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A REPORT
ON
A FIVE HUNDRED AND FIFTY
KILOWATT PLANT

THESIS
FOR
THE DEGREE OF
BACHELOR OF SCIENCE
IN

ELECTRICAL ENGINEERING

UNIVERSITY OF MISSOURI

Clinton
Elmer C. Robinson

1912.

Plan to go at end.

620.2
R56

2

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INTRODUCTION

The object of this thesis is to present a report on an electric generating station of the size most commonly encountered in electric lighting work. This size station , and others varying in size from a little smaller to a little larger capacity , are the type found all over the country with the exception of the cities and in most cases they are in the same condition. Very few of them keep complete reports and some do not keep any records at all except of the customers that have not paid their bills .

The writer has been associated with this plant and only in a few instances have figures been used which were not approximately correct.

The gathering of material for this report was started early in the school year and it was the object to get the full data for it but the Company changed hands , and at the same time policies , and as a result the gathering of material was somewhat checked and information was gathered from various and sundry sources which accounts for the brevity of some parts.

A few suggestions are to be made as to a better arrangement of machinery and to the handling of coal. A few changes in the present condition of steam lines will probably cut down the amount of coal

4

used and this will result in a lower cost per kilowatt hour .

Proposed changes of the station building will be taken up and while they may not be considered by the owners , they will however, be feasible.

The writer wishes to thank Mr. T.F.Fulkerson of the Moberly Light and Power Co. for the History of the plant and other information given : Mr. James T. Menefee , formerly manager of the Trenton Gas and Electric Co. Mr. B.T.Bowne , of the Trenton Gas and Electric Co. Mr ___ Young and Mr. Wilbur Steele , engineers at the plant , for data and reports furnished .

E.C.Robinson .

Columbia Mo.

May, 24, 1912.

The city of Trenton is the County Seat of Grundy County ,located in the north-western part of the State of Missouri.

By the census the population is given ,

| | |
|------|------|
| 1890 | 5039 |
| 1900 | 5396 |
| 1910 | 5656 |

which shows very little growth. These figures are a little low due to the fact that Trenton is partly a railroad town and these people might be called nomadic.

Trenton owes it's present prosperous condition to being in the center of the richest agricultural section in the state and to being a division point on the Chicago, Rock Island and Pacific Railway.

Trenton is connected to the outside world by two railroads , the Rock Island and the Quincy, Omaha, and Kansas City Ry. , The later being controlled by the Burlington Lines.

Trenton is located 101 miles north east of Kansas City and 84 miles east of St. Joseph.

Among the manufacturies , there is an ice plant, a branch of the National Pickle Company, (canning), Brick manufacturies, and Roller Mills.

The city water works is a Municipal Corporation and pumping is by electric power. The shops of the Rock Island are also driven by electricity.

The assessed valuation of Trenton in 1910 was
\$ 1,462,374.00

THE TRIBULATIONS OF AN ELECTRIC LIGHTING PLANT
OR
THE HISTORY OF THE TRENTON LIGHT AND POWER CO.

Twenty five years ago

before the electric meter was a commercial success and when electric lighting was in it's infancy , the Thomson-Houston Company secured a franchise for installing an electric light plant in Trenton. They were not interested in the operation of the plant , but succeeded in inducing a Mr. Anderson ,who had formerly been a successful flouring mill owner and had made a saving of some twenty thousand dollars , to install the plant . Their main object was to sell the necessary dynamos and machinery at a large profit and in turn, they took a small amount of stock in the property. The electric plant developed slowly and owing to the fierce competition of the Gas Company which was then in operation, Mr. Anderson, after losing the greater part of his fortune , traded the plant to Mr. Corrington Layson, a professional trader who had no conception whatever of the electric business .

The property then became a trading stock and for several months was transferred almost monthly, until finally Messrs J.S.Parker and Geo. Gardner succeeded in buying both the electric and gas plants which they combined . This property they operated for one year under the management of Penn Love, now manager of the Gallatin (Mo) municipal plant.

When they were foreclosed under a mortgage and the two plants brought only a total of about \$12000.00 and were sold to twelve representative business men of Trenton, who after holding the property thirty days sold the same to W.B. McKinley of Champaign, Ills., who is now head of the Illinois Traction Company and Chairman of the Republican Taft Campaign. McKinley later sold the property to T.F. Fulkerson and J.B. Carnes who operated it for five years, selling it to William Maul Measey of Philadelphia and his associates. Mr. Measey after operating it four or five years and after re-incorporating it, sold it in January 1912 to Mr. Burdett L. Bowne who is now the owner.

During all this time, the property was re-incorporated and the name changed four or five times. It has been known as the Trenton Gas and Electric Co., The Trenton Thomson-Houston Company, Trenton Gas Light and Power Co., The Citizens Gas and Electric Company of Trenton, and The Trenton Light and Power Co.

A DESCRIPTION OF THE PROPERTY

BUILDING

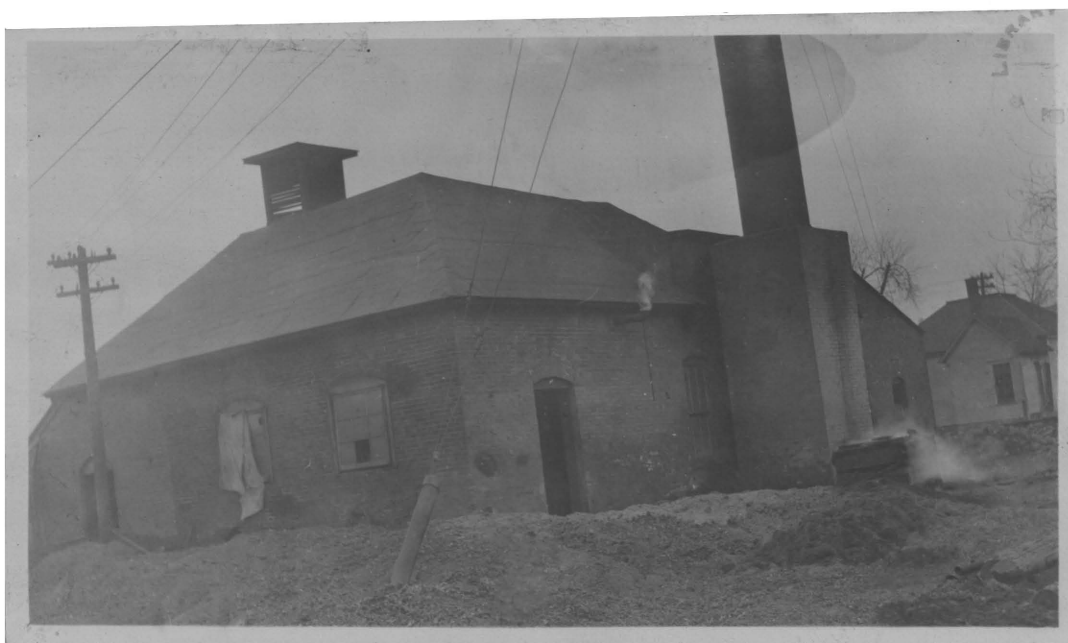
The building is located near the tracks of the Rock Island Lines , thus making coal handling comparatively easy. The building is of a very odd shape , as will be seen by the plan shown on the following pages and is entirely too small . The walls are of brick and the roof and roof trusses are of wood making it very susceptible to fire. The roof covering is rubberoid. The bottom of the trusses clear the floor 18 feet . The roof has burned from the building several times but each time has been replaced in the old form .The roof of the engine room and the boiler room are not joined except at the eaves.

The floors are of concrete and are in very good condition .

BOILER PLANT

The boiler plant consists of three (3) Murray fire tube boilers of one hundred and fifty (150) horse power each and are set in one battery . They have been in operation about five (5) years .

All boilers are hand fired and have shaker grates



**STATION BUILDING ; FROM THE NORTH WEST
CORNER.**

The boilers are in fairly good condition and seem adequate for the present load . Two boilers are used at one time.

These boilers are connected to a four (4) foot steel smoke stack eighty five (85) feet in height located at the southwest corner of the boiler room and on the outside . The stack has an approximate rating of three hundred and twenty five (325) horsepower. The stack is of heavy sheet steel and rests on a brick foundation six(6) feet square and eighteen (18) feet high . The stack has been well painted and appears to be in very good condition . The stack is a guyed stack and has been in use for about five(5) years.

FEED WATER HEATER.

The feed water heater is a Murray with a rating of five hundred(500) horse power . It is located at the south east corner of the boiler battery. It is an open heater.

PIPE WORK

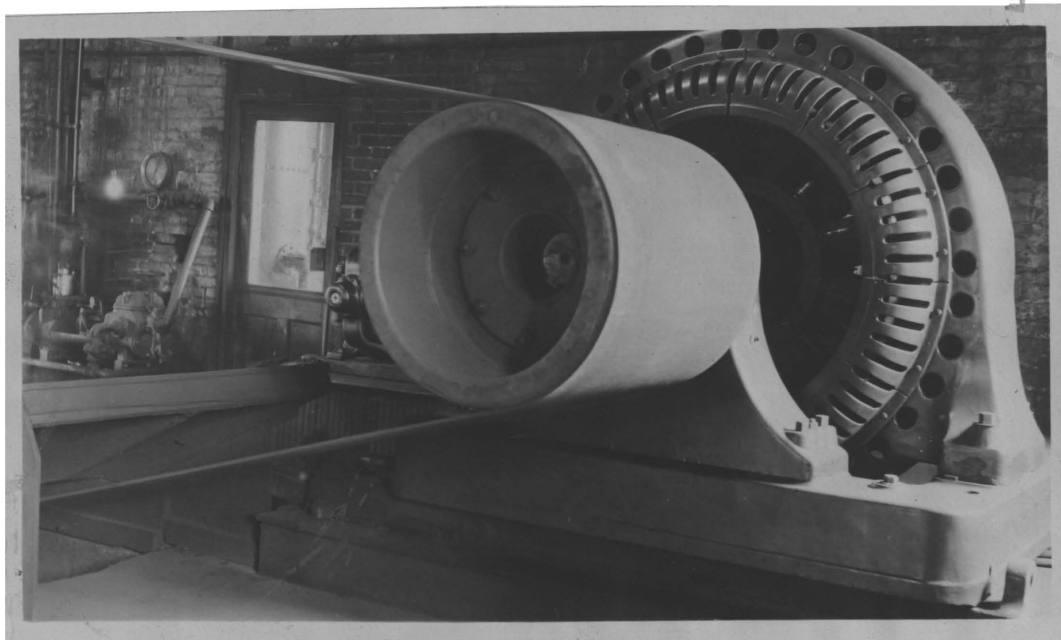
The pipe work in the plant is in very bad condition. There is little or no lagging on the header or steam lines and the leakage is very high. The design of

the pipe work is very bad and gives rise to enormous heat losses. The header is ten(10) inches in diameter and the steam line is six (6) inches in diameter . The length of the steam line is about fifty feet . Two lines of steam piping being run from the boilers. The piping is of sufficient size for the present conditions but has too many right angled bends for economical operation. A design of a new piping system will be given on a later page.

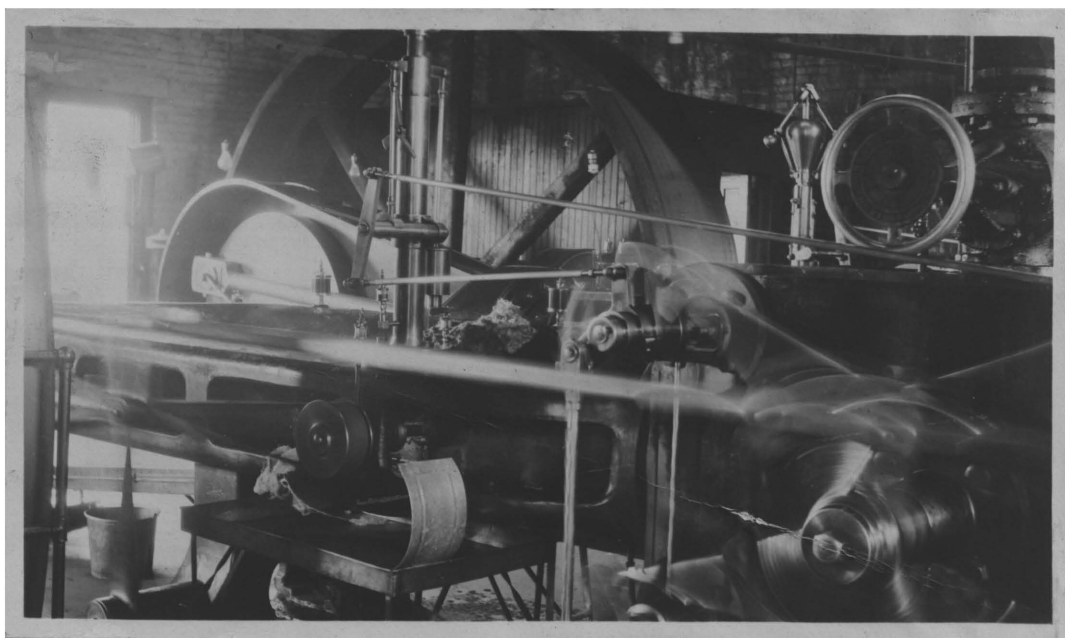
ENGINE ROOM EQUIPMENT

The engine room occupies the south half of the building and is separated from the boiler room by a brick wall. The electric generating plant consists of two(2) Corliss- Allis-Chalmers units.

The south unit consists of one(1) 20"x42" Murray Corliss engine running at a speed of 80 r.p.m. and having a flywheel of 18' in diameter. This engine drives a 250kilowatt- 2200 volt - 3 phase - 60 cycle Allis-Chalmers revolving field generator at a speed of 600 r.p.m. by means of a belt drive. From a pulley on the shaft of this alternator, by means of a belt, is driven a Westinghouse exciter rated at 125 volts and running at a speed of 1200 R.P.M.



**NORTH GENERATOR, SOUTH GENERATOR IS OF
THE SAME TYPE.**



**VIEW ACROSS THE TWO ENGINES. NEAREST ENGINE
RUNNING WHEN PICTURE WAS TAKEN.**

The entire unit is in fairly good condition.

The north unit consists of a 20" x 42" Murray Corliss engine running at a speed of 104 r.p.m. operating , by means of a belt over a 14' fly wheel, an Allis-Chalmers 300kilowatt-2200volt 3 phase - 60 cycle revolving field generator at a speed of 600 r.p.m. To this generator is belted an Allis-Chalmers exciter rated 120 volts- 125 amperes- and running at a speed of 1100r.p.m. The cylinders of the ^{North} south engine are in a bad condition and should be rebored. The generator on this set is in very good condition . The engines are belted inverted and on the north set the distance between centers is only 27'

This is due to the crowded conditions in the engine room . The throttle valve of the north engine is so located that the engineer to manipulate it, must stand directly under the belt and should the belt break the the valve stem would more than likely be broken off. To reach the engine room from the boiler room it is necessary to walk under the belt of the north unit and it is to be considered dangerous as there is not enough clearance above the floor.

FEED PUMPS

In the engine room are located two 6"x4"x6" boiler

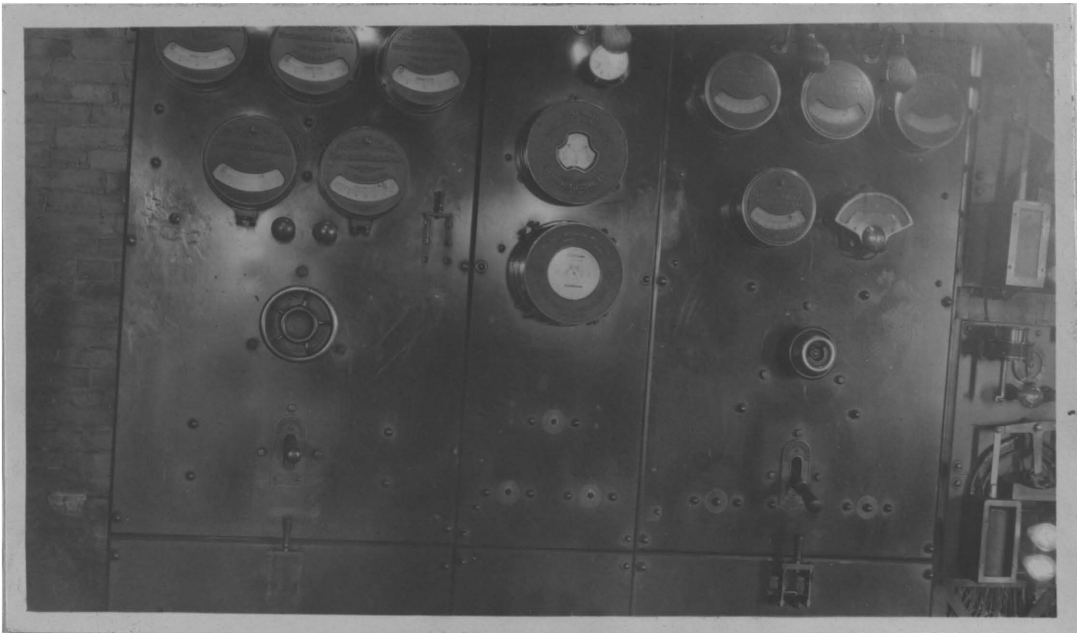
feed pumps .

SWITCH BOARD

The switchboard, located on the east side of the engine room , provides for the control of the two generators, two exciters, arc and incandescent lighting circuits, lighting and power feeders. The generators are connected to the switchboard through conduits under the floor.

The switchboard consists of three General Electric Co pannels and two Chapman regulator panels. In the main switchboard the two outside panels are duplicates each having 3 ammeters, 2 voltmeters , a D.C. and an A.C. voltmeter , and the lower part of the panels having the power and feeder switches. The center panel carries a three phase ground detector and a totalizing wattmeter. There are also switches and lamps to be used in synchronizing . The Chapman Regulator panels hold one 85 amp-250 kilowatt and one 20 amp - 5 ohm 180 kilowatt alternating current voltage regulators.

The switches are all of the plug type. The rheostats are located above the switchboard and are governed from the switchboard by means of sprockets. The voltage through the ammeters is 2200 volts and



THE SWITCH BOARD.

should be considered dangerous. There is a space of two feet between the wall and the switchboard and this puts every thing in rather close quarters.

ELECTRIC SERVICE FURNISHED

The electric service furnished consists of street lighting, commercial incandescent lighting, and electric power.

The street lighting consists of 34 arc lights, and 91 -32 candle power -110 volt incandescent lamps. The arc lamps are 605 watts and 5.5 amperes .

Commercial service is furnished to 840 meter customers and about 17 flat rate customers. The total number of connected lights is approximately 8620 .

Electric Power Service is furnished to 25 customers having a total connected load of 450 horse power.

TOTAL CONNECTED LOAD

The total connected load in kilowatts is as follows, (approximately)

| | |
|----------------------------------|----------------|
| Commercial incandescent lighting | 512 |
| Street lighting | 21 |
| Electric power service | <u>340</u> |
| Total connected load | 873 kilowatts. |

DISTRIBUTING SYSTEM

Electrical distribution is entirely by overhead system which includes approximately 37 miles of pole line in the city.

The secondary wiring from the transformer to the customer is paid for by the customer.

The line wire is mostly of No.6 B&S for the primary and house connections are of No.12 B&S with a few exceptions . The number of poles is 1775. No record is kept of the sizes and lengths of each size of wire.

METERS

The meters are owned by the company and no deposit is required.

TRANSFORMERS

No record is kept of the transformers .

ELECTRIC LIGHTING RATES

Electrical energy is furnished to the citizens of Trenton , by the Trenton Gas and Electric Co. at the rate of ten(10) cents per kilowatt hour , unless by special contract. A 5% discount is allowed for ten days.

VALUATION

| | |
|--|----------------|
| Land, building and fixtures, | 6500 |
| Boiler plant | 8580 |
| Electric generating plant | 17020 |
| Distributing system | 30000 |
| Miscellaneous | <u>12900</u> |
| Total | \$75000 |
| To put this in a more nearly itemized form , | |
| Generator 300 kw frtand setting | 3420 |
| Generator 250 kw " " " | 2950 |
| So. engine 350 hp " " " | 4000 |
| No. engine 350 hp " " " | 4650 |
| Switchboard | 2000 |
| Boilers settings | 6000 |
| Feed water heater | 355 |
| Pumps piping | 225 |
| Cost of building | 3000 |
| Value of real estate | 3500 |
| Stack | 500 |
| Pipe work and extra labor | 1500 |
| Value of pole line , transformers etc | 30000 |
| Belting ,piping & extras not inc above | <u>12900</u> |
| Total | 75000 |

The following Central Station facts and factors compare the electrical department of the Trenton Gas and Electric Co. with three cities in Iowa with an average population of 5670. The population of Trenton being 5656.

| | Other cities | Trenton |
|----------------------------|--------------|---------|
| Total Population | 5670 | 5656 |
| Station Capacity | 268 | 550 |
| Investment per KW Capacity | 203 | 136 |
| Gross Annual income per kw | 85 | 69.8 |
| " "per \$100 INV | | 51.2 |
| Annual Income per Consumer | 42 | 44.5 |
| Total Gen. Load per KW CAP | 2 | 1.6 |
| Lamp Load " " " | 1.4 | .93 |
| Motor Load " " " | .5 | .61 |
| Income per Capita | 4.43 | 6.78 |
| Investment per Capita | 10.00 | 11.66 |
| Station Cap . per Capita | 51 | 91 |
| No. Consumers per 100 Pop. | 10 | 14.5 |

CURVES

It will be noticed that the load curves are not as we would expect them i.e. with the peaks between 5 p m and 10 p m , but with the peaks occurring in two or three places and some of them in the early hours of the morning . This is due to the fact that the city pumping plant does most of it's pumping in the night .

It is also seen that the point where we would expect the highest peak i.e. about dusk, we have a little less load than at three in the afternoon. This is due to a large installation of motors in the railroad shops.

This pump load would be a very good thing at the hour at which it runs if the price for power was higher but at the rate now charged it is a losing proposition and is a detriment to the plant.

Street lights burn all night and several motors exclusive of the pump load run until midnight.

The average daily peak load is 170 K W Hrs.
The average daily load is 2236 K W Hrs and from this, by the A.I.E.E. definition of load factor we get 54.8%

The curves shown are from actual runs and are typical of this plant.

TRENTON GAS AND ELECTRIC COMPANY.

| | | DAILY LOG | | | | SHEET | | Dec. 28-29 1911. | | | | |
|------|----|-----------|-----|-----|------|-------|---------|------------------|-----|-----|------|------|
| | | Amp | Amp | Amp | Volt | Volt | K W Hrs | Amp | Amp | Amp | Volt | Volt |
| Noon | | | | | I20 | I20 | 8I2352 | 36 | 41 | 36 | I2I | I10 |
| I | | | | | I20 | I20 | 8I2400 | 47 | 50 | 45 | I10 | I05 |
| 2 | | | | | I20 | I20 | 8I2590 | 52 | 60 | 55 | I06 | I06 |
| 3 | 25 | 25 | 24 | III | I20 | I20 | 8I2730 | | | | | I06 |
| 4 | 55 | 57 | 55 | III | I20 | I20 | 8I2860 | | | | | I06 |
| 5 | 50 | 50 | 50 | III | I20 | I20 | 8I3010 | | | | | I06 |
| 6 | 45 | 50 | 40 | II2 | I20 | I20 | 8I3090 | | | | | I06 |
| 7 | 50 | 55 | 50 | II2 | I20 | I20 | 8I3170 | | | | | I06 |
| 8 | 65 | 70 | 60 | II2 | I20 | I20 | 8I3265 | | | | | I06 |
| 9 | 60 | 65 | 60 | II2 | I20 | I20 | 8I3410 | | | | | I06 |
| I0 | | | | | | | | | | | | |
| I0 | 55 | 60 | 55 | II2 | I20 | I20 | 8I3520 | | | | | I06 |
| II | 25 | 25 | 20 | II2 | I20 | I20 | 8I3590 | | | | | I06 |
| Mdt | 50 | 50 | 45 | II2 | I20 | I20 | 8I3715 | | | | | I06 |
| I | 50 | 50 | 45 | II2 | I20 | I20 | 8I3855 | | | | | I06 |
| 2 | 20 | 15 | 15 | II0 | I20 | I20 | 8I3930 | | | | | I06 |
| 3 | 20 | 15 | 15 | II0 | I20 | I20 | 8I3995 | | | | | I06 |
| 4 | 45 | 45 | 40 | II0 | I20 | I20 | 8I4120 | | | | | I06 |
| 5 | | | | | I20 | I20 | 8I4195 | 20 | 24 | 20 | II5 | I06 |
| 6 | | | | | I20 | I20 | 8I4260 | 20 | 28 | 20 | II6 | I06 |
| 7 | | | | | I20 | I20 | 8I4320 | 26 | 30 | 22 | II5 | I06 |
| 8 | | | | | I20 | I20 | 8I4420 | 50 | 52 | 50 | II6 | I06 |
| 9 | | | | | I20 | I20 | 8I4570 | 54 | 60 | 55 | II6 | I06 |
| I0 | | | | | I20 | I20 | 8I4730 | 60 | 64 | 62 | II7 | I06 |
| II | | | | | I20 | I20 | 8I4870 | 60 | 62 | 62 | II6 | I06 |
| Noon | | | | | I20 | I20 | 8I5040 | 50 | 56 | 56 | II6 | I06 |

TRENTON GAS AND ELECTRIC COMPANY
DAILY LOG SHEET MAR.31- APR I 1912.

| | Amp | Amp | Amp | Volt | Volt | K W | Hrs | Amp | Amp | Amp | Volt | Volt |
|------|-----|-----|-----|------|------|-------|-----|-----|-----|-----|------|------|
| Noon | | | | | I20 | 47615 | 22 | 25 | 20 | | 112 | 105 |
| I | | | | | I20 | 47680 | 24 | 26 | 20 | | 112 | 105 |
| 2 | | | | | I20 | 47750 | 24 | 26 | 20 | | 112 | 105 |
| 3 | | | | | I20 | 47785 | 8 | 10 | 8 | | 116 | 105 |
| 4 | 24 | 24 | 24 | 115 | I20 | 47845 | | | | | | 105 |
| 5 | 24 | 25 | 24 | 115 | I20 | 47895 | | | | | | 105 |
| 6 | 30 | 30 | 25 | 115 | I20 | 47965 | | | | | | 105 |
| 7 | 35 | 40 | 30 | 115 | I20 | 48145 | | | | | | 105 |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |
| Mat | | | | | | | | | | | | |
| I | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | | | | | I20 | 48830 | 18 | 18 | 10 | | 112 | 105 |
| 7 | | | | | I20 | 48865 | 16 | 16 | 12 | | 115 | 105 |
| 8 | | | | | I20 | 48930 | 22 | 30 | 26 | | 115 | 105 |
| 9 | | | | | I20 | 49030 | 40 | 45 | 45 | | 117 | 105 |
| 10 | | | | | I20 | 49200 | 25 | 35 | 30 | | 115 | 105 |
| 11 | | | | | I20 | 49295 | 30 | 38 | 32 | | 115 | 105 |

TRENTON GAS AND ELECTRIC COMPANY.
 DAILY LOG SHEET
 Apr. 1 - Apr/2, 1912.
 Amp Amp Amp Volt Volt K W Hrs Amp Amp Amp Volt Volt

| | Amp | Amp | Amp | Volt | Volt | K | W | Hrs | Amp | Amp | Amp | Volt | Volt |
|------|-----|-----|-----|------|------|-------|----|-----|-----|-----|-----|------|------|
| Neon | | | | | I20 | 49420 | | 24 | 22 | 26 | | II5 | I05 |
| I | | | | | I20 | 49490 | | 32 | 40 | 32 | | II5 | I05 |
| 22 | | | | | I20 | 49630 | | 40 | 47 | 44 | | II5 | I05 |
| 33 | | | | | I20 | 49780 | | 30 | 37 | 32 | | II5 | I05 |
| 4 | 40 | 40 | 30 | II5 | I20 | 49850 | | | | | | | I05 |
| 5 | 40 | 40 | 35 | II5 | I20 | 49980 | | | | | | | I05 |
| 6 | 30 | 25 | 25 | II5 | I20 | 50050 | | | | | | | I05 |
| 7 | 40 | 45 | 40 | II2 | I20 | 50115 | | | | | | | I05 |
| 8 | 40 | 45 | 30 | II2 | I20 | 50185 | | | | | | | I05 |
| 9 | 40 | 40 | 30 | II2 | I20 | 50250 | | | | | | | I05 |
| 10 | 30 | 35 | 30 | II2 | I20 | 50310 | | | | | | | I05 |
| 11 | 30 | 25 | 25 | II2 | I20 | 50365 | | | | | | | I05 |
| Mdt | 35 | 40 | 35 | II2 | I05 | 50450 | | | | | | | I05 |
| I | 35 | 35 | 30 | II2 | I20 | 50555 | | | | | | | I05 |
| 2 | 35 | 35 | 30 | II2 | I20 | 50665 | | | | | | | I05 |
| 3 | 20 | 15 | 15 | II2 | I20 | 50750 | | | | | | | I05 |
| 4 | | | | | I20 | 50820 | 20 | 22 | 20 | | II5 | | I05 |
| 5 | | | | | I20 | 50875 | 20 | 24 | 20 | | II5 | | I05 |
| 6 | | | | | I20 | 50920 | 15 | 10 | 10 | | II2 | | I05 |
| 7 | | | | | I20 | 50960 | 24 | 26 | 22 | | II3 | | I05 |
| 8 | | | | | I20 | 51065 | 36 | 42 | 40 | | II2 | | I05 |
| 9 | | | | | I20 | 51220 | 38 | 46 | 42 | | II2 | | I05 |
| 10 | | | | | I20 | 51325 | 38 | 46 | 44 | | II5 | | I05 |
| 11 | | | | | I20 | 51440 | 22 | 34 | 24 | | II5 | | I05 |

TRENTON GAS AND ELECTRIC COMPANY.
 DAILY LOG SHEET April 2-3, 1912.
 Amp Amp Amp Volt Volt K W Hrs Amp Amp Amp Volt Volt

| | | | | | | | | | | | |
|------|----|----|----|-----|-----|-------|----|----|----|-----|-----|
| Noon | | | | | I20 | 51520 | 22 | 28 | 22 | 115 | I05 |
| I | | | | | I20 | 51595 | 34 | 42 | 34 | 112 | I05 |
| 2 | | | | | I20 | 51715 | 24 | 30 | 24 | 114 | I05 |
| 3 | | | | | I20 | 51840 | 35 | 35 | 30 | 115 | I05 |
| 4 | 40 | 40 | 35 | 115 | I20 | 51940 | | | | | I05 |
| 5 | 30 | 30 | 30 | 115 | I20 | 52040 | | | | | I05 |
| 6 | 25 | 25 | 25 | 115 | I20 | 52130 | | | | | I05 |
| 7 | 40 | 40 | 40 | 115 | I20 | 52195 | | | | | I05 |
| 8 | 40 | 45 | 40 | 115 | I20 | 52270 | | | | | I05 |
| 9 | 35 | 35 | 35 | 115 | I20 | 52340 | | | | | I05 |
| 10 | 45 | 50 | 45 | 115 | I20 | 52440 | | | | | I05 |
| 11 | 20 | 25 | 20 | 115 | I20 | 52510 | | | | | I05 |
| Mdt | 35 | 35 | 30 | 115 | I20 | 52595 | | | | | I05 |
| I | 35 | 35 | 30 | 115 | I20 | 52680 | | | | | I05 |
| 2 | 35 | 35 | 30 | 115 | I20 | 52775 | | | | | I05 |
| 3 | 35 | 35 | 30 | 115 | I20 | 52865 | | | | | I05 |
| 4 | 20 | 25 | 20 | 115 | I20 | 52960 | | | | | I05 |
| 5 | | | | | I20 | 53015 | 20 | 24 | 20 | 115 | I05 |
| 6 | | | | | I20 | 53050 | 15 | 10 | 5 | 113 | I05 |
| 7 | | | | | I20 | 53105 | 24 | 24 | 22 | 112 | I05 |
| 8 | | | | | I20 | 53210 | 38 | 44 | 42 | 115 | I05 |
| 9 | | | | | I20 | 53340 | 47 | 54 | 53 | 115 | I05 |
| 10 | | | | | I20 | 53515 | 48 | 56 | 52 | 115 | I05 |
| 11 | | | | | I20 | 53660 | 48 | 54 | 52 | 115 | I05 |

TRENTON GAS AND ELECTRIC COMPANY
DAILY LOG SHEET
April 3-4, 1912.

| | Amp | Amp | Amp | Volt | Volt | K W | Hrs | Amp | Amp | Amp | Volt | Volt |
|------|-----------------|---------------|-----|------|------|-------|-----|-----|-----|-----|------|------|
| Noon | | | | | I20 | 53830 | 48 | 54 | 52 | | 115 | 105 |
| I | | | | | I20 | 53930 | 48 | 44 | 46 | | 115 | 105 |
| 2 | | | | | I20 | 54095 | 46 | 54 | 52 | | 115 | 105 |
| 3 | | | | | I20 | 54285 | 28 | 34 | 30 | | 115 | 105 |
| 4 | 30 | 30 | 25 | 115 | I20 | 54400 | | | | | | 105 |
| 5 | 30 | 35 | 27 | 115 | I20 | 54495 | | | | | | 105 |
| 6 | 25 ^b | 25 | 25 | 115 | I20 | 54570 | | | | | | 105 |
| 7 | 25 | 25 | 25 | 115 | I20 | 54635 | | | | | | 105 |
| 8 | 40 | 45 | 40 | 115 | I20 | 54685 | | | | | | 105 |
| 9 | 55 | 55 | 55 | 115 | I20 | 54760 | | | | | | 106 |
| 10 | 50 | 50 | 45 | 116 | I20 | 54875 | | | | | | 105 |
| 11 | 25 | 25 | 20 | 116 | I20 | 54940 | | | | | | 105 |
| Mdt | 25 | 20 | 20 | 116 | I20 | 54990 | | | | | | 105 |
| I | 35 | 35 | 30 | 116 | I20 | 55110 | | | | | | 105 |
| 2 | 20 | 20 | 15 | 115 | I20 | 55150 | | | | | | 105 |
| 3 | 20 | 15 | 15 | 115 | I20 | 55270 | | | | | | 105 |
| 4 | | | | | I20 | 55330 | 34 | 38 | 34 | | 115 | 105 |
| 5 | | | | | I20 | 55430 | 34 | 38 | 36 | | 115 | 105 |
| 6 | | | | | I20 | 55475 | 15 | 15 | 5 | | 115 | 105 |
| 7 | | | | | I20 | 55505 | 10 | 10 | 5 | | 115 | 105 |
| 8 | | | | | I20 | 55590 | 44 | 50 | 46 | | 115 | 105 |
| 9 | | | | | I20 | 55750 | 42 | 50 | 47 | | 115 | 105 |
| 10 | | | | | I20 | 55935 | 32 | 40 | 32 | | 115 | 105 |
| 11 | | | | | I20 | 56070 | 44 | 52 | 46 | | 115 | 105 |

TRENTON GAS AND ELECTRIC COMPANY
DAILY LOG SHEET April 4-5, 1912.

| | Amp | Amp | Amp | Volt | Volt | KW | Hrs | Amp | Amp | Amp | Volt | Volt |
|------|-----|-----|-----|------|------|-------|-----|-----|-----|-----|------|------|
| Noon | | | | | 120 | 56210 | 48 | 52 | 50 | | 115 | 105 |
| I | | | | | 120 | 56330 | 24 | 32 | 36 | | 115 | 105 |
| 2 | | | | | 120 | 56460 | 44 | 50 | 46 | | 115 | 105 |
| 3 | | | | | 120 | 56635 | 30 | 38 | 34 | | 115 | 105 |
| 4 | 45 | 45 | 40 | 115 | 120 | 56800 | | | | | | 105 |
| 5 | 30 | 30 | 25 | 115 | 120 | 56905 | | | | | | 105 |
| 6 | 25 | 25 | 25 | 115 | 120 | 56970 | | | | | | 105 |
| 7 | 35 | 40 | 40 | 115 | 120 | 57045 | | | | | | 105 |
| 8 | 45 | 55 | 45 | 115 | 120 | 57110 | | | | | | 105 |
| 9 | 50 | 55 | 50 | 115 | 120 | 57190 | | | | | | 105 |
| 10 | 30 | 30 | 25 | 115 | 120 | 57305 | | | | | | 105 |
| 11 | 25 | 25 | 20 | 115 | 120 | 57365 | | | | | | 105 |
| Mid | 20 | 25 | 20 | 115 | 120 | 57430 | | | | | | 105 |
| I | 20 | 25 | 20 | 115 | 120 | 57490 | | | | | | 105 |
| 2 | 35 | 35 | 30 | 115 | 120 | 57640 | | | | | | 105 |
| 3 | 20 | 15 | 20 | 115 | 120 | 57775 | | | | | | 105 |
| 4 | 35 | 35 | 30 | 115 | 120 | 57805 | | | | | | 105 |
| 5 | 35 | 35 | 30 | 115 | 120 | 57890 | | | | | | 105 |
| 6 | 5 | 5 | 10 | 115 | 120 | 57930 | | | | | | 105 |
| 7 | 5 | 5 | 7 | 115 | 120 | 57960 | | | | | | 105 |
| 8 | 40 | 40 | 35 | 116 | 120 | 58070 | | | | | | 105 |
| 9 | 25 | 25 | 20 | 115 | 120 | 58170 | | | | | | 105 |
| 10 | 35 | 35 | 30 | 115 | 120 | 58315 | | | | | | 105 |
| 11 | 45 | 45 | 40 | 115 | 120 | 58460 | | | | | | 105 |

TRENTON GAS AND ELECTRIC COMPANY
 DAILY LOG SHEET April 4-5, 1912.

| | Amp | Amp | Amp | Volt | Volt | KW | Hrs | Amp | Amp | Amp | Volt | Volt |
|------|---------------|-----|-----|------|------|-------|-----|-----|-----|-----|------|------|
| Noon | 45 | 45 | 40 | 115 | 120 | 58590 | | | | | | I05 |
| I | 40 | 40 | 35 | 115 | 120 | 58650 | | | | | | I05 |
| 2 | 30 | 30 | 25 | 115 | 120 | 58795 | | | | | | I05 |
| 3 | 40 | 40 | 38 | 115 | 120 | 58945 | | | | | | I05 |
| 4 | 40 | 40 | 35 | 115 | 120 | 59080 | | | | | | I05 |
| 5 | 30 | 30 | 25 | 115 | 120 | 59160 | | | | | | I05 |
| 6 | 30 | 30 | 25 | 115 | 120 | 59250 | | | | | | I05 |
| 7 | 10 | 10 | 15 | 115 | 120 | 59295 | | | | | | I05 |
| 8 | 40 | 40 | 40 | 115 | 120 | 59355 | | | | | | I05 |
| 9 | 40 | 35 | 35 | 115 | 120 | 59440 | | | | | | I05 |
| 10 | 40 | 30 | 30 | 115 | 120 | 59530 | | | | | | I05 |
| 11 | 25 | 25 | 20 | 115 | 120 | 59585 | | | | | | I05 |
| Mdt | 35 | 35 | 35 | 115 | 120 | 59670 | | | | | | I05 |
| I | 35 | 35 | 30 | 115 | 120 | 59755 | | | | | | I05 |
| 2 | 35 | 35 | 30 | 115 | 120 | 59850 | | | | | | I05 |
| 3 | 20 | 20 | 15 | 115 | 120 | 59910 | | | | | | I05 |
| 4 | 20 | 20 | 15 | 115 | 120 | 59970 | | | | | | I05 |
| 5 | | | | | 120 | 60095 | 36 | 40 | 36 | 115 | | I05 |
| 6 | | | | | 120 | 60150 | 1 | 25 | 3 | 115 | | I05 |
| 7 | | | | | 120 | 60180 | 18 | 18 | 10 | 115 | | I05 |
| 8 | | | | | 120 | 60240 | 24 | 30 | 24 | 115 | | I05 |
| 9 | | | | | 120 | 60400 | 35 | 42 | 40 | 116 | | I05 |
| 10 | | | | | 120 | 60540 | 42 | 48 | 44 | 115 | | I05 |
| 11 | | | | | 120 | 60690 | 30 | 36 | 30 | 115 | | I05 |

TRENTON GAS AND ELECTRIC COMPANY

DAILY LOG SHEET

April 6-7, 1912.

| | Amp | Amp | Amp | Volts | Volt | KW | Hrs | Amp | Amp | Amp | Volt | Volt |
|------|----------------------------------|-----|-----|-------|------|-------|-----|-----|-----|-----|------|------|
| Noon | | | | | I20 | 60780 | 42 | 46 | 48 | | 115 | 105 |
| I | | | | | I20 | 60915 | 42 | 48 | 44 | | 115 | 105 |
| 2 | | | | | I20 | 61070 | 44 | 50 | 48 | | 115 | 105 |
| 3 | | | | | I20 | 61210 | 28 | 30 | 28 | | 116 | 105 |
| 4 | 30 | 30 | 25 | 116 | I20 | 61330 | | | | | | 105 |
| 5 | 33 | 33 | 26 | 115 | I20 | 61450 | | | | | | 105 |
| 6 | 30 | 30 | 30 | 115 | I20 | 61530 | | | | | | 105 |
| 7 | 30 | 30 | 30 | 115 | I20 | 61585 | | | | | | 105 |
| 8 | 50 | 50 | 45 | 115 | I20 | 61645 | | | | | | 105 |
| 9 | 45 | 40 | 40 | 115 | I20 | 61720 | | | | | | 105 |
| 10 | 40 | 35 | 35 | 115 | I20 | 61795 | | | | | | 105 |
| 11 | 30 | 30 | 25 | 115 | I20 | 61870 | | | | | | 105 |
| Mdt | 35 | 35 | 35 | 115 | I20 | 61960 | | | | | | 105 |
| I | 35 | 35 | 35 | 115 | I20 | 62050 | | | | | | 105 |
| 2 | 30 | 35 | 30 | 115 | I20 | 62145 | | | | | | 105 |
| 3 | 25 | 25 | 20 | 115 | I20 | 62265 | | | | | | 105 |
| 4 | | | | | I20 | 62350 | 20 | 24 | 22 | | 116 | 105 |
| 5 | | | | | I20 | 62430 | 20 | 24 | 22 | | 115 | 105 |
| 6 | | | | | I20 | 62460 | 1 | 2 | 3 | | 115 | 105 |
| 7 | | | | | I20 | 62515 | 22 | 24 | 20 | | 115 | 105 |
| 8 | | | | | | | | | | | | |
| 9 | Off to make repairs and clean up | | | | | | | | | | | |
| 10 | | | | | I20 | 62730 | 10 | 20 | 10 | | 117 | 105 |
| 11 | | | | | I20 | 62780 | 24 | 26 | 20 | | 115 | 105 |
| Noon | | | | | | 68870 | | | | | | |

In arriving at the output to the busbars the writer was compelled to take a rather doubtful figure but never the less it is not very far off .

To get this readings were taken in the station for a period of seven days and at hourly intervals . Readings taken several months before compared very favorably with the ones given here so it was assumed that the load could be taken as an average of these .

From these readings it was found that the average output from the bus bars was 2208 Kilowatt hours, per day.

As the plant runs 365 days a year we have 805920 KW Hrs per year .

The amount of coal used could only be determined by amounts used in previous months and this equalled on an average 16.3 tons per day or 59495 tons per year , or 11899000 # per year.

We then have $\frac{11899000}{805920} = 14.76$ pounds of coal per kilowatt hour.

Now if the total number of kilowatt hours per year is 805920 and the cost of generating and distributing is \$ 28177.75 we have a cost of \$.0349 per kilowatt hour which is a little too high . This cost per kilowatt hour could be reduced a small fraction of a cent as some of the expense figures cover the expense not only of the electric plant but the gas plant as well

In figuring the expenditures as well as the income only approximate results could be obtained .

| | | | |
|-----------------|---------|--------|------|
| Superintendence | a \$100 | mo | 1200 |
| Book keeper | a | 48 " | 576 |
| 3-Linemen | 2-60 | I-50 " | 2040 |
| 2-Engineers | a | 65 | 1560 |
| 3-Firemen | | 50 | 1800 |

7176

| | | | |
|----------------|------|--|------|
| Depreciation | | | 500 |
| Interest | a 5% | | 3750 |
| Taxes | | | 150 |
| Insurance | | | 75 |
| Office expense | | | 500 |

4975

| | | | |
|----------|--|--|---------|
| Coal | | | 9816.50 |
| Oil | | | 150 |
| Supplies | | | 6000 |

15966.50

Total 28117.50

~~3030.25~~

\$ 3030.25 Total yearly exp.

This figure will possibly be a little high but is taken to be on the safe side.

CONCLUSION

Successful operation of an electric plant necessitates the furnishing of a reliable , continuous , and satisfactory supply of electricity and and it is now becoming customary to measure the excellence of service upon the basis of interruptions . Further the plant must operate economically and must earn enough profit to at least keep it properly maintained and pay a reasonable rate of interest on the investment.

As will be noticed by the previous pages the pounds of coal per kilowatt hour is high and this makes a higher variable charge upon the station and in this way raises the cost per kilowatt hour.

It has not been the intentions of the writer to criticize the plant with any other feeling than to suggest a few improvements which would help in the operation of the plant.

The changes in the building were for the purpose of relieving the crowded condition in the engine room and to give a longer wheel base for the North unit . This would cut down the fixed load on the engine . By increasing the size of the engine room it is also possible to move the switchboard from it's present position , which is too near in line with the belt of the North unit.

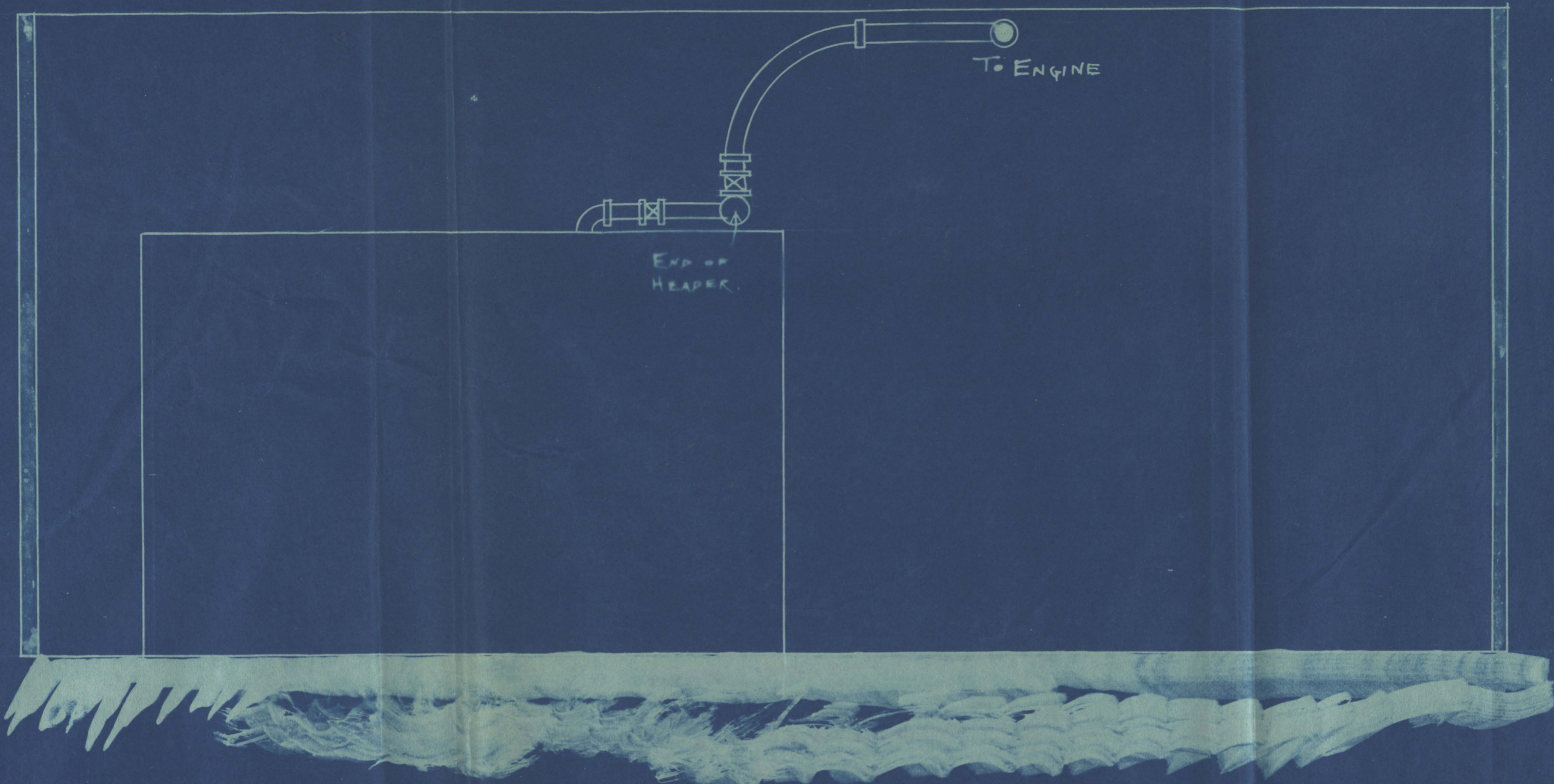
By changing the wall on the east side of the boiler room a great deal more coal storage space is available.

The changing of the steam piping , from short right angled bends to long radial bends, will cut down the friction loss in the pipe and good lagging will also cut down the radiation losses and each of these means a saving of coal and this in turn means more profit to the owner.

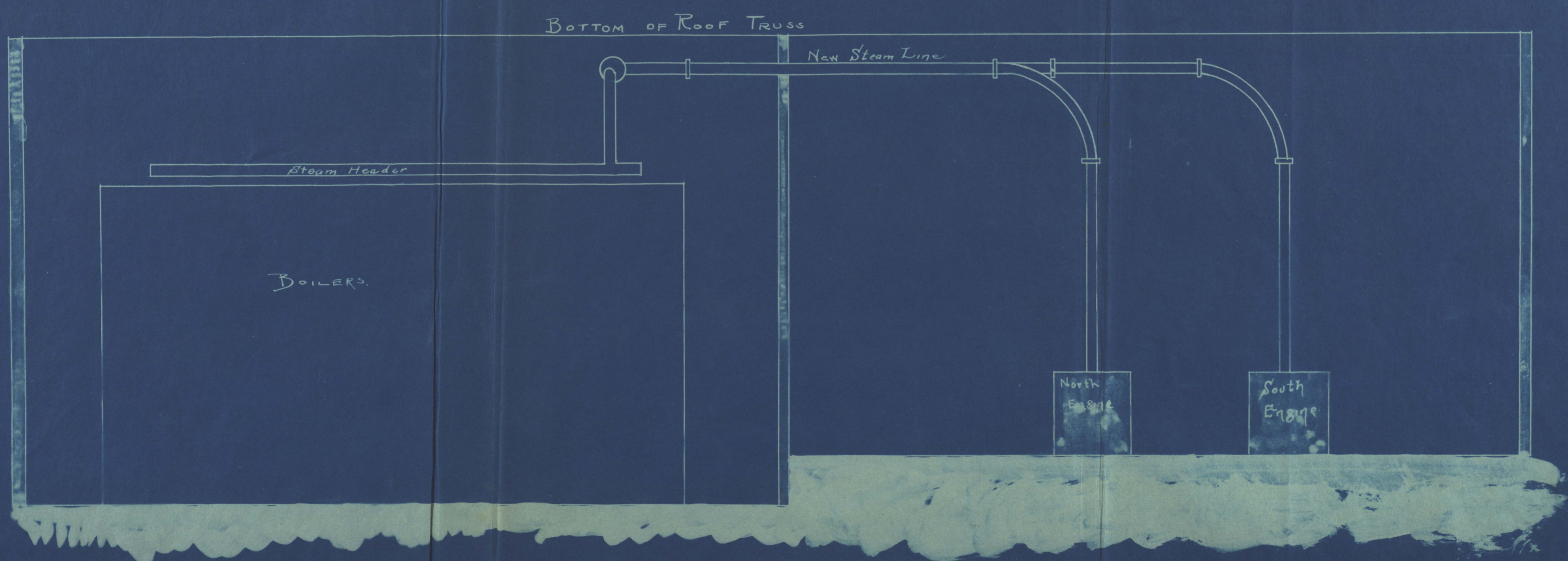
It was the writers intention to cover this more fully but circumstances altered the case and partly due to lack of time and of money , the plant being some 200 miles distant , several things were not taken up which would fit in very well with the material herewith presented.

From the growth of Trenton in the past twenty years and from the present load the plant seems to be of adequate size for the present needs and, unless something out of the ordinary happens , for the future needs.

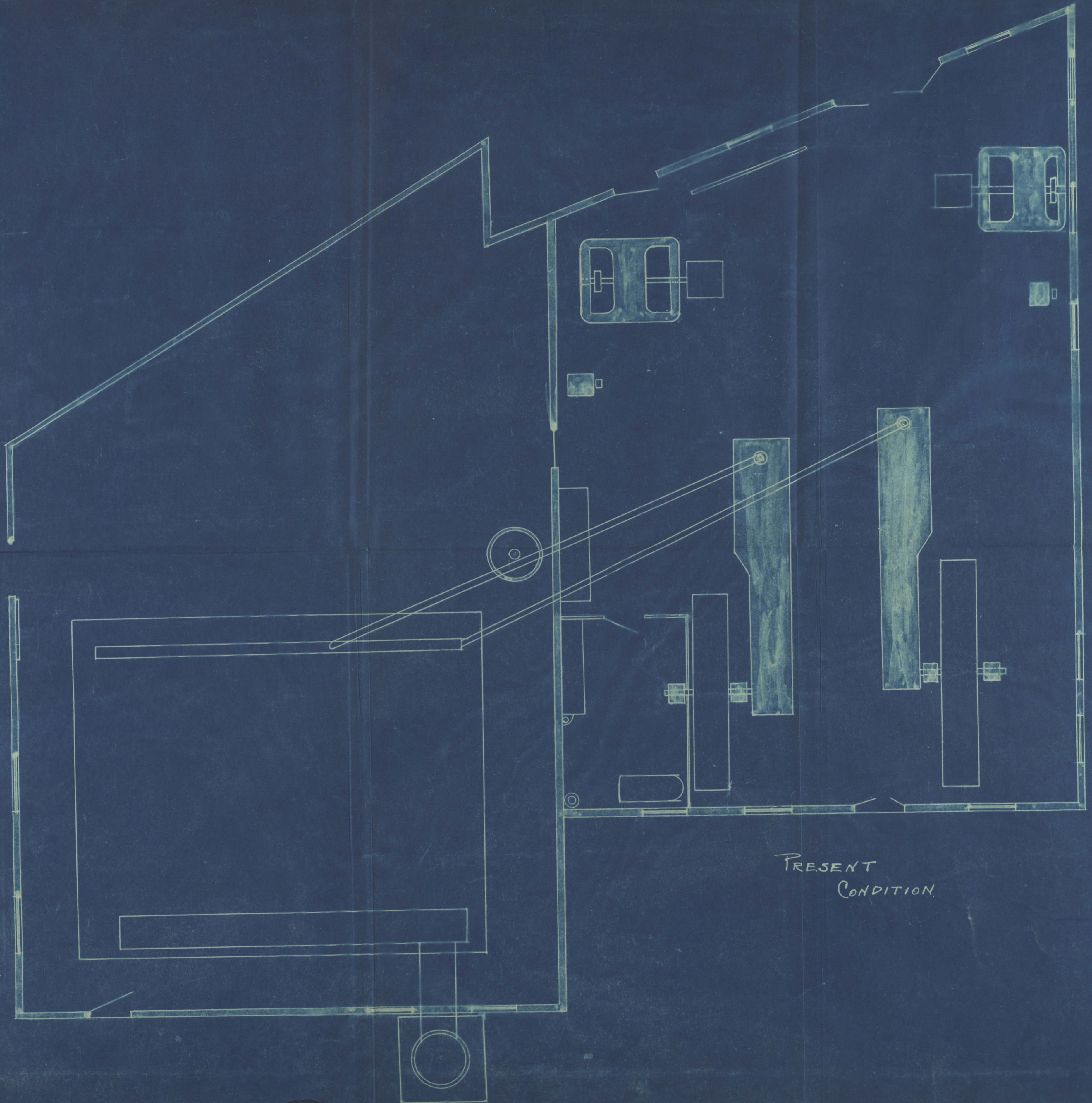
IT is the writers opinion that the changes proposed would be of great benefit to the plant.



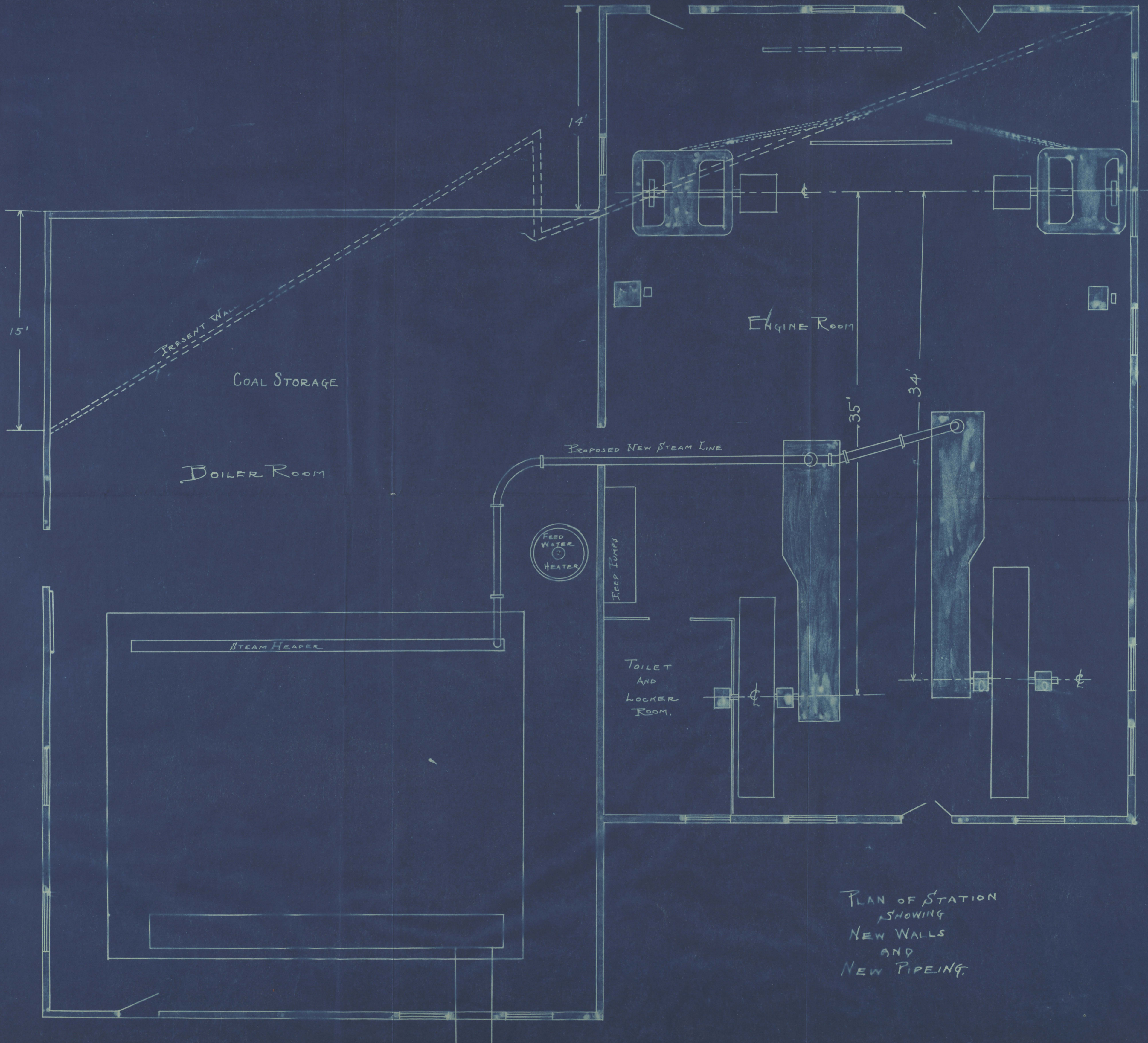
LOOKING NORTH



SECTION THRU PLANT SHOWING NEW PIPING -
LOOKING WEST.



PRESENT
CONDITION.



PLAN OF STATION
SHOWING
NEW WALLS
AND
NEW PIPEING.

6202
R56

UNIVERSITY OF MISSOURI - COLUMBIA



010-10179331 0

BOOK DUE
Dec. 13th

