MINISTRY OF TRANSPORT.

ELECTRIFICATION OF RAILWAYS
ADVISORY COMMITTEE.

INTERIM REPORT.

LONDON:
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1920.

A Committee was appointed by the Minister of Transport to inquire into Railways Electrification.

The Committee was constituted as follows:—

**Sir Alexander Kennedy, LL.D., F.R.S., Past President Inst. C.E., Past President I. Mech. E. (Chairman).**


Mr. A. R. Cooper, M.Inst.C.E., M.Inst.T., Engineer, Metropolitan District Railway and Tube Railways, representing the London Electric Railways.


Mr. Charles H. Merz, M.Inst.C.E., M.I.E.E., Messrs. Merz and McLellan, Consulting Engineers.


Mr. Lightly Simpson, C.B.E., D.S.O., A.M.Inst.C.E., Chief Mechanical Engineer, Ministry of Transport.


The terms of reference were as follows:—

To consider:—

(i) Whether any regulation should be made for the purpose of ensuring that the future electrification of railways in this country is carried out to the best advantage in regard to interchange of electric locomotives and rolling stock, uniformity of equipment and/or other matters.

(ii) If any such regulations are desirable, what matters should be dealt with, and what regulations should be made.

(iii) How far it is desirable, if at all, that railways or sections of railways already electrified should be altered so that they may form parts of a unified system.

The Committee has issued the following Interim Report dated 12th July 1920.
MINISTRY OF TRANSPORT.

ELECTRIFICATION OF RAILWAYS ADVISORY COMMITTEE.


Sir,

I have the honour of forwarding to you the following Interim Report, which has been adopted unanimously by the Electrification of Railways Advisory Committee.

I am, Sir,

Your obedient Servant,

(Sd.) ALEXANDER B. W. KENNEDY,
Chairman.

INTERIM REPORT.

1. The Electrification of Railways Advisory Committee, appointed by the Minister of Transport, held its first meeting on the 22nd March, and has held twenty-eight sittings.

2. The Committee have had before them as witnesses representatives of the London and North-Western Railway, the South Eastern and Chatham Railway, the Metropolitan Railway, the London Electric Railways, the Lancashire and Yorkshire Railway, the North Eastern Railway, the London, Brighton and South Coast Railway, the Midland Railway and the London and South-Western Railway.

3. They have also had the advantage of receiving evidence from Mr. Ivan Ofverholm, the Chief Electrical Engineer to the Swedish State Railways, and from Colonel Huber-Stockar, the Consulting Engineer to the Federal State Railways of Switzerland. The Committee are much indebted to both of these gentlemen for the trouble which they took in coming to England and for the valuable information which they were good enough to place before them.

4. On the side of Electrical Contractors they have also had as witnesses representatives of the British Thomson Houston Company, the English Electrical Company and the Metropolitan Vickers Company, and have had a written communication from the Oerlikon Company, who were unable to send a representative.

5. The Committee sent out in April, to all the Chief Railway Companies, a questionnaire relating to the matters covered by their terms of reference, and from the replies to this, together with those sent in to the questionnaire issued in January by the Ministry, as well as from the information given by the witnesses, full statistical tables have been prepared and have been considered in detail by the Committee.

6. The Committee understand it is very desirable that decisions on certain general points covered by their reference should be arrived at as soon as possible—they have therefore confined their consideration, in the first instance, to points of this nature, and deal only with them in this interim report. Further matters, which there has not yet been sufficient time to examine, are left over for a subsequent Report.

7. The terms of reference under which the Committee were appointed are as follows—:

I. Whether any regulations should be made for the purpose of ensuring that the future electrification of railways in this country is carried out to the best advantage in regard to interchange of electric locomotives and rolling stock, uniformity of equipment and/or other matters.
II. If any such regulations are desirable, what matters should be dealt with, and what regulations should be made.

III. How far it is desirable, if at all, that railways or sections of railways already electrified should be altered so that they may form parts of a unified system.

In respect to Reference I.

8. The Committee consider that, in order to ensure the future electrification of railways in this country being carried out to the best advantage in respect to the matters indicated in the Reference, it is desirable that certain general regulations should be made for observance by the Railway Companies when electrifying their lines.

9. The Committee consider that these regulations should be directed specially to ensuring standardisation of those methods and appliances which are likely to prove the most satisfactory under British conditions.

10. They consider, further, that such regulations should put no avoidable difficulties in the way of the adoption in future, with the approval of the Minister, of any improvements in methods or appliances which may from time to time become available with increasing knowledge and experience.

In respect to Reference II.

11. In view of the desirability of the railways which are now contemplating immediate electrification knowing as soon as possible the decision of the Minister on certain fundamental matters, they recommend that regulations should be issued in accordance with the following conditions:—

(i) That in the case of those railways which have not as yet electrified any lines, as well as those which at present have electrified all or part of their lines on a direct current system, their electrification, or extended electrification as the case may be, should be carried out on the direct current system.

(ii) That the standard pressure of the direct current system at the sub-station busbars shall be 1,500 volts, subject to—

(a) The continuance of any existing 600 volt and/or 1,200 volt installations, and subject to the approval of the Minister of their extension.

(b) The adoption of half the standard voltage—750 volts—in those cases where it can be shown to the satisfaction of the Minister that advantage would arise from the use of this lower pressure.

(c) The adoption of higher pressures—limited to a multiple of the standard pressure—where it can be shown to the satisfaction of the Minister that sufficient advantage would accrue.

(iii) That both overhead and rail conductor collection should be permitted, as long as the position and general design of the conductors and structures are in accordance with recommendations which will be made in a subsequent Report. In that Report the Committee will also suggest the regulations required to ensure that locomotives and/or motor coaches shall be able, wherever it may be necessary, to run at two different voltages, e.g., 600/750 and 1,500 v., and/or with either rail or overhead collection.

(iv) That the generation of current for direct current lines should be alternating 3-phase at such voltage as may be desirable in each case.

(v) That in the case of existing generating stations supplying at any frequency between 25 and 50 cycles it is unnecessary to make any change in frequency, but that it is desirable that where any one such frequency is in general use in a particular electricity district, any new power station put down in that district for supplying a railway should adopt the frequency which has been approved by the Electricity Commissioners or is in general use in that district.

The Committee desire to add on this matter that from the evidence which has been put before them, as well as their own experience, they have come to the conclusion that alternating current supplied to the sub-stations at a frequency of 50 cycles can be used for railway purposes without any detriment to railway working.
In respect to Reference III.

12. There is only one line of any importance in Great Britain which would not come under the terms of Recommendation paragraph 11 (i), above, namely, the electrified portion of the London, Brighton and South Coast railway system. The Committee have considered with special care the very difficult questions introduced into the problem by the fact that this company long ago adopted a single-phase alternating current system for its suburban lines, and did so with a special view to the adoption of a system which at that time appeared the only one admitting of extension from London to Brighton when this extension became feasible. The General Manager of the Company (Sir William Forbes) has come before the Committee to say that his company considers the extension to be now not only feasible, but urgently desirable.

13. The Committee is bound to recognise that if the railway is allowed to electrify its main line to Brighton on its present system, there will, of necessity, have to be a change of locomotives or multiple unit stock in any cases where other companies' trains run over that line, and that to this extent the wished-for general interchangeability will be interfered with. They recognise, on the other hand, that to change the existing suburban equipment of the Brighton railway to a direct current system would involve a large financial expenditure, which the railway itself could not be asked to undertake and which it would be difficult to justify to the public at the present time. It has further been stated to the Committee that the electrification of the main line is in this case very closely connected with that of the suburban lines on account of the necessity, on economical grounds, of using the same rolling stock throughout.

14. Having all these considerations in mind the Committee recommend, as the course which on the whole has the balance of advantages:

(i) That the electrical system of working at present in use, or actually under construction, on the Brighton Co.'s suburban lines need not be changed.

(ii) That in view of the recent proposals of the Government as to grouping of railway companies, the question of the system on which the L.B. & S. Coast Railway Co.'s proposed extensions to the coast should be carried out is now—in the event of the Government's proposals being approved by Parliament—one for special consideration from the point of view of the requirements of through working and interchangeability of traffic with the other systems forming part of the proposed Southern Group. Subject to these matters receiving the fullest consideration, and provided the completion of the proposed extension on the present system shows a substantial financial advantage, the Committee are of opinion that it should be allowed.

(Signed) ALEX. B. W. KENNEDY (Chairman),
JOHN A. F. ASPINALL,
ARTHUR R. COOPER,
PHILIP DAWSON,
ALEXANDER GIBB,
CHARLES H. MERZ,
P. A. M. NASH,
L. SIMPSON,
ROGER T. SMITH,
JOHN SNELL,
H. W. THORNTON.

S. G. REDMAN (Secretary).

12th July 1920.
MINISTRY OF TRANSPORT.

ELECTRIFICATION OF RAILWAYS

ADVISORY COMMITTEE.

FINAL REPORT.

LONDON:
PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE.

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1921.

Price 4d. Net.
A Committee was appointed by the Minister of Transport to inquire into Railways Electrification.

The Committee was constituted as follows:

**Sir Alexander Kennedy, LL.D., F.R.S., Past President Inst.C.E., Past President I.Mech.E. (Chairman).**

**Sir John A. F. Aspinall, Past President Inst.C.E., Past President I.Mech.E., Consulting Mechanical Engineer, Ministry of Transport.**

**Mr. A. R. Cooper, M.Inst.C.E., M.Inst.T., Engineer, Metropolitan District Railway and Tube Railways, representing the London Electric Railways.**


**Sir Alexander Giff, G.R.E., C.B., M.Inst.C.E., M.Inst.T., Director-General of Civil Engineering, Ministry of Transport.**

**Mr. Charles H. Merz, M.Inst.C.E., M.I.E.E., Messrs. Morz and McCallan, Consulting Engineers.**


**Mr. Lightly Simpson, C.B.E., D.S.O., A.M.Inst.C.E., Chief Mechanical Engineer, Ministry of Transport.**

**Mr. Roger T. Smith, B.Sc., President I.E.E., M.Inst.C.E., M.I.Mech.E., M.Inst.T., Electrical Engineer, Great Western Railway.**

**Sir John Snell, M.Inst.C.E., Past President I.E.E., M.I.Mech.E., Chairman of the Electricity Commission.**

**Sir Henry Thornton, K.B.E., M.Inst.C.E., M.Inst.T., General Manager and Consulting Engineer, Great Eastern Railway, representing the Railway Companies.**

**Mr. S. G. Redman, M.I.E.E., A.M.I.Mech.E., Secretary.**

The Committee has issued an Interim Report dated 12th July 1920, and the following Final Report dated 30th June 1921.

**Expenses of Committee.**

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<th>Description</th>
<th>£</th>
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<tr>
<td>Shorthand reporting and translations</td>
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<td>226</td>
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<td>Travelling expenses</td>
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<td>133</td>
<td>15</td>
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<tr>
<td>Services of Electrical Engineers</td>
<td>-</td>
<td>1,500</td>
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<tr>
<td>Cost of printing and publishing Report</td>
<td>-</td>
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MINISTRY OF TRANSPORT.

ELECTRIFICATION OF RAILWAYS ADVISORY COMMITTEE.


Sir,

I have the honour of forwarding to you the following Final Report, which has been adopted unanimously by the Electrification of Railways Advisory Committee, and which, with the Interim Report of 12th July 1920, forms the conclusions of the Committee within the Terms of Reference as referred to them by you in March 1920 and October 1920.

I am, Sir,

Your obedient Servant,

(Sd.) ALEXANDER W. KENNEDY,
Chairman.

FINAL REPORT.

1. The Electrification of Railways Advisory Committee was appointed by the Minister of Transport, in March 1920, to inquire into Railway Electrification.

The terms of reference were as follows:—

To consider and advise—

I. Whether any regulations should be made for the purpose of ensuring that the future electrification of railways in this country is carried out to the best advantage in regard to interchange of electric locomotives and rolling stock, uniformity of equipment and/or other matters.

II. If any such regulations are desirable, what matters should be dealt with, and what regulations should be made.

III. How far it is desirable, if at all, that railways or sections of railways already electrified should be altered so that they may form parts of a unified system.

Subsequently in October 1920 the terms of reference were extended as follows:—

To consider and advise—

I. Whether any regulations should be made to limit the drop of potential in an uninsulated return conductor on electrically operated railways.

II. If any such regulations are desirable, what limits these should impose, and under what conditions.

2. The Committee held their first meeting on March 28th, 1920, and after having had before them as witnesses representatives of the principal railway companies in this country employing or proposing to employ electric traction on their systems, and also receiving evidence from the engineers to the Swedish State Railways and the Federal State Railways of Switzerland, and from British and Continental Electrical Contractors, submitted to the Minister on July 12th, 1920, an Interim Report containing their recommendations in respect to certain general and fundamental matters covered by their reference, which it was understood should be placed before him as early as possible.

The Committee now desire to confirm the recommendations contained in their Interim Report, which for convenience are repeated as follows:—

"In respect to Reference I.

"8. The Committee consider that, in order to ensure the future electrification of railways in this country being carried out to the best advantage in respect to the matters indicated in the Reference, it is desirable that certain general regulations should be made for observance by the railway companies when electrifying their lines."
"9. The Committee consider that these regulations should be directed specially to ensuring standardisation of those methods and appliances which are likely to prove the most satisfactory under British conditions.

"10. They consider, further, that such regulations should put no avoidable difficulties in the way of the adoption in future, with the approval of the Minister, of any improvements in methods or appliances which may from time to time become available with increasing knowledge and experience.

"In respect to Reference II.

"11. In view of the desirability of the railways which are now contemplating immediate electrification knowing as soon as possible the decision of the Minister on certain fundamental matters, they recommend that regulations should be issued in accordance with the following conditions:

"(i) That in the case of those railways which have not as yet electrified any of their lines, as well as those which at present have electrified all or part of their lines on a direct current system, their electrification, or extended electrification as the case may be, should be carried out on the direct current system.

"(ii) That the standard pressure of the direct current system at the sub-station busbars shall be 1,500 volts, subject to —

"(a) The continuance of any existing 600 volt and/or 1,200 volt installations, and, subject to the approval of the Minister, of their extension.

"(b) The adoption of half the standard voltage—750 volts—in those cases where it can be shown to the satisfaction of the Minister that advantage would arise from the use of this lower pressure.

"(c) The adoption of higher pressures—limited to a multiple of the standard pressure—where it can be shown to the satisfaction of the Minister that sufficient advantage would accrue.

"(iii) That both overhead and rail conductor collection should be permitted, as long as the position and general design of the conductors and structures are in accordance with recommendations which will be made in a subsequent Report. In that Report the Committee will also suggest the regulations required to ensure that locomotives and/or motor coaches shall be able, wherever it may be necessary, to run at two different voltages, e.g., 600/750 and 1,500 v., and/or with either rail or overhead collection.

"(iv) That the generation of current for direct current lines should be alternating 3-phase at such voltage as may be desirable in each case.

"(v) That in the case of existing generating stations supplying at any frequency between 25 and 50 cycles it is unnecessary to make any change in frequency, but that it is desirable that where any one such frequency is in general use in a particular electricity district, any new power station put down in that district for supplying a railway should adopt the frequency which has been approved by the Electricity Commissioners or is in general use in that district.

"The Committee desire to add on this matter that from the evidence which has been put before them, as well as their own experience, they have come to the conclusion that alternating current supplied to the sub-stations at a frequency of 50 cycles can be used for railway purposes without any detriment to railway working.

"In respect to Reference III.

"12. There is only one line of any importance in Great Britain which would not come under the terms of Recommendation paragraph 11 (i), above, namely, the electrified portion of the London, Brighton and South Coast Railway system. The Committee have considered with special care the very difficult questions introduced into the problem by the fact that this company long ago adopted a single-phase alternating current system for its suburban lines, and did so with a special view to the adoption of a system which at that time appeared the only one admitting of extension from London to Brighton when this extension became
The General Manager of the Company (Sir William Wrbes) has come before the Committee to say that his company considers the extension to be now not only feasible but urgently desirable.

13. The Committee is bound to recognise that if the railway is allowed to electrify its main line to Brighton on its present system, there will, of necessity, have to be a change of locomotives or multiple unit stock in any cases where other companies’ trains run over that line, and that to this extent the wished-for general interchangeability will be interfered with. They recognise, on the other hand, that to change the existing suburban equipment of the Brighton Railway to a direct current system would involve a large financial expenditure, which the railway itself could not be asked to undertake and which it would be difficult to justify to the public at the present time. It has further been stated to the Committee that the electrification of the main line is in this case very closely connected with that of the suburban lines on account of the necessity, on economical grounds, of using the same rolling stock throughout.

14. Having all these considerations in mind the Committee recommend, as the course which on the whole has the balance of advantages:

(i) That the electrical system of working at present in use, or actually under construction, on the Brighton Co.’s suburban lines need not be changed.

(ii) That in view of the recent proposals of the Government as to grouping of railway companies, the question of the system on which the L.B. & S.C. Railway Company’s proposed extensions to the coast should be carried out is now—in the event of the Government’s proposals being approved by Parliament—one for special consideration from the point of view of the requirements of through working and interchangeability of traffic with the other systems forming part of the proposed Southern Group. Subject to these matters receiving the fullest consideration, and provided the completion of the proposed extension on the present system shows a substantial financial advantage, the Committee are of opinion that it should be allowed.

3. The Committee continued their consideration of the further matters, which, as stated in the Interim Report, were left over for subsequent consideration, and have again had before them representatives of the London and North Western Railway, the South Eastern and Chatham Railway, the Metropolitan Railway, the London Electric Railways, the Lancashire and Yorkshire Railway, the North Eastern Railway, the London Brighton and South Coast Railway, the Midland Railway, and the London and South Western Railway. Mr. Leitch, formerly the Electric Traction Engineer to the Central Argentine Railway, also gave evidence, and a Report was received from Mr. George Gibbs, of Messrs. Gibbs and Hill, Consulting Engineers to the Pennsylvania Railroad and other Railways. The published Reports by Commissions appointed in Continental countries to consider the matter of railway electrification have been obtained, and placed before the Committee.

Sir Frank Dyson, the Astronomer Royal, and Mr. F. E. Smith, until recently the Superintendent of the Electrical Section at the National Physical Laboratory, Teddington, gave evidence in respect to the effect on the indications of certain magnetic instruments by the operation of electric traction systems in the vicinity of the Greenwich Observatory and the National Physical Laboratory.

Further evidence on the side of the Electrical Contractors has been given by representatives of Messrs. Brown, Boveri & Company, Baden, Switzerland.

The Committee desire to put on record their indebtedness to the Railway and other Authorities, as well as to the Astronomer Royal and the other gentlemen mentioned above, for their very valuable assistance.

The Committee, having also had before them the Recommendations made by a Committee of the General Purposes and Public Safety Department with regard to the clearances to be provided for overhead conductors, now recommend, in continuation of the first portion of paragraph 11 (iii) of the Interim Report, that regulations in respect to contact rail collection and overhead collection of current should be issued covering new electrical equipment operating on the recommended system.

4. In respect to contact rail collection, it is essential for the interchange of electrically-operated trains, referred to in the first term of the Reference, that the contact rails should be so placed as to enable current to be collected by the same
trains both on railways employing 1,500 volts and on those employing 600/750 volts. The top-contact type of rail is that now generally in use for the present low voltages; the under-contact type of rail has also been largely used, and, in the opinion of the Committee, possesses advantages in regard to interference by the accumulation of ice and snow, and also in regard to the arrangement of protection for men working on the track with higher voltages. Suitably designed shoes can be run interchangeably with either the top or under-contact type of rail. Under these circumstances, the Committee are of the opinion that the contact rails employed may have either a top-contact or an under-contact surface, and they do not consider it desirable to recommend the exclusive use of either type, some varieties of which may be the subject of patents, but think that the choice in this respect should be left open, subject to the regulations below, so as not to interfere with such future improvements as are likely to be developed in either or both types.

5. The Committee consider that a standard position outside the tracks should be defined within certain limits for the contact surface of the contact rails in relation to the position and level of the running rails, and desire to recommend that in respect to new electrically-operated lines and extensions to existing lines the following regulations should be issued for securing the interchangeability of running:

(i) The contact surface shall be in the horizontal plane.
(ii) The gauge measured between the centre of the horizontal contact surface of contact rails and the gauge line of the nearest rail of the corresponding track shall be 1 ft. 4 ins.
(iii) The vertical height of the contact surfaces above the plane of the top table of the running rails shall be—
   (a) for top-contact rails - - - 3 ins.
   (b) for under-contact rails - - - 1½ ins.
(iv) The vertical height of the contact rail (including, where required, the protection over the top of the rail) above the plane of the top table of the running rails shall be such as to provide the necessary clearance from the load gauges from time to time in use.
(v) The under-contact rail, where employed, shall provide for the engagement of the contact shoe being made from the side nearest to the running rails.
(vi) Above the level of the under-contact surface (iii) (b) no part of the contact rail construction shall be at a less distance than 1 ft. 1½ ins. from the gauge line of the nearest track rail, and below the level of the under-contact surface (iii) (b) at a less distance than 1 ft. 7½ ins. from the gauge line of the nearest track rail.
(vii) The vertical distance between the under side of any contact shoe in the free position and the plane of the top table of the running rails shall not be less than 1½ ins.

The Committee recommend further that existing equipments which do not conform to the above may be continued in use and may, subject to the approval of the Minister, be extended.

The accompanying diagram (Appendix I.) illustrates the dimensions referred to in para. 5 (i), (ii), (iii), (iv) and (vii).

6. In respect to overhead collection it is essential for the interchange of electrically-operated trains referred to in the first term of the Reference, that the position of the overhead live wire and the clearances between the live wire and the fixed and the moving structures, as well as the width and operating range of the collector gear, shall be such that any train may collect current from all electrically-equipped railways.

7. The Committee therefore recommend that in respect to new lines and new electrical equipment of existing lines the following regulations should be issued for securing interchangeability of running:

(i) The standard clearances, after allowance has been made for curvature and super-elevation, including any movements of the live wire or conductors and lateral movements of the collectors, under any circumstances likely to arise, shall be:

   (a) Between the underside of any overhead live wire or conductor and the maximum load gauge likely to be used on the line—
      (1) In the open - - - - - 3 feet.
      (2) Through tunnels and under bridges - - - 10 inches.
(b) Between any part of the structures and the nearest point of any live overhead wire or conductor - - 6 inches.

(c) Between rail level and overhead conductors—

(1) At accommodation and public road level crossings - - - - - - 18 feet.

(2) At places where there is a likelihood of men in the conduct of their duties having to stand on the top of engines or vehicles - - 20 feet.

(2) Between any part of the collector gear and any structure - - - - - - - - - - 3 inches.

The Committee recommend that in the case of the electrical equipment of existing lines the dimensions stated in (a) (2) and (b) may each be reduced to 4 inches as a minimum, that cases of exceptional constructional difficulty may be considered by the Minister as special cases, and that existing equipments which do not conform to the above may be continued in use.

(ii) The horizontal distance of the contact wire from the plane through the centre line of the track and perpendicular to the surface of the track rails shall be within the following limits:—

(a) At a height of 18 feet above rail level - - 1 foot 3 inches.

(b) At a height of 4 inches above the maximum load gauge likely to be used on the line - - 1 foot 9 inches.

(iii) The weight and construction of the contact wire and supports shall be suitable for the passage of collectors exerting an upward pressure of from 25 to 40 lbs.

(iv) The width of the renewable contact surfaces of the collectors at right angles to the track shall not be less than 4 feet, and the extreme width over the horns of the collectors shall not exceed 7 feet 6 inches.

The Committee recommend that in the case of those railways that have already equipped any or all of their lines with overhead contact wires which do not conform to the above recommendations, the employment of these may be continued in use and may, subject to the approval of the Minister, be extended.

The accompanying diagram (Appendix II.) illustrates the dimensions referred to in para. 7 (i), (ii), and (iv).

8. With regard to the second portion of para. 11 (iii) of the Interim Report and having regard to the practicability of further standardisation of equipment by regulations, the Committee desire to confirm the views expressed in clause 10 of the Interim Report to the effect "that such regulations should put no avoidable difficulties in the way of the adoption in future, with the approval of the Minister, of any improvements in methods or appliances which may from time to time become available with increasing knowledge and experience," and to add that the Committee do not consider it desirable, in the interests of railway electrification, that further regulations (other than those recommended in this Report) should be issued for the time being.

9. With regard to the extended References I. and II., the Committee, after careful consideration, find that:—

(i) The evidence given by the Railway Companies operating electric railways indicates that the cases of harmful effects due to a drop in potential substantially in excess of that allowed by Tramway Acts in earthed railway conductors have been few and unimportant, and readily corrected by the Railway Companies themselves on their own initiative.

(ii) The clauses for the protection of observatories inserted in the Acts of Railway Companies applying for powers to operate their railways electrically have had, and continue to have, a retarding effect on railway electrification. The Committee having heard in evidence officers concerned with the observatory instruments likely to be affected by the operation of electric railways, are of the opinion that the interests of observatories would in any case be sufficiently protected if the scope of the clauses referred to were limited to the portions of electric railways within the vicinity of the observatories.
(iii) Some railways, by virtue of the wording of their Acts, are under no necessity
to apply for new powers for electrifying their systems, and are therefore
not placed under the disadvantages in respect to limitation in the drop of
potential by their Acts as in the case of the other companies.

10. Having regard to these considerations and to the views expressed in clause 10
of the Interim Report, as well as to the difficulties in imposing any definite limit to
the voltage drop owing to the variety of conditions which present themselves along
different portions of any railways, the Committee therefore recommend that:

(i) It is not desirable that regulations should be issued to limit the drop of
potential in an uninsulated return conductor on electrically-operated
railways.

(ii) In cases where it is found impossible to dispense altogether with the present
obligations which are imposed upon Railway Companies by the protective
clauses inserted by the Board of Trade and other Authorities into the Acts
of the Companies, these obligations should be specified definitely in each
particular case.

11. The recommendations are briefly summarised in Appendix III.

12. The Committee desire, in concluding their work, to express their cordial
recognition of the great diligence and care with which Mr. S. G. Redman has carried
out his duties as Secretary, and the valuable assistance which he has continuously
given them.

(Signed) ALEX. B. W. KENNEDY (Chairman),
JOHN A. F. ASPINALL.
ARTHUR R. COOPER.
PHILIP DAWSON.
ALEXANDER GIBB.
CHARLES H. MERZ.
P. A. M. NASH.
L. SIMPSON.
ROGER T. SMITH.
JOHN SNELL.
H. W. THORNTON.

S. G. REDMAN (Secretary).

30th June 1921.
STANDARDISATION OF CONTACT RAILS

DIAGRAM ILLUSTRATING RECOMMENDATIONS RELATIVE TO THE POSITION OF CONTACT SURFACES AND CLEARANCES OF CONTACT RAIL AND SHOE CONSTRUCTION.
MINISTRY OF TRANSPORT
ELECTRIFICATION OF RAILWAYS
A D V I S O R Y C O M M I T T E E
STANDARDISATION OF OVERHEAD CONTACT WIRES

Diagram illustrating recommendations in respect to clearance below overhead contact wire and collector gear

Clearances below contact wire and supports except where the track passes under overhead structures

Appendix II

MINISTRY OF TRANSPORT ADVISORY COMMITTEE
APPENDIX III.

MINISTRY OF TRANSPORT.

ELECTRIFICATION OF RAILWAYS ADVISORY COMMITTEE.

SUMMARY OF RECOMMENDATIONS.

Standard System of Power Generation:
See p. 4, Clause 11 (iv) of Interim Report.
Three-phase alternating current.

Standard System of Power Distribution:
See p. 4, Clause 11 (i) of Interim Report.
Direct current.

Standard Pressure:
See p. 4, Clause 11 (ii) of Interim Report.
1,500 volts at substation busbars; in special cases a multiple or sub-multiple of 1,500 volts, if approved by the Minister.

Standard Collection:
See p. 4, Clause 11 (iii) of Interim Report.
Contact rail and/or overhead contact wire.

Contact Rail Standards:
See p. 6, Clause 5.
Top-contact or under-contact rail, with the contact surface in a horizontal plane installed at a gauge of 1 foot 4 inches from the gauge line of the nearest track rail.

Overhead Contact Wire Standards:
See p. 7, Clause 7.
Installed normally over the centre of the track at a height of 3 feet above the maximum load gauge likely to be used on the line, and at a maximum height of 20 feet above track rail level.

Limitation of Drop in Earthed Return Conductors:
See p. 8, Clause 10.
No regulations to be issued.