximum Momentary Overload	Min.
.9	90.5	90.0	88.7	86.0	300%	

APPROXIMATE NET WEIGHTS AND DIMENSIONS.

ROTATING MEMBER		STATIONARY MEMBER		Base Bearings and Accessories	Exciter Complete	Weight of Set	OVERALL DIMENSIONS		
Motor	Generator	Motor	Generator				Length	Width	Height above floor
19500	31000	16000	40300	22000	4000	132800	(See print)		

EFFICIENCY.—The efficiencies include bearing and windage losses and all electrical losses in both machines. Losses in field rheostat of alternating current machine not included.

Two bearing sets have rotating members mounted on single shaft, the weight of this shaft being included with generator rotating member. Sets with more than two bearings have the rotating members mounted on separate shafts connected by suitable couplings.

* When tests are made for heating the full load is continued until the temperatures become constant. The overload temperatures are based on making the overload run immediately following the full load run.

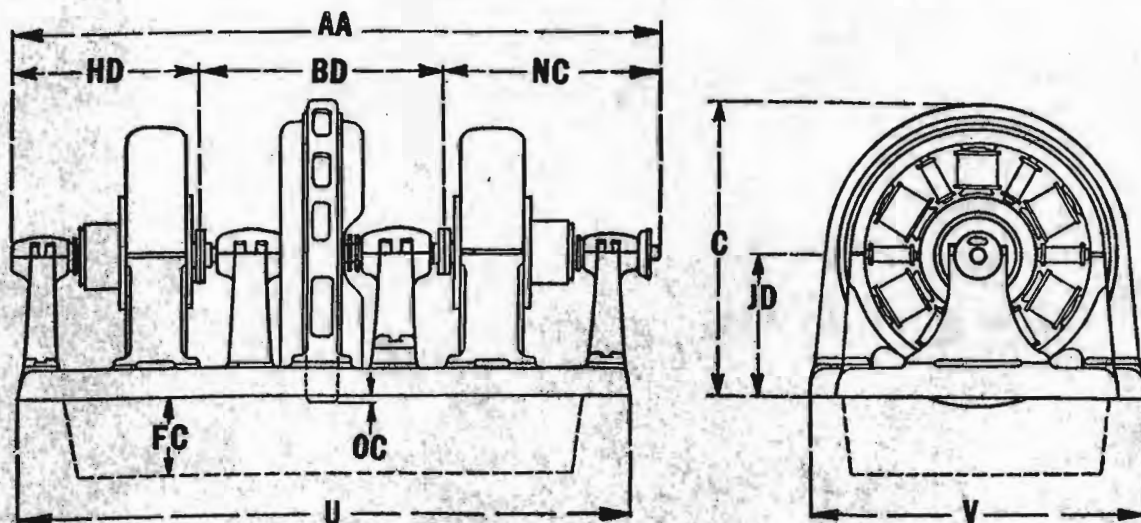
† The maximum exciting current required by the synchronous machine at its rated overload and p-f. is approximately equal to the normal rated current of the exciter recommended.

(2) D.C. Generators operate in series for 5000 V. Pole face, series and comm. windings are connected on low side. Shunt fields separately excited from 125 V. exciter. Exciter for syn. motor to be compounded by current from the generator so that excitation at 300% load will maintain 1.0 P.F. input to motor with 15% line drop and excitation at normal load will maintain approx. .9 P.F. leading current input at normal voltage.

H. F. T. FROEN,
Per - Motor.

GENERAL DIMENSIONS OF MOTOR-GENERATOR SETS—FOUR BEARINGS

PRELIMINARY DESIGN



MOTOR A. P. I. 14-2500-514, 2500 V.

GENERATOR M. O. P. 8-1000-514, 1000 V.

M. P. 6-12-514- 125 V.

M. P. 6-25-514, 125 V.

AA	BD	C	FC	HD	JD	NC	OC	U	V
261"	110"	96"	36"	75.5"	42"	75.5"	12"	25.5"	117"

DIMENSIONS ARE APPROXIMATE AND MUST NOT BE USED FOR CONSTRUCTION

EXCITERS ADD 24" and 25" TO DIMENSION "AA"

" " 20" " 18" " " " "U"

FOR CHICAGO, MILWAUKEE & ST. PAUL RAILWAY

ENGINEERING DEPT.
GENERAL ELECTRIC COMPANY

M.C. 48062

H. F. T. PRINCE
APPROVED Per - Motor.

Date Aug. 6, 1914.

GENERAL ELECTRIC COMPANY

SPECIFICATION FOR OIL-COOLED TRANSFORMERS

For CHICAGO, MILWAUKEE & ST. PAUL R. R.Spec. No. P- 38121-8

CLASSIFICATION					OUT DOOR TYPE
Type	No. of Phases	Cycles	Kv-a.	High Voltage Winding	Low Voltage Winding
HT	3	60	1900	Volts 100,000	Volts 2300

The ratio of transformation is based on no-load operation and will be subject to the effect of regulation at various loads and power-factors.

This transformer is designed for Delta connection on 100,000 volt circuits.

Taps will be provided for the following additional approximate voltages: High voltage winding -- There will be (4) 2 1/2% high tension tap voltages, obtained by means of equivalent taps on the low voltage winding. Low voltage winding, 1/2 starting tap. Full Kv-a capacity will be obtained at high voltages without exceeding the specified temperature rise.

PER CENT EFFICIENCY (AT 1.00 P-F.)					PER CENT REGULATION	
TO BE DETERMINED BY THE AVERAGE OF THE CORE LOSSES AND OF THE I ² R LOSSES OF ALL TRANSFORMERS FURNISHED IN ACCORDANCE WITH THIS SPECIFICATION					1.0 P-F.	1.0 P-F(x)
1 1/2 Load	Full Load	3/4 Load	1/2 Load	1/4 Load	1.1	2.05
98.5	98.4	98.1	97.6	95.6		

TEMPERATURE RISE (By Increase of Resistance)			INSULATION TESTS (For One Minute—Transformer Filled with Oil)		
Per cent of rated Kv-a.	Hours	Temp. Rise Deg. C.	H.V. Winding to L.V. Winding and Core Volts	L.V. Winding to Core Volts	Across Full Windings (at Suitable Frequency)
100	Until Constant	40			
150	2	60	200,000	5000	Two Times Normal

The efficiency and temperature rise specified above are based on full rated voltage and frequency.

The temperature rise is further based on a surrounding air temperature of 25 deg. C., normal conditions of ventilation and a barometric pressure of 760 mm. of mercury; corrections for variations from this barometric pressure will be made in accordance with the standardization rules of the A.I.E.E., i.e., by changing the observed rise of temperature by one per cent for each 10 mm. deviation in barometric pressure. The transformers should not be operated under conditions, resulting in an actual temperature higher than 90 deg. C., as measured by increase in resistance of windings or by thermometer.

When more than two transformers are furnished in accordance with this specification, complete temperature tests will be made on two transformers only and the average results of these two tests will be considered as determining the temperature rise on all transformers. If an overload test is specified it will immediately follow full load test.

APPROXIMATE NET WEIGHTS AND DIMENSIONS

THE WEIGHTS AND DIMENSIONS HERE GIVEN ARE NOT FOR CONSTRUCTION AND PURCHASER ASSUMES ALL RISK IF SO USED

NET WEIGHT (In Lb.)		DIMENSIONS (In Inches)		
Trans. (Not Inc. Oil)	Oil	Height over Leads	Height over Cover (A)	Floor Space (B x C)
26000	21000	217	156	140 x 77

REMARKS:

(x) Regulation at 1-1/2 load.

Continued on DS- 40920 attached.

Schenectady, N. Y. August 5, 1914 (DS) Prepared by W. S. Moody (EST)

GENERAL ELECTRIC COMPANY

SPECIFICATION FOR OIL-COOLED TRANSFORMERS

For **CHICAGO, MILWAUKEE & ST. PAUL R. R.**

Spec. No. **P- 38121-10**

CLASSIFICATION

Type	No. of Phases	Cycles	Kv-a.	High Voltage Winding	Low Voltage Winding
HT	3	60	2500	Volts 100,000	Volts 2500

The ratio of transformation is based on no-load operation and will be subject to the effect of regulation at various loads and power-factors.

This transformer is designed for **Delta** connection on **100,000** volt circuits.

Taps will be provided for the following additional approximate voltages: High voltage winding - There will be (4) 2-1/2% high tension tap voltages, obtained by means of equivalent taps on the low voltage winding. Low voltage winding, 1/2 starting tap. Full Kv-a capacity will be obtained at high voltages without exceeding the specified temperature.

PER CENT EFFICIENCY (AT 1.00 P-F.)

TO BE DETERMINED BY THE AVERAGE OF THE CORE LOSSES AND OF THE I²R LOSSES OF ALL TRANSFORMERS FURNISHED IN ACCORDANCE WITH THIS SPECIFICATION

1 1/2 Load	Full Load	3/4 Load	1/2 Load	1/4 Load	1.0 P-F.	1.0 P-F. (x)
98.7	98.6	98.4	98.0	96.4	1.0	1.8

PER CENT REGULATION

TEMPERATURE RISE (By Increase of Resistance)			INSULATION TESTS (For One Minute—Transformer Filled with Oil)		
Per cent of rated Kv-a.	Hours	Temp. Rise Deg. C.	H.V. Winding to L.V. Winding and Core Volts	L.V. Winding to Core Volts	Across Full Windings (at Suitable Frequency)
100	Until Constant	40			
150	2	60	200,000	5000	Two Times Normal

The efficiency and temperature rise specified above are based on full rated voltage and frequency.

The temperature rise is further based on a surrounding air temperature of 25 deg. C., normal conditions of ventilation and a barometric pressure of 760 mm. of mercury; corrections for variations from this barometric pressure will be made in accordance with the standardization rules of the A.I.E.E., i.e., by changing the observed rise of temperature by one per cent for each 10 mm. deviation in barometric pressure. The transformers should not be operated under conditions, resulting in an actual temperature higher than 90 deg. C., as measured by increase in resistance of windings or by thermometer.

When more than two transformers are furnished in accordance with this specification, complete temperature tests will be made on two transformers only and the average results of these two tests will be considered as determining the temperature rise on all transformers. If an overload test is specified it will immediately follow full load test.

APPROXIMATE NET WEIGHTS AND DIMENSIONS

THE WEIGHTS AND DIMENSIONS HERE GIVEN ARE NOT FOR CONSTRUCTION AND PURCHASER ASSUMES ALL RISK IF SO USED

NET WEIGHT (In Lb.)		DIMENSIONS (In Inches)			
Trans. (Not Inc. Oil)	Oil	Height over Leads	Height over Cover (A)	Floor Space (B x C)	
31700	24630	241	180	140 x 77	

REMARKS:

(x) Regulation at 1 1/2 load.

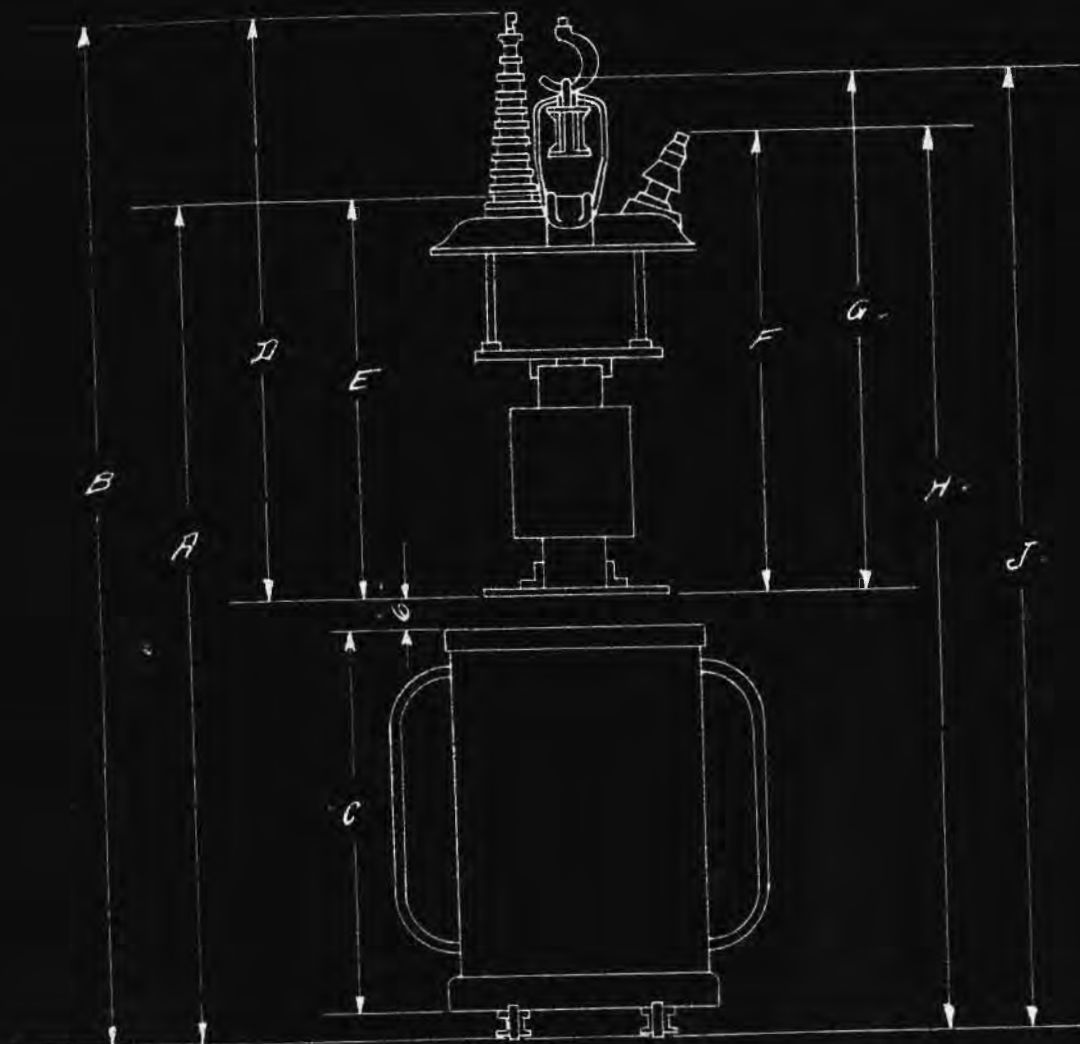
Continued on D. S. 40920 attached.

Schenectady, N. Y. **August 5, 1914.**

Prepared by **W. S. Moody**

A	B	C	D	E	F	G	H	J	
25 ¹¹ / ₁₆ "	30 ¹¹ / ₁₆ "	12 ¹¹ / ₁₆ "	17 ¹¹ / ₁₆ "	12 ¹¹ / ₁₆ "	13 ¹¹ / ₁₆ "	16 ¹¹ / ₁₆ "	27 ¹¹ / ₁₆ "	29 ¹¹ / ₁₆ "	1900 KVA
23 ¹¹ / ₁₆ "	34 ¹¹ / ₁₆ "	14 ¹¹ / ₁₆ "	19 ¹¹ / ₁₆ "	14 ¹¹ / ₁₆ "	15 ¹¹ / ₁₆ "	18 ¹¹ / ₁₆ "	31 ¹¹ / ₁₆ "	33 ¹¹ / ₁₆ "	2500 KVA

TO TANK OR UNTANK TRANSFORMER REMOVE HIGH VOLTAGE LEAD.



CRANE LIFT

FIRST MADE FOR TRANSFORMER HT

BEGUN BY P. M. L. & C.

TRACED BY B. ODELL AUGER

FINISHED BY P. M. L. & C.

INSPECTED BY P. M. L. & C. 13-14

GENERAL ELECTRIC CO.
PITTSFIELD WORKS

K554071

JOB# 86001 DI-CI-FF-TF^L-MN-PI-E¹ E-11

SWITCHBOARD GENERAL SPECIFICATIONS AND CONDITIONS No. **66938**

January 7, 191**5**

To **CHICAGO, MILWAUKEE & ST. PAUL Rwy. CO.,**
(Hereinafter called the Purchaser)

Address **CHICAGO, ILL.**
(Give location of installation in full)

Except as elsewhere expressly modified by Company's specifications attached, the switchboard covered by these specifications will be sold subject to the following general specifications and conditions:

THE PURCHASER WILL FURNISH UNLESS OTHERWISE EXPRESSLY AGREED:

- (A) Labor of installing said switchboard.
- (B) Foundations, sill, supports, or iron framework built into floor, walls or roof, on which panels, compartments or busses rest or are supported.
All necessary supports for mounting current and potential transformers.
- (C) All masonry work, either of brick or concrete, for switch cells, busbar compartments and similar structures.
- (D) All connections between switchboard and
Any main and auxiliary apparatus not included as a part of these specifications.
Switching devices mounted on or near machines or other apparatus.
Lightning arresters and line disconnecting switches.
Primary connections between current transformers and switchboard apparatus unless otherwise specified in the following specifications.
All control wiring for electrically operated apparatus except as may be specified in a separate item under these specifications.
- (E) All ducts and conduits.
- (F) Doors for bus, lightning arrester or static discharger compartments.
- (G) All lengths of standard pipe for switchboard tie rods and for remote control mechanism for oil switches or other remote control apparatus requiring it.
- (H) Field rheostat discharge resistances for use in connection with discharge clips of field switches, or starting resistances for use with starting switches.
- (I) Necessary drawings of station buildings, and show in such drawings at the request of the Company, all necessary openings in floors, walls or roof, ducts, tie pipes and iron armored conduit.

THE COMPANY WILL FURNISH:

Switchboard apparatus as described in detail specifications attached, and in addition:

- (A) All auxiliary apparatus to make instrument equipment furnished by this Company complete such as resistances and reactances.

- (B) The necessary small wiring material with fuses for interconnecting instruments, meters, relays and other apparatus mounted on the panels.
For panels not an integral part of benchboards this wiring material is assembled on the panels. For benchboard panels this material is not assembled excepting the interconnections between control switches and their indicating lamps mounted on the benchboard.
- (C) Primary leads for potential transformers, not exceeding 5 feet, and secondary leads for potential and current transformers, not exceeding 15 feet in length, unless special leads of greater length are specified in the following detail specifications.
- (D) Secondary leads not exceeding 10 feet for direct current instrument shunts when required unless special leads of greater length are specified in the following detail specifications.
- (E) Fittings to go with the standard iron pipe furnished by Purchaser for braces, tie rods and remote control mechanisms.
- (F) Unless otherwise specified Company will furnish complete rheostat operating mechanism and supports for rheostats, when rheostat is mounted on back of panel. When itemized specifications attached state "No handwheel or dial plate included" it is assumed Purchaser will use the handwheel and dial plate which is supplied with the rheostat and in such cases panel will be drilled for G.E. standard dial plate and shaft unless modifying instructions accompany order.
- (G) Oil for oil switches, oil insulated current and potential transformers and aluminum cell lightning arresters covered in these specifications.

COPPER BUS, WIRE AND CABLE CONNECTIONS

The amounts of wire, cable, bus and connection bar copper specified in this proposal, and stated in pounds or feet, is sufficient to meet the requirements and conditions outlined in the following detail specifications.

If more or less than the amount stated is supplied, due to a change in requirements or conditions, an extra charge will be made or credit given (as the case may be).

PROMISE OF SHIPMENT

The shipment of apparatus as promised is contingent upon the receipt of full and complete information with order, to enable the Company to proceed with the manufacture of apparatus. The promise provides only for performing actual work on this order and any delay exceeding two (2) days for approval of plans by Purchaser or due to changes made by Purchaser, will cause an extension of time of shipment based upon Purchaser's delay and conditions at the Factory of the Company.

INSTRUMENT CALIBRATION

All indicating, curve drawing and watthour meters, relays and tripping devices are calibrated before shipment from the Factory, and any subsequent calibration shall be at the expense of the Purchaser.

RESPONSIBILITY

The Company will not be responsible for the operation of switchboard devices specified by the Purchaser not manufactured by the Company, nor for the infringement of any patent growing out of the use of the devices referred to in this paragraph.

SPECIFICATIONS FOR SWITCHBOARD

- F O R -

CHICAGO, MILWAUKEE, AND ST. PAUL RAILWAY COMPANY,

CHICAGO, ILLINOIS.

SPECIFICATION NO. 66938

The switchboard included in these specifications has not been designed to match or line up with any existing installation as the Company has no information that this is necessary.

It is understood that the general location and arrangement of apparatus, busses, and connections will be jointly agreed upon.

The Company will not furnish under these specifications any disconnecting switches or other apparatus for the line side of the feeder oil switches in the Power Company's lines or any disconnecting switches for the 2300 volt A.C. lightning arresters.

It is understood only one high tension lightning arrester is to be furnished for each station; this to be connected to the bus; and high tension choke coils are to be furnished for each of the transformer feeder circuits. Under certain conditions, with this arrangement, the lightning arrester may not protect all of the high tension oil switches. The Company therefore, does not assume responsibility for failure of such switches, due to lightning discharges.

The oil switches included in these specifications can safely be used for the protection of machines and feeders under short circuit conditions, providing the total rated capacity (including overheads) available on the bus bars or circuit to which the switches are connected, does not exceed the following limits:-

SPECIFICATIONS FOR SWITCHBOARD

#66938

110,000 volt K-21 inverse time limit or non-automatic switch
used on 100,000 volt circuit, 50,000 kv-a.
4500 volt K-12 inverse time limit or non-automatic switch used
on 2300 volt circuit, 15000 kv-a.
15000 volt K-12 instantaneous automatic switch used on 2300
volt circuit 9800 kv-a.
4500 volt K-5 inverse time limit automatic switch used on
2300 volt circuit, 11000 kv-a.

The capacities given above for time limit automatic switches
apply only when such time limit is set to trip in not less than two
seconds.

Material of panels will be Natural Black Slate and
Steel.

Instruments will have a dull black finish.

Panels will be mounted on iron framework.

Switches will be provided with cardholders where
necessary.

SPECIFICATIONS FOR SWITCHBOARD

#66938

MOREL SUB-STATION

SWITCHBOARD WILL CONTROL:

- 1- Incoming line 100,000 V. 3-phase delta 60 cycle (Power Co. Transmission Line)
- 2- Incoming and outgoing lines, 100,000 volt 3-phase, delta, 60 cycle (Railway Co. Trans. Line)
- 2- 2500 (B) Kv.-a. transformers 100,000/2300 V. (indoor type) with 50% starting taps.
- 2- 3000 (B) KW. 3000 volt Motor generator sets, each consisting of:
 - 1- 2500 (B) kv.-a. 2300 volt 3-phase 60 cycle synchronous motor, started from transformer taps direct connected to 2- 1000 (B) KW. 1500 volt generators connected in series for 3000 volt DC and 2- 125 volt exciters rated 22 and 11 Kw. respectively.
- 2- 3000 volt 2000 amp. DC feeder circuits.

NOTE: Above equipments besides having the standard (B) overload guarantees, will carry three times normal load for five minutes without injury.

- 1- 10 kv.-a. 3-phase transformer 2300/110 volts.
- 4- 110 volt single-phase station lighting circuits.
- 1- air compressor 3-phase, 110 volts.
- 2- spare feeders, 3-phase, 110 volts.
- 1- signal circuit, single-phase, 2300 volts

SWITCHBOARD WILL CONSIST OF:

- | ITEM NO. | |
|----------|---|
| 1. | 1- line feeder switch panel (Power Co. Trans. Line) |
| 1A. | 3- disconnecting switches (indoor) |
| 1B. | 3- voltage detectors, |
| 2. | 2- line section switch panels (Ry. Co.'s Trans. Line) |
| 2A. | 12- Disconnecting switches and 2 hooks (indoor) |
| 2B. | 6- voltage detectors, |
| 3. | 2- Transformer feeder panels, |
| 3A. | 6- Disconnecting switches (indoor) |
| 4. | 2- Synchronous Motor and Exciter panels, |
| 5. | 1- swinging bracket, |
| 6. | 1- Battery and Lighting Panel, |
| 6A. | 1- Storage Battery |
| 7. | 1- Lighting and Local Power Panel, |
| 8. | 1- signal system feeder panel, |
| 8A. | 1- ground detector, |
| 9. | 1- selector switch and power panel |

SPECIFICATIONS FOR SWITCHBOARD

#66938

(SWBD. TO CONSIST OF- CONT'D)

ITEM NO.	10.	Expulsion fuses etc. for 2300 volt feeder,
	11.	2-DC Generator Panels,
	11A	2- DC Lightning arresters,
	12.	2- DC Feeder Panels,
	12A	2- DC Lightning arresters,
	13	1- swinging bracket,
	14	3000 volt DC Bus material
	15	Iron framework.
	15A.	Metal screen,
	16.	DC Disconnecting switches and operating hooks,
	17	AC Lightning arrester (indoor)
	18	AC Choke coils (indoor)

SPECIFICATIONS FOR SWITCHBOARD

#66938

MOREL SUB-STATION

ITEM #1: One (1) 3-phase Line Feeder Switch Panel, (Steel),
Capacity- 100,000 volts.
Size - 48 x 16 x 1 1/4" with re-enforcing plate
and supports for mounting in wall

EQUIPMENT:

- 1- TP ST 110,000 volt 300 amp. form K-21 automatic oil switch with remote hand operating mechanism and one coil trip.
- 4- Bushing type current transformers for above oil switch, for 200 amp. circuit with 1 tap for 100 amp. circuit.
- 1- Bell alarm switch equipment.
- 2- SP Reverse power circuit closing relays.
- 1- DP Definite time limit circuit closing overload relay.
- 1- DP Inverse time limit circuit closing overload relay.
- 2- 2200/110 volt 200 watt 60 cycle potential transformers with fuses.
(Potential transformers connected to 2300 volt local power circuit for energizing reverse power relays on line feeder and line section panels).

ITEM #1A: 3- SP ST 110,000 volt 300 amp. IG-6 disconnecting switches mounted on steel bases (indoor type) with safety catches.

ITEM #1B: 3- Deflecting vane type voltage detectors for use on 100,000 volt lines Cat. 35329.

ITEM #2: Two 3-phase Line Section switch Panels (Steel),
Capacity- 100,000 volts
Size - 48 x 16 x 1 1/4" with re-enforcing plate
and supports for mounting in wall,

EQUIPMENT PER PANEL:

- 1- TP ST 110,000 volt 300 amp. form K-21 automatic oil switch with remote hand operating mechanism and one coil trip.
- 4- Bushing type current transformers for above oil switch for 200 amp. circuit with 1 tap for 100 amp. circuit.
- 1- Bell alarm switch equipment.
- 1- DP Definite time limit circuit closing overload relay.
- 2- SP Reverse power circuit opening relays

SPECIFICATIONS FOR SWITCHBOARD

ITEM #2A: 12- 3P ST 110,000 volt 300 amp. disconnecting switches on steel bases, (indoor type) with safety catches.
2- 20 ft. operating hooks with grounding terminal.

ITEM #2B: 6- Deflecting Vane Type voltage detectors for use on 100,000 volt lines Cat. 35329

ITEM #3: Two (2) 3-phase Transformer Feeder Panels, (Steel),
Capacity- 100,000 volts,
Size- 48 x 16 x 1/4" with re-enforcing plate
and supports for mounting in wall,

EQUIPMENT PER PANEL:

1- TP ST 110,000 volt 100 amp. form K-21 non-automatic oil switch with remote hand operating mechanism.

ITEM #3A: 6- 3P ST 110,000 volt 300 amp. IG-6 disconnecting switches on steel bases, (indoor type) with safety catches.

ITEM #4: Two (2) 3-phase 60 cycle Synchronous Motor and Exciter Panels.
Capacity- 2300 volts 2500(B)kv-a.
Size- (Top section 31 x 24 x 2",
(Middle " 31 x 24 x 2",
(Bottom " 28 x 24 x 2",
on 90" Supports -

EQUIPMENT PER PANEL:

1- 6 amp. H-2 ammeter with 1800 amp. scale,
1- 300 amp. DH-3 field ammeter,
1- 110 volt 5 amp. H-2 wattless component indicator with 3000-0-3000 kw. scale,
1- 110 volt 5 amp. polyphase DS-5, 2 coil watt-hour meter, front of panel, with ratchet device,
1- concentric operating mechanism for rheostat with extension shaft and mounting for dial plate,
1- 4 point potential receptacle,
1- DP ST 300 amp. field switch with discharge resistance clips on base back of panel with handle on front
1- TP ST 4500 volt 1800 amp. automatic K-12 oil switch for coil mounting (running) with hand operating mechanism, 1 coil trip, and bell alarm switch

SPECIFICATIONS FOR SWITCHBOARD

#66938

(ITEM #4 CONT'D)

- 1- TP ST 7500 volt 500 amp. non-automatic K-5 oil switch for cell mounting (starting) with hand operating mechanism,
Cell doors for above.
- 1- Mechanical interlock for above oil switches.
- 1- SP Inverse time limit circuit closing overload relay.
- 1- SP Reverse power circuit opening relay.
- 2- 2200/110 volt 200 watt 60 cycle potential transformers with fuses.
- 3- 1500 amp. form E-18 current transformers.

- ITEM #5:
- 1- swinging bracket, equipped with-
 - 1- 5500 volt H-2 voltmeter, connected to Potential transformer with 20:1 ratio
 - 1- 4 point potential plug and holder.

- ITEM #6:
- One (1) Battery and Lighting Panel.
Capacity- 30 V. DC
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:

- 1- 20-0-20 amp. D-7 ammeter with shunt (for battery circuit)
- 1- 75 volt D-7 voltmeter.
- 1- Handwheel and mounting for rheostat.
- 1- DP DT 250 volt 100 amp. form D-12 lever switch.
- 2- NEG3 Fuse blocks with fuses on front of panel.
- 1- DP 100 amp. automatic lever switch with 110 volt AC low voltage release (for connecting emergency lights to battery on failure of AC circuit)
- 1- charging rheostat,
(Copper for interconnections)

- ITEM #6A:
- 1- Storage Battery equipment, consisting of:
3 trays each containing- 9 cells Edison B-2 storage battery complete.

SPECIFICATIONS FOR SWITCHBOARD

#66938

- ITEM #7: One (1) 3-phase Lighting and Local Power Panel,
Capacity- 110 volts,
Size- (Top section 31 x 24 x 1-1/2"
(Middle " 31 x 24 x 1-1/2"
(Bottom " 28 x 24 x 1-1/2",
on 90" Supports -

EQUIPMENT:

- 4- DP 3P 250 volt 100 amp. form D-12 lever switches with
NECS Fuses on front of panel.
- 3- TP 3P 250 volt 100 amp. form D-12 lever switches with
NECS Fuses on front of panel
Copper for interconnections between above switches
mounted by Company.

- ITEM #8: One (1) single-phase 2 circuit Signal System Feeder
Panel,
Capacity- 2500 volts,
Size- (Top section 31 x 24 x 1-1/2"
(Middle " 31 x 24 x 1-1/2"
(Bottom " 28 x 24 x 1-1/2",
on 90" Supports -

EQUIPMENT:

- 2- 5 amp. H-2 ammeters with 10 amp. scale.
- 1- Bristol Model 510 recording voltmeter with 8" 24 hour
chart with 0-2500 volt scale connected to potential
transformer with 20-1 ratio.
- 2- DP 3P 4500 volt 200 amp. form K-5 automatic oil switches
mounted 5" back of panel, with hand operating mechanism,
and bell alarm switch, 1 coil trip, including inter-
connections between above switches.
- 2- 3P Inverse time limit overload circuit closing relays,
- 2- 10 amp. form K-6 current transformers,
- 1- 2200/110 volt 200 watt 60 cycle potential transformer
with fuses

- ITEM #9A: 1- Rigid Bracket, containing-
- 1- 2500 volt 3-phase electrostatic ground detector with
metal cover,

SPECIFICATIONS FOR SWITCHBOARD

#66938

ITEM #9:

One (1) 3-phase 3-wire Selector Switch and Power Panel,
Capacity- 2300 volts,
Size- (Top section 31 x 24 x 1-1/2",
(Middle " 31 x 24 x 1-1/2",
(Bottom " 28 x 24 x 1-1/2",
on 90" Supports -

EQUIPMENT:

- 2- TP ST 15000 volt 300 amp. form K-12 automatic oil switches for cell mounting with hand operating mechanism, 1 coil trip, with bell alarm switches and circuit opening auxiliary switches, Cell doors for above,
- 2- SP D.C. Definite time limit circuit opening relays,
- 1- DP Instantaneous over load 3 contact circuit closing relay,
- 2- 10 amp. form K-6 current transformers.

ITEM #10: 3- SP 2500 volt 100 amp. TD-3 expulsion fuse blocks and holders with fuses mounted on Blue Vermont Marble bases front connected (for 10 kv-a. transformers)
1- operating hook Cat. 45229.

ITEM #11:

Two (2) DC Generator Panels,
Capacity- 3000 volt 2060(B)Kw. 2000 amp. max.
Size- (Top section 31 x 28 x 1-1/2",
(Middle " 31 x 28 x 1-1/2",
(Bottom " 28 x 28 x 1-1/2",
on 90" Supports -

EQUIPMENT PER PANEL:

- Insulating caps,
- 1- 1000-0-2000 amp. D-7 ammeter with shunt and external insulating cover,
- 1- concentric chain operating mechanism for field rheostat,
- 1- handwheel and mounting for exciter field rheostat,
- 2- DP ST 200 amp. field switches, with discharge resistance clips, mounted on base back of panel, with handles on front,
- 1- 4 point potential receptacles,
- 2- operating handles for circuit breaker and lever switches.

SPECIFICATIONS FOR SWITCHBOARD

#66938

(ITEM #11 CONT'D)

- 1- Natural Black Slate Base, 52 x 28 x 2" mounted on pipe framework back and above panel, with two barriers,
 - 1- SP ST 3600 volt 1500 amp. lever switch with remote control and auxiliary switch,
 - 1- SP ST 3600 volt 1500 amp. circuit breaker, with remote control, arc deflector, and magnetic blowout, low voltage release, and auxiliary switch, (one contact to be used for field resistance contactor)
- Copper for connections between above apparatus and to bus with clamps for same,

ITEM #11A:2- 3000 volt DC Aluminum cell lightning arresters, (each complete with disconnecting switch and fuse)

ITEM #12: Two (2) DC Feeder Panels,
Capacity- 3000 volt 2000 amp.
(Top section 31 x 28 x 1-1/2",
Size- (Middle " 31 x 28 x 1-1/2",
(Bottom " 28 x 28 x 1-1/2",
on 90" supports -

EQUIPMENT PER PANEL:

- Insulating caps,
- 1- 1250-0-2500 amp. D-7 ammeter with shunt and external insulating cover,
- 1- 2 point potential receptacle,
- 2- operating handles (for circuit breaker and lever switch)
- 1- Natural Black Slate base, 52 x 28 x 2" mounted on pipe framework back and above panel, with two barriers,
 - 1- SP ST 3600 volt 2000 amp. lever switch with remote control and auxiliary switch,
 - 1- SP ST 3600 volt 2000 amp. circuit breaker with remote control, arc deflector, with magnetic blowout, and auxiliary switch
- Copper for connections between above apparatus and to bus with clamps for same,
- 1- extra barrier for end panel only.

SPECIFICATIONS FOR SWITCHBOARD

#66938

- ITEM #12A: 2- 3000 volt DC Aluminum cell lightning arresters (each complete with disconnecting switch and fuse)
- ITEM #13: 1- Swinging bracket, containing:
- 1- 4500 volt A I-2 (TID Illuminated dial) voltmeter with multiplier (permanent magnet type)
 - 1- 2 point potential plug and holder,
- ITEM #14: 3000 volt DC Bus material
- ITEM #15: Iron framework to be used with DC board as a unit.
- ITEM #15A: Metal screen to be located below barriers on DC Panels.
- ITEM #16: 2- SP ST 7500 volt 2000 amp. disconnecting switches with safety catches on insulators and steel bars, front connected, (for DC feeders)
- 1- SP ST 7500 volt 2000 amp. disconnecting switch with safety catch, on insulators and steel base, (front connected (for DC Feeder tie switch)
 - 1- SP DT 7500 volt 2000 amp. disconnecting switch, with safety catch, on insulators and steel base, front connected, (for yard feeder switch)
- 2- 4 foot operating hooks Cat. 65849.

SPECIFICATIONS FOR SWITCHBOARD

#66938

LIGHTNING PROTECTIVE APPARATUS

- ITEM #17: 1- 3-phase aluminum cell lightning arrester equipment complete with tanks, horn gaps, electrolyte, and charging resistances, and short circuiting contacts, indoor type, for 100,000 volt delta connected circuit.
- 2- single-phase DP multigap graded shunt resistance lightning arrester equipments Cat. 149755 for 2300 V. signal feeder circuits
- ITEM #18: 6- 300 amp. hour glass type (indoor) choke coils for 100,000 volt circuit Cat. 78832
- 4- 25 amp. choke coils Cat. 76339 on steel bracket for 2300 volt circuit

SPECIFICATIONS FOR SWITCHBOARD

#66938

JANNEY SUB-STATION

SWITCHBOARD WILL CONTROL:

- 1- Incoming Line 100,000 volt 3-phase 60 cycle (Power Co.'s Trans. Line)
- 2- Incoming and outgoing lines 100,000 volt 3-phase 60 cycle (Railway Co. Trans. Line)
- 3- 1900(B)kv-a. transformers 100,000/2300 volt indoor type) with 50% starting taps,
- 3- 1800(B)KW. 3000 volt motor-generator sets, each consisting of:
 - 1- 1900(B)kv-a. 2300 volt 3-phase 60 cycle synchronous motor started from transformer taps direct connected to 2- 750(B)KW. 1500 volt generators, connected in series for 3000 volt DC and 2- 125 volt Exciters rated 13 and 8 kw. respectively.
- 2- 3000 volt 2000 amp. DC Feeder circuits

NOTE: Above equipment, besides having the standard (B) over load guarantees, will carry three times normal load for five minutes without injury

- 1- 10 kv-a. 3-phase transformer 2300/110 volts,
- 4- 110 volt single-phase station lighting circuits,
- 1- air compressor 3-phase 110 volts,
- 2- spare feeder circuits 3-phase 110 volts
- 2- signal circuits single-phase, 2300 volts

SWITCHBOARD WILL CONSIST OF:

- | | | |
|----------|------|--|
| ITEM NO. | 19. | 1- line feeder switch panel (Power Co. Trans. Line) |
| | 19A. | 6- Disconnecting switches (indoor) |
| | 19B. | 3- Voltage detectors, |
| | 20. | 2- Line section switch panels (Rwy. Co. Trans. Line) |
| | 20A. | 12- Disconnecting switches and 2 hooks (indoor) |
| | 20B. | 6- Voltage detectors, |
| | 21. | 3- Transformer Feeder Panels, |
| | 21A. | 9- Disconnecting switches (indoor) |
| | 22. | 3- synchronous motor and exciter panels, |
| | 23. | 1- swinging bracket, |
| | 24. | 1- Battery and Lighting Panel |
| | 24A. | 1- Storage Battery |
| | 25. | 1- Lighting and Local Power Panel |
| | 26. | 1- signal system feeder Panel |
| | 26A. | 1- ground detector |
| | 27. | 1- selector switch and power panel |
| | 28. | Expulsion fuse, etc. for 2300 volt feeders |

SPECIFICATIONS FOR SWITCHBOARD

#66938

(SWED. TO CONSIST OF- CONT'D)

- | | | |
|----------|------|--|
| ITEM NO. | 29. | 3- DC Generator Panels. |
| | 29A. | 3- DC Lightning arresters. |
| | 30. | 2- DC Feeder Panels. |
| | 30A. | 2- DC Lightning arresters. |
| | 31. | 1- swinging bracket. |
| | 32. | 3000 volt DC Bus material |
| | 33. | Iron framework. |
| | 33A. | Metal screen |
| | 34. | DC Disconnecting switches and operating hooks. |
| | 35. | AC Lightning arresters (indoor) |
| | 36. | AC choke coils (indoor) |

SPECIFICATIONS FOR SWITCHBOARD

#669 38

JANNEY SUB-STATION

- ITEM #19: One (1) 3-phase line Feeder Switch Panel (Steel).
Capacity- 100,000 volts.
Size - 48 x 16 x 1/4" with re-enforcing plate
and supports for mounting in wall.

EQUIPMENT:

- 1- TP SP 110,000 volt 300 amp. form K-21 automatic oil switch with remote hand operating mechanism,
- 4- Bushing type current transformers for above oil switch for 200 amp. circuit with 1 tap for 100 amp. circuit,
- 1- bell alarm switch equipment,
- 2- SP reverse power circuit closing relays,
- 1- DP definite time limit circuit closing overload relay,
- 1- DP Inverse time limit circuit closing overload relay
- 2- 2200/110 volt 200 watt 60 cycle potential transformers with fuses,
(Potential transformers connected to 2300 volt local power circuit, for energizing reverse power relays on line feeder and line section panels)

ITEM #19A:

- 3- SP SP 110,000 volt 300 amp. IG-6 disconnecting switches on steel bases with safety catches,

ITEM #19B:

- 3- Deflecting Vane Type voltage detectors for use on 100,000 volt lines Cat. 35329.

ITEM #20:

- Two (2) 3-phase line section switch panels (steel)
Capacity- 100,000 volts,
Size - 48 x 16 x 1/4" with re-enforcing plate and
supports for mounting in wall

EQUIPMENT PER PANEL:

- 1- TP SP 110,000 volt 300 amp. form K-21 automatic oil switch with remote hand operating mechanism, and 1 coil trip,
- 4- bushing type current transformers for above oil switch for 200 amp. circuit with 1 tap for 100 amp. circuit,
- 1- bell alarm switch equipment for above oil switch
- 1- DP definite time limit overload relay
- 2- SP Reverse power circuit opening relays

SPECIFICATIONS FOR SWITCHBOARD

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- ITEM #20A: 12- SP ST 110000 volt 300 amp. IG-6 disconnecting switches on steel bases (indoor type) with safety catches,
2- 20 ft. operating hooks with grounding terminal

- ITEM #20B: 6- Deflecting Vane Type Voltage Detectors for use on 100,000 volt lines Cat. 35329

- ITEM #21: Three (3) 3-phase transformer Feeder Panels,
Capacity- 100,000 volts,
Size- 48 x 16 x 1/4" with re-enforcing plate and supports for mounting in wall

EQUIPMENT PER PANEL:

- 1- TP ST 110,000 volt 100 amp. form K-21 non-automatic oil switch with remote hand operating mechanism

- ITEM #21A: 9- SP ST 110,000 volt 300 amp. IG-6 disconnecting switches on steel bases (indoor type) with safety catches.

- ITEM #22: Three (3) 3-phase 60 cycle synchronous Motor and Exciter Panels
Capacity- 2500 volts 1900(B)kv-a.
(Top section 31 x 24 x 2"
Size- (Middle " 31 x 24 x 2"
(Bottom " 28 x 24 x 2"
on 90" supports -

EQUIPMENT PER PANEL:

- 1- 6 amp. H-2 ammeter with 1200 amp. scale,
1- 150 amp. DH-3 field ammeter,
1- 110 volt 5 amp. H-2 wattless component indicator with 2000-C-2000 kw. scale,
1- 110 volt 5 amp. polyphase DS-5 2-coil watt-hour meter, front of panel,
1- concentric operating mechanism for rheostats with extension shaft and mounting for dial plate,
1- 4 point potential receptacle,
1- DP ST 300 amp. field switch with discharge resistance clips on base back of panel with handle on front,
1- TP ST 2500 volt 1800 amp. automatic K-12 oil switch for oil mounting (running) with hand operating mechanism, 1 coil trip, and bell alarm switch

SPECIFICATIONS FOR SWITCHBOARD

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(ITEM #22 CONT'D)

- 1- TP ST 7500 volt 200 amp. non-automatic K-5 oil switch for cell mounting (starting) with hand operating mechanism. Cell doors for above.
- 1- Mechanical interlock for above oil switches.
- 1- SP Inverse time limit circuit closing overload relay.
- 1- SP Reverse power circuit opening relay.
- 2- 2200/110 volt 200 watt 60 cycle potential transformers with fuses.
- 3- 1000 amp. form R-18 current transformers.

ITEM #23: One (1) swinging bracket, equipped with-

- 1- 3500 volt H-2 voltmeter, connected to potential transformer with 20:1 ratio.
- 1- 4 point potential plug and holder.

ITEM #24: One (1) Battery and Lighting Panel,
Capacity- 30 volt DC

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:

- 1- 20-0-20 amp. D-7 ammeter with shunt (for battery circuit)
- 1- 75 volt D-7 voltmeter,
- 1- handwheel and mounting for rheostat,
- 1- DP DT 250 volt 100 amp. form D-12 lever switch.
- 2- NEC3 Fuse blocks with fuses on front of panel,
- 1- DP 100 amp. automatic lever switch with 110 volt AC low voltage release (for connecting emergency lights to battery on failure of AC circuit)
- 1- charging rheostat,
Copper for connections

ITEM #24A:

- 1- storage battery equipment, consisting of:
3 trays, each containing- 9 cells Edison B-2 storage battery complete.

SPECIFICATIONS FOR SWITCHBOARD

#66938

- ITEM #25: One (1) 3-phase Lighting and Local Power Panel,
Capacity- 110 volts,
(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"
mounted on 90" Supports -

EQUIPMENT:

- 4- DP ST 250 volt 100 amp. form D-12 lever switches with
NECS Fuses on front of panel,
- 3- TP ST 250 volt 100 amp. form D-12 lever switches with
NECS Fuses on front of panel,
Copper for interconnections between above switches
mounted by Company.

- ITEM #26: One (1) single-phase Signal System Feeder Panel,
Capacity- 2300 volts,
(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:

- 2- 5 amp. H-2 ammeters with 10 amp. scale,
- 1- Bristol Model 510 recording voltmeter with 8"- 24 hr.
chart with 0-2600 volt scale, connected to potential
transformer with 20-1 ratio,
- 2- DP ST 4500 volt 200 amp. form K-6 automatic oil
switches mounted 5" back of panel, with hand operating
mechanism and bell alarm switch, 1 coil trip, and
interconnections between above oil switches,
- 2- 3P Inverse time limit overload circuit closing relays,
- 2- 10 amp. form K-6 current transformers,
- 1- 2200/110 volt 200 watt 60 cycle potential transformer
with fuses

ITEM #26A:

- 1- rigid bracket, containing-
- 1- 2500 volt 3-phase electrostatic ground detector with
metal cover.

SPECIFICATIONS FOR SWITCHBOARD

#66938

ITEM #27: One (1) 3-phase, 3-wire Selector Switch and Power Panel.

Capacity- 2300 volts.

Size- (Top section 31 x 24 x 1-1/2",
(Middle " 31 x 24 x 1-1/2",
(Bottom " 28 x 24 x 1-1/2",
on 90" Supports -

EQUIPMENT:

- 2- TP ST 15000 volt 300 amp, form K-12 automatic oil switches for cell mounting, with hand operating mechanism, 1 coil trip, with bell alarm switches, and circuit opening auxiliary switches.
Cell doors for above.
- 2- SP D.C. Definite time limit circuit opening relays,
- 1- DP Instantaneous overload 3 contact circuit closing relay,
- 2- 10 amp. form K-6 current transformers.

ITEM #28:

- 3- SP 2500 volt 100 amp. TD-3 expulsion fuse blocks and holders with fuses mounted on Blue Vermont Marble bases, front connected, (for 10 kv-a. transformers)
- 1- operating hook Cat. 45229

ITEM #29:

Three (3) DC Generator Panels.

Capacity- 3000 volt 1500 (3) kw. 1500 amp. max.

Size- (Top section 31 x 28 x 1-1/2",
(Middle " 31 x 28 x 1-1/2",
(Bottom " 28 x 28 x 1-1/2",
on 90" Supports -

EQUIPMENT: PER PANEL:

- Insulating caps.
- 1- 750-0-1500 amp. D-7 ammeter with shunt and external insulating cover,
- 1- concentric chain operating mechanism for field rheostat,
- 1- handwheel and mounting for exciter field rheostat,
- 2- DP ST 200 amp. field switches with discharge resistance clips mounted on base back of panel with handles on front,
- 1- 4 point potential receptacle,
- 2- operating handles (for circuit breaker and lever switch)

SPECIFICATIONS FOR SWITCHBOARD

#66938

(ITEM #29 CONT'D)

- 1- Natural Black Slate base, 52 x 28 x 2" mounted on pipe framework back and above panel, with 2- barriers, containing:
 - 1- SP ST 3600 volt 1500 amp. lever switch, with remote control and auxiliary switch,
 - 1- SP ST 3600 volt 1500 amp. circuit breaker, with remote control, arc deflector, and magnetic blowout, low voltage release, and auxiliary switch,
(one contact to be used for field resistance contactor)
- Copper for connections between above apparatus and to bus with clamps for same.

ITEM #29A:

- 3- 3000 volt DC Aluminum cell lightning arresters (each complete, with disconnecting switch and fuse)

ITEM #30:

Two (2) DC Feeder Panels,

Capacity- 3000 volt 2000 amps.

Size - (Top section 31 x 28 x 1-1/2",
(Middle " 31 x 28 x 1-1/2",
(Bottom " 28 x 28 x 1-1/2",
on 90" supports -

EQUIPMENT PER PANEL:

Insulating caps,

- 1- 1250-0-2500 amp. D-7 ammeter with shunt and external insulating cover,
 - 1- 2 point potential receptacle,
 - 2- operating handles (for circuit breaker and lever switch)
-
- 1- Natural Black Slate Base, 52 x 28 x 2", mounted on pipe framework back and above panel with two barriers, containing:
 - 1- SP ST 3600 volt 2000 amp. lever switch with remote control and auxiliary switch,
 - 1- SP ST 3600 volt 2000 amp. circuit breaker with remote control and arc deflector with magnetic blowout and auxiliary switch
- Copper for connections between above apparatus and to bus with clamps for same.
- 1- Extra barriers for end panel only.

SPECIFICATIONS FOR SWITCHBOARD

#66938

ITEM #30A: 2- 3000 volt DC Aluminum cell lightning arresters,
(each complete with disconnecting switch and fuse)

ITEM #31: 1- swinging bracket, containing -
1- 4500 volt A I-2 (TID Illuminated dial) voltmeter,
with multiplier, (permanent magnet type)
1- 2 point potential plug and holder.

ITEM #32: 3000 volt DC Bus material

ITEM #33: Iron framework to be used with DC Board as a unit.

ITEM #33A: Metal screen to be located below barriers on DC
panels.

ITEM #34: 2- SP ST 7500 volt 2000 amp. disconnecting switches with
safety catches on insulators and steel bars, front
connected (for DC Feeders)
1- SP ST 7500 volt 2000 amp. disconnecting switch, with
safety catch, on insulators, and steel base, (front
connected) (for DC feeder tie switch)
1- SP DT 7500 volt 2000 amp. disconnecting switch with
safety catch, on insulators, and steel base, front
connected, (for yard feeder switch)
2- 4 foot operating hooks Cat. 65849

SPECIFICATIONS FOR SWITCHBOARD

#66938

LIGHTNING PROTECTIVE APPARATUS

ITEM #35: 1- 3-phase aluminum cell lightning arrester equipment, complete, with tankam horn gaps, electrolyte, and charging resistance, and short circuiting contacts, indoor type, for 100,000 volt delta connected circuit.

2- single-phase DP multigap graded shunt resistance lightning arrester equipments Cat. 149753 for 2300 V. signal feeder circuits.

ITEM #36: 9- 200 amp. hour glass type (indoor) choke coils for 100,000 volt circuit Cat. 78832.

4- 25 amp. choke coils Cat. 76539 on steel bracket for 2300 volt circuit.

SPECIFICATIONS FOR SWITCHBOARD

#66938

PIEDMONT SUB-STATION

SWITCHBOARD WILL CONTROL:

- 2- Incoming and outgoing Lines 100,000 volt 3-phase, delta (Railway Co. Transmission Line)
- 3- 1900(B)kv-a. transformers 100,000/2300 volts with 50% starting taps (indoor type)
- 3- 1500(B)KW. 3000 volt Motor-Generator sets, each consisting of:
 - 1- 1900(B)kv-a. 2300 volt 3-phase 60 cycle synchronous motor, started from transformer taps, direct connected to 2- 750(B)kw. 1500 volt generators connected in series for 3000 volt DC and 2- 125 volt Exciters rated 13 and 8 Kw. respectively.
- 2- 3000 volt 2000 amp. DC Feeder circuits

NOTE: Above equipment, besides having the standard (B) overload guarantee, will carry three times normal load for five minutes without injury.

- 1- 10 kv-a. 3-phase transformer 2300/110 volts
- 4- 110 volt single-phase station lighting circuits
- 1- air compressor 3-phase 110 volts
- 2- spare feeders, 3-phase, 110 volts,
- 2- signal circuits, single-phase, 2300 volts

SWITCHBOARD WILL CONSIST OF:

- | | | |
|----------|------|--|
| ITEM NO. | 37. | 1- disconnecting switch, (Rwy. Co. Trans. Line)(outdoor) |
| | 37A. | 3- voltage detectors, |
| | 38. | 1- Disconnecting switch, (Ry. Co. Trans. Line)(outdoor) |
| | 38A. | 3- Voltage detectors, |
| | 39. | 3- Transformer feeder panels, |
| | 39A. | 9- disconnecting switches and 2 hooks (indoor) |
| | 40. | 3- synchronous motor and exciter panels |
| | 41. | 1- swinging bracket |
| | 42. | 1- battery and Lighting Panel |
| | 42A. | 1- Storage Battery |
| | 43. | 1- Lighting and Local Power Panel |
| | 44. | 1- Signal system feeder panel |
| | 44A. | 1- ground detector |
| | 45. | 1- selector switch and power panel |
| | 46. | Expulsion fuses etc. for 2300 volt feeder |
| | 47. | 3- DC Generator Panels, |
| | 47A. | 3- DC Lightning arresters |

SPECIFICATIONS FOR SWITCHBOARD

#66983

(SEED. TO CONSIST OF- CONT'D)

ITEM NO. 48.	2- DC Feeder Panels,
48A.	2- DC Lightning arresters,
49.	1- Swinging bracket,
50.	3000 volt DC Bus material
51.	Iron framework
51A	Metal screen
52	DC Disconnecting switches and operating hooks,
53.	AC Lightning arrester (indoor)
54.	AC Choke coils, (indoor)

SPECIFICATIONS FOR SWITCHBOARD

#66938

PIEDMONT SUB-STATION

ITEM #37: 1- TP ST 110,000 volt 300 amp. IG-9 disconnecting switch, hand operated, (outdoor type) for line section switch

ITEM #37A: 3- Deflecting Vane Type Voltage Detectors for use on 100,000 volt lines Cat. 35329

ITEM #38: 1- TP ST 110,000 volt 300 amp. IG-9 disconnecting switch, hand operating (outdoor type) *Belongs Custs.*

ITEM #38A: 3- Deflecting Vane Type voltage detectors for use on 100,000 volt lines Cat. 35329

ITEM #39: Three (3) 3-phase transformer feeder panels,
Capacity- 100,000 volts,
Size- 48 x 16 x 1/4" with reinforcing plate
and supports for mounting in wall,

EQUIPMENT PER PANEL:

1- TP ST 110,000 volt 100 amp. form K-21 non-automatic oil switch with remote hand operating mechanism.

ITEM #39A: 9- ST ST 110,000 volt 300 amp. IG-6 disconnecting switches on steel bases (indoor type) with safety catches,
2- 20 ft. operating hooks with grounding terminal

ITEM #40: Three (3) 3-phase 60 cycle synchronous Motor and Exciter Panels,
Capacity- 2300 volts 1900(B)kv-a.
(Top section 31 x 24 x 2",
Size- (Middle " 31 x 24 x 2",
(Bottom " 36 x 24 x 2",
on 90" Supports -

SPECIFICATIONS FOR SWITCHBOARD

#66938

(ITEM #40 CONT'D)

EQUIPMENT PER PANEL:

- 1- 6 amp. H-2 ammeter with 1200 amp. scale,
- 1- 150 amp. DH-3 field ammeters,
- 1- 110 volt 5 amp. H-2 wattless component indicator with 2000-0-2000 kw. scale,
- 1- 110 volt 5 amp. polyphase DS-5, 2 coil watt-hour meter on front of panel,
- 1- concentric operating mechanism for rheostat, with extension shaft and mounting for dial plate,
- 1- 4 point potential receptacle,
- 1- DT ST 200 amp. field switch with discharge resistance clips, on base back of panel, with handle on front,
- 1- TP ST 4500 volt 1200 amp. automatic K-12 oil switch for cell mounting (running) with hand operating mechanism, 1 coil trip, and bell alarm switch
- 1- TP ST 7500 volt 500 amp. non-automatic K-5 oil switch for cell mounting (starting) with hand operating mechanism,
Cell doors for above
- 1- Mechanical interlock for above
- 1- SP Inverse time limit circuit closing overload relay
- 1- SP Reverse power circuit opening relay
- 2- 2200/110 volt 200 watt 60 cycle potential transformers with fuses
- 3- 1000 amp. form K-18 current transformers

- ITEM #41: 1- swinging bracket, equipped with
- 1- 3500 volt H-2 voltmeter, connected to Potential transformer with 20:1 ratio,
 - 1- 4 point potential plug and holder

- ITEM #42: One (1) Battery and Lighting Panel,
Capacity- 30 volts, DC
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:

- 1- 20-0-20 amp. D-7 ammeter with shunt (for battery circuit)
- 1- 75 volt D-7 voltmeter,
- 1- handwheel and mounting for rheostat,

SPECIFICATIONS FOR SWITCHBOARD

#66938

(ITEM #42 CONT'D)

- 1- DP DT 250 volt 100 amp. form D-12 lever switch,
- 2- NE CS Fuse blocks with fuses on front of panel,
- 1- DP 100 amp. automatic lever switch with 110 volt AC low voltage release (for connecting emergency lights to battery on failure of AC circuit)
- 1- charging rheostat,
- Copper for connections.

ITEM #42A:

- 1- Storage Battery equipment, consisting of:
- 3- Trays each containing- 9 cells Edison B-2 storage battery complete.

ITEM #43:

One (1) 3-phase Lighting and Local Power Panel.
Capacity- 110 volts.
Size- (Top section 31 x 24 x 1-1/2"
(Middle " 31 x 24 x 1-1/2"
(Bottom " 28 x 24 x 1-1/2"
on 90" Supports-

EQUIPMENT:

- 4- DP ST 250 volt 100 amp. form D-12 lever switches with NECS Fuses on front of panel,
- 3- TP ST 250 volt 100 amp. form D-12 lever switches with NE CS Fuses on front of panel,
Copper for interconnections between above switches mounted by Company

ITEM #44:

One (1) single-phase 2 circuit Signal System Feeder Panel.
Capacity- 2200 volts.
Size- (Top section 31 x 24 x 1-1/2"
(Middle " 31 x 24 x 1-1/2"
(Bottom " 28 x 24 x 1-1/2"
on 90" Supports -

EQUIPMENT:

- 2- 5 amp. H-2 ammeters with 10 amp. scales,
- 1- Bristol Model 510 recording voltmeter with 8"- 24 hour chart, with 0-2600 volt scale connected to potential transformer with 20-1 ratio

SPECIFICATIONS FOR SWITCHBOARD

#66938

(ITEM #44 CONT'D)

- 2- DP ST 4500 volt 200 amp. form K-5 automatic oil switches mounted 5" back of panel, with hand operating mechanism, and bell alarm switch, 1 coil trip, including interconnections between above oil switches
- 2- SP Inverse time limit overload circuit opening relays
- 2- 10 amp. form K-5 current transformers
- 1- 2200/110 volt 200 watt 60 cycle potential transformer with fuses

ITEM #44A:

- 1- Rigid bracket, containing-
- 1- 2500 volt 3-phase electrostatic ground detector with metal cover

ITEM #45:

One (1) 3-phase 3-wire Selector Switch and Power panel
Capacity- 2500 volts

Size- (Top section 31 x 24 x 1-1/2",
(Middle " 31 x 24 x 1-1/2",
(Bottom " 28 x 24 x 1-1/2",
on 90" supports -

EQUIPMENT:

- 2- TP ST 15000 volt 300 amp. form K-12 automatic oil switches for cell mounting with hand operating mechanism, 1 coil trip, with bell alarm switches, and circuit opening auxiliary switches,
- 2- SP D.C. Definite time limit circuit opening relays,
- 1- DP Instantaneous, overload 3 contact circuit closing relay
- 2- 10 amp. form K-6 current transformers

ITEM #46: 3- 2500 volt 100 amp. TD-3 expulsion fuse blocks and holders with fuses mounted on Blue Vermont Marble bases, front connected, (for 10 kv.-a. transformers)
1- operating hook Cat. 45229.

SPECIFICATIONS FOR SWITCHBOARD

#66938

ITEM #47:

Three (3) DC Generator Panels,
Capacity- 3000 volt 1500(M)kw. 1500 amp. max.
Size- (Top section 31 x 28 x 1-1/2",
(Middle " 31 x 28 x 1-1/2",
(Bottom " 28 x 28 x 1-1/2",
on 90" Supports -

EQUIPMENT PER PANEL:

- Insulating caps,
- 1- 750-0-1500 amp. D-7 ammeter with shunt and external insulating cover,
- 1- concentric chain operating mechanism for field rheostats,
- 1- Handwheel and mounting for exciter field rheostat,
- 2- DP ST 200 amp. field switches with discharge resistance clips mounted on base back of panel with handle on front
- 1- 4 point potential receptacle,
- 2- operating handles (for circuit breaker and lever switch)
- 1- Natural Black Slate base, 52 x 28 x 2" mounted on pipe framework back and above panel, with 2 barriers,
- 1- SP ST 3600 volt 1500 amp. lever switch with remote control and auxiliary switch
- 1- SP ST 3600 volt 1500 amp. circuit breaker, with remote control, arc deflector, and magnetic blowout, low voltage release, and auxiliary switch, (one contact to be used for field resistance contactor)
- Copper for connections between above apparatus and to buses with clamps for same.

ITEM #47A:

3- 3000 volt DC Aluminum cell lightning arresters (each complete with disconnecting switch and fuse)

ITEM #48:

Two (2) DC Feeders Panels,
Capacity- 3000 volt 2000 amps. max.
Size- (Top section 31 x 28 x 1-1/2",
(Middle " 31 x 28 x 1-1/2",
(Bottom " 28 x 28 x 1-1/2",
on 90" Supports -

SPECIFICATIONS FOR SWITCHBOARD

#66938

(ITEM #48 CONT'D)

EQUIPMENT PER PANEL:

- Insulating caps,
- 1- 1250-0-2500 amp. D-7 ammeter with shunt and external insulating cover,
- 1- 2 point potential receptacle,
- 2- operating handles (for circuit breaker, and lever switches)

- 1- Natural Black Slate base, 52 x 28 x 2", mounted on pipe framework, back and above panel, with 2 barriers
- 1- 3P 3T 3600 volt 2000 amp. lever switch with remote control and auxiliary switch
- 1- 3P 3T 3600 volt 2000 amp. circuit breaker, with remote control and arc deflector with magnetic blow-out and auxiliary switch.
- Copper for connections between above apparatus and to bus with clamps for same
- 1- extra barrier for end panel only

ITEM #48A:

- 2- 3000 volt DC Aluminum rail lightning arresters (each complete with disconnecting switch and fuse.)

ITEM #49: 1- swinging bracket, containing-

- 1- 4500 volt A I-E (TID) illuminated dial, voltmeter with multiplier (permanent magnet type)
- 1- 2 point potential plug and holder

ITEM #50: 3000 volt DC Bus material

ITEM #51: Iron framework to be used with DC Board as a unit

ITEM #51A: Metal screen to be located below barriers on DC panels.

ITEM #52: 2- 3P 3T 7500 volt 2000 amp. disconnecting switches with safety catches on insulators and steel bases, front connected (for DC feeders)

- 1- 3P 3T 7500 volt 2000 amp. disconnecting switch with safety catch on insulators and steel base, (front connected (for DC Feeder tie switch

2- 4 foot operating hooks Cat. 65849

SPECIFICATIONS FOR SWITCHBOARD

#66938

LIGHTNING PROTECTIVE APPARATUS

- ITEM #53: 1- 3-phase aluminum cell lightning arrester equipment, complete with tanks, horn gaps, electrolyte, and charging resistance, and short circuiting contacts, indoor type, for 100,000 volt delta connected circuit
- 2- Single-phase DP multigap graded shunt resistance lightning arrester equipments Cat. 149753 for 2300 volt signal feeder circuits
- ITEM #54: 9- 200 amp. hour glass type (indoor) choke coils for 100,000 volt circuit Cat. 78832
- 4- 25 amp. choke coils Cat. 76339 on steel bracket for 2300 volt circuit

SPECIFICATIONS FOR SWITCHBOARD

#669 38

EUSTIS SUB-STATION

SWITCHBOARD WILL CONTROL:

- 1- Incoming line, 100,000 volt 3-phase delta 60 cycle.
- 1- Incoming and outgoing line 100,000 volt 3-phase delta (Rwy. Co. Trans. Line)
- 2- 2500(B)kv-a. transformers 100,000/2300 volts with 50% starting taps (indoor type)
- 2- 2000(B)kw. 3000 volt motor generator sets, each consisting of:
 - 1- 2500(B)kv-a. 2300 volt 3-phase 60 cycle synchronous motor started from transformer taps, direct connected to 2- 1000(B)kw. 1500 volt Generators connected in series for 3000 volt DC and 2- 125 volt Exciters rated 22 and 11 Kw. respectively.
 - 2- 3000 volt 2000 amp. DC Feeder circuits.

NOTE: Above equipment besides having the standard (B) overload guarantees, will carry three times normal load for five minutes without injury.

- 1- 10 kv-a. 3-phase transformer 2300/110 volts.
- 4- 110 volt single-phase station lighting circuits.
- 1- air compressor 3-phase 110 volts.
- 2- spare feeders 3-phase 110 volts.
- 2- signal circuits, single-phase, 2300 volts

SWITCHBOARD WILL CONSIST OF:

- | | |
|--------------|---|
| ITEM NO. 55. | 1- Line feeder switch panel (Power Co. Trans. Line) |
| 55A. | 3- Disconnecting switches (indoor) |
| 55B. | 3- Voltage detectors. |
| 56. | 1- Line section switch panel (Rwy. Co. Trans. Line) |
| 56A. | 6- disconnecting switches and 2 hooks (indoor) |
| 56B. | 3- voltage detectors. |
| 57. | 2- transformer feeder panels. |
| 57A. | 6- disconnecting switches (indoor) |
| 58. | 2- synchronous motor and exciter panels. |
| 59. | 1- swinging bracket. |
| 60. | 1- Battery and lighting panel. |
| 60A. | 1- Storage battery. |
| 61. | 1- Lighting and Local Power Panel. |
| 62. | 1- signal system feeder panel |
| 62A. | 1- ground detector |
| 63. | 1- selector switch and power panel |
| 64. | Expulsion fuses etc. for 2300 volt feeder |

SPECIFICATIONS FOR SWITCHBOARD

#66938

(SWBD. TO CONSIST OF- CONT'D)

ITEM NO. 65.	2- DC Generator Panels,
65A.	2- DC lightning arresters,
66.	2- DC Feeder panels,
66A.	2- DC lightning arresters,
67.	1- swinging bracket,
68.	3000 volt DC Bus material
69.	Iron framework
69A.	Metal screen
70.	DC Disconnecting switches and operating hook
71.	AC lightning arrester (indoor)
72.	AC Choke coils (indoor)

SPECIFICATIONS FOR SWITCHBOARD

#66938

HUSTIS SUB-STATION

ITEM #55: One (1) 3-phase Line Feeder Switch Panel,
Capacity- 100,000 volts,
Size- 48 x 16 x 1/4" with reinforcing plate and
supports for mounting in wall.

EQUIPMENT:

- 1- TP ST 110,000 volt 300 amp. form K-21 automatic oil switch with remote hand operating mechanism and 1 coil trip,
- 4- Bushing type current transformers for above oil switch for 200 amp. circuit with 1 tap for 100 amp. circuit
- 1- bell alarm switch equipment,
- 2- SP Reverse power circuit closing relays,
- 1- DP Definite time limit circuit closing overload relay,
- 1- DP Inverse time limit circuit closing overload relay,
- 2- 2200/110 volt 200 watt 60 cycle potential transformers with fuses,
(Potential transformers connected to 2300 volt Local Power circuit for energizing reverse power relays on line feeder and line section panels)

ITEM #55A: *L.G. 9 M.S. 102644 9/9/15*
3- SP ST 110,000 volt 300 amp. IG-6 disconnecting switches on steel bases (indoor type) with safety catches,

ITEM #55B:
3- Deflecting Vane Type Voltage detectors for use on 100,000 volt lines Cat. 35329

ITEM #56: One (1) 3-phase Line section switch Panel,
Capacity- 100,000 volts
Size- 48 x 16 x 1/4" with reinforcing plate and
supports for mounting in wall

EQUIPMENT:

- 1- TP ST 110,000 volt 300 amp. form K-21 automatic oil switch with remote hand operating mechanism and 1 coil trip,
- 2- bushing type current transformers for above oil switch for 200 amp. circuit with 1 tap for 100 amp. circuit,
- 1- bell alarm switch equipment,
- 1- DP Definite time limit circuit closing overload relay

SPECIFICATIONS FOR SWITCHBOARD

#66938

ITEM #56A: 6- SP ST 110,000 volt 300 amp. IG-6 disconnecting switches on steel bases (indoor type) with safety catches,
2- 20 ft. operating hooks with grounding terminal

ITEM #56B: 3- Deflecting vane type voltage detectors for use on 100,000 volt lines Cat. 35329

ITEM #57: Two (2) 3-phase transformer feeder panels,
Capacity- 100,000 volts,
Size- 48 x 16 x 1/4" with reenforcing plate
and supports for mounting in wall

EQUIPMENT PER PANEL:

1- TP ST 110,000 volt 100 amp. form K-21 non-automatic oil switch with remote hand operating mechanism,

ITEM #57A: 6- TP ST 110,000 volt 300 amp. IG-6 disconnecting switches, on steel bases (indoor type) with safety catches

ITEM #58: Two (2) 3-phase 60 cycle Synchronous Motor and Exciter Panels,
Capacity- 2300 volt 2500(B)kv-a.
Size- (Top section 31 x 24 x 2",
(Middle " 31 x 24 x 2",
(Bottom " 28 x 24 x 2",
on 90" Supports-

EQUIPMENT PER PANEL:

1- 6 amp. H-2 ammeter with 1800 amp. scale,
1- 300 amp. DH-3 field ammeter,
1- 110 volt 5 amp. H-2 wattless component indicator with 3000-0-3000 Kw. scale,
1- 110 volt 5 amp. polyphase DS-5, 2 coil watthour meter, front of panel with ratchet device,
1- concentric operating mechanism for rheostat with extension shaft and mounting for dial plate,
1- 4 point potential receptacle,
1- DP ST 300 amp. field switch with discharge resistance clips on base back of panel, with handle on front,
1- TP ST 4500 volt 1200 amp. automatic K-12 oil switch for cell mounting, (running) with hand operating mechanism 1 coil trip, and bell alarm switch

SPECIFICATIONS FOR SWITCHBOARD

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(ITEM #58 CONT'D)

- 1- TP ST 7500 volt 500 amp. non-automatic K-5 oil switch for cell mounting (starting) with hand operating mechanism,
Cell doors for above,
- 1- mechanical interlock for above oil switch
- 1- SP Inverse time limit circuit closing overload relay,
- 1- SP Reverse power circuit opening relay
- 2- 2200/110 volt 200 watt 60 cycle potential transformers with fuses
- 3- 1500 amp. form E-18 current transformers

ITEM #59: 1- swinging bracket, equipped with-

- 1- 3500 volt H-2 voltmeter, connected to potential transformer with 80:1 ratio
- 1- 4 point potential plug and holder

ITEM #60:

One (1) Battery and Lighting Panel,

Capacity- 30 volts DC

(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- 20-0-20 amp. D-7 ammeter with shunt (for battery circuit)
- 1- 75 volt D-7 voltmeter,
- 1- Handwheel and mounting for rheostat,
- 1- DP DT 250 volt 100 amp. form D-12 lever switch,
- 2- NE CS Fuse blocks with fuses on front of panel,
- 1- DP 100 amp. automatic lever switch with 110 volt AC low voltage release (for connecting emergency lights to battery on failure of AC circuit)
- 1- charging rheostat,
- Copper for connections

ITEM #60A:

- 1- storage battery equipment, consisting of:-
- 3- trays, each consisting of 9 cells Edison B-2 storage battery complete.

SPECIFICATIONS FOR SWITCHBOARD

#66938

ITEM #61: One (1) 3-phase lighting and local power panel,
Capacity- 110 volts,
(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:

4. DP ST 250 volt 100 amp. form D-12 lever switches with
NE CS Fuses on front of panel,
3. TP ST 250 volt 100 amp. form D-12 lever switches with
NE CS Fuses on front of panel,
Copper for interconnections between above switches
mounted by company.

ITEM #62: One (1) single-phase, 2 circuit Signal System Feeder
Panel,
Capacity- 2300 volts,
(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:

2. 5 amp. H-2 ammeters with 10 amp. scale,
1. Bristol Model 510 recording voltmeter with 8" 24 hour
chart, with 0-2500 volt scale connected to potential
transformer with 20-1 ratio
2. DP ST 4500 volt 200 amp. form K-5 automatic oil switches
mounted 5" back of panel, with hand operating mechanism,
and bell alarm switch, 1 coil trip, including inter-
connections between above switches,
2. HP Inverse time limit overload circuit opening relays,
2. 10 amp. form K-6 current transformers,
1. 2200/110 volt 200 watt 60 cycle potential transformer
with fuses.

ITEM #62A:
1. rigid bracket, containing-
1. 2300 volt 3-phase electrostatic ground detector with
metal cover.

SPECIFICATIONS FOR SWITCHBOARD

ITEM #63: One (1) 3-phase 3 wire Selector Switch and Power Panel,
Capacity- 2500 volts,
Size- (Top section 31 x 24 x 1-1/2",
(Middle " 31 x 24 x 1-1/2",
(Bottom " 28 x 24 x 1-1/2",
on 90" supports-

EQUIPMENT:

- 2- TP ST 15000 volt 300 amp. form K-12 automatic oil switches for cell mounting with hand operating mechanism, 1 coil trip, with bell alarm switches and circuit opening auxiliary switches, Cell doors for above,
- 2- SP D.C. Definite time limit circuit opening relays,
- 1- DP Instantaneous overload 3 contact circuit closing relay
- 2- 10 amp. form K-6 current transformers

ITEM #64: 3- SP 2500 volt 100 amp. TD-3 expulsion fuse blocks and holders with fuses mounted on Blue Vermont marble bases front connected (for 10 kv.-a. transformers)

- 1- operating hook Cat. 45229

ITEM #65: Two (2) DC Generator Panels,
Capacity- 3000 volt 2000 (B)kw. 2000 amp. max.
Size- (Top section 31 x 28 x 1-1/2",
(Middle " 31 x 28 x 1-1/2",
(Bottom " 28 x 28 x 1-1/2",
on 90" supports -

EQUIPMENT: PER PANEL:

- Insulating caps
- 1- 1000-0-2000 amp. D-7 ammeter with shunt and external insulating cover,
- 1- concentric chain operating mechanism for field rheostat,
- 1- handwheel and mounting for exciter field rheostat,
- 2- DP ST 200 amp. field switches with discharge resistance clips mounted on base back of panel with handles on front,
- 1- 4 point potential receptacle
- 2- operating handles for circuit breaker and lever switches

SPECIFICATIONS FOR SWITCHBOARD.

#66938

(ITEM #65 CONT'D)

- 1- Natural Black Slate base, 52 x 28 x 2" mounted on pipe framework back and above panel with 2 barriers,
 - 1- SP ST 3600 volt 1500 amp. lever switch with remote control and auxiliary switch,
 - 1- SP ST 3600 volt 1500 amp. circuit breaker with remote control, arc deflector, and magnetic blowout, low voltage release, and auxiliary switch, (one contact to be used for field resistance contactor)
- Copper for connections between above apparatus and to bus with clamps for same.

ITEM #65A:

- 2- 3000 volt DC Aluminum cell lightning arresters, each complete with disconnecting switch and fuse

ITEM #66:

Two (2) DC Feeder Panels,
Capacity- 3000 volt 2000 amp.
Size- (Top section 31 x 28 x 1-1/2",
(Middle " 31 x 28 x 1-1/2",
(Bottom " 28x 28 x 1-1/2",
on 90" Supports -

EQUIPMENT PER PANEL:-

- Insulating caps.
- 1- 1250-0-2500 amp. D-7 ammeter with shunt and external insulating cover,
 - 1- 2 point potential receptacle,
 - 2- operating handles (for circuit breaker and lever switch)
- 1- Natural Black Slate base, 52 x 28 x 2" mounted on pipe framework back and above panel with two barriers,
 - 1- SP ST 3600 volt 2000 amp. lever switch with remote control and auxiliary switch
 - 1- SP ST 3600 volt 2000 amp. circuit breaker with remote control and arc deflector with magnetic blowout and auxiliary switch,
- Copper for connections between above apparatus and to bus with clamps for same,
- 1- extra barrier for end panel only.

SPECIFICATIONS FOR SWITCHBOARD

#66938

ITEM #66A: 2- 3000 volt DC Aluminum cell lightning arresters,
(each complete with disconnecting switch and fuse)

ITEM #67: 1- swinging bracket containing-
1- 4500 volt A I-2 (TID Illuminated dial) voltmeter,
with multiplier, (permanent magnet type)
1- 2 point potential plug and holder

ITEM #68: 3000 volt DC Bus material

ITEM #69: Iron framework to be used with DC Board as a unit.

ITEM #69A: Metal screen to be located below barriers on DC
panels.

ITEM #70: 2- SP ST 7500 volt 2000 amp. disconnecting switches with
safety catches on insulators and steel bars, front
connected, (for DC feeders)
1- SP ST 7500 volt 2000 amp. disconnecting switch with
safety catch, on insulators, and steel base, front
connected, (for DC Feeder tie switch)
1- SP DT 7500 volt 2000 amp. disconnecting switch, with
safety catch on insulators and steel base, front
connected, (for yard feeder switch)
2- 4 foot operating hooks Cat. 65849

SPECIFICATIONS FOR SWITCHBOARD

#66938

LIGHTNING PROTECTIVE APPARATUS.

ITEM #71: 1- 3-phase aluminum cell lightning arrester equipment, complete with tanks, horn gaps, electrolyte, and charging resistance, and short circuiting contacts, indoor type, for 100,000 volt delta connected circuit.

2- single-phase DP multigap graded shunt resistance lightning arrester equipments Cat. 149753 for 2300 volt signal feeder circuits

ITEM #72: 3- 200 amp. hour glass type (indoor) choke coils for 100,000 volt circuit Cat. 78832

4- 25 amp. choke coils Cat. 78539 on steel bracket for 2300 volt circuit

SWITCHBOARD GENERAL SPECIFICATIONS AND CONDITIONS No. 65512-A

Aug. 5th 1914

To CHICAGO, MILWAUKEE & ST. PAUL RY COMPANY,
(Hereinafter called the Purchaser)

Address CHICAGO, ILLINOIS,
(Give location of installation in full)

Except as elsewhere expressly modified by Company's specifications attached, the switchboard covered by these specifications will be sold subject to the following general specifications and conditions:

THE PURCHASER WILL FURNISH UNLESS OTHERWISE EXPRESSLY AGREED:

- (A) Labor of installing said switchboard.
- (B) Foundations, sill, supports, or iron framework built into floor, walls or roof, on which panels, compartments or busses rest or are supported.
- (C) All masonry work, either of brick or concrete, for switch cells, busbar compartments and similar structures.
- (D) All connections between switchboard and
 - Any main and auxiliary apparatus not included as a part of these specifications.
 - Switching devices mounted on or near machines or other apparatus.
 - Lightning arresters and line disconnecting switches.
 - Primary connections between current transformers and switchboard apparatus unless otherwise specified in the following specifications.
 - All control wiring for electrically operated apparatus except as may be specified in a separate item under these specifications.
- (E) All ducts and conduits.
- (F) Doors for bus, lightning arrester or static discharger compartments.
- (G) All lengths of standard pipe for switchboard tie rods and for remote control mechanism for oil switches or other remote control apparatus requiring it.
- (H) Field rheostat discharge resistances for use in connection with discharge clips of field switches, or starting resistances for use with starting switches.
- (I) Necessary drawings of station buildings, and show in such drawings at the request of the Company, all necessary openings in floors, walls or roof, ducts, tie pipes and iron armored conduit.

THE COMPANY WILL FURNISH:

Switchboard apparatus as described in detail specifications attached, and in addition:

- (A) All auxiliary apparatus to make instrument equipment furnished by this Company complete such as resistances and reactances.

- (B) The necessary small wiring material with fuses for interconnecting instruments, meters, relays and other apparatus mounted on the panels.
For panels not an integral part of benchboard this wiring material is assembled on the panels. For benchboard panels this material is not assembled excepting the interconnections between control switches and their indicating lamps mounted on the benchboard.
- (C) Primary leads for potential transformers, not exceeding 5 feet, and secondary leads for potential and current transformers, not exceeding 15 feet in length, unless special leads of greater length are specified in the following detail specifications.
- (D) Secondary leads not exceeding 10 feet for direct current instrument shunts when required unless special leads of greater length are specified in the following detail specifications.
- (E) Fittings to go with the standard iron pipe furnished by Purchaser for braces, tie rods and remote control mechanisms.
- (F) Unless otherwise specified Company will furnish complete rheostat operating mechanism and supports for rheostats, when rheostat is mounted on back of panel. When itemized specifications attached state "No handwheel or dial plate included" it is assumed Purchaser will use the handwheel and dial plate which is supplied with the rheostat and in such cases panel will be drilled for G.E. standard dial plate and shaft unless modifying instructions accompany order.
- (G) Oil for oil switches, oil insulated current and potential transformers and aluminum cell lightning arresters covered in these specifications.

COPPER BUS, WIRE AND CABLE CONNECTIONS

The amounts of wire, cable, bus and connection bar copper specified in this proposal, and stated in pounds or feet, is sufficient to meet the requirements and conditions outlined in the following detail specifications.

If more or less than the amount stated is supplied, due to a change in requirements or conditions, an extra charge will be made or credit given (as the case may be).

PROMISE OF SHIPMENT

The shipment of apparatus as promised is contingent upon the receipt of full and complete information with order, to enable the Company to proceed with the manufacture of apparatus. The promise provides only for performing actual work on this order and any delay exceeding two (2) days for approval of plans by Purchaser or due to changes made by Purchaser, will cause an extension of time of shipment based upon Purchaser's delay and conditions at the Factory of the Company.

INSTRUMENT CALIBRATION

All indicating, curve drawing and watthour meters, relays and tripping devices are calibrated before shipment from the Factory, and any subsequent calibration shall be at the expense of the Purchaser.

RESPONSIBILITY

The Company will not be responsible for the operation of switchboard devices specified by the Purchaser not manufactured by the Company, nor for the infringement of any patent growing out of the use of the devices referred to in this paragraph.

SPECIFICATIONS FOR SWITCHBOARD

FOR

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.
Chicago, Illinois

Specification #63612-A

The switchboard included in these specifications has not been designed to match or line up with any existing installation as the Company has no information that this is necessary.

It is understood that the general location and arrangement of apparatus, busses and connections will be jointly agreed upon.

The Company will not furnish under these specifications any disconnecting switches or other apparatus for the line side of the feeder oil switches in the Power Company's lines or any disconnecting switches for the 2300 volt A.C. lightning arresters.

It is understood only one high tension lightning arrester is to be furnished for each station; this to be connected to the bus; and high tension choke coils are to be furnished for each of the transformer feeder circuits. Under certain conditions, with this arrangement, the lightning arrester may not protect all of the high tension oil switches. The Company therefore does not assume responsibility for failure of such switches due to lightning discharges.

Certain apparatus listed in the following specifications is intended for use with "Outdoor" substations and such apparatus will be changed to the "Indoor" type. The upset price as given herein is based upon apparatus of the indoor type.

The type and arrangement of relays as herein described is subject to such modification as may be agreed upon during the development of final substation drawings.

The oil switches included in these specifications can safely be used for the protection of machines and feeders under short circuit conditions, providing the total rated capacity (including overloads) available on the bus bars or circuit to which the switches are connected does not exceed the following limits:--

SPECIFICATIONS FOR SWITCHBOARD

SPPC. #63612-A

110,000 V. K-22 inverse time limit or non-automatic switch
used on 100,000 V. circuit, 50,000 KV-a.

4500 V. K-12 inverse time limit or non-automatic switch
used on 2300 V. circuit, 15,000 kv-a.

15,000 V. K-12 instantaneous automatic switch used on 2300
V. circuit, 9600 kv-a.

4500 V. K-5 inverse time limit automatic switch used on
2300 V. circuit, 11,000 kv-a.

The capacities given above for time limit automatic
switches apply only when such time limit is set to trip in not less
than two seconds.

Material of panels will be Natural Black slate.
Instruments will have a Dull black finish.
Panels will be mounted on iron framework.
Switches will be provided with cardholders where
necessary.

SPFC. # 63612-4

SPECIFICATIONS FOR SWITCHBOARD

MODEL SUBSTATION

SWITCHBOARD WILL CONTROL:

- 1- Incoming line, 100,000 V. 3-phase, delta 60 cycle (Power Company's Transmission line).
- 2- Incoming and Outgoing 100,000 V. 3-phase, delta, 60 cycle. (Railway Company's Transmission line).
- 2- 2500 (B) KVA banks of transformers 100,000 V./2500 V. (outdoor type) with 50% starting taps.
- 2- 2000 (B) KW 3000 V. motor generator sets, each consisting of:-
 - 1- 2500 (B) KVA 2500 V. 3-phase, 60 cycle, Synchronous Motor, started from transformer taps direct connected to 2- 1000 (B) KW 1500 V. generators connected in series for 3000 V. DC and 2- 125 V. exciters rated 22 and 11 KW respectively.
 - 2- 3000 V. 2000 amp. DC Feeder circuits.

NOTE:- Above equipment besides having the standard (M) overload guarantees, will carry three times normal load for five minutes without injury.

- 1- 10 KVA 3-phase, Transformer 2500/110 V.
- 4- 110 V. single-phase, station lighting circuits.
- 1- Air compressor 3-phase, 110 V.
- 1- Spare feeder 3-phase, 110 V.
- 1- Spare feeder 3-phase, 2500 V.
- 2- Signal circuits single-phase, 2500 V.

SWITCHBOARD WILL CONSIST OF:

- | | |
|------------|--|
| ITEM NO. 1 | 1- Line feeder switch panel (Power Company's Transmission Line). |
| 1-A. | 1- Disconnecting switch. |
| 2. | 2- Line section switch panels, (Rwy Co. Trans. Line). |
| 2-A. | 4- Disconnecting switches. |
| 3. | 2- Transformer feeder panels. |
| 3-A. | 2- Disconnecting switches. |
| 4. | 2- Synchronous Motor and Exciter Panels. |
| 5. | 1- Swinging Bracket. |
| 6. | 1- Battery and Lighting Panel. |
| 6-A. | 1- Storage Battery. |
| 7. | 1- Local Power Panel. |
| 7-A. | 1- Ground detector. |
| 7-B. | 1- Selector switch. |
| 8. | 1- Signal system feeder panel. |
| 9. | 1- Spare feeder panel. |
| 10. | Expulsion fuses, etc., for 2500 V. feeder. |
| 11. | 2- DC Generator Panels. |
| 11-A. | 2- DC Lightning arresters. |

SPECIFICATIONS FOR SWITCHBOARD

- ITEM NO. 12. 2- DC Feeder Panels.
12-A. 2- DC Lightning arresters.
13. 1- Swinging Bracket.
14. DC and AC Bus Material.
15. Iron framework.
16. DC Disconnecting switches and operating blocks.
17. AC lightning arrester.
18. AC choke coils.
-

SPECIFICATIONS FOR SWITCHBOARD

MOREL SUBSTATION

ITEM #1: One (1) 3-phase, line feeder switch panel.
Capacity- 100,000 V.
Size- 48 x 24 x 2" on 76" supports.

EQUIPMENT:

- 1- TP ST 110,000 V. 300 amp. form K-22 automatic oil switch, with remote hand operating mechanism.
- 4- Bushing type current transformers for above oil switch.
- 1- Bell alarm switch equipment.
- 2- SP Reverse power circuit opening relays.
- 1- DP Definite time limit circuit closing overload relay.
- 1- DP Inverse time limit circuit closing overload relay.
- 2- 2200/110 V. 200 watts, 60 cycle, potential transformers with fuses.
(Potential transformers connected to hinge clip of TP DT 2200 V. selector disconnecting switch for emergency reverse power relays on line feeder and line section panels.)

ITEM #1-A.

- 1- TP ST 110,000 V. 300 amp. LG-9 disconnecting switches, hand operated (outdoor type).

ITEM #2: Two (2) 3-phase, Line Section Switch Panels.
Capacity- 100,000 V.
Size- Top Section 48 x 24 x 2" on 76" supports.

EQUIPMENT PER PANEL:

- 1- TP ST 110,000 V. 300 amp. form K-22 automatic oil switch with remote hand operating mechanism, and
- 2- coil trip.
- 4- Bushing type current transformers for above oil switch.
- 1- Bell alarm switch equipment.
- 1- DP Definite time limit circuit closing overload relay.
- 2- SP Reverse power circuit opening relay.

ITEM #2-A:

- 4- TP ST 110,000 V. 300 amp. LG-9 disconnecting switches, hand operating (outdoor type).

ITEM #3: Two (2) 3-phase, transformer feeder panels.
Capacity- 100,000 V.
Size- 48 x 16 x 2" on 76" supports.

SPFC. # 63612-A

SPECIFICATIONS FOR SWITCHBOARD

(ITEM #3 CONT'D)

EQUIPMENT PER PANEL:

- 1- TP ST 110,000 V. 100 amp. form K-22 non-automatic oil switch, with remote hand operating mechanism.

ITEM #3-A:

- 2- TP ST 110,000 V. 300 amp. LG-9 disconnecting switches, hand operated (outdoor type).

ITEM #4:

Two (2) 3-phase, 60 cycle, Synchronous Motor and Exciter Panels.
Capacity- 2300 V. 2500 (B) KVA 2000 (M) amps.
Size- Top Section 31 x 24 x 2"
Middle " 31 x 24 x 2"
Bottom " 28 x 24 x 2" on 90" supports.

EQUIPMENT PER PANEL:

- 1- 4- amp. H-2 ammeter with 2500 amp. scale.
- 1- 300 amp. DH-3 field ammeter.
- 1- 110 V. 4- amp. H-2 wattless component indicator with 4000-7-4000 Kw. scale.
- 1- 110 V. 5- amp. polyphase, DS-5 2- coil watt-hour meter, front of panel, with ratchet device.
- 1- Concentric chain operating mechanism for rheostat.
- 1- 4-point potential receptacle.
- 1- DP ST 300 amp. field switch with discharge resistance clips, on base back of panel, with handle on front.
- 1- TP ST 4500 V. 2000 amp. automatic K-12 oil switch mounted on pipe framework (running) with hand operating mechanism, 1- coil trip, including pipe framework for supporting switch and bell alarm switch.
- 1- TP ST 7500 V. 500 amp. non-automatic K-5 oil switch, mounted on pipe framework (starting) with hand operating mechanism.
- 1- Interlock for above.
- 1- SP Inverse time limit circuit closing overload relay.
- 1- SP Reverse power circuit opening relay.
- 2- 2200/110 V. 200 watts, 60 cycle, potential transformers with fuses.
- 3- 3000 amp. form K-18 current transformers.
(Above transformers to be mounted by Purchaser).

ITEM #5: One (1) Swinging Bracket- equipped with:-

- 1-- 175 V. H-2 voltmeter.
- 1- 4-point potential plug and holder.

SPECIFICATIONS FOR SWITCHBOARD

- ITEM #6:** One (1) Battery and Lighting Panel.
 Capacity- 30 V. DC 110 V. AC.
 Size- Top Section 31 x 20 x 1 1/2"
 Middle " 31 x 20 x 1 1/2"
 Bottom " 28 x 20 x 1 1/2" on 90" supports.

EQUIPMENT:

- 1- 10-2-20 amp. D-7 ammeter with shunt (for battery circuit).
- 1- 5/150 V. D-7 voltmeter (double scale).
- 1- Handwheel and mounting for rheostat.
- 1- 4-point potential receptacle and 1- 4-point plug and holder.
- 1- DP DT 250 V. 100 amp. form D-12 lever switch.
- 2- HE CS fuse blocks with fuses on front of panel.
- 4- DP ST 250 V. 100 amp. form D-12 lever switches, with HE CS fuses on front of panel.
- 1- DP 100 amp. automatic lever switch with 110 V. AC low voltage release (for connecting emergency lights to battery on failure of AC circuit).
- 1- Charging rheostat.
 (Copper for interconnections)

ITEM #6-A:

- 1- Storage Battery equipment, consisting of:-
 3- Trays each containing:- 9- cells Edison B-2 Storage Battery.

ITEM #7:

- 1- 3-phase, Local Power Panel.
 Capacity- 2500/110 V.
 Size- Top Section 31 x 20 x 1 1/2"
 Middle " 31 x 20 x 1 1/2"
 Bottom " 28 x 20 x 1 1/2" on 90" supports.

EQUIPMENT:

- 1- 5- amp. H-2 ammeter with 5- amp. scale.
- 1- TP ST 15000 V. 300 amp. form X-12 automatic oil switch, mounted on pipe framework with hand operating mechanism, 2- coil trip and bell alarm switch, with connections between switch and busses.
- 2- TP ST 100 amp. 250 V. D-12 lever switches, with HE CS fuses on front of panel.
- 2- 10 amp. form K-6 current transformers.
 (Above transformers to be mounted by Purchaser).

ITEM #7-A:

- One (1) Rigid bracket- containing:-
 1- 2500 V. 3-phase, electrostatic ground detector with metal cover.

SPEC. # 63612-A.

SPECIFICATIONS FOR SWITCHBOARD

ITEM #7-B:

- 1- TP DT 2500 V. 200 amp. 40-2 lever switch, (for selector switch) with wood barriers and eye handle mounted on Blue Vermont Marble bases.
- 1- 4 ft. operating hook, Cat. #65849.

ITEM #8:

One (1) Single-phase, 2- circuit Signal System Feeder Panel.

Capacity- 2500 V.

Size- Top Section 31 x 24 x 1 1/2"

Middle " 31 x 24 x 1 1/2"

Bottom " 28 x 24 x 1 1/2" on 90" supports.

EQUIPMENT:

- 2- A.C. Ammeters.
- 1- A.C. recording voltmeter.
- 2- DP ST 4500 V. 200 amp. form K-5 automatic oil switches, for mounting on pipe framework, with hand operating mechanism, and bell alarm switch.
- 1- coil trip, including pipe framework and fittings for supporting switch and connections between switch and busses with clamps for attaching to same.
- 2- SP Inverse time limit overload circuit opening relays.
- 2- 5- amp. form K-6 current transformers.
(Above transformers to be mounted by Purchaser).

ITEM #9:

One (1) 3-phase, Spare Feeder Panel.

Capacity- 2500 V.

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:

- 1- TP ST 4500 V. 200 amp. form K-5 automatic oil switch, for mounting on pipe framework with hand operating mechanism and bell alarm switch.
- 1- coil trip, including pipe framework and fittings for supporting switch and connections between switch and busses with clamps for attaching to same.
- 1- DP Inverse time limit overload circuit opening relay.
- 2- 5- amp. form K-6 current transformers.
(Above transformers to be mounted by Purchaser).

SPEC. # 63612-4.

SPECIFICATIONS FOR SWITCHBOARD

ITEM #10:

- 3- SP 2500 V. 100 amp. TD-3 expulsion fuse blocks and holders with fuses mounted on Blue Vermont Marble bases front connected, (for 10 KVA transformer)
- 1- Operating hook, Cat. #45229.

ITEM #11:

Two (2) DC Generator Panels.

Capacity- 3000 V. 2000 (B) KW 2000 amp. max.

Size- Top section 51 x 28 x 1 1/2"

Middle " 51 x 28 x 1 1/2"

Bottom " 28 x 28 x 1 1/2" on 90" supports.

EQUIPMENT PER PANEL:

Insulating caps.

- 1- 1250-2500 amp. D-7 ammeter with shunt and insulating cover.
 - 1- Concentric chain operating mechanism for field rheostat.
 - 1- Handwheel and mounting for exciter field rheostat.
 - 2- DP ST 200 amp. field switches, with discharge resistance clips mounted on base back of panel, with handles on front.
 - 1- 4-point potential receptacle.
 - 2- Operating handles for circuit breaker and lever switches.
 - 1- Natural Black Slate base, 52 x 28 x 2" mounted on pipe framework and back above panel with two barriers.
 - 1- SP ST 3600 V. 1500 amp. lever switch with remote control, and auxiliary switch.
 - 1- SP ST 3600 V. 1500 amp. circuit breaker with remote control, arc deflector and magnetic blowout, low voltage release and auxiliary switch (one contact to be used for field resistance).
- Copper for connections between above apparatus and to bus with clamps for same.

ITEM #11-A:

- 2- 3000 V. D.C. aluminum cell lightning arresters, (without disconnecting switches).

ITEM #12:

Two (2) DC Feeder Panels.

Capacity- 3000 V. 2000 amp.

Size- Top section 51 x 28 x 1 1/2"

Middle " 51 x 28 x 1 1/2"

Bottom " 28 x 28 x 1 1/2" on 90" supports.

SPEC. #63612-A.

SPECIFICATIONS FOR SWITCHBOARD

ITEM #12 CONT'D)

EQUIPMENT PER PANEL:

- 24- Insulating caps.
 - 1- 1250-0-2500 amp. D-7 ammeter with shunt and insulating cover.
 - 1- 2-point potential receptacle.
 - 2- Operating handles (for circuit breaker and lever switch).
- 1- Natural Black Slate base, 52 x 28 x 2" mounted on pipe framework back and above panel, with two barriers.
 - 1- SP ST 3500 V. 2000 amp. lever switch, with remote control and auxiliary switch.
 - 1- SP ST 3500 V. 2000 amp. circuit breaker, with remote control, and arc deflector with magnetic blowout and auxiliary switch.
- Copper for connections between above apparatus and to bus with clamps for same.

ITEM #12-A.

- 2- 3000 V. DC aluminum cell lightning arresters (without disconnecting switches).

ITEM #13:

One (1) swinging Bracket- containing:-

- 1- 4500 V. A I-2 (T I D illuminated dial) voltmeter with multiplier (permanent magnet type).
- 1- 2- point potential plug and holder.

ITEM #14:

- 3000 V. DC Bus Material.
- 110 V. AC Bus Material.
- 2500 V. AC Bus Material.

ITEM #15:

Pipe framework and channel iron to be used with DC board as a unit.

ITEM #16:

- 2- SP ST 3500 V. 2000 amp. disconnecting switches with safety catches on Blue Vermont Marble bases, front connected (for DC feeders).
- 4- SP ST 3500 V. 500 amp. disconnecting switches, front connected on Blue Vermont Marble bases for DC lightning arrester.
- 2- 4- ft. operating hooks, Cat. # 65849.

SPEC. # 63612-A.

SPECIFICATIONS FOR SWITCHBOARD

LIGHTNING PROTECTIVE APPARATUS

ITEM #17:

- 1- 3-phase, aluminum cell lightning arrester equipment, complete with tanks, horn gaps, electrolyte and charging resistance and short circuiting contacts, out-door type, for 100,000 V. delta connected circuit.
- 2- Single-phase, D P multigap graded shunt resistance lightning arrester equipments, Cat. # 149753 for 2500 V. Signal feeder circuits.

ITEM #18:

- 3- 200 amp. Line suspension type (outdoor) choke coils, for 100,000 V. circuit, each consisting of 2- Cat. #144961 in series.
 - 4- 25- amp. choke coils Cat. #76539 on steel bracket for 2500 V. circuit.
-

The Company will furnish 300 lbs. bare copper bar for DC and AC busses and main connections.

SPEC. # 63612-A.

SPECIFICATIONS FOR SWITCHBOARD

J A N N E Y - S U B S T A T I O NSWITCHBOARD WILL CONTROL:

- 1- Incoming line, 100,000 V., 3-phase, 60 cycle, (Power Company's Transmission Line).
- 2- Incoming and Outgoing line, 100,000 V., 3-phase, 60 cycle (Railway Company's Transmission Line).
- 3- 1900 (B) KVA banks of transformers, 100,000 V./2300 V. (outdoor type) with 5% starting taps.
- 3- 1500 (B) KW 3000 V. Motor Generator sets, each consisting of:-
 - 1- 1900 (B) KVA 2300 V. 3-phase, 60 cycle, synchronous Motor, started from transformer taps direct connected to 2- 750 (B) KW 1500 V. generators, connected in series for 3000 V. DC and 2- 125 V. exciters rated 13 and 8 KW respectively.
 - 2- 3000 V. 3000 amp. DC feeder circuits.

NOTE:- Above equipment, besides having the standard (B) overload guarantees, will carry three times normal load for five minutes without injury.

- 1- 10 KVA 3-phase, transformer 2300/110 V.
- 4- 110 V. single-phase, station lighting circuits.
- 1- Air compressor 3-phase, 110 V.
- 1- Spare feeder circuit, 3-phase, 110 V.
- 1- Spare feeder circuit, 3-phase, 2300 V.
- 2- Signal circuits single-phase, 2300 V.

SWITCHBOARD WILL CONSIST OF:

- | | |
|------------|---|
| ITEM # 19. | 1- Line feeder switch panel (Power Co. Trans. Line). |
| 19-A. | 1- Disconnecting switch. |
| 20. | 2- Line section switch panels (Rwy. Co. Trans. Line). |
| 21. | 3- Transformer Feeder Panels. |
| 21-A. | 3- Disconnecting switches. |
| 22. | 3- Synchronous Motor and Exciter panels. |
| 23. | 1- Swinging Bracket. |
| 24. | 1- Battery and Lighting Panel. |
| 24-A. | 1- Storage Battery. |
| 25. | 1- Local Power Panel. |
| 25-A. | 1- Ground detector. |
| 25-B. | 1- Selector switch. |
| 26. | 1- Signal system feeder. |
| 27. | 1- Spare feeder panel. |
| 28. | Explosion fuse, etc., for 2300 V. feeder. |
| 29. | 3- DC generator panels. |
| 29-A. | 3- DC Lightning arresters. |
| 30. | 2- DC Feeder Panels. |

SPEC. # 63612-A.

SPECIFICATIONS FOR SWITCHBOARD

- ITEM # 30-A. 2- DC Lightning arresters.
31. 1- Swinging Bracket.
32. DC and AC Bus Material.
33. Iron framework.
34. DC Disconnecting switches and operating hooks.
35. AC Lightning arresters.
36. AC Choke coils.
-

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SPEC. #63612-A. SPECIFICATIONS FOR SWITCHBOARD

J A N E Y _ S U B S T A T I O N

ITEM #19: One (1) 3-phase, line feeder switch panel.
Capacity- 100,000 V.
Size- 48 x 24 x 2" on 76" supports.

EQUIPMENT:

- 1- TP BT 110,000 V. 300 amp. form K-22 automatic oil switch, with remote hand operating mechanism.
- 4- Bushing type current transformers for above oil switch.
- 1- Bell alarm switch equipment.
- 1- BP Reverse power circuit closing relay.
- 1- DP Definite time limit circuit closing overload relay.
- 1- DP Inverse time limit circuit closing overload relay.
- 2- 2200/110 V. 200 watts, 60 cycle, potential transformers with fuses.
(Potential transformers connected to hinge clips of TP reverse power relays on line feeder and line section panels).

ITEM #19-A: 1- TP BT 110,000 V. 300 amp. LG-9 disconnecting switches, hand operated (outdoor type).

ITEM #20: Two (2) 3-phase, Line section switch panels.
Capacity- 100,000 V.
Size- 48 x 24 x 2" on 76" supports.

EQUIPMENT PER PANEL:

- 1- TP BT 110,000 V. 300 amp. form K-22 automatic oil switch, with remote hand operating mechanism, and
- 2- coil trip.
- 4- Bushing type current transformers for above oil switch.
- 1- Bell alarm switch equipment for above oil switch.
- 1- DP Definite time limit overload relay.
- 2- BP Reverse power circuit opening relays.

ITEM #20-A: 4- TP BT 110,000 V. 300 amp. LG-9 disconnecting switches, hand operated (outdoor type)

ITEM #21: Three (3) 3-phase, transformer feeder panels.
Capacity- 100,000 V.
Size- 48 x 16 x 2" on 76" supports.

SPECIFICATIONS FOR SWITCHBOARD

ITEM #21 CONT'D)

EQUIPMENT:

- 1- TP ST 110,000 V. 100 amp. form K-22 non-automatic oil switch, with remote hand operating mechanism.

ITEM #21-A: 3- TP ST 110,000 V. 300 amp. LG-9 Disconnecting switches, hand operated (outdoor type).

ITEM #22: Three (3) 3-phase, 60 cycle, Synchronous Motor and Exciter panels.
 Capacity- 2500 V. 1900 (B) KVA 1500 (M) amps.
 Size- Top Section 31 x 24 x 2"
 Middle " 31 x 24 x 2"
 Bottom " 23 x 24 x 2" on 90" supports.

EQUIPMENT PER PANEL:

- 1- 5 amp. H-2 ammeter with 2000 amp. scale.
- 1- 150 amp. DH-3 field ammeter.
- 1- 110 V. 5 amp. H-2 wattless component indicator with 3000-0-3000 Kw. scale.
- 1- 110 V. 5 amp. polyphase, DS-5 2- coil watt-hour meter front of panel with ratchet device.
- 1- Concentric chain operating mechanism for rheostat.
- 1- 4-pt. potential receptacle.
- 1- DP ST 200 amp. field switch with discharge resistance clips on base back of panel with handle on front.
- 1- TP ST 4500 V. 1500 amp. automatic K-12 oil switch, mounted on pipe framework, (running) with hand operating mechanism, 1- coil trip, including pipe framework for supporting switch and bell alarm switch.
- 1- TP ST 7500 V. 300 amp. non-automatic K-5 oil switch mounted on pipe framework (starting) with hand operating mechanism.
- 1- Interlock for above.
- 1- SP Inverse time limit circuit closing overload relay.
- 1- SP Reverse power circuit opening relay.
- 2- 2200/110 V. 200 watts, 60 cycle, potential transformers with fuses.
- 3- 2000 amp. form E-18 current transformers.
 (Above transformers to be mounted by Purchaser).

ITEM #23: One (1) Swinging Bracket- equipped with:
 1- 175 V. H-2 voltmeter.
 1- 4- pt. potential plug and holder.

SPECIFICATIONS FOR SWITCHBOARD

ITEM #24:

- One (1) Battery and lighting panel.
 Capacity- 30 V. DC and 110 V. AC.
 Size- Top Section 51 x 20 x 1 1/2"
 Middle " 51 x 20 x 1 1/2"
 Bottom " 28 x 20 x 1 1/2" on 9" supports.

EQUIPMENT:

- 1- 10-0-20 amp. D-7 ammeter with shunt (for battery circuit).
- 1- 5/150 V. D-7 voltmeter (double scale).
- 1- Handwheel and mounting for rheostat.
- 1- 4-point potential receptacle with 1- 4-point plug and holder.
- 1- DP DT 250 V. 100 amp. form D-12 lever switch.
- 2- NE CS fuse blocks with fuses on front of panel.
- 4- DP ST 250 V. 100 amp. form D-12 lever switches, with NE CS fuses on front of panel.
- 1- DP 100 amp. automatic lever switch, with 110 V. AC low voltage release (for connecting emergency lights to Battery on failure of AC circuit).
- 1- Charging rheostat.
- Copper for connections.

ITEM #24-A:

- One (1) Storage Battery equipment, consisting of:-
 3- Trays, each containing 9- cells Edison
 B-2 storage battery.

ITEM #25:

- One (1) 3-phase Local power Panel.
 Capacity- 2500/110 V.
 Size- Top Section 51 x 20 x 1 1/2"
 Middle " 51 x 20 x 1 1/2"
 Bottom " 28 x 20 x 1 1/2" on 9" supports.

EQUIPMENT:

- 1- 5 amp. E-2 ammeter with 5- amp. scale.
- 1- TP ST 15000 V. 300 amp. form K-12 automatic oil switch mounted on pipe framework with hand operating mechanism, 2- coil trip, and bell alarm switch with connections between switch and busses.
- 2- TP ST 100 amp. 250 V. D-12 lever switches, with NE CS fuses, on front of panel.
- 2- 10 amp. form K-6 current transformers.
 (Above transformers to be mounted by Purchaser).

ITEM #25-A:

- One (1) Rigid Bracket, containing:-
 1- 2500 V. 3-phase, electrostatic ground detector with metal cover.

SPECIFICATIONS FOR SWITCHBOARD

ITEM #25-B:

- 1- TP DT 2500 V. 200 amp. QC-2 lever switch, (for selector switch) with wood barriers and eye handle mounted on Blue Vermont Marble base.
- 1- 4 ft. operating hook, Cat. #63849.

ITEM #26:

- 1- Single phase, 2-circuit Signal System feeder panel, Capacity- 2300 V.
Size- Top Section 31 x 24 x 1 1/2"
Middle " 31 x 24 x 1 1/2"
Bottom " 28 x 24 x 1 1/2" on 90" supports.

EQUIPMENT:

- 2- A.C. ammeters.
- 1- A.C. recording voltmeter.
- 2- DP ST 4500 V. 200 amp. form K-3 automatic oil switches, for mounting on pipe framework, with hand operating mechanism and bell alarm switch 1- coil trip, including pipe framework and fittings for supporting switch and connections between switch and busses with clamps for attaching to same.
- 2- EP Inverse time limit overload circuit opening relays.
- 2- 5- amp. form K-6 current transformers.
(Above transformers to be mounted by Purchaser).

ITEM # 27:

- 1- 3-phase spare feeder panel.
Capacity- 2300 V.
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:

- 1- TP ST 4500 V. 200 amp. form K-3 automatic oil switch, for mounting on pipe framework with hand operating mechanism, and bell alarm switch, 1- coil trip, including pipe framework and fittings for supporting switch and connections between switch and busses with clamps for attaching to same.
- 1- DP Inverse time limit overload circuit opening relay.
- 2- 5- amp. form K-6 current transformers.
(Above transformers to be mounted by Purchaser).

SPEC. #63612-A.

SPECIFICATIONS FOR SWITCHBOARD

- ITEM #28: 3- SP 2500 V. 100 amp. TD-3 expulsion fuse blocks and holders with fuses mounted on Blue Vermont Marble bases front connected (for 10 KVA transformers).
1- Operating hook, Cat. # 45229.
- ITEM #29: Three (3) D.C. Generator Panels.
Capacity- 5000 V. 1500 (B) KW. 1500 amp. max.
Size- Top Section 31 x 28 x 1 1/2"
Middle " 31 x 28 x 1 1/2"
Bottom " 28 x 28 x 1 1/2" on 90" supports.

EQUIPMENT PER PANEL:

- Insulating caps.
- 1- 1000-0-2000 amp. D-7 ammeter with shunt and insulating cover.
- 1- Concentric chain operating mechanism for field rheostat.
- 1- Handwheel and mounting for exciter field rheostat.
- 2- DP ST 200 amp. field switches with discharge resistance clips mounted on base back of panel with handles on front.
- 1- 4-point potential receptacle.
- 2- Operating handles (for circuit breaker and lever switch).
- 1- Natural Black Slate base, 52 x 28 x 2" mounted on pipe framework back and above panel with 2- barriers containing:-
- 1- SP ST 3600 V. 1500 amp. lever switch, with remote control and auxiliary switch.
- 1- SP ST 3600 V. 1200 amp. circuit breaker, with remote control arc deflector and magnetic blowout low voltage release and auxiliary switch.
(One contact to be used for field resistance).
Copper for connections between above apparatus and to bus with clamps for same.
- ITEM #29-A: 3- 5000 V. DC aluminum cell lightning arresters, (without disconnecting switches).
- ITEM #30: Two (2) DC Feeder Panels.
Capacity- 5000 V. 2250 amp.
Size- Top Section 31 x 28 x 1 1/2"
Middle " 31 x 28 x 1 1/2"
Bottom " 28 x 28 x 1 1/2" on 90" supports.

SPEC. #63612-A.

SPECIFICATIONS FOR SWITCHBOARD

(ITEM #30 CONT'D)

EQUIPMENT PER PANEL:

- ✓ Insulating caps.
- 1- 1500-2-3000 amp. D-7 ammeter with shunt and insulating cover.
- 1- 2-point potential receptacle.
- 2- Operating handles (for circuit breaker and lever switch).
- 1- Natural Black Slate base, 52 x 28 x 2" mounted on pipe framework, back and above panel, with two barriers containing:-
 - 1- SP ST 3600 V. 3000 amp. lever switch, with remote control and auxiliary switch.
 - ✓ 1- SP ST 3600 V. 3000 amp. circuit breaker, with remote control and arc deflector with magnetic blowout and auxiliary switch.
- Copper for connections between above apparatus and to bus with clamps for same.

ITEM #30-A:

- 2- 3000 V. DC aluminum cell lightning arresters, (without disconnecting switches).

ITEM #31:

- One (1) winging Bracket- containing:-
 - 1- 4500 V. A I-2 (T I D illuminated dial) voltmeter with multiplier (permanent magnet type).
 - 1- 2-point potential plug and holder.

ITEM #32:

- 3000 V. DC Bus Material.
- 110 V. AC Bus Material.
- 2300 V. AC Bus Material.

ITEM #33:

- Pipe framework and channel iron to be used with DC board as a unit.

ITEM #34:

- 2- SP ST 3500 V. 3000 amp. disconnecting switches, with safety catches on Blue Vermont Marble bases, front connected (for DC feeders).
- 5- SP ST 3500 V. 300 amp. disconnecting switches, front connected on Blue Vermont Marble bases (for DC lightning arresters).
- 2- 4- ft. operating hooks, Cat. #65849.

SPEC. #63612-A.

SPECIFICATIONS FOR SWITCHBOARD

LIGHTNING PROTECTIVE APPARATUS

ITEM #55:

- 1- 3-phase, aluminum ocell lightning arrester equipment, complete, with tanks, horn gaps, electrolyte and charging resistance and short circuiting contacts out-door type for 100,000 V. delta connected circuit.
- 2- Single-phase, DP multigap graded shunt resistance lightning arrester equipments, Cat. #149753 for 2300 V. signal feeder circuits.

ITEM #36:

- 9- 200 amp. line suspension type (outdoor) choke coils, for 100,000 V. circuit each consisting of 2- Cat. # 144961 in a series.
- 4- 25- amp. choke coils Cat. # 76339 on steel bracket for 2300 V. circuit.

The Company will furnish 365 lbs. bare copper bar for DC and AC busses and main connections.

SPECIFICATIONS FOR SWITCHBOARD

P I D M O N T S U B S T A T I O N

SWITCHBOARD WILL CONTROL:

- 2- Incoming and Outgoing lines, 100,000 V. 3-phase, delta (Rwy. Co. Transmission Line).
- 3- 1900 (B) KVA banks of transformers, 100,000 V. 2300 V. with 80% starting taps (outdoor type).
- 3- 1500 (B) Kw. 3000 V. motor generator sets, each consisting of:-
 - 1- 1900 (B) KVA 2300 V. 3-phase, 60 cycle, synchronous motor, started from transformer taps, direct connected to 2- 750 (B) Kw 1500 V. generators connected in series for 3000 V. DC and 2- 125 V. exciters rated 15 and 8 Kw respectively.
 - 2- 3000 V. 2250 amp. DC feeder circuits.

NOTE:- Above equipment, besides having the standard (B) overload guarantees, will carry three times normal load for five minutes without injury.

- 1- 10 KVA 3-phase, Transformer, 2300/110 V.
- 4- 110 V. single-phase, Station lighting circuits.
- 1- Air compressor 3-phase, 110 V.
- 1- Spare feeder 3-phase, 110 V.
- 1- Spare feeder 3-phase, 2300 V.
- 2- Signal circuits single-phase, 2300 V.

SWITCHBOARD WILL CONSIST OF:

- ITEM NO. 37: 1- Disconnecting switch (Rwy. Co. Trans. Line).
- 38: 1- Disconnecting switch " " " "
- 39: 3- Transformer feeder panels.
- 39-A: 3- Disconnecting switches.
- 40: 3- Synchronous Motor and Exciter Panels.
- 41: 1- Swinging Bracket.
- 42: 1- Battery and Lighting panel.
- 42-A: 1- Storage Battery.
- 43: 1- Local Power Panel.
- 43-A: 1- Ground detector.
- 43-B: 1- Selector switch.
- 44: 1- Signal system feeder panel.
- 45: 1- Spare feeder panel.
- 46: Expulsion fuses, etc., for 2300 V. feeder.
- 47: 3- DC Generator Panels.
- 47-A: 3- DC lightning arresters.
- 48: 2- DC Feeder Panels.
- 48-A: 2- DC Lightning arresters.
- 49: 1- Swinging Bracket.

SPECIFICATIONS FOR SWITCHBOARD

- ITEM # 50: DC and AC Bus Material.
51: Iron framework.
52: DC Disconnecting switches and operating hooks.
53: AC lightning arrester.
54: AC choke coils.
-

SPECIFICATIONS FOR SWITCHBOARD

PIEDMONT SUBSTATION

ITEM #37: 1- TP ST 110,000 V. 300 amp. LG-9 disconnecting switch, hand operated (outdoor type) for line section switch.

ITEM #38: 1- TP ST 110,000 V. 300 amp. LG-9 disconnecting switch, hand operated, (outdoor type) for line section switch.

ITEM #39: Three (3) 3-phase, transformer feeder panels.
Capacity- 100,000 V.
Size- 48 x 16 x 2" on 76" supports.

EQUIPMENT PER PANEL:

1- TP ST 110,000 V. 100 amp. form K-22 non-automatic oil switch, with remote hand operating mechanism.

ITEM #39-A: 3- TP ST 110,000 V. 300 amp. LG-9 disconnecting switches, hand operated (outdoor type).

ITEM #40: Three (3) 3-phase, 60 cycle, Synchronous Motor and Exciter Panels.
Capacity- 2500 V. 1900 (B) KVA 1500 (M) amps.
Size- Top Section 51 x 24 x 2"
Middle " 51 x 24 x 2"
Bottom " 28 x 24 x 2" on 90" supports.

EQUIPMENT PER PANEL:

- 1- 5- amp. H-2 ammeter with 2000 amp. scale.
- 1- 150 amp. DH-3 field ammeter.
- 1- 110 V. 5- amp. H-2 wattless component indicator with 3000-0-3000 kw scale.
- 1- 110 V. 5- amp. polyphase, DS-5, 2- coil watt-hour meter on front of panel with ratchet device
- 1- Concentric chain operating mechanism for rheostat
- 1- 4- point potential receptacle.
- 1- DP ST 200 amp. field switch, with discharge resistance clips, on base back of panel, with handle on front
- 1- TP ST 4500 V. 1500 amp. automatic K-12 oil switch, mounted on pipe framework (running) with hand operating mechanism, 1- coil trip, including pipe framework, for supporting switch and bell alarm switch.
- 1- TP ST 7500 V. 500 amp. non-automatic K-5 oil switch, mounted on pipe framework (starting) with hand operating mechanism.

SPFO. /63612-A.

SPECIFICATIONS FOR SWITCHBOARD

(ITEM #40 C'NT'D)

- 1- Interlock for above.
- 1- SP Inverse time limit circuit closing overload relay.
- 1- SP Reverse power circuit opening relay.
- 2- 2200/110 V. 200 watts, 60 cycle, potential transformers with fuses.
- 2- 2000 amp. form B-18 current transformers.
(Above transformers to be mounted by Purchaser).

ITEM #41: One (1) swinging bracket- equipped with:-
 1- 175 V. D-2 voltmeter.
 1- 4-point potential plug and holder.

ITEM #42: One (1) Battery and lighting panel.
 Capacity- 30 V. DC 110 V. AC.
 Size- Top Section 31 x 20 x 1 1/2"
 Middle " 31 x 20 x 1 1/2"
 Bottom " 28 x 20 x 1 1/2" on 90" supports.

EQUIPMENT:

- 1- 10-0-20 amp. D-7 ammeter with shunt (for battery circuit)
- 1- 5/150 V. D-7 voltmeter (double scale).
- 1- Handwheel and mounting for rheostat.
- 1- 4- point potential receptacle and 1- 4-point plug and holder.
- 1- DP DT 250 V. 100 amp. Form D-12 lever switch.
- 2- NE CS fuse blocks with fuses on front of panel.
- 4- DP ST 250 V. 100 amp. form D-12 lever switches, with NE CS fuses on front of panel.
- 1- DP 100 amp. automatic lever switch, with 110 V. A.C. low voltage release (for connecting emergency lights to battery on failure of AC circuit).
- 1- Charging rheostat.
- Copper for connections.

ITEM #42-A:
 1- Storage Battery equipment, consisting of:-
 2- Trays each containing:- 9- Cells Edison B-2 Storage Battery.

ITEM #43: One (1) 3-phase, Local Power Panel.
 Capacity- 2500/110 V.
 Size- Top Section 31 x 20 x 1 1/2"
 Middle " 31 x 20 x 1 1/2"
 Bottom " 28 x 20 x 1 1/2" on 90" supports.

SPECIFICATIONS FOR SWITCHBOARD

(ITEM #43 CONT'D)

EQUIPMENT:

- 1- 5- amp. H-2 ammeter with 5 amp. scale.
- 1- TP ST 15000 V. 300 amp. form K-12 automatic oil switch, mounted on pipe framework, with hand operating mechanism, 2- coil trip and bell alarm switch with connections between switch and busses.
- 2- TP ST 100 amp. 250 V. D-18 lever switches, with NE CS fuses on front of panel.
- 2- 10 amp. form K-6 current transformers.
(Above transformers to be mounted by Purchaser).
Copper for interconnections.

ITEM #43-A:

- 1- Rigid bracket containing:
 - 1- 2500 V. 3-phase electrostatic ground detector with metal cover.

ITEM #43-B:

- 1- TP DT 2500 V. 200 amp. 40-2 lever switch (for selector switch) with wood barriers and eye handle on Blue Vermont Marble bases.
- 1- 4 ft. operating hook Cat. #65949.

ITEM #44:

- 1- Single phase, 2-circuit Signal System Feeder Panel, Capacity- 2500 V.
Size- Top Section 31 x 24 x 1 1/2"
Middle " 31 x 24 x 1 1/8"
Bottom " 26 x 24 x 1 1/2" on 90" supports.

EQUIPMENT:

- 2- A.C. ammeters.
- 1- A.C. recording voltmeter.
- 2- DP ST 4500 V. 200 amp. form K-5 automatic oil switches, for mounting on pipe framework, with hand operating mechanism, and bell alarm switch, 1- coil trip, including pipe framework and fittings for supporting switch and connections between switch and busses with clamps for attaching to same.
- 2- SP Inverse time limit overload circuit opening relays/
- 2- 5- amp. form K-6 current transformers.
(Above transformers to be mounted by Purchaser).

SPKO. #68612-A.

SPECIFICATIONS FOR SWITCHBOARD

- ITEM #45: One (1) 3-phase, Spare feeder panel.
 Capacity- 2500 V.
 Size- Top Section 51 x 16 x 1 1/2"
 Middle " 51 x 16 x 1 1/2"
 Bottom " 28 x 16 x 1 1/2" on 90" supports.

EQUIPMENT:

- 1- TP ST 4500 V. 200 amp. form X-5 automatic oil switch, for mounting on pipe framework with hand operating mechanism and bell alarm switch, 1- coil trip, including pipe framework and fittings for supporting switch and connections between switch and busses with clamps for attaching to same.
- 1- DP Inverse time limit overload circuit opening relay.
- 2- 5- amp. form X-6 current transformers.
 (Above transformers to be mounted by Purchaser).

- ITEM #46: 5- 2500 V. 100 amp. TD-3 expulsion fuse blocks and holders with fuses mounted on Blue Vermont Marble bases, front connected (for 10 KVA transformers).
 1- Operating hook Cat. #45229.

- ITEM #47: Three (3) DC Generator Panels.
 Capacity- 3000 V. 1500 (B) KW 1500 amp. max.
 Size- Top Section 51 x 28 x 1 1/2"
 Middle " 51 x 28 x 1 1/2"
 Bottom " 28 x 28 x 1 1/2" on 90" supports.

EQUIPMENT PER PANEL:

- Insulating caps.
- 1- 1000-0-2000 amp. D-7 ammeter with shunt and insulating cover.
 - 1- Concentric chain operating mechanism for field rheostats.
 - 1- Handwheel and mounting for exciter field rheostat.
 - 2- DP ST 200 amp. field switches with discharge resistance clips mounted on base back of panel with handle on front.
 - 1- 4- point potential receptacle.
 - 2- Operating handles (for circuit breaker, and lever switch).
 - 1- Natural Black Slate base, 52 x 28 x 2" mounted on pipe framework back and above panel, with 2- barriers.
 - 1- SP ST 2400 V. 1500 amp. lever switch, with remote control and auxiliary switch.
 - 1- SP ST 2400 V. 1200 amp. circuit breaker with remote control, arc deflector and magnetic blowout, low voltage release and auxiliary switch (one contact to be used for field resistance).
- Copper for connections between above apparatus and to busses with clamps for same.

SPEC. #63618-A.

SPECIFICATIONS FOR SWITCHBOARD

ITEM #47-A:

- 2- 3000 V. DC aluminum cell lightning arresters,
(without disconnecting switches). *9/21/15 Inc. 11-1-15*

ITEM #48:

Two (2) DC Feeder Panels.

Capacity- 3000 V. 3250 amps.

Size- Top Section 51 x 28 x 1 1/2"

Middle " 51 x 28 x 1 1/2"

Bottom " 28 x 28 x 1 1/2" on 90° supports.

EQUIPMENT PER PANEL:

Insulating caps.

- 1- 1500-2-3000 amp. D-7 ammeter with shunt and insulating cover.

- 1- 2- point potential receptacle.

- 2- Operating handles (for circuit breaker and lever switches).

- 1- Natural Black Slate base, 52 x 28 x 2" mounted on pipe framework back and above panel, with 2- barriers.

- 1- SP ST 3600 V. 3000 amp. lever switch with remote control and auxiliary switch.

- 1- SP ST 3600 V. 3000 amp. circuit breaker, with remote control and arc deflector with magnetic blowout and auxiliary switch.

Copper for connections between above apparatus and to bus with clamps for same.

ITEM #48-A:

- 2- 3000 V. DC aluminum cell lightning arrester (without disconnecting switches). *156015. D. Amundson Sol. 9/21/15 complete shipment 4/4/16*

ITEM #49:

- 1- Swinging Bracket- containing:-

- 1- 4500 V. A I-2 (T I D illuminated dial) voltmeter with multiplier (permanent magnet type).

- 1- 2- point potential plug and holder.

ITEM #50:

3000 V. DC Bus Material.

110 V. AC Bus Material.

2500 V. AC Bus Material.

SPECIFICATIONS FOR SWITCHBOARD

- ITEM #51: Pipe framework and channel iron to be used with DC board as a unit.
- ITEM #52: 2- 8P 8T 3500 V. 3000 amp. disconnecting switches, with safety catches on Blue Vermont Marble base, front connected (for DC feeders). 9/9/5
- 5- 8P 8T 3500 V. 300 amp. disconnecting switches, front connected on Blue Vermont Marble bases (for DC lightning arresters).
- 2- 4 ft. operating hooks, Cat. #65552.
-

SPEC. # 63612-A.

SPECIFICATIONS FOR SWITCHBOARD

LIGHTNING PROTECTIVE APPARATUS

ITEM #53:

- 1- 3-phase, aluminum cell lightning arrester equipment, complete, with tanks, horn gaps, electrolyte, and charging resistance and short circuiting contacts outdoor type for 100,000 V. delta connected circuit. *How Rep mechanism 9/15*
- 2- Single-phase, DP multigap graded shunt resistance lightning arrester equipment, Cat. #149755 for 2300 V. signal feeder circuits.

ITEM #54:

- 3- 200 amp. line suspension type (outdoor) choke coils for 100,000 V. circuit, each consisting of 2- Cat. #144961 in series.
- 4- 25 amp. choke coils Cat. #76359 on steel bracket for 2300 V. circuit.

The Company will furnish 355 lbs. bare copper bar for DC and AC busses and main connections.

SPECIFICATIONS FOR SWITCHBOARD

E E S T I S - S U B S T A T I O NSWITCHBOARD WILL CONTROL:

- 1- Incoming line, 100,000 V. 3-phase, delta, 60 cycle.
- 1- Incoming and Outgoing line, 100,000 V. 3-phase, delta (Rwy. Co. Trans. Line).
- 2- 2500 (B) KVA banks of transformers 100,000/2500 V. with 50% starting taps (outdoor type).
- 2- 2000 (B) KW 3000 V. Motor-Generator Sets, each consisting of:-
 - 1- 2500 (B) KVA 2500 V. 3-phase, 60 cycle, Synchronous Motor, started from transformer taps, direct connected to 2- 1000 (B) KW 1500 V. generators connected in series for 3000 V. DC and 2- 125 V. Exciters rated 22 and 11 KW respectively.
- 2- 3000 V. 2000 amp. DC Feeder Circuits.

NOTE:- Above equipment, besides having the standard (B) overload guarantees, will carry three times normal load for five minutes without injury.

- 1- 10 KVA 3-phase, Transformer, 2500/110 V.
- 4- 110 V. single-phase, station Lighting Circuits.
- 1- Air compressor 3-phase, 110 V.
- 1- Spare feeder 3-phase 110 V.
- 1- Spare feeder 3-phase, 2500 V.
- 2- Signal circuits single-phase 2500 V.

SWITCHBOARD WILL CONSIST OF:

- | | |
|-----------|--|
| ITEM #55. | 1- Line Feeder switch panel (Power Co. Trans. Line). |
| 55-A. | 1- Disconnecting switch. |
| 56. | 1- Line section switch panel (Rwy. Company's Trans. Line). |
| 56-A. | 2- Disconnecting switches. |
| 57. | 2- Transformer feeder panels. |
| 57-A. | 2- Disconnecting switches. |
| 58. | 2- Synchronous Motor and Exciter Panels. |
| 59. | 1- Swinging Bracket. |
| 60. | 1- Battery and Lighting Panel. |
| 60-A. | 1- Storage Battery. |
| 61. | 1- Local Power Panel. |
| 61-A. | 1- Ground detector. |
| 61-B. | 1- Selector switch. |
| 62. | 1- Signal system feeder panel. |
| 63. | 1- Spare feeder panel. |
| 64. | Expulsion fuses, etc., for 2500 V. feeder. |
| 65. | 2- DC Generator Panels. |
| 65-A. | 2- DC lighting arresters. |

SPECIFICATIONS FOR SWITCHBOARD

- | | |
|-----------|---|
| ITEM #66. | 2- DC Feeder Panels. |
| 66-A: | 2- DC "lightning arresters. |
| 67. | 1- Swinging Bracket. |
| 68. | DC and AC Bus Material. |
| 69. | Iron framework. |
| 70 | DC Disconnecting switches and operating hook. |
| 71. | AC Lightning arrester. |
| 72. | AC Choke coils. |
-

SPECIFICATIONS FOR SWITCHBOARD

E U S T I E - S U B S T A T I O N

ITEM #55.

One (1) 3-phase, Line Feeder switch Panel.
Capacity- 100,000 V.
Size- 48 x 24 x 2" on 76" supports.

EQUIPMENT:

- 1- TP ST 110,000 V. 500 amp. form K-22 automatic oil switch, with remote hand operating mechanism.
- 4- Bushing type current transformers for above oil switch.
- 1- Bell alarm switch equipment.
- 2- SP Reverse power circuit opening relays.
- 1- DP Definite time limit circuit closing overload relay.
- 1- DP Inverse time limit circuit closing overload relay.
- 2- 2200/110 V. 200 watt, 60 cycle, potential transformers, with fuses.
(Potential transformers connected to hinge clip of TP DP 2500 V. selector disconnecting switch for energizing Reverse power relays on line feeder and line section panels).

ITEM #55-A: 1- TP ST 110,000 V. 500 amp. LG-9 disconnecting switch, hand operated (outdoor type).

ITEM #56: One (1) 3-phase, Line section Switch Panel.
Capacity- 100,000 V.
Size- 48 x 24 x 2" on 76" supports.

EQUIPMENT:

- 1- TP ST 110,000 V. 500 amp. form K-22 automatic oil switch, with remote hand operating mechanism and 2- coil trip.
- 2- Bushing type current transformers for above oil switch.
- 1- Bell alarm switch equipment.
- 1- DP Definite time limit circuit closing overload relay.

ITEM #56-A.

2- TP ST 110,000 V. 500 amp. LG-9 disconnecting switches hand operated (outdoor type).

ITEM #57: Two (2) 3-phase, Transformer Feeder Panels.
Capacity- 100,000 V.
Size- 48 x 16 x 2" on 76" supports.

SPEC. # 62612-A.

SPECIFICATIONS FOR SWITCHBOARD

(ITEM #57 CONT'D)

EQUIPMENT PER PANEL:

- 1- TP ST 110,000 V. 100 amp. form K-22 non-automatic oil switch with remote hand operating mechanism.

ITEM #57-A: 2- TP ST 110,000 V. 500 amp. LG-9 disconnecting switches, hand operated (outdoor type).

ITEM #58: Two (2) 3-phase, 60 cycle, Synchronous Motor and Exciter Panels.
Capacity- 2500 V. 2500 (B) KVA 2000 (M) amps.
Size- Top Section 31 x 24 x 2"
Middle " 31 x 24 x 2"
Bottom " 28 x 24 x 2" on 90" supports.

EQUIPMENT PER PANEL:

- 1- 4- amp. H-2 ammeter with 2500 amp. scale.
- 1- 500 amp. DH-5 field ammeter.
- 1- 110 V. 4- amp. H-2 wattless component indicator, with 4000-0-4000 Kw scale.
- 1- 110 V. 5- amp. polyphase, DS-5, 2- coil watt-hour meter, front of panel, with ratchet device.
- 1- Concentric chain operating mechanism for rheostat.
- 1- 4-point potential receptacle.
- 1- DP ST 500 amp. field switch with discharge resistance slips on base back of panel, with handle on front.
- 1- TP ST 4500 V. 2000 amp. automatic K-12 oil switch mounted on pipe framework, (running) with hand operating mechanism, 1- coil trip, including pipe framework, for supporting switch and bell alarm switch.
- 1- TP ST 7500 V. 500 amp. non-automatic K-5 oil switch, mounted on pipe framework (starting) with hand operating mechanism.
- 1- Interlock for above.
- 1- SP Inverse time limit circuit closing overload relay.
- 1- SP Reverse power circuit opening relay.
- 2- 2200/110 V. 200 watts, 60 cycle, potential transformers with fuses.
- 2- 3000 amp. form K-16 current transformers.
(Above transformers to be mounted by Purchaser).

ITEM #59: One (1) Swinging Bracket equipped with:-
1- 175 V. H-2 voltmeter.
1- 4- point potential plug and holder.

SPECIFICATIONS FOR SWITCHBOARD

ITEM #60: One (1) Battery and Lighting Panel.
 Capacity- 30 V. DC 110 V. AC.
 Size- Top Section 31 x 20 x 1 1/2"
 Middle " 31 x 20 x 1 1/2"
 Bottom " 28 x 20 x 1 1/2" on 90" supports.

EQUIPMENT:

- 1- 10-0-20 amp. D-7 ammeter with shunt (for Battery circuit).
- 1- 5- 150 V. D-7 voltmeter (double scale).
- 1- Handwheel and mounting for rheostat.
- 1- 4-point potential receptacle and - 1- 4-point plug and holder.
- 1- DP DT 250 V. 100 amp. form D-12 lever switch.
- 2- HE CS fuse blocks with fuses on front of panel.
- 4- DP ST 250 V. 100 amp. form D-12 lever switches, with HE CS fuses on front of panel.
- 1- DP 100 amp. automatic lever switch with 110 V. AC low voltage release (for connecting emergency lights to battery on failure of AC circuit).
- 1- Charging rheostat.
- Copper for interconnections.

ITEM #60-A. 1- Storage Battery Equipment, consisting of:-
 5- Trays, each consisting of:- 9- cells
 Edison B-2 storage Battery.

ITEM #61: One (1) 3-phase, Local Power Panel.
 Capacity- 2500/110 V.
 Size- Top Section 31 x 20 x 1 1/2"
 Middle " 31 x 20 x 1 1/2"
 Bottom " 28 x 20 x 1 1/2" on 90" supports.

EQUIPMENT:

- 1- 5- amp. H-2 ammeter with 5 amp. scale.
- 1- EP ST 15000 V. 500 amp. form K-12 automatic oil switch, mounted on pipe framework, with hand operating mechanism, 2- coil trip and bell alarm switch, with connections between switch and busbars.
- 2- EP ST 100 amp. 250 V. D-12 lever switches with HE CS fuses on front of panel.
- 2- 10 amp. form K-6 current transformers.
 (Above transformers to be mounted by Purchaser).
 Copper for interconnections.

SPEC. / 63612-A.

SPECIFICATIONS FOR SWITCHBOARD

ITEM #61-A: One (1) Rigid Bracket- containing:-
1- 2300 V. 3-phase, electrostatic ground detector with metal cover.

ITEM #61-B. 1- TP DT 2500 V. 200 amp. QC-2 lever switch, (for selector switch) with wood barriers and eye handle mounted on Blue Vermont Marble bases.
1- 4 ft. operating hook, Cat. #65849.

ITEM #62: One (1) Single-phase, 2- circuit Signal System Feeder Panel.
Capacity- 2500 V.
Size- Top Section 31 x 24 x 1 1/2"
Middle " 31 x 24 x 1 1/2"
Bottom " 28 x 24 x 1 1/2" on 90" supports.

EQUIPMENT:

- 2- A.C. ammeters.
- 1- A.C. recording voltmeter.
- 2- DP ST 4500 V. 200 amp. form K-5 automatic oil switches, for mounting on pipe framework with hand operating mechanism, and bell alarm switch, 1- coil trip, including pipe framework, and fittings for supporting switch and connections between switch and busses with clamps for attaching to same.
- 2- SP Inverse time limit overload circuit opening relays.
- 2- 5- amp. form K-6 current transformers.
(Above transformers to be mounted by Purchaser).

ITEM #63: One (1) 3-phase, Spare Feeder Panel.
Capacity- 2500 V.
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:

- 1- TP ST 4500 V. 200 amp. form K-5 automatic oil switch, for mounting on pipe framework, with hand operating mechanism, and bell alarm switch, 1- coil trip, including pipe framework, and fittings for supporting switch and connections between switch and busses with clamps for attaching to same.
- 1- DP Inverse time limit overload circuit opening relay.
- 2- 5- amp. form K-6 current transformers.
(Above transformers to be mounted by Purchaser).

SPECIFICATIONS FOR SWITCHBOARD

- ITEM #64: 5- SP 2500 V. 100 amp. TD-3 expulsion fuse blocks and holders with fuses mounted on Blue Vermont Marble bases front connected (for 10 KVA transformers).
1- Operating hook Cat. #45229.

- ITEM # 65: Two (2) DC Generator Panels.
Capacity- 3000 V. 2000 (B) KW. 2000 amp. max.
Size- Top Section 31 x 28 x 1 1/2"
Middle " 31 x 28 x 1 1/2"
Bottom " 28 x 28 x 1 1/2" on 90" supports.

EQUIPMENT PER PANEL:

- Insulating caps.
1- 1250-2-2500 amp. D-7 ammeter with shunt and insulating cover.
1- Concentric chain operating mechanism for field rheostat.
1- Handwheel and mounting for exciter field rheostat.
2- DP ST 200 amp. field switches with discharge resistance clips mounted on base back of panel with handles on front.
1- 4-point potential receptacle.
2- Operating handles for circuit breaker and lever switches.
1- Natural Black Slate base, 52 x 28 x 2" mounted on pipe framework back and above panel with 2- barriers.
1- SP ST 3600 V. 1500 amp. lever switch, with remote control, and auxiliary switch.
1- SP ST 3600 volt 1500 amp. circuit breaker with remote control, arc deflector and magnetic blowout, low voltage release and auxiliary switch (one contact to be used for field resistance).
Copper for connections between above apparatus and to bus with clamps for same.

- ITEM #65-A. 2- 3000 V. DC aluminum cell lightning arresters (without disconnecting switches).

- ITEM #66: Two (2) DC Feeder Panels.
Capacity- 3000 V. 2000 amp.
Size- Top Section 31 x 28 x 1 1/2"
Middle " 31 x 28 x 1 1/2"
Bottom " 28 x 28 x 1 1/2" on 90" supports.

SPECIFICATIONS FOR SWITCHBOARD

(ITEM #66 CONT'D)

EQUIPMENT PER PANEL:

Insulating caps.

- 1- 1250-0-2500 amp. D-7 ammeter with shunt and insulating cover.
- 1- 2- point potential receptacle.
- 2- Operating handles (for circuit breaker and lever switch).

- 1- Natural Black Plate Base, 52 x 28 x 2" mounted on pipe framework back and above panel, with two barriers.

- 1- SP ST 3600 V. 2000 amp. lever switch, with remote control and auxiliary switch.

- 1- SP ST 3600 V. 2000 amp. circuit breaker, with remote control, and arc deflector with magnetic blowout and auxiliary switch.

Copper for connections between above apparatus and to bus with clamps for same.

- ITEM #66-A: 2- 3000 V. DC aluminum cell lightning arresters (without disconnecting switches).

- ITEM #67: One (1) Swinging Bracket- containing:-
- 1- 4500 V. AI-2 (F I D illuminated dial) voltmeter with multiplier (permanent magnet type).
 - 1- 2- point potential plug and holder.

- ITEM #68: 3000 V. DC Bus Material.
110 V. AC Bus Material.
2500 V. AC Bus Material.

- ITEM #69: Pipe framework and channel iron to be used with DC board as a unit.

- ITEM #70: 2- SP ST 3600 V. 2000 amp. disconnecting switches, with safety catches on Blue Vermont Marble bases, front connected (for DC feeders).
4- SP ST 3600 V. 800 amp. disconnecting switches, front connected on Blue Vermont Marble bases for DC lightning arresters.
2- 4 ft. operating hooks, Cat. #65849.

SPECIFICATIONS FOR SWITCHBOARD

LIGHTNING PROTECTIVE APPARATUS

ITEM #71:

- 1- 3-phase, aluminum cell lightning arrester equipment, complete with tanks, horn gaps, electrolyte, and charging resistance and short circuiting contacts outdoor type for 100,000 V. delta connected circuit.
- 2- Single-phase, DP multigap graded shunt resistance lightning arrester equipment, Cat. #149755 for 2300 V. Signal Feeder circuits.

ITEM #72:

- 3- 200 amp. Line suspension type (outdoor) choke coils for 100,000 V. circuit, each consisting of 2- Cat. #144961 in series.
- 4- 25- amp. choke coils Cat. #76339 on steel bracket for 2300 V. circuit.

The Company will furnish 300 lbs. bare copper bar for DC and AC busses and main connections.

SWITCHBOARD GENERAL SPECIFICATIONS AND CONDITIONS No. **63687-A**

Aug. 3rd

1914

To **CHICAGO, MILWAUKEE & ST. PAUL RY. COMPANY,**
(Hereinafter called the Purchaser)

Address **CHICAGO, ILLINOIS.**
(Give location of installation in full)

Except as elsewhere expressly modified by Company's specifications attached, the switchboard covered by these specifications will be sold subject to the following general specifications and conditions:

THE PURCHASER WILL FURNISH UNLESS OTHERWISE EXPRESSLY AGREED:

- (A) Labor of installing said switchboard.
- (B) Foundations, sill, supports, or iron framework built into floor, walls or roof, on which panels, compartments or busses rest or are supported.
- (C) All masonry work, either of brick or concrete, for switch cells, busbar compartments and similar structures.
- (D) All connections between switchboard and
 - Any main and auxiliary apparatus not included as a part of these specifications.
 - Switching devices mounted on or near machines or other apparatus.
 - Lightning arresters and line disconnecting switches.
 - Primary connections between current transformers and switchboard apparatus unless otherwise specified in the following specifications.
 - All control wiring for electrically operated apparatus except as may be specified in a separate item under these specifications.
- (E) All ducts and conduits.
- (F) Doors for bus, lightning arrester or static discharger compartments.
- (G) All lengths of standard pipe for switchboard tie rods and for remote control mechanism for oil switches or other remote control apparatus requiring it.
- (H) Field rheostat discharge resistances for use in connection with discharge clips of field switches, or starting resistances for use with starting switches.
- (I) Necessary drawings of station buildings, and show in such drawings at the request of the Company, all necessary openings in floors, walls or roof, ducts, tie pipes and iron armored conduit.

THE COMPANY WILL FURNISH:

Switchboard apparatus as described in detail specifications attached, and in addition:

- (A) All auxiliary apparatus to make instrument equipment furnished by this Company complete such as resistances and reactances.

- 30
- (B) The necessary small wiring material with fuses for interconnecting instruments, meters, relays and other apparatus mounted on the panels.
For panels not an integral part of benchboard this wiring material is assembled on the panels. For benchboard panels this material is not assembled excepting the interconnections between control switches and their indicating lamps mounted on the benchboard.
 - (C) Primary leads for potential transformers, not exceeding 5 feet, and secondary leads for potential and current transformers, not exceeding 15 feet in length, unless special leads of greater length are specified in the following detail specifications.
 - (D) Secondary leads not exceeding 10 feet for direct current instrument shunts when required unless special leads of greater length are specified in the following detail specifications.
 - (E) Fittings to go with the standard iron pipe furnished by Purchaser for braces, tie rods and remote control mechanisms.
 - (F) Unless otherwise specified Company will furnish complete rheostat operating mechanism and supports for rheostats, when rheostat is mounted on back of panel. When itemized specifications attached state "No handwheel or dial plate included" it is assumed Purchaser will use the handwheel and dial plate which is supplied with the rheostat and in such cases panel will be drilled for G.E. standard dial plate and shaft unless modifying instructions accompany order.
 - (G) Oil for oil switches, oil insulated current and potential transformers and aluminum cell lightning arresters covered in these specifications.

COPPER BUS, WIRE AND CABLE CONNECTIONS

The amounts of wire, cable, bus and connection bar copper specified in this proposal, and stated in pounds or feet, is sufficient to meet the requirements and conditions outlined in the following detail specifications.

If more or less than the amount stated is supplied, due to a change in requirements or conditions, an extra charge will be made or credit given (as the case may be).

PROMISE OF SHIPMENT

The shipment of apparatus as promised is contingent upon the receipt of full and complete information with order, to enable the Company to proceed with the manufacture of apparatus. The promise provides only for performing actual work on this order and any delay exceeding two (2) days for approval of plans by Purchaser or due to changes made by Purchaser, will cause an extension of time of shipment based upon Purchaser's delay and conditions at the Factory of the Company.

INSTRUMENT CALIBRATION

All indicating, curve drawing and watthour meters, relays and tripping devices are calibrated before shipment from the Factory, and any subsequent calibration shall be at the expense of the Purchaser.

RESPONSIBILITY

The Company will not be responsible for the operation of switchboard devices specified by the Purchaser not manufactured by the Company, nor for the infringement of any patent growing out of the use of the devices referred to in this paragraph.

PAGE No.....

SPECIFICATIONS FOR SWITCHBOARD

F O R

CHICAGO, MILWAUKEE & ST. PAUL RY COMPANY,

CHICAGO, ILL.

SPECIFICATION # 63687-A.

The switchboard included in these specifications has been designed to be used in connection with Proposal # 63612-A.

It is understood that the Company can use its own discretion as to the location and arrangement of apparatus.

No disconnecting switches are included for the A.C. lightning arresters.

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 earholders where necessary.

SWITCHBOARD WILL CONTROL:

Pilot wire system for Power Limiting Scheme.

In Dispatcher's Office:-

- 1- Induction Motor-Generator Set, consisting of:-
 - 1- 110 V. 3-phase, Induction Motor, 1- Kw, 60 cycle,
 - 2- 600 V. D.C. Generators, connected in series to give 1200 V. with common connection grounded.
- 1- Transformer, 3- KW, 3-phase, 60 cycle, 2300/110 V.
- 1- Incoming line 3-phase, 2300 volts.
- 2- D.C. lines 1200 V.

In Hustis Sub-Station only:-

- 1- Outgoing line (to Dispatcher's Office) 3-phase 2300 V.

SPECIFICATIONS FOR SWITCHBOARD

SWITCHBOARD WILL CONTROL CONT'D)In Each Sub-Station:-

- 1- Motor, 125 V. DC for driving rheostats.
- 2- D.C. Lines 1200 volts.

SWITCHBOARD WILL CONSIST OF:Dispatcher's Office:-

- | | | |
|----------|------|------------------------------|
| ITEM NO. | 1. | 1- Instrument Panel. |
| | 2. | 1- M. G. Panel. |
| | 2-A. | 2- D.C. Lightning arresters. |
| | 3. | 1- Ammeter base. |
| | 4. | 3- Expulsion fuses and hook. |
| | 5. | 1- A.C. lightning arrester. |
| | 6. | 3- Choke coils. |

Sub-stations:

- | | |
|-----|--|
| 7. | Expulsion fuses, transformers, etc. (Kustis Sub-Station only). |
| 8. | 1- Lever switch (per station). |
| 9. | 1- Instrument Panel" |
| 10. | 2- D.C. Lightning arresters (per station). |
| 11. | 1- D.C. Lightning arrester " |
| 12. | 1- A.C. Lightning arrester (Kustis Sub-station only). |
| 13. | 3- Choke coils " |
-

SPECIFICATIONS FOR SWITCHBOARD

Apparatus to be mounted in Dispatcher's Office.

- ITEM #1: One (1) Instrument Panel.
 Size- Top Section 31 x 24 x 1 1/2"
 Middle " 31 x 24 x 1 1/2"
 Bottom " 28 x 24 x 1 1/2" on 90" supports.

EQUIPMENT:

- 1- 1200 V. curve drawing milli-ammeter with chart marked to read KW mounted on front of panel.
- 1- D-7 milli-ammeter for indicating ground.
- 1- 3-pole plug rack front of panel.

- ITEM #2: One (1) Motor Generator Panel.
 Capacity- 110 V. AC, 1200 V. DC 1- KW.
 Size- Top Section 31 x 24 x 1 1/2"
 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 double scale and insulating cover.
- 1- 750 W. D-7 voltmeter with insulating cover and 2 to 1 multiplier.
- 1- Handwheel and mounting for field rheostat.
- 2- SP ST 100 amp. plug switches with 2- plugs.
- 2- 1200 V. 1- amp. NF CS fuses with blocks mounted back of panel.
- 1- TP ST 250 V. 30 amp. D-12 lever switch, with NF CS fuses on front of panel.
Insulating caps.
- 1- Set of brackets at side of panel for TD regulator.
(Regulator not included).

- ITEM #2-A. 2- 600 V. DC aluminum cell lightning arresters.
(outdoor type Cat. #77160).

- ITEM #3: One (1) Natural Black Slate Base, 14 x 14 x 1 1/4"
without supports.

- Mounting -

- 1- Special D-7 milli-ammeter with KW scale and insulated cover.
(Above to be mounted by Purchaser at Dispatcher's Desk).

SPEC. #62687-1.

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SPECIFICATIONS FOR SWITCHBOARD

ITEM #4:

3- SP 2500 V. 100 amp. TD-3 Expulsion fuse blocks and holders with fuses on Blue Vermont Marble bases, Cat. #59443 (for line from Eustis Substation 2500 V. 3-phase).

1- Operating hook, Cat. #45229.

SPEC. #63687-A.

SPECIFICATIONS FOR SWITCHBOARD

A.C. LIGHTNING PROTECTIVE APPARATUS

- ITEM #5: 1- 3-phase, TP multigap graded shunt resistance lightning arrester equipment Cat. #149754 for 2500 V. line from Eustis.
- ITEM #6: 3- 25- amp. choke coils Cat. #76839 on steel bracket.
-

SPECIFICATIONS FOR SWITCHBOARD

Apparatus to be installed in the various Sub-stations

ITEM #7: (To be mounted in Rustis Sub-Station).

- 3- SP 2500 V. 100 amp. TD-3 expulsion fuse blocks and holders with fuses on Blue Vermont Marble bases Cat. #59443 (for line to Dispatcher's Office).
- 2- 2200/110 V. 50 watts, 60 cycle, potential transformers with fuses and :-
- 2- Lamp brackets for panel mounting (to be connected on feeder side of above fuses to indicate a blown fuse).

ITEM #8: 4- DP ST 250 V. 100 amp. D-12 lever switches, with EE CB fuses mounting on front of panel.
(1- for each of 4- sub-stations to be mounted on Local Power Panel) for rheostat motor circuit.

ITEM #9: 4- Natural Black Slate Instrument Panels.
Size- Top Section 31 x 24 x 1 1/2"
Middle " 31 x 24 x 1 1/2"
Bottom " 28 x 24 x 1 1/2" on 90° supports.

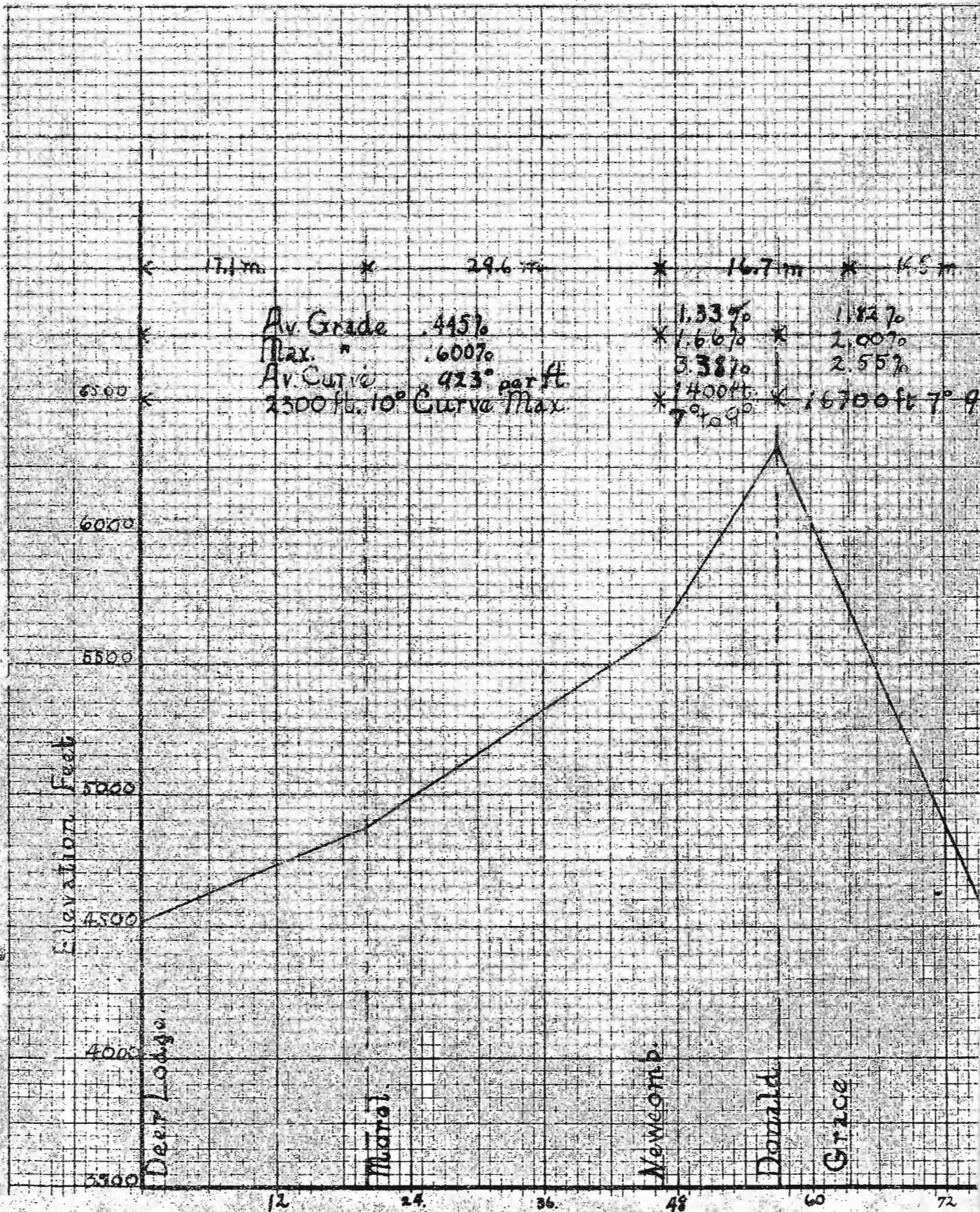
EQUIPMENT PER PANEL:

- Space and drilling for 1- contact making ammeter (not furnished by this department).
- 1- Dynamometer type DC relay.
 - 1- DC overload relay.
 - 1- SP short circuiting plug switch for short circuiting the resistance on relay when calibrating.
 - 1- Plug rack on front of panel.
(1- panel to be mounted in each of 4- sub-stations).

SPECIFICATIONS FOR SWITCHBOARD

LIGHTNING PROTECTIVE APPARATUS

- ITEM #10: 6- 600 V. DC aluminum cell lightning arresters-
(outdoor type) Cat. #77160.
(2- for each of 4- sub-stations).
- ITEM #11: 4- 60 V. DC Vacuum Tube Lightning arresters (indoor
type) (1- for each of 4- sub-stations for
protecting resistances) Cat. #148057.
- ITEM #12: 1- 3-phase, 2P multigap graded shunt resistance
lightning arrester equipment Cat. #149754 for
2300 V. line from Tustis Sub-station to
Dispatcher's Office.
- ITEM #13: 3- 25- amp. choke coils Cat. #76339 on steel bracket
for 2300 V. circuit.



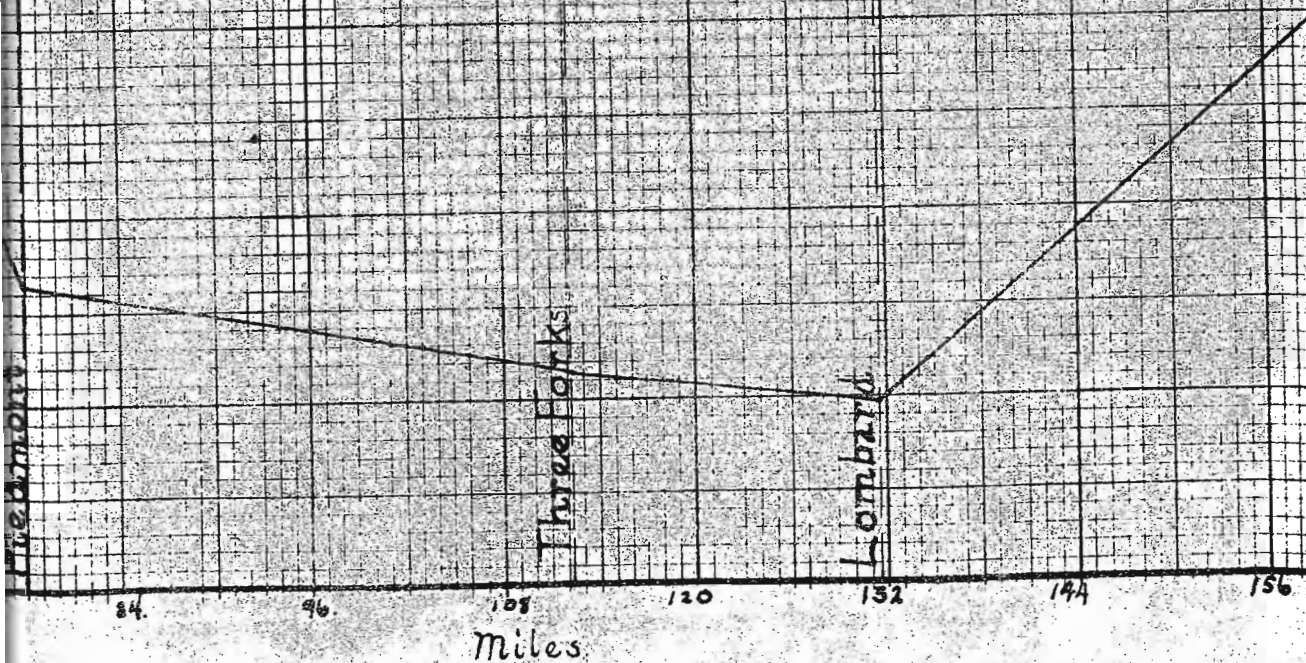
C.M. and St. P. R.R. Co.

PROFILE.

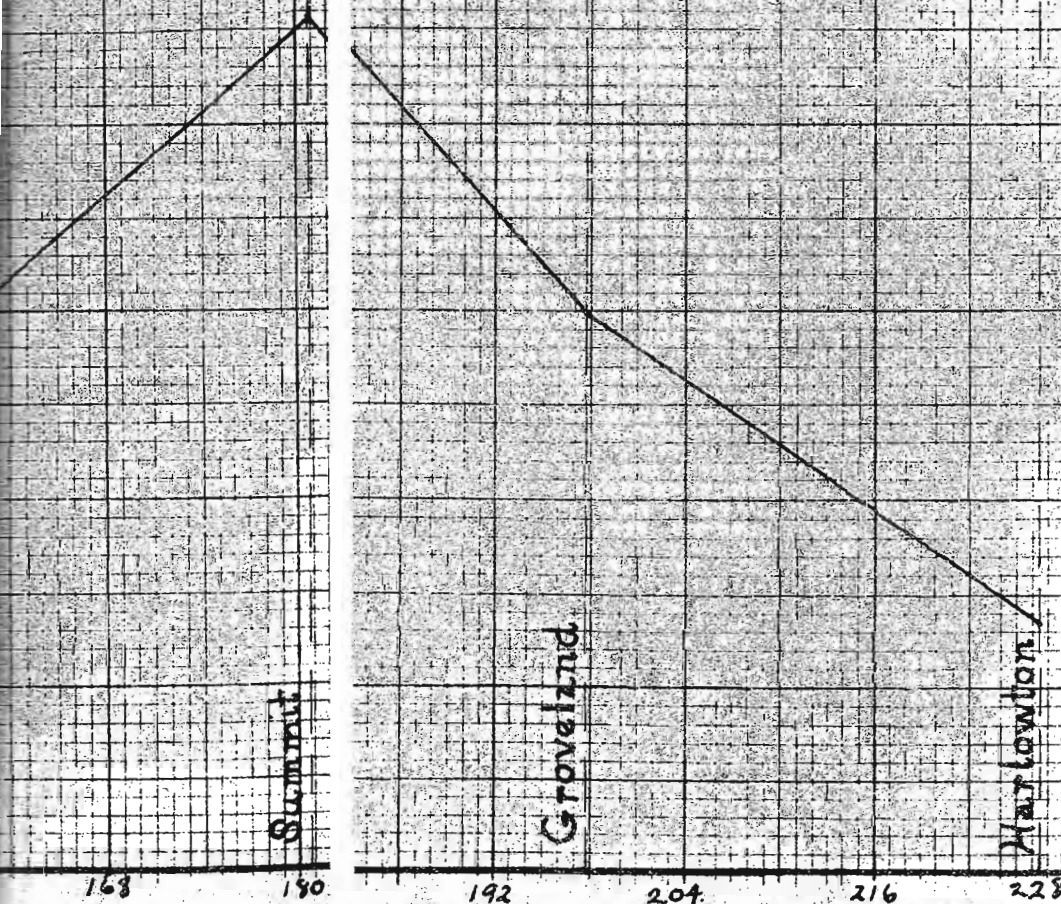
Harlowton to Deer Lodge

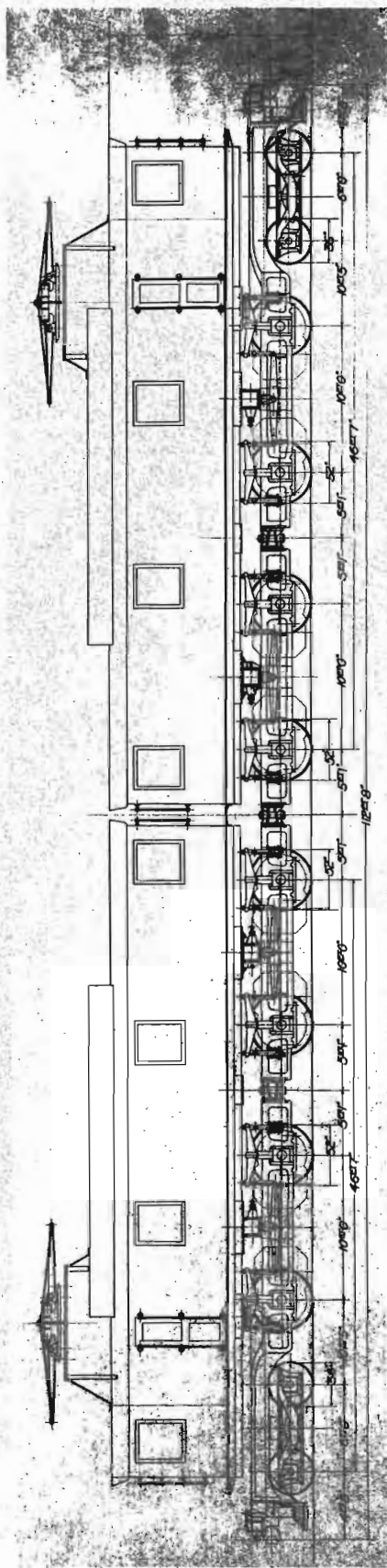
E.S.J. Oct. 21, 1914

34.3 m.	*	14.2 m.	*	49.2 m.
161%	*	077%	*	1691%
30%	*	300%	*	1000%
81%	*	1145%	*	2.03%
600 ft. 70 90	*	1500 ft. 70 90	*	9.00 ft.



*	16.4m	*	28.7m	*
*	886%	*	55.7%	*
*	1.000%	*	1.000%	*
*	1.75°	*	2.0°	*
*	2900ft 10°	*	11.0 ft 4°	*





232289 444444-E-564-8GEZ445-3000 VOLT LOCOMOTIVE.
INDEX E-318.31

CHARACTERISTIC CURVES.

8- GE-253 -1500/3000 VOLT RAILWAY MOTORS,

VOLTS PER MOTOR 1500.

Gear 82 Teeth

Reduction 4.56

Pinion 18 teeth

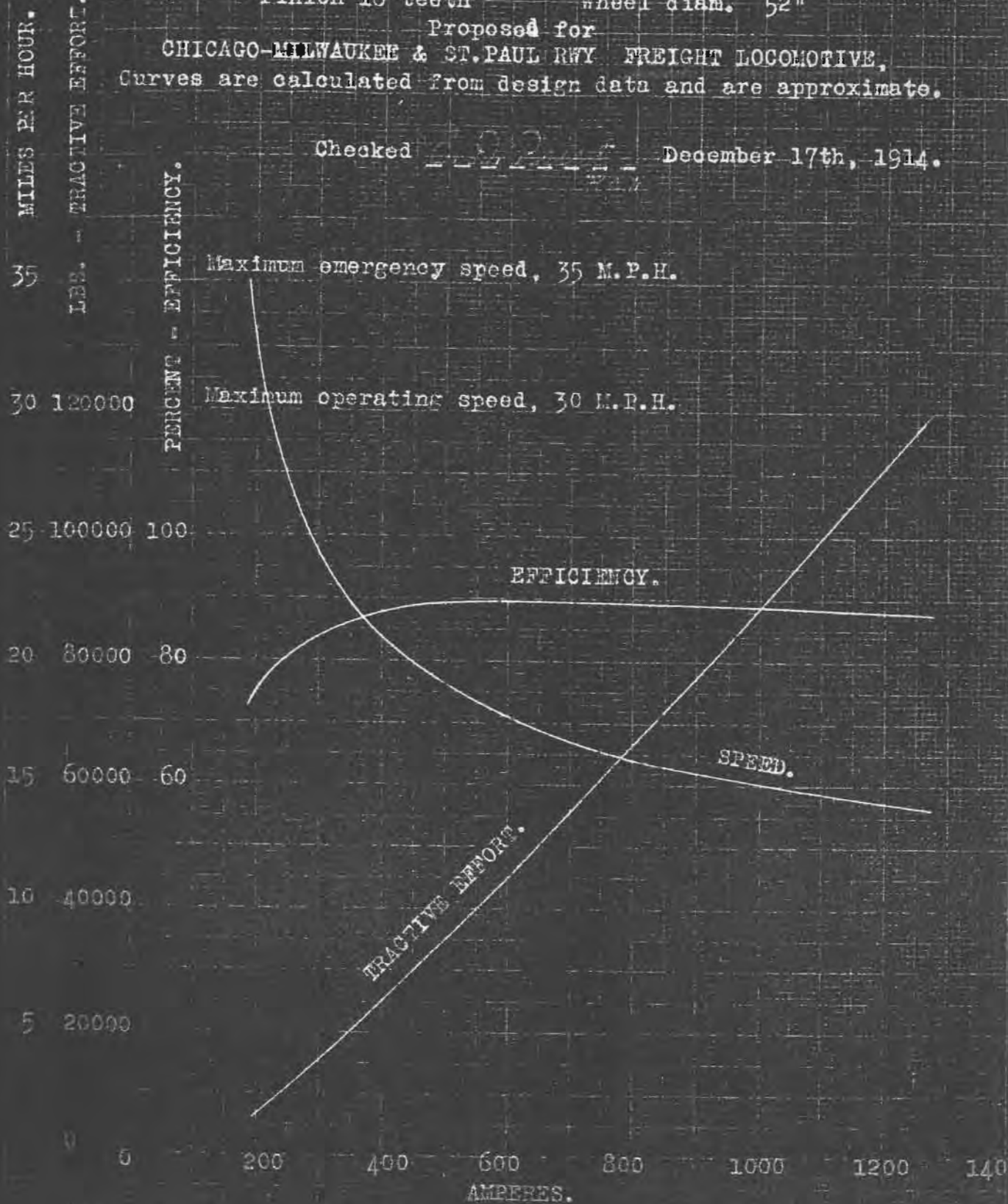
Wheel diam. 52"

Proposed for

CHICAGO-MILWAUKEE & ST. PAUL Rwy FREIGHT LOCOMOTIVE.

Curves are calculated from design data and are approximate.

Checked 12245 December 17th, 1914.



0-32758

CHARACTERISTIC CURVES,
GE-253 -1500/3000 VOLT RAILWAY MOTOR,
VOLTS PER MOTOR, 1500.
Gear 82 Teeth Reduction 4.56
Pinion 18 Teeth Wheel diam. 52"

Curves are calculated from design data and are approximate.

Checked

December 17th, 1914.

MILES PER HOUR.
LBS. - TRACTIVE EFFORT.
PERCENT - EFFICIENCY.

35 14000

30 12000

25 10000 100

20 8000 80

15 6000 60

10 4000

5 2000

0

0

50

100

150

200

250

300

AMPERES.

Maximum emergency speed, 35 M.P.H.

Maximum operating speed, 30 M.P.H.

EFFICIENCY.

TRACTIVE EFFORT.

SPEED.

C-32757

REGENERATIVE BRAKING CURVES.

8- GE-253 -1500/3000 VOLT RAILWAY MOTORS,

VOLTS PER MOTOR 1500

Gear 82 Teeth

Reduction 4.56

Pinion 18 Teeth

Diam. of Wheels 52"

Field Current 125% of Armature Current.

Proposed for

CHICAGO-MILWAUKEE & ST. PAUL RY FREIGHT LOCOMOTIVE.

Curves are calculated from design data and are approximate.

Checked ELP December 1, 1914.

MILES PER HOUR.

LBs. - TRACTIVE EFFORT.

Maximum operating speed, 30 M.P.H.

30

25

20

15

10

5

80000

60000

40000

20000

SPEED

TRACTIVE EFFORT.

Maximum allowable current 670 Amperes.

0

0

200

400

600

800

Amperes Line.

C-32737

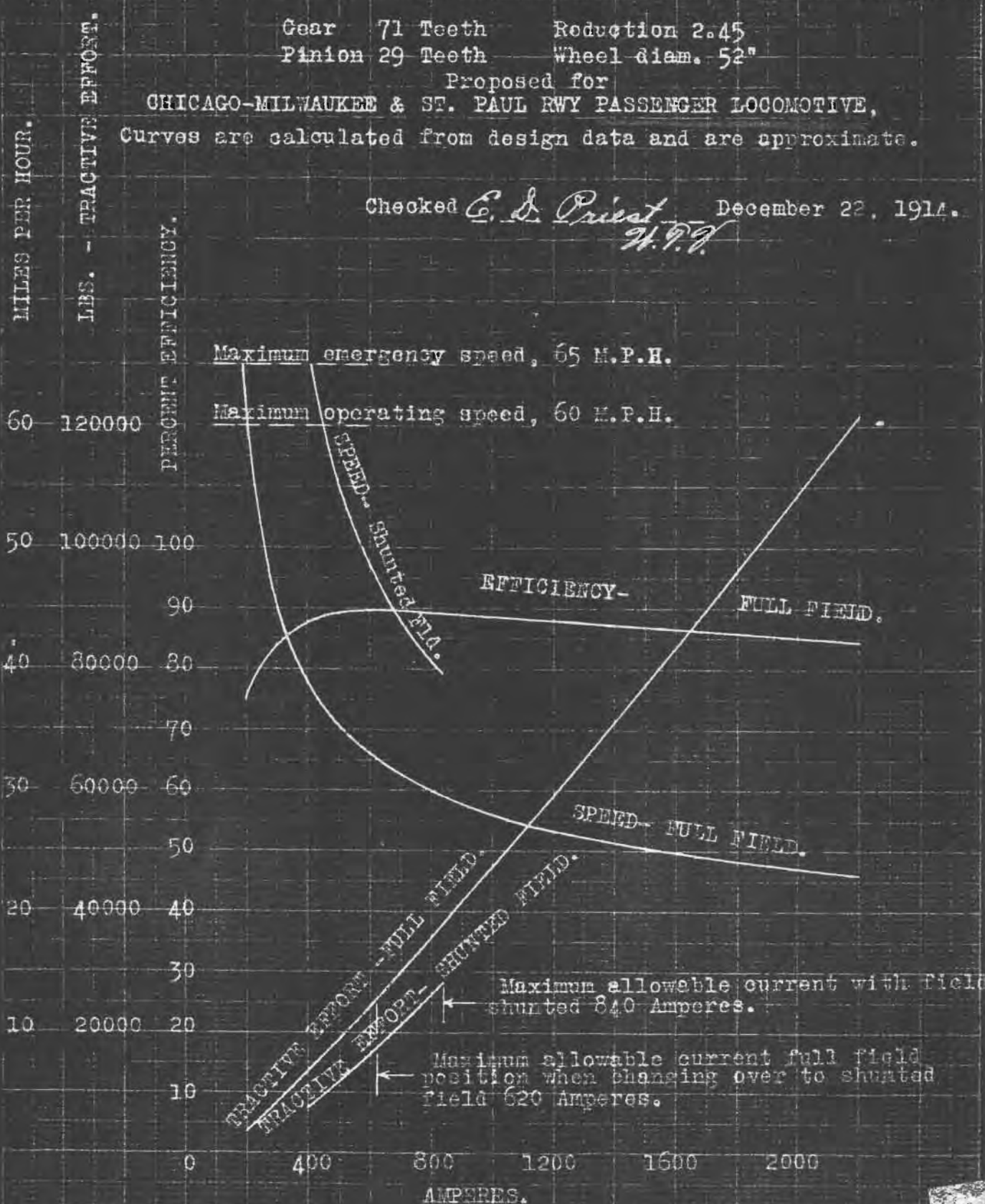
CHARACTERISTIC CURVES, S- GE-253 -1500/3000 VOLT RAILWAY MOTORS, VOLTS PER MOTOR 1500

Gear 71 Teeth Reduction 2.45
Pinion 29 Teeth Wheel diam. 52"

Proposed for
CHICAGO-MILWAUKEE & ST. PAUL Rwy PASSENGER LOCOMOTIVE,
Curves are calculated from design data and are approximate.

Checked *C. S. Priest* December 22, 1914.
H. P. J.

THIS MARGIN RESERVED FOR BINDING.

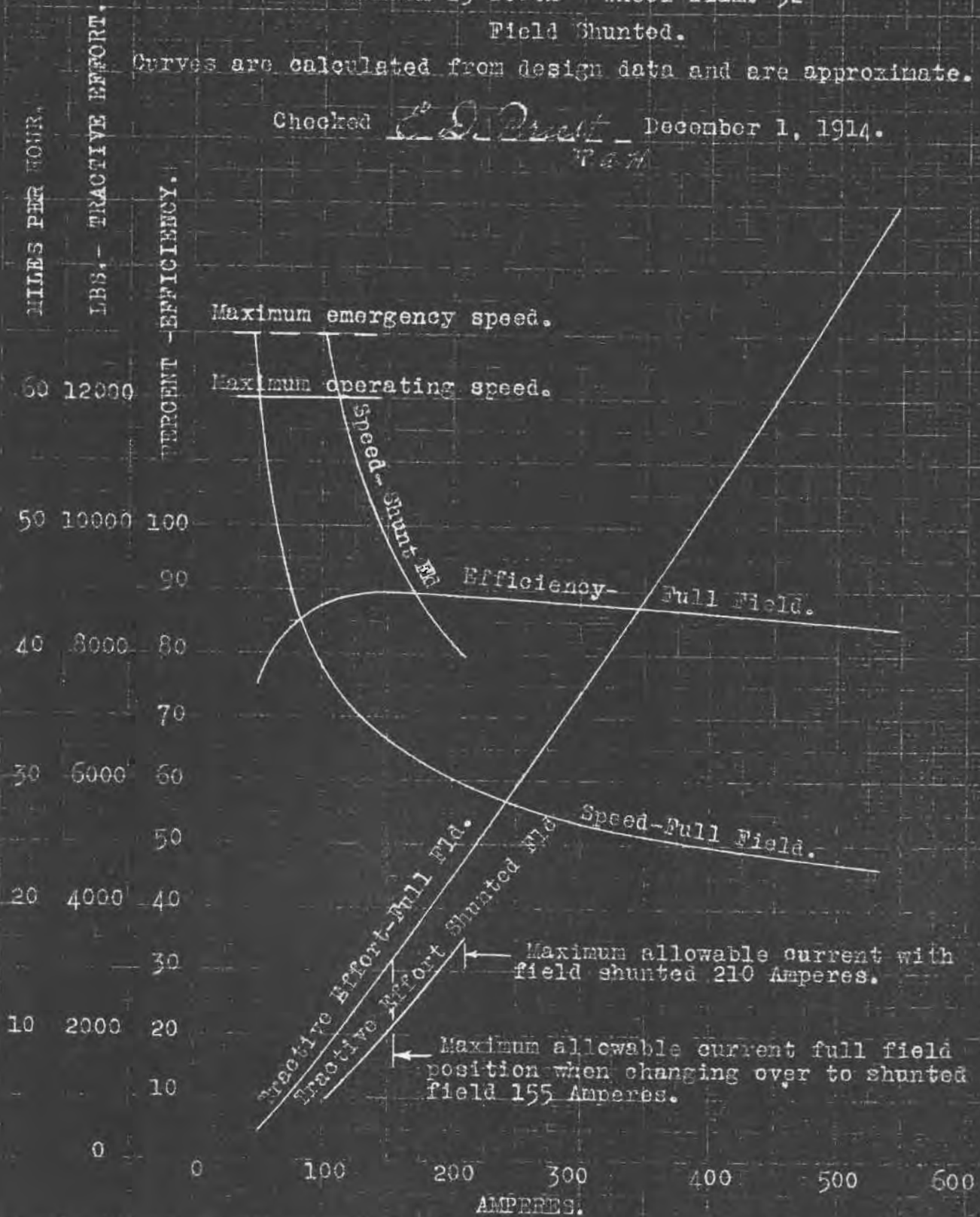


CHARACTERISTIC CURVES,
GE-253 -1500/3000 VOLT RWY MOTOR,
VOLTS PER MOTOR 1500

Gear 71 Teeth Reduction 2.45
Pinion 29 Teeth Wheel diam. 52"
Field Shunted.

Curves are calculated from design data and are approximate.

Checked E. D. Pratt December 1, 1914.
T. A. H.



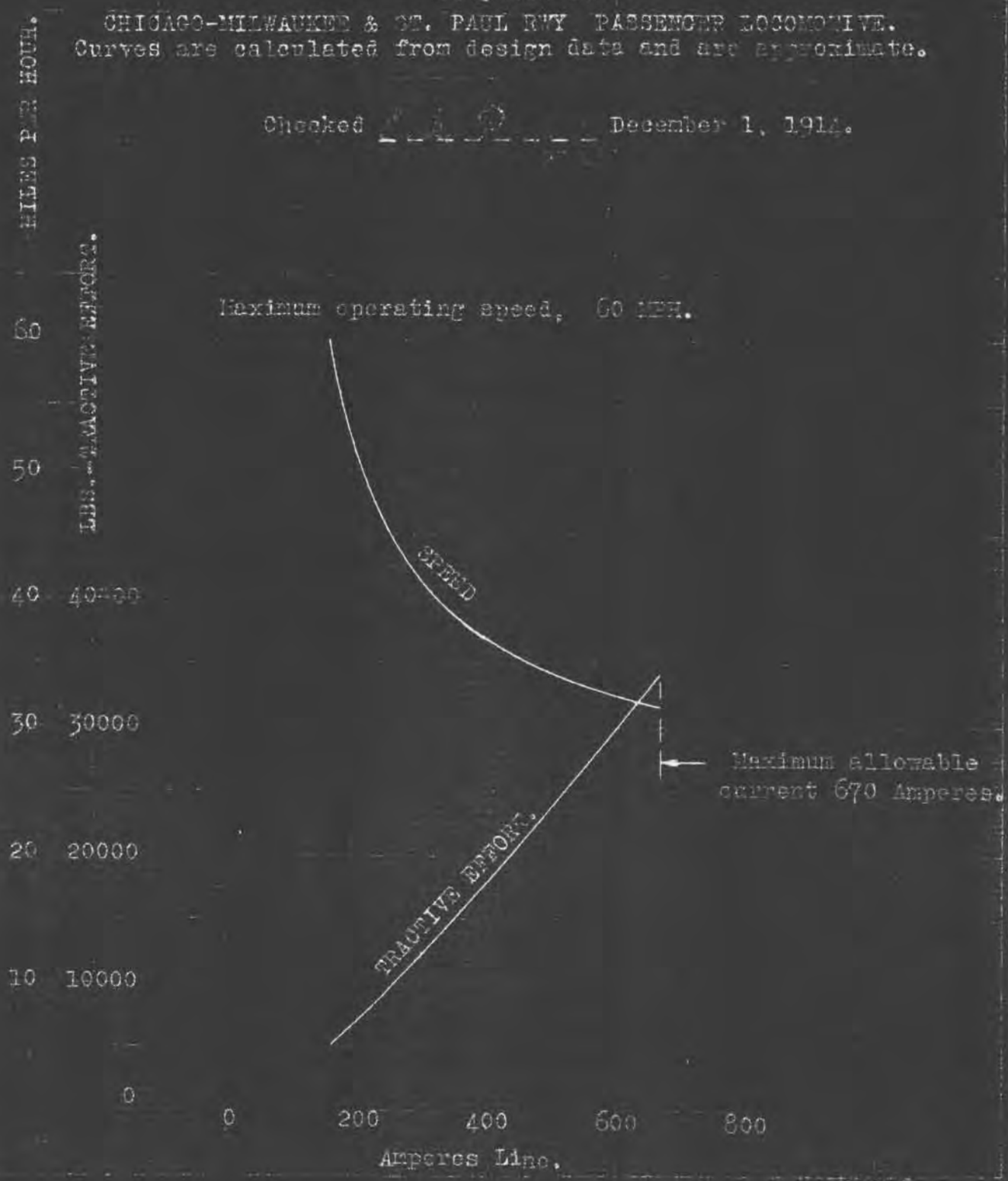
0-32735

REGENERATIVE BRAKING CURVES,
8- GE-253 -1500/3000 VOLT RAILWAY MOTORS,
VOLTS PER MOTOR 1500

Gear 71 Teeth Reduction 2.45
Pinion 29 Teeth Wheel diam. 52"
Field Current 125% of Armature Current.
Proposed for

CHICAGO-MILWAUKEE & ST. PAUL RY. PASSENGER LOCOMOTIVE.
Curves are calculated from design data and are approximate.

Checked December 1, 1914.



G-32736

Principal Connections of 2400 or 3000 Volt Locomotive for C.M. and St. P. R.R.



⊗ Series Parallel Switch
 ⊙ Line Contactors
 X Resistance Contactors

Checked B. L. S.
 6 July 1914

Engineering Dept.
 General Electric Company

Approved R. E. C.

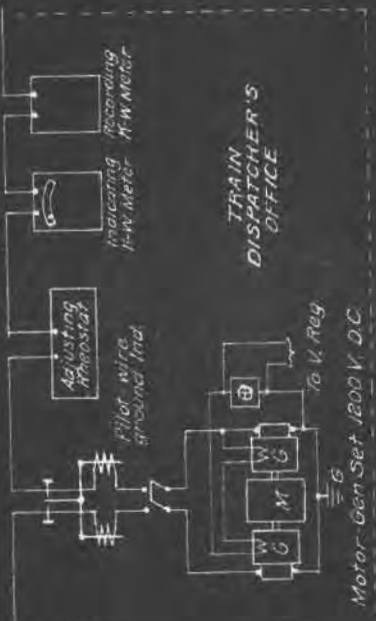
115 39874

44

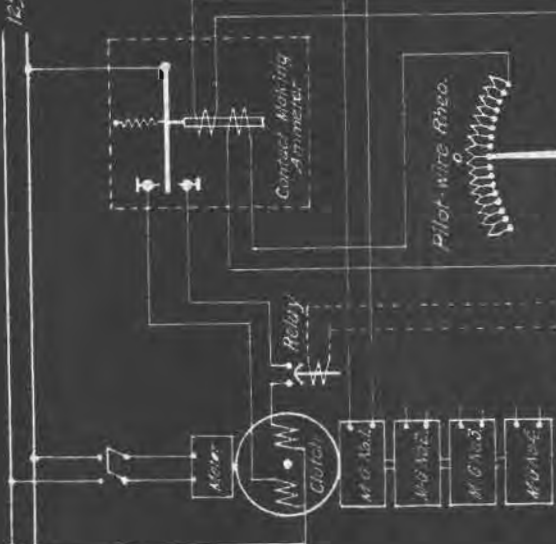
100000 VOLT 60 CYCLE 3 PHASE M.T. BUS.

To Next Substation

Pilot wire circuit



125 V. BUS



To Next Substation

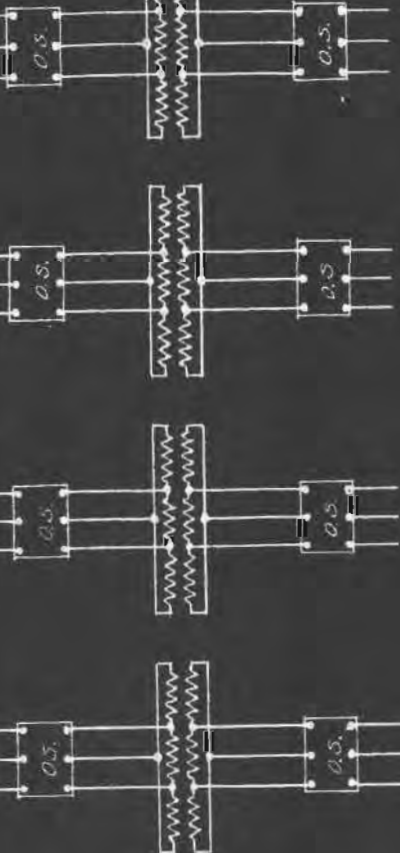
Pilot wire circuit



125 V. BUS



Transformers
10000/2300



RAILWAY SUBSTATION POWER LIMITING & INDICATING SYSTEM

RAILWAY & TRACTION ENGINEERING DEPT.
JULY 8, 1944.

Positive Bus

Negative Bus

Track Rails

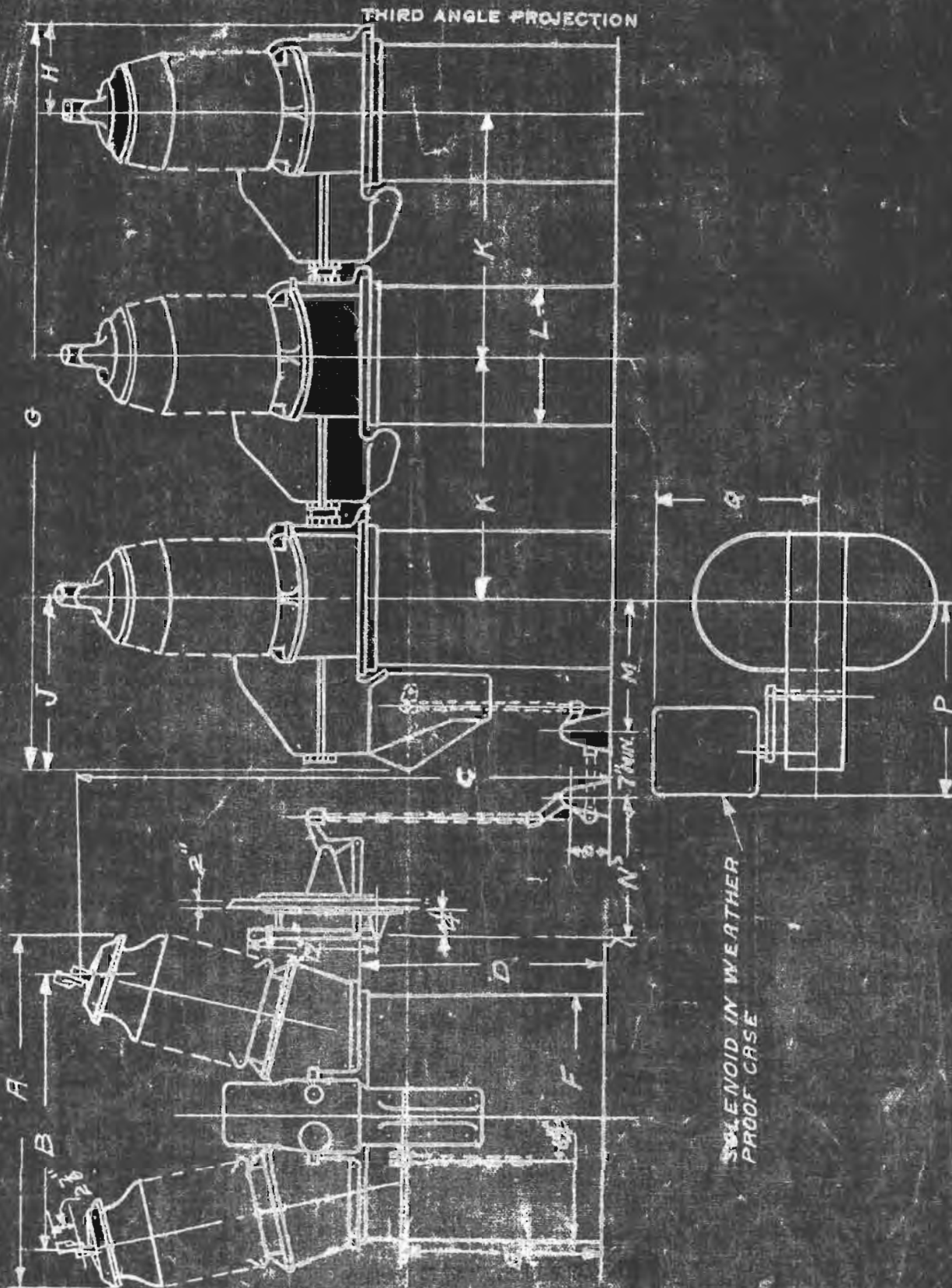
Resistance

Shunt

Pilot wire Rheo.

Wattmeter

Gen. Set, 1200 V. D.C.



DIMENSIONS OF OIL SWITCHES TYPE F FORM H-22
GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

DESIGNATION	VOLTS	AMP	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	WEIGHT OF OIL
11110311	70000	150	2.50	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.00	32.50	35.00	37.50	40.00	2.50
11110312	70000	150	2.50	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00	27.50	30.00	32.50	35.00	37.50	40.00	2.50

① REVISED MAR 31-13
S.B.A.

DRAWN BY G. J. HALEKOWSKI FOR 204-11110311

DEC 18-12

K1162327