

A. C. vs. D. C. ARC SYSTEMS.

A Paper read by W. L. McFarlane before the Canadian Electrical Association.

For reasons apart from arc lighting, the tendency at present in equipping electric power stations is towards the installation of A. C. generators of large capacity. The source of power may be water or steam, or a combination of both. Having regard to this established tendency we will consider the bearing of the arc system on it and the relative costs and advantages of the different systems.

Arrangements Available from the Different Sources of Power.

If water power is used, and the frequency of the system is between 40 and 125 cycles, the arc lighting will probably be done either by arc dynamos driven by A. C. motors of the synchronous or induction type, or by transformers operating A. C. arc lamps. If the frequency in use is lower than 40 cycles, the transformer and A. C. arc lamp arrangement will only be practical through the medium of frequency changers. Should engines be the prime movers, A. C. transformers and arc lamps may be used, or arc dynamos may be driven direct from an engine or by motors.

When, as is often the case, a combination of engines and water power has to be used, A. C. transformers and lamps, or motor driven arc dynamos are possible as in the other two cases, there being also the arrangement where the arc dynamos are operated from line shafting to which are connected both an A. C. motor and an engine. By means of suitable clutches or quills, either the motor or the engine can be used to supply the necessary power to the shafting. When mentioning here the A. C. transformers and arc lamps, the series alternating enclosed arc lamp system operating from constant current transformers is meant. Multiple constant potential arc lamps, of both the open and enclosed type, are extensively used for inside lighting, and occa-

sionally for outside street lighting, but only when there is some special reason for so doing. In the case of the D. C. arc system, we have to consider the open and enclosed lamp, and the small arc dynamo and its larger and more modern rival. Generally speaking, there are four systems of series arc lighting at present in use, namely:

- 1st. The small arc dynamo supplying about 50 open lamps at 9.6 or 6.6 amperes.
- 2nd. The larger and more modern arc dynamo supplying as many as 175 open lamps in series, or, by the multi-circuit arrangement.
- 3rd. Large arc dynamos wound for 6.6 amperes for supplying current to enclosed lamps.
- 4th. Transformers to which are connected circuits having as many as 100 constant current series alternating enclosed arc lamps.

Whichever one of these systems of arc lighting is in use in a station, in all probability only a small portion of the total energy generated is delivered to the arc system, the larger portion being taken care of by comparatively large A. C. generators arranged with the object of keeping operating, maintenance, and all other costs at a minimum. Under these circumstances we will consider the four different systems of arc lighting mentioned, assuming, for the sake of simplicity, an arc equipment of 500-480 watt lamps, in a station of 3,000 K.W. capacity. For the same reason, and owing to the great difference of opinion on the subject, the induction motor will be considered instead of the synchronous motor; the former, while having a poorer power factor, will be less affected by trouble on the system, besides requiring a much simpler means of control and less experienced attendants than the synchronous motor.

Small Dynamos of About Fifty Lights Capacity.

For this class of service, about eleven arc dynamos, with the necessary shafting and belting, and an engine or motors to drive them will be required, and owing to the space occupied, a special department, or perhaps a special station, will require to be devoted to it, thus incurring special ex-

TABLE No. 1.
Showing Comparative Approximate Annual Station Costs, Using Small Arc Dynamos.

Items of Cost		Water Power		Steam Power	Water Power with Steam Reserve				
		60 Cycles	25 Cycles	60 Cycles	60 Cycles	25 Cycles			
Account	Sub-Account	Motors and Shafting \$	Motors and Shafting \$	Motors and Shafting \$	Engine and Shafting \$	Engine and Motors Driving Shafting \$	Motors and Shafting \$	Engines and Motors Driving Shafting \$	Motors Driving Shafting, Reserve Steam Power Through Fre- quency Changers \$
Construction..	Engine .....	....	....	....	10000	10000	....	10000	....
	Motors	10000	11000	11000	....	11000	11000	11000	11000
	Motor S.B. and Conn.....								
	Shafting and Belting.....	2888	2888	2888	3161	4328	2888	4328	2888
	Arc Dynamos.....	11000	11000	11000	11000	11000	11000	11000	11000
	Arc S.B. and Conn.....								
	Foundations	880	880	880	1720	1880	880	1880	880
Total		25768	25768	25768	25881	38208	25768	38208	25768
Maintenance..	Interest and Depreciation....	3865	3865	3865	3882	5731	3865	5731	3865
	Engine .....	....	....	....	200	50	....	50	....
	Motors	120	120	120	....	120	120	120	120
	Motor S.B. and Conn.....								
	Shafting and Belting.....	202	202	202	221	303	202	303	202
	Arc Dynamos.....	650	650	650	650	650	650	650	650
	Arc S.B. and Conn.....								
Total		972	972	972	1071	1123	972	1123	972
Operating.....	Wages	1768	1768	1768	2253	1768	1768	1768	1768
	Supplies	402	402	402	612	402	402	402	402
Total		2230	2230	2230	2865	2230	2230	2230	2230
Grand Total.....		7067	7067	7067	7818	9084	7067	9084	7067