in the North-West, but Mrs. Ross attended the party with a number of ladies, and when the train reached the station in Montreal, three rousing cheers were given for her and her husband.

SOME NOTES ON THE CONSOLIDATION OF TWO SYSTEMS OF ELECTRIC SUPPLY.*

BY A. A. DION, M.A.I.E.E.

1 The march of electrical progress has been so rapid within the last few years, such marked advances have been made in the methods of supply and distribution of electrical energy for light and power, that central stations, which six or seven years ago were looked upon as the embodiment of the best and latest practice, are already handicapped in the race for wealth, in view of the many improvements which have been made since that time.

2 The constant and rapid increase in the use of electricity in cities has correspondingly increased the difficulties of distribution at constant potential, and new systems have had to be devised to meet the new conditions. Electric supply companies, whose stations were equipped when distribution at one thousand volts seemed like tempting providence, and small generator units were the rule rather than the exception, now find it impossible to adopt more economical systems of distribution without undue sacrifice of apparatus, and must confine their efforts towards the improvement of their services to changes within the limits of existing pressures.

3 The amalgamation of rival electrical interests, which is not infrequent in these times, brings up another and more difficult problem, that of consolidating various and oftentimes conflicting elements to form a single and uniform system. To do this without throwing any apparatus out of service was the task that the writer was lately called upon to undertake.

4 He does not claim originality for any of the features of the plan adopted, but simply states how it was done, in a particular case, believing that in furnishing each other information regarding work done in our respective fields of action, we best carry out the objects of this association, and he trusts that some of the members may be benefited by the discussion which this paper may bring out, if not by the paper itself.

5. The amalgamation above referred to comprised three electric light companies, namely, "The Ottawa Electric Light Company," "The Chaudiere Electric Light and Power Company, and "The Standard Electric Company of Ottawa.

THE OTTAWA ELECTRIC LIGHT COMPANY.

6. This was the oldest company, it having commenced business in 1887, and its operations were confined to arc lighting. It owned a substantial stone power house The motive power was water, and was transmitted through four vertical turbines operating under a head of sixteen feet. The electrical equipment consisted of eighteen T. H ten ampere generators manufactured by the Royal Co., of Montreal, supplying 325 lights for lighting the streets of the city and 95 lights for private lighting This company also owned a small workshop for armature and arc lamp repairs.

THE CHAUDIERE ELECTRIC LIGHT AND POWER COMPANY.

7. This company was the next in point of age, it having commenced business in 1887. Its business was confined to incandescent lighting and supplying power for motors. Its first plant was a multiple series system, using the well-known U.S. double magnet generators of 25 amperes and 550 volts. The lighting was limited to stores and other public places; five lights were run in series. Each light pendant consisted of two lamps, one above the other. The lower lamp alone normally burned. When, however, it burned out, an electro-magnetic device, contained in the socket, instantly brought the upper lamp in circuit, thereby preserving the continuity thereof.

8. These machines were replaced in 1889 by the Alternating Current Converter system, but were used later for other purposes. The first installation of the latter system consisted of two Westinghouse smooth core alternators of 750 lights capacity each, that were separately excited by small machines of the U.S. type. At the time of amalgamation this company had installed 27,000 incandescent lights and 42 500-volt motors ranging from one and one-half to 20 h. p. and aggregating 320 h. p.

9. This company occupied three power houses, which, for the purpose of this paper, we will designate as *a*, *b*, and *c*.

10. *a* was the original power house, and was operated by water. It contained eight 750 light Westinghouse alternators separately excited. From this station eleven pairs of lighting feeders ran to various parts of the city The switchboard was equipped with indicating instruments of the Westinghouse pendulum type—one ampere meter for each pair of feeders and one voltmeter for each alternator—Westinghouse compensators, Wurtz non-arcing lightning arresters, and a large number of double-throw switches, by means of which the feeders and generators were made interchangeable Some of the longer circuits were supplied with regulators or "boosters."

11 *b* was the next power house to be occupied. It was also a water power station, and was built when the daily loads outgrew the capacity of *a*. The electrical equipment of *b* consisted of a 1,500-light Westinghouse alternator with smooth core armature and a 120 K W. alternator with toothed core armature, both separately excited, and a 75 K. W. 500-volt U. S. direct current generator of the upright type. The alternators were separately connected by wires to the switchboard in station *a*, some four hundred feet away, and the D.C generator supplied the motor circuits, two in number, which ran from this station.

12. *c* was a steam power station which had been built in 1893 as an auxiliary, made necessary on account of periodical diminution of the water power through anchor ice and other causes. No place could be found for the steam plant on the premises of the other stations, therefore it had to be erected some distance away on a water course where an abundant supply of water was available for condensing purposes. Additional electrical equipment had therefore to be provided for this station. The building was a one-story brick structure with stone foundation 85 feet by 130 feet. It contained six return tube boilers 14 feet by 60 inches, and a pair of tandem compound condensing engines, rated at six hundred horse-power each These engines were belted through clutch pulleys to a six-inch shaft running through the building. Two Westinghouse alternators of 240 K. W. capacity, each with toothed armatures, were belted to the shaft, also through clutch pulleys. They were separately connected by wires to the switchboard in station *a*, some two thousand feet distant. In this case pressure wires were run back from the switchboard to the voltmeter in the steam station. Floor and shaft space and stone piers were provided for additional generators.

13 The alternators of this company were run at about 1,100 volts, except those in the steam station, which, owing to their distance from the switchboard, etc., were run at nearly 1,200 volts, when fully loaded, that being their rated capacity. The frequency in every case was about 133 cycles per second. Westinghouse converters—1,000/50 volt—were used, mostly small ones, 1,000 to 2,000 watts, and a few 4,000 watts and 5,000 watts. Over three-quarters of the current output was supplied through meters, the Schallenberger being used exclusively. This company also had a small workshop for re-winding armatures and field coils.

THE STANDARD ELECTRIC COMPANY OF OTTAWA.

14. This was the junior company, it having commenced business in 1891. It could thus profit by the experience of others, and it had made provision for considerable extensions of the original plant. It occupied a substantial two-story building with a hydraulic plant consisting of four 66-inch turbines operating under a head of twenty-two feet, with shafting, clutch pulleys, etc., which made each turbine capable of running the whole station or any part of it. This station contained six separately excited alternators of the Royal Company's manufacture, *i.e.*, one of 5,000 lights capacity, one of 2,000 lights capacity, and four of 1,500 lights each, and four sixty horse-power direct current compound wound generators, also manufactured by the Royal Company. The direct current machines were used for the supply of power for motors; two of them were run in series operating a one hundred horse-power 500 volt motor running an entire flour mill day and night. Another was used to supply 33 250-volt motors ranging from ¼ h. p. to 20 h. p., and aggregating 105 h. p. The other was held in reserve.

The alternators were run at a frequency of about 133 cycles per second. The lighting switchboard was equipped with T. H. measuring instruments and plug panels which made the ten lighting circuits and the six alternators interchangeable. The voltmeters were connected with the centres of distribution by pressure wires, the distribution being made through T. H. and "Royal" transformers—1040/52 volts: 52 volt lamps and T. H. wattmeters were used throughout the system.

15. There were 18,000 incandescent lights installed.

CONSOLIDATION.

16. The plans adopted for consolidating these several systems have not all been carried out at this time. The work is being done in a gradual manner in order to cause no commotion among subscribers, but for the purpose of this paper we will assume that

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