1916

Comparison of operating expenses and capital expenditures of two different types of boiler rooms covering extensions expected during the next twenty years

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Department:

COMPARISON OF OPERATING EXPENSES AND CAPITAL EXPENDITURES OF TWO DIFFERENT TYPES OF BOILER ROOMS COVERING EXTENSIONS EXPECTED DURING THE NEXT TWENTY YEARS

BY

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THESIS

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Approved by A L McRae
Professor of Physics

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PRESENT HOUSE

NEW HOUSE

INTRODUCTION

COMPARISON OF OPERATING EXPENSES AND CAPITAL EXPENDITURES OF TWO DIFFERENT TYPES OF BOILER ROOMS COVERING EXTENSIONS EXPECTED DURING THE NEXT TWENTY YEARS.

This thesis applies to a central power station located in a rapidly growing manufacturing city with a present population of 40,000. The station is connected by high voltage transmission lines with six hydro and steam generating stations located in other cities. These transmission lines are mainly for emergency purposes so that this report considers that the station here studied will carry its full load.

The boiler room is the only part of the station considered in this thesis as a previous study showed that there was ample space in the engine room for turbo-generator for years to come. Reference to drawing one shows that the space occupied by the 3500 K.W. turbo-generator is quite small compared to that occupied by the two 1500 K.W. cross compound units.

Plan No.1:- (Refer to drawings 1 to 7 incl.) This is to develop along the line of the present boiler room, adding three more boilers to the north, removing the four old Stirling boilers, and replacing with three boilers of larger capacity. This boiler room will be modernized as much as possible, overhead bunkers for coal being installed, and ash pits and an ash alley excavated under the boilers. Owing to the large cost of the extra excavation and the rebuilding of foundations, it would hardly be possible to reconstruct so as to use any other type of underfeed stoker than the Jones, which are at present installed. The coal would be raised to the bunkers by electric chain belt bucket elevators. The ashes would be flushed from the ash pits into ash cars in the same manner as is now done at Commerce Street. These cars will run on a track to the north end of the building where they will be lifted by an electric platform elevator to the top of an ash hopper, into which the ashes can be dumped. The space under the hopper will be open, so that teams or auto trucks will have ready access for loading ashes. Superheaters will be installed in all the new boilers and in the three Edge Moor boilers now in place.

Plan No.2:- (Refer to drawings 8 to 16) The other plan that suggests itself is the building of an entirely new boiler room to consist of a double row of boilers at the north end of the present engine room, at right angles to the present line, and reaching from the alley to Lake Street. There will be room in this location

for twelve boilers, which can be equipped with the most efficient type of underfeed stokers, and coal and ash handling equipment. The stokers installed will be of the Riley or similar type, the ashes flushed from the ash pits into ash cars which will be raised over ash bunkers at the west end of the building by an electric platform elevator, in the same manner as suggested for the present boiler room extension. The coal can be dumped by teams or auto trucks into a receiving hopper beneath the ground at the west end of the building, which will feed into a chain belt bucket elevator. This will raise the coal to the top of the bunkers, where a belt conveyor will carry it to any desired point. All boilers will be equipped with superheaters. There will be room for feed water heaters and boiler feed pumps at the north end of the engine room, where they can be readily observed by the engine room attendants. The three Edge Moor boilers in the present boiler room can be moved to a new location in the new house whenever the load permits.

The discussion of these two extensions is divided into three parts. Part one considers the estimated load each year, the time for necessary additions to equipment, the cost of coal for different types of stokers, the operating labor required, the maintenance cost of different types of stokers, and the saving resulting from the use of the new boiler room. Part two deals with the costs of making the changes in equipment outlined in part one, and the distribution as between Capital Expenditures, Depreciation Reserve, and Operating Expenses. A comparison is made of the overhead charges for the two plans for extensions. Part three is a recapitulation of the figures in Parts One and Two, and shows the overall saving in the new boiler room from decreased coal and labor costs which is partly offset by heavier overhead charges. Attached to this report are a set of blue prints showing the development of both plans for extensions and typical cross sections of each arranged in chronological order.

PART ONE

INDEX TO COLUMN NUMBERS

ESTIMATED INCREASE IN PEAK LOAD and B.H.P. DEMANDS

Year beginning Oct.1st	1. K.W.Peak	2. Estimated water rate of station Lbs.steam per KWH	3. Ratio - K.W. per rated B.H.P.	4. B.H.P. required for K.W. Peak	5. B.H.P. for steam to Gas Works	6. Total B.H.P. Required
1916	4402	30	1.50	2940	220	3160
1917	4842	29.5	1.52	3180	242	3422
1918	5282	29	1.55	3410	264	3674
1919	5722	28.5	1.58	3620	286	3906
1920	6163	28	1.61	3830	308	4138
1921	6603	27.5	1.64	4020	330	4350
1922	7043	20	2.25	3130	352	3482
1923	7483	20	2.25	3330	374	3704
1924	7924	20	2.25	3525	396	3921
1925	8364	20	2.25	3720	418	4138
1926	8804	20	2.25	3920	440	4360
1927	9244	20	2.25	4110	462	4572
1928	9684	20	2.25	4310	484	4794
1929	10124	20	2.25	4500	506	5006
1930	10565	20	2.25	4690	528	5218
1931	11005	20	2.25	4890	550	5440
1932	11445	20	2.25	5085	572	5657
1933	11885	20	2.25	5280	594	5874
1934	12326	20	2.25	5480	616	6096
1935	12766	20	2.25	5670	638	6308
1936	13206	20	2.25	5870	660	6530

EXPLANATION

Column 1. Estimated Peak for Oct.1916 is figured as doubled in 10 years and tripled in 20 years.

Column 2. 30 lbs. per K.W.H. represents present results - estimated that this would decrease gradually to 1922 when new engine room equipment would bring it down to 20 lbs. where it would remain practically constant.

Column 3. One rated boiler horsepower is taken as 30 lbs. of steam per hour. If boilers are run at 150% rating, then for every rated boiler horsepower, 45 lbs. of steam per hour would be obtained. 45 divided by Column number 2 gives ratio of K.W. per rated B.H.P.

Column 4. Column number 1 divided by Column number 3.

Column 5. Present requirements estimated as doubled in 10 years and tripled in 20 years. This is not the Peak demand of the Gas Works, which is about 450 H.P. and occurs about noon, but the demand at six o'clock during the K.W. Peak.

Column 6. Column number 4 plus Column number 5.

PROPOSED CHANGES AND EXTENSIONS

Year beginning Oct.1st	PRESENT BOILER ROOM 6 B.H.P. required		OR B.H.P. installed	NEW BOILER ROOM	B.H.P. installed
1916	3160	Install 2-500 H.P.boilers as #9 & 10	3500	Install 2-500 H.P.boilers as #1 & 3	3500
1917	3422	Install 1-500 H.P.boiler as #8	4000	Move #7 present house to #2 new house and install 1-500 H.P.boiler as #4	4000
1918	3674		4000	Move #5 & 6 present house to #6 & 8 new house.	4000
1919	3906	Remove boilers #3 & 4 and install 2-500 H.P. boilers.	4600	Install 2-500 H.P. boilers as #5 & 7	5000
1920	4138	Remove boilers #1 & 2 and install 1-765 H.P. boiler.	4765	Install 2-765 H.P. boilers as #10 & 12 and remove old Stirling boilers in present house.	5530
1921	4350		4765		5530
1922	3482		4765		5530
1923	3704		4765		5530
1924	3921		4765		5530
1925	4138		4765		5530
1926	4360		4765		5530
1927	4572		4765		5530
1928	4794	Limit of capacity of Present House		Install 2-765 H.P. boilers as #9 & 11	5530
1929	5006				7060
1930	5218				7060
1931	5440				7060
1932	5657				7060
1933	5874				7060
1934	6096				7060
1935	6308				7060
1936	6530				7060

-Note-

The B.H.P. required will occur about October 1st of the year given, and the changes and additions will have to be made in the summer and completed by this date.

ESTIMATED STEAM REQUIREMENTS

Year beginning Oct. 1st	1. Est. K.W. Peak	7. Est. Load Factor	8. Aver. Load	9. % of total time Station is in operation	10. Hrs. of Operation	11. Total K.W.H.	2. Lbs. of Steam per K.W.H. for Station	12. Lbs. of Steam for Station	13. Lbs. of Steam to Gas Works	14. Total Steam
1916	4402	45	1980	75	6577	13,000,000	30	390,000,000	65,120,000	455,120,000
1917	4842	45	2175	85	7453	16,200,000	29.5	478,000,000	71,632,000	549,632,000
1918	5282	45	2360	95	8329	19,650,000	29	570,000,000	78,144,000	648,144,000
1919	5722	45	2575	100	8760	22,550,000	28.5	643,000,000	84,656,000	727,656,000
1920	6163	45	2770	100	8760	24,250,000	28	679,000,000	91,168,000	770,168,000
1921	6603	45	2970	100	8760	26,000,000	27.5	715,000,000	97,680,000	812,680,000
1922	7043	45	3165	100	8760	27,700,000	20	554,000,000	104,192,000	658,192,000
1923	7483	45	3365	100	8760	29,450,000	20	588,000,000	110,704,000	698,704,000
1924	7924	45	3560	100	8760	31,200,000	20	624,000,000	117,216,000	741,216,000
1925	8364	45	3760	100	8760	32,900,000	20	658,000,000	123,728,000	781,728,000
1926	8804	45	3960	100	8760	34,700,000	20	694,000,000	130,240,000	824,240,000
1927	9244	45	4160	100	8760	36,450,000	20	729,000,000	136,752,000	865,752,000
1928	9684	45	4360	100	8760	38,200,000	20	764,000,000	143,264,000	907,264,000
1929	10124	45	4560	100	8760	39,950,000	20	799,000,000	149,776,000	948,776,000
1930	10565	45	4750	100	8760	41,600,000	20	832,000,000	156,288,000	988,288,000
1931	11005	45	4950	100	8760	43,350,000	20	867,000,000	162,800,000	1,029,800,000
1932	11445	45	5150	100	8760	45,100,000	20	902,000,000	169,312,000	1,071,312,000
1933	11885	45	5350	100	8760	46,850,000	20	937,000,000	175,824,000	1,112,824,000
1934	12326	45	5540	100	8760	48,500,000	20	970,000,000	182,336,000	1,152,336,000
1935	12766	45	5745	100	8760	50,300,000	20	1,006,000,000	188,848,000	1,194,848,000
1936	13206	45	5940	100	8760	52,000,000	20	1,040,000,000	195,360,000	1,235,360,000

EXPLANATION

Column 1. Estimated Peak for Oct. 1916 considered doubled in 10 years and tripled in 20 years.

Column 7. About the average for 1915. By load factor is meant the ratio of the average load to maximum load.

Column 8. Obtained by multiplying column 1 by column 7.

Column 9. Present operation of station is for 75% of time. Estimated shut down periods decreased to 1919, when station would have to be run all the time, as transmission line could not carry load during night and on Sundays.

Column 10. Total hours in year are 8760 - figures obtained by taking Column 9 percentage of this.

Column 11. Product of average load, Column 8, and total hours, Column 10.

Column 2. 30 lbs. per K.W.H. represent present results - estimated that this would decrease gradually to 1922, when new engine room equipment would bring it down to 20 lbs. where it would remain practically constant.

Column 12. Product of Column 11 and Column 2.

Column 13. Steam for Gas Works estimated as doubled in 10 years and tripled in 20 years. Extra pipe lines would be installed for this.

Column 14. Sum of Column 12 and Column 13.

ESTIMATED FUEL CONSUMPTION AND SAVING IN COAL DUE TO USING HIGH EFFICIENCY STOKERS.

Year beginning Oct. 1st	14. Total Steam to be evaporated by Boilers	15. Coal for this Steam at 7.93# evaporation Present House Rating	16. Cost of coal per ton	17. Total Cost for coal at 7.93# evap. Present House Rating	18. Coal for this Steam at 8.71# evaporation, New House Rating	16. Cost of coal per Ton	19. Total Cost of coal at 8.71# evap. New House Rating	20. Money saved in cost of coal from using high Efficiency Stokers
1916	455,120,000	57,400,000	$2.61	$74907.00	52,200,000	$2.61	$ 68121.00	$ 3393.00
1917	549,632,000	69,300,000	2.61	90436.00	63,050,000	2.61	82280.00	5437.00
1918	648,144,000	81,700,000	2.61	106618.00	74,400,000	2.61	97092.00	9526.00
1919	727,656,000	91,800,000	2.61	119799.00	83,500,000	2.61	108967.00	10832.00
1920	770,168,000	97,100,000	2.61	126715.00	88,400,000	2.61	115362.00	11353.00
1921	812,680,000	102,400,000	2.61	133632.00	93,250,000	2.61	121691.00	11941.00
1922	758,192,000	83,000,000	2.61	108315.00	75,550,000	2.61	98593.00	9722.00
1923	698,704,000	88,100,000	2.61	114970.00	80,200,000	2.61	104661.00	10309.00
1924	741,216,000	93,500,000	2.61	122017.00	85,050,000	2.61	110990.00	11027.00
1925	781,728,000	98,600,000	2.61	128673.00	89,700,000	2.61	117058.00	11615.00
1926	824,240,000	103,900,000	2.61	135589.00	94,600,000	2.61	123453.00	12136.00
1927	865,752,000	109,100,000	2.61	142375.00	99,400,000	2.61	129717.00	12658.00
1928	907,264,000				104,100,000	2.61	135850.00	
1929	948,776,000				108,900,000	2.61	142114.00	
1930	988,288,000				113,500,000	2.61	148117.00	
1931	1,029,800,000				118,100,000	2.61	154120.00	
1932	1,071,312,000				122,900,000	2.61	160384.00	
1933	1,112,824,000				127,600,000	2.61	166518.00	
1934	1,152,336,000				132,200,000	2.61	172521.00	
1935	1,194,848,000				137,100,000	2.61	178915.00	
1936	1,235,360,000				141,800,000	2.61	185049.00	

EXPLANATION

Column 14. Same as Column 14 on previous page.

Column 15. 7.93# evaporation represents 70% boiler efficiency, which is that obtained with hand cleaned Jones Stokers. Steam pressure 190# abs. Superheat 150°. Feed Water Temperature 210°. This coal is only figured up to 1928 which is the limit of the capacity of the present boiler room development.

Column 18. 8.71# evaporation represents 77% boiler efficiency, which is that obtained with Taylor or other high grade underfeed stokers. Same conditions as Column 15.

Column 16. Average price for latter part of year 1915.

Column 17. Column 15 divided by 2000 and multiplied by $2.61.

Column 19. Column 18 divided by 2000 and multiplied by $2.61.

Column 20. Column 17 less Column 19. Year 1916 is divided by two and 1917 by one and one-half to compensate for steam furnished by Jones stoker fired boilers in present boiler room.

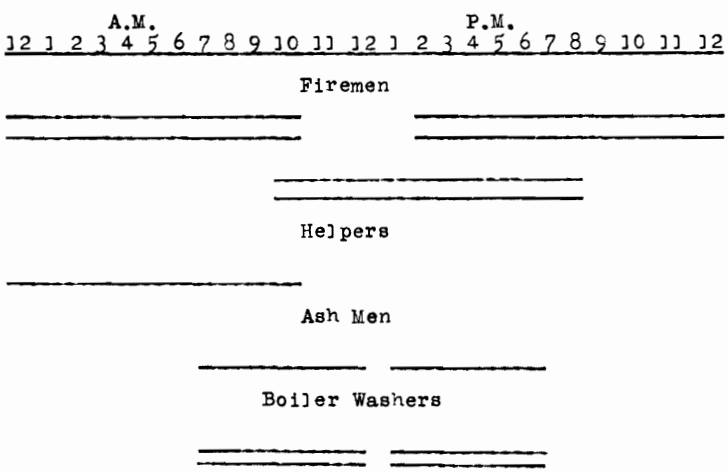
OPERATING LABOR - PRESENT BOILER ROOM

Year beginning Oct.1st	21. No.of Boilers on Peak	22. Aver. No.of boilers	23. No.of firemen on peak	24. No.of firemen on other times	25. Total No.of firemen	26. Firemen helpers	27. Ash Men	28. Boiler Washers	29. Firemen 25¢ per hr 10 hrs.per day,365 da. per year	30. Firemen Helpers,22½¢ per hr. 10 hrs.per day, 365 days per year	31. Ash Men 22½¢ per hr.10 hrs per day, 365 days per year	32. Boiler Washers 22½¢ per hr. 10 hrs.per day	33. Total Cost of Operating labor
1916	8	3	4	2	6	1	1	2	$5475.	$821.	$821.	$1642.	$8759
1917	8	3	4	2	6	1	1	2	5475.	821.	821.	1642.	8759
1918	9	4	4	2	6	1	1	3	5475.	821.	821.	2464.	9581
1919	8	4	4	2	6	1	1	3	5475.	821.	821.	2464.	9581
1920	8	4	4	2	6	1	1	3	5475.	821.	821.	2464.	9581
1921	8	4	4	2	6	1	1	3	5475.	821.	821.	2464.	9581
1922	7	3	4	2	6	1	1	2	5475.	821.	821.	1642.	8759
1923	7	3	4	2	6	1	1	2	5475.	821.	821.	1642.	8759
1924	8	3	4	2	6	1	1	2	5475.	821.	821.	1642.	8759
1925	8	4	4	2	6	1	1	3	5475	821.	821.	2464.	9581
1926	8	4	4	2	6	1	1	3	5475.	821.	821.	2464.	9581
1927	9	4	4	2	6	1	1	3	5475.	821.	821.	2464.	9581
1928	Limit of capacity of Present Boiler House												

EXPLANATION

With Jones hand cleaned Stokers, ash pits in front of the boilers and coal bunkers overhead, one fireman can tend two boilers. One helper is used during the night for the miscellaneous work that has to be done then. One ash man during the day time can remove all the ashes. The services of a coal man are included in the price of coal.

Following are the shifts that would fit in with the above number of men:-



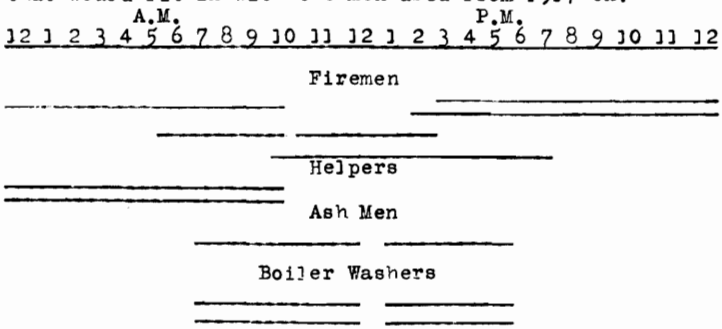
OPERATING LABOR - NEW BOILER ROOM

Year beginning Oct.1st	21. No.of Boilers on Peak	22. Aver. No.of Boilers	34. No.of Firemen on Peak	35. No.of firemen on other times	36. Total No.of firemen	37. Firemen helpers	38. Ash Men	39. Boiler Washers	COST OF OPERATING LABOR 40. Fireman 25¢ per hr 10 hrs.per day,365 da. per year	41. Fireman helpers 22½¢ per hr.10 hr. per day, 365 days per year	42. Ash Men 22½¢ per hr.10 hr per day, 365 days per year	43. Boiler Washers 22½¢ per hr. 10 hrs.per day	44. Total cost of Operating labor
1916	8	3	4	2	6	1	1	2	$5475.	$ 821.	$821.	$1642.	$8759.
1917	8	3	3	2	5	2	1	2	4562.	1642.	821.	1642.	8667.
1918	9	4	3	2	5	2	1	3	4562.	1642.	821.	2464.	9489.
1919	8	4	2	2	5	2	1	3	4562.	1642.	821.	2464.	9489.
1920	8	4	2	2	5	2	1	3	4562.	1642.	821.	2464.	9489.
1921	9	4	3	2	5	2	1	3	4562.	1642.	821.	2464.	9489.
1922	7	3	2	2	5	2	1	2	4562.	1642.	821.	1642.	8667.
1923	7	3	2	2	5	2	1	2	4562.	1642.	821.	1642.	8667.
1924.	8	3	2	2	5	2	1	2	4562.	1642.	821.	1642.	8667.
1925	8	4	2	2	5	2	1	3	4562.	1642.	821.	2464.	9489.
1926	9	4	3	2	5	2	1	3	4562.	1642.	821.	2464.	9489.
1927	9	4	3	2	5	2	1	3	4562.	1642.	821.	2464.	9489.
1928	9	4	3	2	5	2	1	3	4562.	1642.	821.	2464.	9489.
1929	9	4	3	2	5	2	1	3	4562.	1642.	821.	2464.	9489.
1930	9	4	3	2	5	2	1	3	4562.	1642.	821.	2464.	9489.
1931	9	4	3	2	5	2	1	3	4562.	1642.	821.	2464.	9489.
1932	9	4	3	2	5	2	1	3	4562.	1642.	821.	2464.	9489.
1933	10	4	3	2	5	2	1	3	4562.	1642.	821.	2464.	9489.
1934	10	4	3	2	5	2	1	3	4562.	1642.	821.	2464.	9489.
1935	11	4	3	2	5	2	1	3	4562.	1642.	821.	2464.	9489.
1936	11	4	3	2	5	2	1	3	4562.	1642.	821.	2464.	9489.

EXPLANATION

With the Taylor type of stokers, one fireman can take care of four boilers, although in this case, we figured two firemen on the floor during time of the heaviest load. Two helpers are used during the night to do miscellaneous work that has to be attended to every night. During the day time the boiler washers and ash men can be used as helpers as the work permits. The services of a coal man are included in the price of coal.

Following are the shifts that would fit in with the men used from 1917 on:-



COMPARATIVE MAINTENANCE COST

	15.	45.	46.	18.	47.	48.
Year beginning Oct.1st	Tons of Coal Jones Stokers	Cost of Maint. per ton of Coal Jones Stokers	Total Cost Jones Stoker Maintenance	Tons of Coal Taylor Stokers	Cost of Maint. per ton of Coal Taylor Stokers	Total Cost Taylor Stoker Maintenance
1916	28,700	$.008	$229	26,100	$.02	$ 522
1917	34,650	.008	277	31,525	.02	630
1918	40,850	.008	327	37,200	.02	745
1919	45,900	.008	367	41,750	.02	835
1920	48,550	.008	388	44,200	.02	884
1921	51,200	.008	410	46,625	.02	932
1922	41,500	.008	332	37,775	.02	755
1923	44,050	.008	352	40,100	.02	802
1924	46,750	.008	374	42,525	.02	853
1925	49,300	.008	395	44,850	.02	897
1926	51,950	.008	415	47,300	.02	946
1927	54,550	.008	436	49,700	.02	994
1928	Limit of capacity of Present Boiler Room			52,050	.02	1041
1929				54,450	.02	1089
1930				56,750	.02	1135
1931				59,050	.02	1181
1932				61,450	.02	1229
1933				63,800	.02	1276
1934				66,100	.02	1322
1935				68,550	.02	1371
1936				70,900	.02	1418

EXPLANATION

Jones Stokers Maintenance unit cost obtained from records of Oneida Street Power Plant, and Taylor Stokers from manufacturers guarantees in 1916. The Taylor type of Stoker, on account of its construction, will have a considerably heavier maintenance cost than the Jones, but will burn coal much more efficiently.

Only the Stoker Maintenance is compared, as boiler and all auxiliary repairs will be about the same for both extensions.

COMPARISON OF OPERATING & MAINTENANCE COSTS

Year beginning Oct. 1st	Present House 17. Cost of Coal	33. Operating Labor	46. Stoker Maint.	49. Total	New House 19. Cost of Coal	44. Operating Labor	48. Stoker Maint.	50. Total	51. Saving
1916	$ 74907	$8759	$229	$ 83895	$ 68121	$8759	$522	$77402	$ 6493
1917	90436	8759	277	99472	82280	8667	630	91577	7895
1918	106618	9581	327	116526	97092	9489	745	107326	9200
1919	119799	9581	367	129747	108967	9489	835	119291	10556
1920	126715	9581	388	136684	115362	9489	884	125735	10949
1921	133632	9581	410	143623	121691	9489	932	132112	11411
1922	108315	8759	332	117406	98593	8667	755	108015	9391
1923	114970	8759	352	124081	104661	8667	802	114130	9951
1924	122017	8759	374	131150	110990	8667	853	120510	10640
1925	128673	9581	395	138649	117058	9489	897	127444	11205
1926	135589	9581	415	145585	123453	9489	946	133888	11697
1927	142375	9581	436	152392	129717	9489	994	140200	12192
1928	Limit of capacity of Present Boiler Room				135850	9489	1041	146380	
1929					142114	9489	1089	152692	
1930					148117	9489	1135	158741	
1931					154120	9489	1181	164790	
1932					160384	9489	1229	171102	
1933					166518	9489	1276	177283	
1934					172521	9489	1322	183332	
1935					178915	9489	1371	189775	
1936					185049	9489	1418	195956	
Total 1916-1927	$1404046	$110862	$4302	$1519210	$1277985	$109850	$9795	$1397630	$121580
Grand Total	$1404046	$110862	$4302	$1519210	$2721573	$195251	$20857	$2937681	$121580

PART TWO.

INDEX TO SECTIONS

COST DATA USED IN DETERMINING CONSTRUCTION EXPENDITURES.

YEARLY CONSTRUCTION EXPENDITURES - PRESENT HOUSE

YEARLY CONSTRUCTION EXPENDITURES - NEW HOUSE

COST DATA USED IN DETERMINING CONSTRUCTION EXPENDITURES

General:

The unit costs have been obtained from a variety of sources, such as those submitted in a Valuation as of January 1st, 1914, Work Orders and Operating Expense Job Orders issued subsequent to January 1st, 1914, and on general data used in making up estimates for power plant construction work, so that the following estimates are made from the latest and most accurate data obtainable. Altho the problem involves construction work spread over a period of ten years no allowance has been made for any increase in cost of material and labor because it would effect both plans by equal amounts. Under each section, such as Boilers-Present House, will be given a unit cost statement covering each operation and a Summary of the yearly expenditures, including charges to the Depreciation Reserve for equipment retired. The bracketed letter for each sub-title is for purpose of reference in the summary of yearly Construction Expenditures.

It may be well to explain the method of accounting required by the State authorities in which this utility operates. Under "General Instructions Regarding Charges and Credits to Depreciation Reserve" we have the following rules:-

> "When any building, structure, machine, facility, or unit of equipment which at the time of its construction or installation was classified as tangible capital becomes thru wear and tear no longer economically reparable, it shall be charged to "Depreciation Reserve" and credited to the appropriate Capital Expenditure Account, and the substitute therefor shall be charged to the appropriate Capital Expenditure account.
>
> Where such unit of equipment has not been in service for the full period of its useful life but is replaced or retired for reasons other than that it is not economically reparable the loss of useful life resulting because of such early replacement or retirement is properly chargeable to the appropriate maintenance accounts.
>
> An estimate should be made of the probable remainder life of property thus replaced or retired and the ratio of expired life to probable remainder life be used as the basis of prorating the total charge between "Depreciation Reserve" account and the appropriate maintenance accounts.
>
> The cost of wrecking, removing and displacing units of equipment to be replaced or retired, shall not be charged to the "Depreciation Reserve" account but to the appropriate maintenance accounts.
>
> The salvage or scrap value of any unit of equipment retired from service or replaced by any other unit shall be credited to the "Depreciation Reserve" account.

The way this rule works out is well illustrated under section (I) Boilers Erected - New House. Referring to boiler No.7 Present House, we see that the cost of removing the setting and covering costs $300.00 which is a charge to Operating Expenses. The value of the setting and covering is $1250.00 and as it is only five years old and has a probable life of 25 years only one-fifth or $250.00 is properly chargeable to the Depreciation Reserve, while the remaining $1000.00 is charged to Operating Expenses under the head of Foreshortened or Unexpired Life.

In all other respects the charges to the different accounts are made as in ordinary practice. In this report no scrap values are considered as they would be too small to affect the problem.

(A) Building - Present House

In figuring the cost of extensions to the present house we considered that it would be of the same type of construction as that now over boilers #5 & 6 and of the same width. The building for boilers #9 & 10 will require an extension about 58 feet long to the north of the present building and will also have room for boiler #8. Boilers #3 & 4 will require an extension 20 feet long to the south of the present location of the feed water heater. This heater will have to be removed in order to permit boilers being located under the heater floor. Boiler #1 (765 HP) will require a 30 foot extension and will complete the south end of the building. The details are as follows:-

Cost of building for Boilers #9 & 10.

Excavation	120	cu.yds.	@ $1.00		$120.
Steel	17,000	lbs.	@ .05		850.
Concrete	1,400	cu.ft.	@ .25		350.
Bricks	80,000		@ 18.00	per M	1440.
Roof	2,000	sq.ft.	@ .25		500
Ventilators	6		@ 25.00		150.
Windows,Doors,& Misc.					340.
				Total	$3750.

Cost of building for Boilers #3 & 4

Excavation	25	cu.yds.	@ $1.00		$ 25.
Steel	7,000	lbs.	@ .05		350.
Concrete	320	cu.ft.	@ .25		80.
Brick Work	14,000		@ 18.00	per M	252.
Roof	800	sq.ft.	@ .25		200.
Windows,Doors,& Misc.					293.
				Total	$1200.

The cost of the 30 foot extension for #1 boiler is taken the same as the above in proportion to its length and $600.00 has been added for the south wall, a total cost of $2400.00. It will cost about $300.00 to remove the present building over Stirling Boilers #3 & 4 and the same amount to remove the building over #1 & 2. When the building over #1 & 2 is taken out we shall remove the present brick stack at an expense of $300.00 as it will be of no further use and can be taken out then at the minimum expense. The charge to the depreciation reserve for these old buildings will be $1200. for the section over #3 & 4 and $2300. for the

section over #1 & 2; the stack being written off at $4450. All of these are about 25 years old and are considered to have lived the full period their useful lives.

Yearly charges are:-

Year 1916		
Building for #9 & 10	$3750.	Charged to Capital Expenditures
Year 1919		
Removal of old building over boiler #3 & 4	$ 300.	Charged to Operating Expenses
First cost of old building	1200.	Charged to Depreciation Reserve
Building for new boiler #3 & #4	1200.	Charged to Capital Expenditures
Year 1920		
Remove old building over Boilers #1 & 2	$ 300.	Charged to Operating Expenses
Remove old brick stack	300.	Charged to Operating Expenses
First cost of old building	2300.	Charged to Depreciation Reserve
First cost of old stack	4450.	Charged to Depreciation Reserve
Cost of new building for Boiler #1	2400.	Charged to Capital Expenditures

(B) Building - New House

The new house is expected to be about 70 feet wide and 110 feet long the length being the full distance between the alley and Lake Street. It will be erected in three equal parts, each part to house four boilers with their auxiliary equipment.

The cost of the new house is given in detail below:-

Excavation	2,500 cu.yds.	@	$1.00	$ 2500.
Steel	230 tons	@	70.00	16000.
Concrete	8,500 cu.ft.	@	.37	3140.
Brick Work	11,500 sq.ft.	@	.55	6330.
Roof	5,300 sq.ft.	@	.30	1590.
Pent House	8,900 sq.ft.	@	.18	1600.
Basement Floor	7,700 sq.ft.	@	.15	1150.
First Floor	7,700 sq.ft.	@	.40	3080.
				$35390.
Engineering & Superintendence		@	5%	1770.
				$37160.
Miscellaneous		@	10%	3716.
		Total Cost		$40876.

This makes the cost of each one-third section at $13,630. It will be necessary to erect temporary end walls with each of the first two sections. These will be of 4" tile, costing 25¢ per square footerected, or about $500. for one wall. It will cost $50. to remove the first temporary wall when the Second Section is built.

If the new house is built it is expected that the space now occupied as a boiler room will be used for sub-station equipment or by some other department of the company. That portion of the boiler room building housing boilers #5, 6, & 7 is of new construction and will remain, but will no longer be charged as a boiler room investment. For the purpose of this report, it will be charged to the Depreciation Reserve at its full value. That portion of the present boiler room housing boilers #1, 2, 3, & 4 is about 25 years old and is in worn out condition, hence will be considered to have lived the full period of its useful life and will be removed and full value charged to Depreciation reserve. The brick stack will also be removed at this time.

The removal costs will be the same as those given in the preceding Section (Building - Present House) which are $300. for building over boilers #1 & 2; $300. for building over boilers #3 & 4 and $300. for removing the stack. The amounts to be written off (Charges to Depreciation Reserve) are also the same, which are $2300. for housing over Boilers #1 & 2; $1200. for housing over boilers #3 & 4, and $4450. for the stack. The amount to be charged to the Depreciation Reserve, for reasons stated above, to cover building over boilers #5, 6, & 7, is $4000.

Yearly expenditures are as follows:-

	Year 1916	
Building for four boilers	$13,630	Charged to Capital Expenditures
Temporary end wall of tile	500	Charged to Operating Expenses
	Year 1918	
Building for four boilers	$13,630	Charged to Capital Expenditures
Removal of temporary wall on first section	50	Charged to Operating Expenses
Temporary end wall from second section	500	Charged to Operating Expenses
First cost of building over Boilers #5, 6, & 7 Present House	4,000	Charged to Depreciation Reserve

	Year 1920	
Remove building over present Boilers #1,2,3,& 4 and brick stacks	$ 900.	Charged to Operating Expenses
First cost of building	3500.	Charged to Depreciation Reserve
First cost of Brick Stack	4450.	Charged to Depreciation Reserve
Building for four boilers	13630.	Charged to Capital Expenditures
Removal of end wall from second section	50.	Charged to Operating Expenses

(C) Coal Bunker - Present House

We are now installing a bunker approximately 45 feet long at a cost of $1200. over boilers #5, 6, & 7 in the present house. On this basis the additional bunkers for boilers #9 & 10 will be 50 feet in length and cost $1330. for boilers #3 & 4, 30 feet in length and cost $800. and for boiler #1 the same as for boilers #3 & 4 or $800. The bunkers for #9 & 10 will be long enough for #8 boiler.

Yearly expenditures will be:-

	Year 1916	
Bunkers for boilers #9 & 10	$1330.	Charged to Capital Expenditures
	Year 1919	
Bunker for boilers #3 & 4	$ 800.	Charged to Capital Expenditures
	Year 1920	
Bunker for boiler #1	$ 800.	Charged to Capital Expenditures

(D) Coal Bunkers - New House

The bunker for the new house will be of suspended parabolic steel plate construction and is estimated to cost $3600. One-third, costing $1200. will be erected with each section of the building housing four boilers. When boilers #5 & 6 in Present House are moved to the New House in 1918, the bunker in Present House costing $1200. will be written off on the basis of a 30 year life and 2 year age or 7% to Depreciation Reserve, and 93% to Operating Expenses, in the event of not being able to use it as an ash hopper in the New House.

The yearly expenditures are:-

	Year 1916	
Bunker for four boilers	$1200.	Charged to Capital Expenditures
	Year 1918	
Bunker for four boilers	$1200.	Charged to Capital Expenditures
Remove bunker Present House	100.	Charged to Operating Expenses
Value Foreshortened Life of bunker	1150.	Charged to Operating Expenses
First cost of bunker	50.	Charged to Depreciation Reserve
	Year 1920	
Bunker for four boilers	$1200.	Charged to Capital Expenditures

(E) Ash Alley - Present House

The main difficulty of installing an ash alley is in excavating for the alley and the ash pits under the present boilers #5, 6, & 7, on account of the foundations already in. The cost of excavating and erecting ash pits for boilers to be installed, is included with cost of boiler and not with ash alley. When boilers #1, 3, 4, 8, 9, & 10 are installed, the work of excavating the ash alley will be done at a much less unit cost.

The entire length of the ash alley will be 150 feet and the cost was figured on that basis, a proportion based on distance used for each addition. The details are as follows:-

Excavation	950 cu.yds.	@ $2.00	$1900.
Retaining wall	6,600 cu.ft.	@ .30	1980.
Floor	2,250 sq.ft.	@ .15	338.
		Total	$4218.

In addition there will be ash hoppers and ash handling equipment, all of which will be required the first year of construction.

Excavation for boilers Foundations #5,6,& 7	180 cu.yds.	@ $2.00	$ 360.
Foundations (See boilers for detail)	3	@ 650.00	1950.
Track	150 ft.	@ 1.00	150.
Ash Cars	2	@ 100.00	200.
Ash Elevator	1	@ 500.00	500.
Ash Storage Bin	1	@ 500.00	500.
		Total	$3660.

The $4218 for the ash alley proper will be divided as follows:- 90/150 or $2530. for that portion in front of boilers #5,6,7,8,9 & 10; 30/150 or $845. for that part in front of boilers #3 & 4 and the same amount for in front of boiler #1.

The yearly expenditures will be:-

	Year 1916	
Ash alley for boilers 5,6,7,8,9 & 10	$2530.	Charged to Capital Expenditures
Ash pits for boilers 5,6, & 7; Ash elevators, etc.	3660.	Charged to Capital Expenditures
	Year 1917	
Changes to #7 ash hopper due to re-setting	$ 300.	Charged to Operating Expenses
	Year 1919	
Ash alley for boilers #3 & 4	$ 845.	Charged to Capital Expenditures
	Year 1920	
Ash alley for boiler #1	$ 845.	Charged to Capital Expenditures

(F) Coal Elevators - Present House

At the present time we are installing a 10-ton elevator which costs approximately $1200. It is estimated that we shall need a second 10-ton elevator of the same type in about two years and when the last boiler goes in the Present House, a 20-ton elevator of the same type at $2000. will be required. Whether we continue with the present design or adopt a new one, the cost will remain about the same.

The yearly expenditures are:-

	Year 1917	
One 10-ton conveyor	$1200.	Charged to Capital Expenditures
	Year 1920	
One 20-ton conveyor	$2000.	Charged to Capital Expenditures

(G) Coal Conveyors and Ash Handling Equipment - New House

In the new boiler house only the Taylor or similar type of stoker would be considered, ash cars and an

electric elevator will be used to remove the ashes. The electric elevator for raising ash cars will have a capacity of 2500 lbs. and is priced at $1500. based on Building Department prices used in valuation. Two ash cars will be required costing $100. each. A bucket elevator and a belt conveyor over the bunkers is the most feasible coal handling equipment. The coal elevator will have a capacity of 50 tons per hour and on a price obtained from the Chain Belt Company of $40.00 per ton per hour erected will cost $2000.00. The belt conveyor over the coal bunker will be a 20" belt 110 feet long. A price of $42.00 per foot is taken based on a similar conveyor in Oneida Street, making the cost $4620. The Electric elevator and ash cars will be purchased with the first section as will the coal conveyor. One-half of the total cost of the 20" belt conveyor or $2310. will be required for the first section as the motor, tripper, etc. will have to be installed at that time. One-fourth or $1155. will be expended with each additional section. When boilers #5 & 6, Present House, are moved over to the New House, the coal elevator in the Present House costing $1200. will be written off on the basis of a 30 year life and 2 year age. There is no doubt but that proper use can be found for this elevator.

The yearly expenditures will be:-

	Year 1916	
Electric elevator	$1500.	Charged to Capital Expenditures
Ash Cars	200.	Charged to Capital Expenditures
50-ton Coal Conveyor	2000.	Charged to Capital Expenditures
First section 20" belt	2310.	Charged to Capital Expenditures
Total	$6010.	
	Year 1918	
Second section 20" belt	$1155.	Charged to Capital Expenditures
Removal Coal Conveyor, Present House	50.	Charged to Operating Expenses
Value Foreshortened Life Coal Conveyor	1150.	Charged to Operating Expenses
First cost Coal Conveyor	50.	Charged to Depreciation Reserve.
	Year 1920	
Third section 20" belt	$1155.	Charged to Capital Expenditures

(H) Boilers Erected - Present House

The price of a 500 H.P. Edge Moor boiler f.o.b. Racine is taken at $4500. which is the price qupted in December 1915. The cost of erecting a boiler is placed at $475. which was the actual cost of erecting #9

boiler at Oneida Street. An extra water column installed will cost $45. The cost of Flue Blowers is based on an installation made on the Oneida Street boilers, which was $110. for three blowers on a 500 H.P. boiler. The cost of galleries is also the result of a similar job in which the cost for one boiler is $250. erected. The cost of setting including side wall and furnace with plastering of baffles is based on cost of #9 boiler at Oneida Street, which was $900. It will cost $350. to cover the side and top of setting. One stack will serve two boilers; the cost per boiler is based on cost of stack for boilers #5 & 6 for Racine Plant which is $1165. per boiler. A Flowmeter for each boiler will cost $250. In the Present House it will be necessary to excavate for the ash pit which will be 60 cu.yds. at $1.00 or $60. The cost of the ash pit including air pipe inside of pit is based on cost of #9 boiler at Oneida Street and will cost $650. Detail of Boiler costs:-

Excavation	$ 60.
Foundation	650.
Boiler	4500.
Erecting Boiler	475.
Setting	900.
Covering	350.
Extra Water Column	45.
Flue Blowers	110.
Galleries	250.
Stack	1165.
Flowmeter	250.
Total	$8755.

The cost of a 765 H.P. Boiler is based on data used for the 500 H.P. raised in proportion to size.

Excavation	$ 90.	
Foundation	750.	
Boiler	7000.	
Erecting	700.	
Setting	1100.	
Covering	400.	
Extra Water Column	45.	
Flue Blower	125.	
Galleries	275.	
Stack	350.	(Erecting Stack now on #7 Boiler)
Flowmeter	250.	
Total	$11085.	

When boiler #8 is installed it will be necessary to move #7 boiler back about 3 feet in order to bring it into line with the other boilers in the Station. The stack will be removed at a cost of $200. and stored for two

years for erection on #1 boiler. The setting and covering will be removed at a cost of $200. and will be written off at first cost of $900. and on the basis of a 25-year life and 5-year age. The new setting will cost $900. the covering $350., and miscellaneous $50. the proportionate cost of the new stack being $1165.

The removal of the old Stirling Boilers will be as follows:- It will cost $300. to remove #3 & 4 and they will be considered to have lived the full period of their useful lives and will be charged to Depreciation Reserve for $8000. Boilers #1 & 2 will be removed for $400. and will be charged at their full first cost, or $12000. to the Depreciation Reserve.

The yearly expenditures are:-

	Year 1916	
Boilers #9 & 10 complete	$17510.	Charged to Capital Expenditures
Flowmeters for Boilers #5, 6, & 7	750.	Charged to Capital Expenditures
	Year 1917	
Boiler #8 Complete	$ 8755.	Charged to Capital Expenditures
Move #7 Boiler into line	200.	Charged to Operating Expenses
Remove Stack	200.	Charged to Operating Expenses
Foreshortened Life of Setting & Covering	1000.	Charged to Operating Expenses
Value of Setting & Covering	250.	Charged to Depreciation Reserve
Erecting, Setting & Covering, etc. for #7 Boiler	1300.	Charged to Capital Expenditures
Cost of new Stack for #7 Boiler	1165.	Charged to Capital Expenditures
	Year 1919	
Boilers #3 & 4 complete	$17510.	Charged to Capital Expenditures
Removal Old Stirling #3 & 4	300.	Charged to Operating Expenses
First Cost Old Stirling #3 & 4	8000.	Charged to Depreciation Reserve
	Year 1920	
Boiler #1 complete	$11085.	Charged to Capital Expenditures
Removal Old Stirling #1 & 2	400.	Charged to Operating Expenses
First Cost Stirling #1 & 2	12000.	Charged to Depreciation Reserve

(I) Boiler Erected - New House

The cost of boilers in the new house is practically the same as for the Present House, the only difference being in the foundation and ash pit. The New House will not require the brick ash pit but will have

ash and combustion chamber hoppers. There will be no charge for excavation as the whole basement will be excavated when the building is erected. The cost of ash and combustion hoppers is taken from Commerce Street valuation which is $335. for both 500 and 765 H.P. boilers. This will make the cost as follows:-

500 H.P. Boiler complete as installed in Present House		$ 8755.
Less cost of excavation and foundation		700.
		$ 8055.
Add for ash and combustion Hopper		355.
Cost of 500 H.P. boiler New House		$ 8410.
765 H.P. Boiler complete for Present House		$11085.
Less cost of erecting Old Stack	$350.	
Less cost of excavation and Foundation	840.	1190.
		$ 9895.
Add for cost of new Stack	$1350.	
Add for ash and combustion Hoppers	355.	1705.
Cost of 765 H.P. Boiler New House		$11600.

It will be necessary to move boilers 5, 6, & 7 from Present House to New House and this will affect the cost as follows:- To dismantle each boiler will cost $300. and it will cost $700. to move and erect in new position in new House. To move stack from boiler #5 & 6 in Present House to boilers #6 & 8 New House will cost $400. In all other respects the costs will be the same as for resetting Boiler #7 in Present House. The old Stirling boilers will be removed for same figures given under Present House. The yearly expenditures are:-

	Year 1916	
500 H.P. Boilers #1 & 3 Complete	$16820.	Charged to Capital Expenditures
	Year 1917	
500 H.P. Boiler #2 Complete	$ 8410.	Charged to Capital Expenditures
Dismantle Boiler #7 Present House	300.	Charged to Operating Expenses
Dismantle Stack on #7 Present House	200.	Charged to Operating Expenses
Foreshortened Life of setting and Covering	1000.	Charged to Operating Expenses
Value of Setting & Covering	250.	Charged to Depreciation Reserve
Foreshortened Life of #7 Boiler Stack	930.	Charged to Operating Expenses
Value of #7 Boiler Stack	230.	Charged to Depreciation Reserve
Move Boiler from #7 Present House to #4 New House and erect	700.	Charged to Capital Expenditures
Setting & Covering for #4 New House	1300.	Charged to Capital Expenditures
Proportionate cost of New Stack	1165.	Charged to Capital Expenditures

	Year 1918	
Dismantle #5 & 6 Boiler Present House	$ 600.	Charged to Operating Expenses
Dismantle #5 & 6 Boiler Stack	200.	Charged to Operating Expenses
Foreshortened Life of Setting & Covering	2000.	Charged to Operating Expenses
Value of Setting & Covering	500.	Charged to Depreciation Reserve
Move boilers from #5 & 6 Present House to #6 & 8 New House and erect	1400.	Charged to Capital Expenditures
Erecting Stack	200.	Charged to Capital Expenditures
Setting & Covering	2600.	Charged to Capital Expenditures
	Year 1919	
500 H.P. Boilers #5 & 7 New House complete	$16820.	Charged to Capital Expenditures
	Year 1920	
765 H.P. Boilers #10 & 12 New House complete	$23180.	Charged to Capital Expenditures
Remove old Stirling Boilers #1,2,3, and 4.	700.	Charged to Operating Expenses
First cost of Stirling Boilers #1, 2,3, & 4	20000.	Charged to Depreciation Reserve
	Year 1929	
765 H.P. Boilers #9 & 11 New House complete	$23180.	Charged to Capital Expenditures

(J) Superheaters - Present House

The cost of superheaters for the 500 H.P. Boilers is taken from a quotation received from the manufacture on November 30, 1915, and is as follows:-

	500 H.P.	765 H.P.
Cost of installing in 500 H.P. Boilers already erected		
Superheaters	$1250.	
Erection	80.	
Brick Work	25.	
Total	$1355.	
Cost of installing in 500 H.P. Boilers when being erected		
Superheater	$1250	$1750 (Erected)
Erection	60	
Total	$1310.	$1750.

The price of the Superheaters for the 765 H.P. Boiler is taken from the contract for the same size Superheaters installed in our Commerce Street Plant. If the Present House is continued we shall install Superheaters in the Edge Moor Boilers #5, 6, & 7 now in place but not in the old Stirlings as they will all be out by 1920.

The yearly expenditures are:-

	Year 1916	
Superheaters for #5, 6, & 7 Boilers	$4065.	Charged to Capital Expenditures
Superheaters for #9 & 10 Boilers	2620.	Charged to Capital Expenditures
	Year 1917	
Superheater for #8 Boiler	$1310.	Charged to Capital Expenditures
	Year 1919	
Superheaters for #3 & 4 Boilers	$2620.	Charged to Capital Expenditures
	Year 1920	
Superheater for #1 Boiler 765 H.P.	$1750.	Charged to Capital Expenditures

(K) Superheaters - New House

The cost of Superheaters for the New House will be the same as for the Old House except that no Superheaters will be installed in #5, 6, & 7 boilers until they are moved to their location in the New House.

Yearly expenditures are:-

	Year 1916	
Superheaters for #1 & 3 Boilers, 500 H.P.	$2620.	Charged to Capital Expenditures
	Year 1917	
Superheaters for #2 & 4 Boilers, 500 H.P.	$2620.	Charged to Capital Expenditures
	Year 1918	
Superheaters for #6 & 8 Boilers, 500 H.P.	$2620.	Charged to Capital Expenditures

	Year 1919	
Superheaters for #5 & 7 Boilers, 500 H.P.	$2620.	Charged to Capital Expenditures
	Year 1920	
Superheaters for #10 & 12 Boilers, 765 H.P.	$3500.	Charged to Capital Expenditures
	Year 1929	
Superheaters for #9 & 11 Boilers, 765 H.P.	$3500.	Charged to Capital Expenditures

(L) Stokers - Old House

We shall install the Jones hand cleaned Stoker in the old house because the installation of a Taylor type of stoker would necessitate the excavation of a basement under the whole boiler room and the practical rebuilding of the present boilers and boiler room and as this could not be done for less than $30,000. the Jones stoker is the only practical installation. The Jones stoker installation will be the same as that put under boiler #9 at Oneida Street which cost $980. for cylinders, retort casting, etc. A boiler front will cost $110. based on the same job. Coal valve and Spout will be $80. The Cole Automatic with motor and piping complete will cost $255. These costs are summarized as follows:-

Stoker	$980.
Boiler Front	110.
Coal Valve & Spout	80.
Coal Automatic	255.
Total	$1425.

The cost of a Jones stoker for a 765 H.P. Boiler is calculated in proportion to be:-

Stoker	$1300.
Boiler Front	140.
Coal Valve & Spout	80.
Cole Automatic	300.
Total	$1720.

The cost of stokers for boilers #3 & 4 will be reduced by $200. for the two cylinders now under #3 & 4 Stirlings and #1 will be reduced by $400. for the four cylinders now in place.

Yearly expenditures are:-

	Year 1916	
Stokers for #9 & 10 Boilers, 500 H.P.	$2850.	Charged to Capital Expenditures
	Year 1917	
Stoker for #8 Boiler, 500 H.P.	$1425.	Charged to Capital Expenditures
	Year 1919	
Stoker for #3 & 4 Boilers, 500 H.P.	$2650.	Charged to Capital Expenditures
	Year 1920	
Stoker for #1 Boiler, 765 H.P.	$1320.	Charged to Capital Expenditures

(M) Stokers - New House

We have a quotation as of January 1916 for the Westinghouse Stoker of $3250. per stoker to go under 500 H.P. Boilers. This price includes a man to supervise erection. The cost of erecting a Taylor stoker at Commerce Street including the drive from fan turbine to Stoker was $600. per boiler. This makes cost of a Westinghouse Stoker for one 500 H.P. Boiler $3850. For a 765 H.P. Boiler the cost is set at $4600. As the boilers are installed in the New House, it will be necessary to remove the Jones Stokers from the Old House and write them off at values given in preceeding section. They are considered to have a 30 year life. Stokers under boilers #1, 2, 3, & 4 will have had a 10 year age and under #5, 6, & 7 a 5 year age. It will cost about $5. a retort to remove the Stokers. Yearly expenditures are as follows:-

	Year 1916	
Stokers for #1 & 3 Boilers, 500 H.P.	$7700.	Charged to Capital Expenditures
	Year 1917	
Stokers for #2 & 4 Boilers, 500 H.P.	$7700.	Charged to Capital Expenditures
Remove Jones from #7 Present House	15.	Charged to Operating Expenses
Value Foreshortened Life #7 Stoker	1185.	Charged to Operating Expenses
First Cost of Stokers removed	240.	Charged to Depreciation Reserve

	Year 1918	
Stokers for #6 & 8 Boilers, 500 H.P.	$7700.	Charged to Capital Expenditures
Remove Jones stokers from #5 & 6 Present House	30.	Charged to Operating Expenses
Value Forshortened life of #5 & 6 stoker	2370.	Charged to Operating Expenses
First cost of stoker removed	480.	Charged to Depreciation Reserve
	Year 1919	
Stokers for #5 & 7 Boilers, 500 H.P.	$7700.	Charged to Capital Expenditures
	Year 1920	
Stokers for #10 & 12 Boilers,765 H.P.	$9200.	Charged to Capital Expenditures
Remove Jones Stokers #1, 2, 3 & 4	30.	Charged to Operating Expenses
Value Forshortened Life	1950.	Charged to Operating Expenses
First cost of Stokers removed	950.	Charged to Depreciation Reserve
	Year 1929	
Stokers for #9 & 11 Boilers,765 H.P.	$9200.	Charged to Capital Expenditures

(N) Pumps - Present House

The boiler feed pumps now installed have a capacity of approximately 8500 H.P. per hour which is considered ample for all Proposed extensions.

(O) Pumps - New House

If the new house is built the pumps will be moved over with the boilers which will give sufficient pump capacity until the last two boilers are installed in 1929, when a new turbine pump will have to be installed at a cost of $925. which is the value accepted by the Railroad Rate Commission for one of the present installations. The cost of moving the pumps from the Present House to the New House is so small that it need not be considered, nor is there anything to be written out due to the moving.

(P) Stoker Fans - Present House

A turbine driven Sirocco Fan as now installed on 500 H.P. Boilers with air piping up to the Setting costs $725. This is the price accepted by the Railroad Rate Commission. The 20,000 cu.ft. fan now on the Stirlings will be used on the 765 H.P. Boiler when installed which will cost $50.

Yearly expenditures are:-

	Year 1916	
Fans for #9 & 10 Boilers, 500 H.P.	$1450.	Charged to Capital Expenditures
	Year 1917	
Fan for #8 Boiler, 500 H.P.	$ 725.	Charged to Capital Expenditures
	Year 1919	
Fans for #3 & 4 Boilers, 500 H.P.	$1450.	Charged to Capital Expenditures
	Year 1920	
Install 20,000 cu.ft. Fan	$ 50.	Charged to Capital Expenditures

(q) Stoker Fans - New House

The cost of a fan for a 500 H.P. Boiler will be the same as in the Present House. The 20,000 cu.ft. fan will be installed on one 765 H.P. Boiler and the fan for the other 765 H.P. Boilers will cost $850. each. The Fans on boilers #5, 6, & 7 Present House will be installed on the New House at a cost of $50. each.

Yearly expenditures are:-

	Year 1916	
New Fans for #1 & 3 Boilers, 500 H.P.	$1450.	Charged to Capital Expenditures
	Year 1917	
New Fan for #2 Boiler, 500 H.P.	$ 725.	Charged to Capital Expenditures
Install Fan from #7 Boiler	50.	Charged to Capital Expenditures
	Year 1918	
Install Fans from #5 & 6 on #6 & 8 New House	$ 100.	Charged to Capital Expenditures
	Year 1919	
New Fans for #5 & 7 Boilers, 500 H.P.	$1450.	Charged to Capital Expenditures
	Year 1920	
20,000 cu.ft. Fan on #10 Boiler	$ 50.	Charged to Capital Expenditures
New Fan on #12 Boiler,765 H.P.	850.	Charged to Capital Expenditures
	Year 1929	
New Fans on #9 & 11 Boilers, 765 H.P.	$1700.	Charged to Capital Expenditures

(R) Feed Water Heater - Present House

The Heater now installed has a capacity of 3,000 H.P. and cost $1000. This heater will have to be moved when boilers #3 & 4 are installed, costing $300. It will be necessary to install another 3000 H.P. Heater with boiler #8.

Yearly expenditures are:-

	Year 1917	
3000 H.P. Heater	$1000.	Charged to Capital Expenditures
	Year 1919	
Reset present Heater	$ 300.	Charged to Operating Expenses

(S) Feed Water Heaters - New House

We shall install a 3000 H.P. Heater in 1916 with the first boilers going into the New House and this together with the Present Heater which can be moved for $400. will be sufficient capacity for the full row of boilers.

(T) Piping - Present House

The installation of Superheaters in the Present House will require the replacement of the cast iron valves and fittings in the present header and in lines between boiler and header with valves and fittings made of cast steel. Using standard piping and labor prices this change for the present installation will cost $1150. Steam piping for #9 & 10 boilers will cost $750. For #8 boiler $200. For boilers #3 & 4, $500. and for #1 boiler $300. It will cost $100. to remove the cast iron fittings from the present header. They will be written off at a value of $750. on the basis of a 25 year life and 3 year age. It will cost $200. per boiler for feed water and other miscellaneous piping. The piping over Stirling Boilers is valued at $1000. and will all be charged to Depreciation Reserve.

	Year 1916	
Removal of Cast Iron Fittings	$100.	Charged to Operating Expenses
Forshortened life of Fittings removed	660.	Charged to Operating Expenses
First cost of Fittings removed	90.	Charged to Depreciation Reserve

	Year 1916 (Con'd)	
Cost of Steel Fittings	$1150.	Charged to Capital Expenditures
Cost of Steam Piping to #9 & 10 Boilers	750.	Charged to Capital Expenditures
Feed Piping, etc.	400.	Charged to Capital Expenditures
	Year 1917	
Cost of Steam Piping #8 Boiler	$ 200.	Charged to Capital Expenditures
Cost of Feed Piping, etc.	200.	Charged to Capital Expenditures
	Year 1919	
Cost of Steam Piping #3 & 4 Boilers	$ 500.	Charged to Capital Expenditures
Cost of Feed Piping, etc.	400.	Charged to Capital Expenditures
Value of Piping on #3 & 4 Stirlings	500.	Charged to Depreciation Reserve
	Year 1920	
Cost of Steam Piping #1 Boiler	$ 300.	Charged to Capital Expenditures
Cost of Feed Piping, etc.	200.	Charged to Capital Expenditures
Value of Piping on #1 & 2 Stirlings	500.	Charged to Depreciation Reserve

(U) Piping - New House

If the New House is built, only the main part of the present header will have to be rebuilt for Superheated Steam at a cost of $760. We have figured an extension of the present header costing $570. which will permit of unit piping construction for each additional two-boiler battery as installed. This unit construction will cost $700. for 500 H.P. Boilers and $750. for 765 H.P. Boilers. The Piping for Boilers #5, 6, & 7 Present House is valued at $500. per boiler and will be retired on the basis of a 25 year life and 5 year age. The Piping on the old Stirling Boilers will be retired on the same basis as the preceeding Section. The cost of removing this Piping is too small to be taken into account.

Yearly expenditures are:-

	Year 1916	
Removal of Cast Iron Fittings	$ 80.	Charged to Operating Expenses
Forshortened life of Fittings removed	525.	Charged to Operating Expenses

	Year 1916 (Con'd)	
First cost of Fittings removed	$ 75.	Charged to Depreciation Reserve
Cost of Steel Fittings for Header	750.	Charged to Capital Expenditures
Cost of Header extension	570.	Charged to Capital Expenditures
Cost of Steam Pipe for #1 & 3 Boilers	700.	Charged to Capital Expenditures
Cost of Feed Piping, etc.	400.	Charged to Capital Expenditures
	Year 1917	
Cost of Steam Piping #2 & 4 Boilers	$700.	Charged to Capital Expenditures
Cost of Feed Piping, etc.	400.	Charged to Capital Expenditures
Forshortened Life of #7 Boiler Piping	450.	Charged to Operating Expenses
First cost of #7 Boiler Piping	50.	Charged to Depreciation Reserve
	Year 1918	
Cost of Steam Piping #6 & 8 Boilers	$ 700.	Charged to Capital Expenditures
Cost of Feed Piping, etc.	400.	Charged to Capital Expenditures
Forshortened Life #5 & 6 Boiler Piping	900.	Charged to Operating Expenses
First cost of #5 & 6 Boiler Piping	100.	Charged to Depreciation Reserve
	Year 1919	
Cost of Steam Piping #5 & 7 Boilers	$ 700.	Charged to Capital Expenditures
Cost of Feed Piping, etc.	400.	Charged to Capital Expenditures
	Year 1920	
Cost of Steam Piping #10 & 12 Boilers	$ 750.	Charged to Capital Expenditures
Cost of Feed Piping, etc.	400.	Charged to Capital Expenditures
First cost of Piping, #1, 2, 3, & 4 Stirlings	1000.	Charged to Depreciation Reserve
	Year 1929	
Cost of Steam Piping #9 & 11	$ 750.	Charged to Capital Expenditures
Cost of Feed Piping, etc.	400.	Charged to Capital Expenditures

(V) Value of Equipment now installed in Present Boiler Room

In the problem under consideration it is necessary to take into consideration the investment in the present boiler room which is obtained from the 1914 valuation records and is as follows:-

Building (Including Brick Stack)	$11,950.
Bunkers (Now being installed)	1,200.
Conveyor(Now being installed)	1,200.
Boilers	46,265.
Stokers	8,365.
Pumps	2,750.
Fans	3,075.
Heater	1,000.
Piping	3,000.
Total	$78,805.

YEARLY CONSTRUCTION EXPENDITURES - PRESENT HOUSE

In the following Sections we have assembled all the Expenditures occuring in any one year. To the left of each Section is placed a double letter in paranthesis for the purpose of reference in a further summary. To the left of each item of expense is a single letter in paranthesis, referring to the detailed cost data. Thus under 1916 if it is desired to determine how the different charges for Piping originated, a reference to Section (T) in the cost data will show the year 1916 how these costs are determined. The costs are given in column Nos.1, 2, 3, & 4. Columns Nos. 1 & 2 give the charges to Operating Expenses, No.1 having all charges arising from the removal of equipment or from temporary construction,and No.2 taking all charges arising from Equipment being retired before it had served the full period of its useful life. Column No.3 has all the costs properly chargeable to Capital Expenditures and Column No.4 carries the charges to the Depreciation Reserve.

(AA) Construction 1916 - Present House.

B.H.P. required, 3160; B.H.P. installed, 3500. This year we shall install two 500 H.P. Boilers as numbers 9 & 10. An ash alley will be dug to take care of these two boilers and Boilers Nos. 5, 6, & 7 already in place. Superheaters will be fitted in the new boilers and in #5, 6, & 7.

	1. Charges to Operating Expenses		3.	4.
	Removal & Temp.Const.	Forshortened Life	Capital Expenditures	Charges to Dep.Res.
(A) Building for #8, 9 & 10 Boilers			$3750.	
(C) Bunker for #8, 9, & 10 Boilers			1330.	
(E) Ash Alley for #5, 6, 7, 8, 9 & 10 Boilers			6190.	
(H) Boilers #9 & 10			18260.	
(J) Superheaters for #5, 6, 7, 9 & 10 Boilers			6685.	
(L) Stokers for #9 & 10 Boilers			2850.	
(P) Stoker Fans for #9 & 10			1450.	
(T) Piping for #9 & 10 and changing Present Header	$100.	$660.	1300.	$90.
Total for 1916 Present House	$100.	$660.	$41815.	$90.

(BB) Construction 1917 - Present House

B.H.P. required,3422; B.H.P. installed,4000. We shall move #7 boiler into line and install a new 500 H.P.Boiler as number 8.

	1. Charges to Operating Expenses		3.	4.
	Removal & Temp. Constr.	Forshortened Life	Capital Expenditures	Charges to Dept.Res.
(E) Changing #7 Ash Hopper	$300.			
(F) Coal Conveyor			$1200.	
(H) Boiler #8 Complete; Reset #7 Boiler	400.	$1000.	11220.	$250.
(J) Superheater #8 Boiler			1310.	
(L) Stoker #8 Boiler			1425.	
(P) Stoker Fan #8 Boiler			725.	
(R) Feed Water Heater			1000.	
(T) Piping			400.	
Total for 1917 - Present House	$700.	$1000.	$17280.	$250.

(CC) Construction 1919 - Present House

B.H.P. required,3909; B.H.P.installed,4600. Stirling Boilers #3 & 4 will be removed and the heater reset so that two 500 H.P. Boilers can be set as #3 & 4.

(A) Building for #3 & 4 Boilers	$300.		$ 1200.	$1200.
(C) Bunker for #3 & 4 Boilers			800.	
(E) Ash Alley for #3 & 4 Boilers			845.	
(H) Boilers #3 & 4 Complete	300.		17510.	8000.
(J) Superheaters for #3 & 4 Boilers			2620.	
(L) Stokers for #3 & 4 Boilers			2650.	
(P) Stoker Fans for #3 & 4 Boilers			1450.	
(R) Reset present feed water Heater	300.			
(T) Piping			900.	500.
Total for 1919 - Present House	$900.		$27975.	$9700.

(DD) Construction 1920 - Present House

B.H.P. required,4138; B.H.P.installed,4765. Stirling Boilers #1 & 2 will be removed. One 765 H.P. Boiler will be installed in their place and called No.1; in all this discussion their is no number 2 boiler in the Present House when rebuilt.

		1. CHARGES TO OPERATING EXPENSES Removal & Temp. Constr.	2. Forshortened Life	3. Capital Expenditures	4. Charges to Dept.Res.
(A)	Building for #1 Boiler & Remove Stack	$600.		$2400.	$6750.
(C)	Bunker for #1 Boiler			800.	
(E)	Ash Alley for #1 Boiler			845.	
(F)	Coal Conveyor - 20 capacity			2000.	
(H)	Boilers #1 Complete 765 H.P.	400.		11085.	12000.
(J)	Superheaters for #1 Boiler			1750.	
(L)	Stoker for #1 Boiler			1320.	
(P)	Stoker Fan for #1 Boiler (Reset 20000 cu.ft.)			50.	
(T)	Piping			500.	500.
	Total for 1920 - Present House	$1000.		$20750.	$19250.

No additional construction is contemplated after 1920 in the Present House as any further extensions would be impractical.

YEARLY CONSTRUCTION EXPENDITURES - New House

The yearly charges for the New House are arranged the same way as for the Present House.

(EE) Construction 1916 - New House

B.H.P. required,3160; B.H.P.installed 3500. The first one-third section of the New House will be built and two 500 H.P. Boilers put in as Nos. 1 & 2.

		1. CHARGES TO OPERATING EXPENSES Removal & Temp. Constr.	2. Forshor-tened Life	3. Capital Expenditures	4. Charges to Dep.Res.
(B)	Building for four Boilers	$500.		$13630.	
(D)	Bunker for four Boilers			1200.	
(G)	Coal & Ash Conveyors			6010.	
(I)	Boilers #1 & 3 Complete			16820.	
(K)	Superheaters for #1 & 3 Boilers			2620.	
(M)	Stokers for #1 & 3 Boilers			7700.	
(Q)	Stoker Fans for #1 & 3 Boilers			1450.	
(S)	Feed Water Heater			1000.	
(U)	Piping	80.	$525.	2420.	$75.
	Total for 1916 - New House	$580.	$525.	$52850.	$75.

(FF) Construction 1917 - New House

B.H.P. required,3160; B.H.P. installed,4000. We shall move #7 Boiler from the Present House and place it with a new 500 H.P. Boiler as #2 & 4 in the New House. The building erected in 1916 is large enough for these Boilers.

	1. CHARGES TO OPERATING EXPENSES Removal & Temp.Constr.	2. Forshortened Life	3. Capital Expenditures	4. Charges to Dep.Res.
(I) Boiler #2 Complete, Move #7 Present House	$500.	$1930.	$11575.	$480.
(K) Superheater for #2 & 4 Boilers			2620.	
(M) Stokers for #2 & 4 Boilers	15.	1185.	7700.	240.
(Q) Stoker Fans for #2 & 4 Boilers			775.	
(U) Piping		450.	1100.	50.
Total for 1917 - New House	$515.	$3565.	$23770.	$770.

(GG) Construction 1918 - New House

B.H.P. required,3674; B.H.P.installed,4000. As we will have sufficient capacity for the 1918 peak, we shall take this opportunity to move boilers #5 & 6 Present House to location of #6 & 8 in the New House.

(B) Building large enough for four boilers	$550.		$13630.	$4000.
(D) Bunker large enough for four boilers	100.	$1150.	1200.	50.
(G) Coal Conveyor	50.	1150.	1155.	50.
(I) Boilers (Move #5 & 6 to #6 & 8	800.	2000.	4200.	500.
(K) Superheaters for #6 & 8 Boilers			2620.	
(M) Stokers for #6 & 8 Boilers	30.	2370.	7700.	480.
(Q) Stoker Fans for #6 & 8 Boilers			100.	
(U) Piping		900.	1100.	100.
Total for 1918 - New House	$1530.	$7570.	$31705.	$5180.

(HH) Construction 1919 - New House

B.H.P. required,3906; B.H.P.installed,5000. We shall install two new 500 H.P. boilers as #5 & 7; building erected in 1918 being sufficient to hold them.

(I) Boilers #5 & 7 Complete	$16820.
(K) Superheaters for #5 & 7 Boilers	2620.
(M) Stokers for Boilers #5 & 7	7700.
(Q) Stoker Fans for Boilers #5 & 7	1450.
(U) Piping	1100.
Total for 1919 - New House	$29690.

(II) Construction 1920 - New House

B.H.P. required,4138; B.H.P.installed,5530. We shall now put the third and last Section on the building and place two 765 H.P. Boilers as #10 & 12 in it. We shall also wreck the Stirling Boilers with their buildings and brick stack.

	1. CHARGES TO OPERATING EXPENSES Removal & Temp. Constr.	2. CHARGES TO OPERATING EXPENSES Forshortened Life	3. Capital Expenditures	4. Charges to Dep.Res.
(B) Building for four Boilers & wreck old house	$950.		$13630.	$7950.
(D) Bunker for four boilers			1200.	
(C) Coal Conveyor			1155.	
(I) Boilers #10 & 12 complete - wreck Stirling	700.		23180.	20000.
(K) Superheaters for #10 & 12 Boilers			3500.	
(M) Stokers for #10 & 12 Boilers	30.	$1950.	9200.	950.
(Q) Stoker Fans for #10 & 12 Boilers			900.	
(U) Piping			1150.	1000.
(S) Relocate, Feed Water Heater			400.	
Total for 1920 - New House	$1680.	$1950.	$54315.	$29900.

(JJ) Construction 1929 - New House

B.H.P. required,5006; B.H.P.installed,7060. We shall place two 765 H.P. Boilers in the remaining space of the boiler building and will fill up the house.

(I) Boilers #9 & 11 Complete	$23180.
(K) Superheaters for #9 & 11 Boilers	3500.
(M) Stokers for #9 & 11 Boilers	9200.
(O) Feed Pumps	925.
(Q) Stoker Fans for #9 & 11 Boilers	1700.
(U) Piping	1150.
Total for 1929 - New House	$39655.

(KK) Summary of Yearly Construction Expenditures - Present House

Year	5. Operating Exp. Removal and Temp. Const.	6. Operating Exp. Due to Foreshortened Life	7. Total yearly Operating Exp. due to Construction	8. Charges to Dep. Reserve Fund	9. Total yearly Credits to Cap. Exp.	10. Capital Expenditures	11. Net Cap. Expenditures	12. Total net cap. expenditures to date	13. Overhead to cover interest and Dep. at 16%	14. Total overhead; interest & Depreciation plus Operating Charges
Present								$ 78805.		
1916(AA)	$ 100.	$ 660.	$ 760.	$ 90.	$ 750.	$42815.	$42065.	120870.	$19339.	$20099.
1917(BB)	700.	1000.	1700.	250.	1250.	17280.	16030.	136900.	21904.	23604.
1918								136900.	21904.	21904.
1919(CC)	900.		900.	9700.	9700.	27975.	18275.	155175.	24828.	25728.
1920(DD)	1000.		1000.	19250.	19250.	20750.	1500.	156675.	25068.	26068.
1921								156675.	25068.	25068.
1922								156675.	25068.	25068.
1923								156675.	25068.	25068.
1924								156675.	25068.	25068.
1925								156675.	25068.	25068.
1926								156675.	25068.	25068.
1927								156675.	25068.	25068.
Total	$2700.	$1660.	$4360.	$29290.	$30950.	$108820.	$77870.	$156675.	$288519.	$292879.

(LL) Summary of Yearly Construction Expenditures - New House

Year	5. Operating Exp. Removal and Temp. Const.	6. Operating Exp. Due to Foreshortened Life	7. Total yearly Operating Exp. due to Construction	8. Charges to Dep. Reserve Fund	9. Total yearly Credits to Cap. Exp.	10. Capital Expenditures	11. Net Cap. Expenditures	12. Total net cap. expenditures to date	13. Overhead to cover interest and Dep. at 16%	14. Total overhead; interest & Depreciation plus Operating Charges
Present								$ 78805.		
1916(EE)	$ 580.	$ 525.	$1105.	$ 75.	$ 600.	$ 52850.	$52250.	131055.	$20968.	$ 22073.
1917(FF)	515.	3565.	4080.	770.	4335.	23770.	19435.	150490.	24078.	28158.
1918(GG)	1530.	7570.	9100.	5180.	12750.	31705.	18955.	169445.	27111.	36211.
1919(HH)						29690.	29690.	199135.	31862.	31862.
1920(II)	1680.	1950.	3630.	29900.	31850.	54315.	22465.	221600.	35456.	39086.
1921								221600.	35456.	35456.
1922								221600.	35456.	35456.
1923								221600.	35456.	35456.
1924								221600.	35456.	35456.
1925								221600.	35456.	35456.
1926								221600.	35456.	35456. (1927)
1927								221600.	35456.	35456. (405.582
1928								221600.	35456.	35456.
1929(JJ)						39655.	39655.	261855.	41801.	41801.
Total	$4305.	$13610.	$17915.	$35925.	$49535.	$231985.	$182450.	$261855.	$464924.	$482839.

EXPLANATION

Column 5 - Is yearly total of Column 1.
Column 6 - Is yearly total of Column 2.
Column 7 - Is sum of Column 5 & 6.
Column 8 - Is yearly total of Column 4.
Column 9 - Is sum of Column 6 & 8

Column 10 - Is yearly total of Column 3.
Column 11 - Is Column 10 minus Column 9.
Column 12 - Is total of Column 11.
Column 13 - Is Column 12 multiplied by 16%.
Column 14 - Is Column 13 plus Column 7.

PART THREE

PART THREE

SUMMARY OF OPERATING AND OVERHEAD CHARGES

Year	PRESENT BOILER ROOM, Total Operating Charges	Total Overhead	Grand Total	NEW BOILER ROOM Total Operating Charges	Total Overhead	Grand Total	Comparison
1916	$ 83895.	$20099.	$103994.	$ 77402.	$22073.	$ 99475.	$4519.
1917	99472.	23604.	123076.	91577.	28158.	119735.	3341.
1918	116526.	21904.	138430.	107326.	36211.	143537.	5107.
1919	129747.	25728.	155475.	119291.	31862.	151153.	4322.
1920	136684.	26068.	162752.	125735.	39086.	164821.	2069.
1921	143623.	25068.	168691.	132112.	35456.	167568.	1123.
1922	117406.	25068.	142474.	108015.	35456.	143471.	997.
1923	124081.	25068.	149149.	114130.	35456.	149586.	437.
1924	131150.	25068.	156218.	120510.	35456.	155966.	252.
1925	138649.	25068.	163717.	127444.	35456.	162900.	817.
1926	145585.	25068.	170653.	133888.	35456.	169344.	1309.
1927	152392.	25068.	177460.	140200.	35456.	175656.	1804.
1928	Limit of capacity of Present Boiler Room			146380.	35456.	181836.	
1929				152692.	41810.	194502.	
1930				158741.	41810.	200551.	
1931				164790.	41810.	206600.	
1932				171102.	41810.	212912.	
1933				177283.	41810.	219093.	
1934				183332.	41810.	225142.	
1935				189775.	41810.	231585.	
1936.				195956.	41810.	237766.	
Total 1916 to 1927	$1519210.	$292879.	$1812089.	$1397630.	$405582.	$1803212.	$8877.
Grand Total				$2937681.	$775518.	$3713199.	

Total operating charges consist of coal operating labor and stoker maintenance, all other expenses are not considered as they are not required in a comparison, being the same in both cases. Present Boiler Room is same as Column 49, page 12, and New Boiler Room is the same as Column 50, on page 12.

Total overhead charges consist of 16% total net Capital Expenditures. The removal and foreshortened life being charged to operation. These are shown in Column 14, page 41.

Grand total columns are the respective totals of Operating Charges and overhead, being the total comparitive costs against each plan.

The comparison shows the saving with the new boiler room in black and the loss in red.

Conclusion:-

The total of the "comparison" column on page 42 shows a net total saving of $8877.00 from the use of the new boiler room, the lowered operating expenses offsetting the higher overhead charges by that amount. The lowering of the operating expenses is practically all in the increased efficiency obtained from the Taylor type of stoker over the Jones. The question naturally arises as to why high efficiency stokers cannot be placed under the boilers in the present house. On investigation it is found that to change over the present three Edge Moor boilers, which would mean rebuilding the setting and excavating under their foundations, would cost about the same as to move them to the new house. This extra cost and the higher price of the stokers themselves, if added to the cost of the present house, would raise it to the cost of the new house. For this reason and the fact that at the end of eleven years the boiler room would be inadequate for the existing load, the proposition of an extension to the present house with the boilers equipped with high efficiency stokers, is not considered.

The main conclusion to be drawn from this report is that an extension of the present boiler room would only permit nine boilers to be installed before practical limits were reached, while with the new house there would be ample room for twelve, four of which could be of high capacity. The new boiler room would be made modern in every respect, the steam pressure could be raised to 200 lbs. and high superheat obtained. The method of handling coal and ashes is very simple and would require the minimum of operating and maintenance labor. The location of the feed pumps and heater at the north end of the engine room would afford a very good distribution of operating labor, as the modern steam turbine requires very little attendance and the oilers and engineers could also tend the boiler auxiliaries with the exception of fans and stokers.

On the basis of this study and the additional considerations that the present house has a comparatively short life and the greatly improved operating conditions of the new boiler room; it was suggested that the building of the new house be undertaken, and this suggestion is now being carried out.