DCode

DCRP_16_03_08

Distribution Code Review Panel

Meeting 61 – Thursday 8 September 2016

Withdrawal of P14 and its removal from the DCODE

Paper by Secretary

1. Engineering Recommendation (ER) P14 *Preferred Switchgear Ratings* was published 45 years ago in 1971 and has not been amended since. Although ER P14 is referenced as a qualifying standard in Annex 1 of the Distribution Code, it is not specifically referenced in any clauses in the Code.

2. The original intent of ER P14 was to provide guidance on the recommended switchgear ratings when procuring HV switchgear. The current relevant Standards for switchgear specification, used by Member Companies, are as follows:

- IEC 62271-100 High-voltage switchgear and controlgear Part 100: Alternating current circuit-breakers (Also applicable is IEC 62271-1 High-voltage Switchgear and Controlgear Part 1: Common Specifications)
- ENA TS 41-36, Switchgear for Service up to 36 kV (Cable and Overhead Conductor Connected. Table 1.3 from TS 41-36 duplicates information from P14.
- ENA TS 41-37 Part 1, Switchgear for use on 66 kV to 132 kV distribution systems (Common clauses). Table 2 from TS 41-37 Part 1 duplicates information from P14.

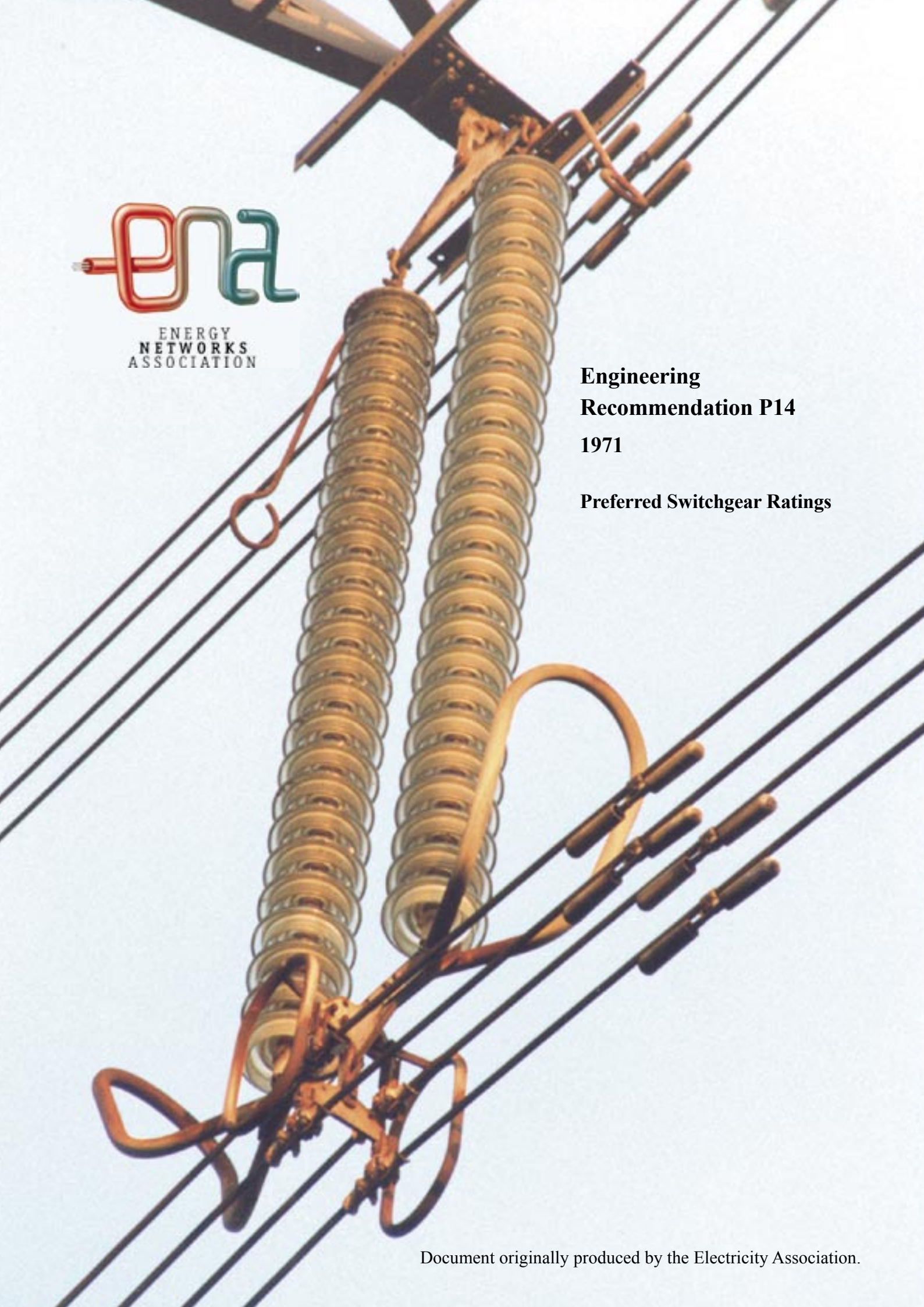
3. The ENA Switchgear Assessment Panel (SAP) has confirmed that ER P14 is not a relevant document and is no longer referenced by Member Companies.

4. The SAP agreed that P14 should be withdrawn and archived. The SAP also agreed that it may be appropriate to review the following two points mentioned in P14, during future revisions of TS 41-36 and TS 41-37:

- How transformer ratings match preferred switchgear ratings
- Capability of switchgear to be temporarily overloaded

Recommendation

The Panel is requested to approve the withdrawal of ER P14 and sanction the removal of its status as an Annex 1 qualifying standard from the Distribution Code



ENERGY
NETWORKS
ASSOCIATION

Engineering Recommendation P14

1971

Preferred Switchgear Ratings

Document originally produced by the Electricity Association.

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1971

PREFERRED SWITCHGEAR RATINGS

1. RECOMMENDATION

This document recommends the switchgear ratings which should be preferred by the electricity supply industry for transmission and distribution. These have been selected from the IEC recommended ratings having regard to the size of system equipment already available and the trends of plant performance. Fused switchgear equipments are not covered by this Recommendation.

2. CONSIDERATIONS

2.1 IEC Recommendations

Account has been taken of the new IEC publication 56 which was approved late in 1970.

The current ratings remain as in IEC 56-3 (1959) and are selected from the R 10 series of preferred numbers namely:

400 A, 630 A, 800 A, 1250 A, 1600 A, 2000 A, 2500 A, 3150 A, 4000 A, 5000 A, 6300 A.

The new draft IEC proposals define rated IEC voltages as the upper limit of the highest voltage of the system for which the circuit breaker is intended. Preferred rated voltages in kV include:

3.6, 7.2, 12, 17.5, 24, 36, 52, 72.5, 100, 123, 145.

Rated short circuit breaking current is defined as the highest symmetrical short circuit current which the breaker should be capable of breaking at rated voltage and under prescribed transient recovery voltage (TRV) conditions. The r.m.s. values of the a.c. component of the rated breaking current are selected from the R 10 series of numbers and include (in kA for symmetrical faults):

5.0, 6.3, 8, 10, 12.5, 16, 20, 25, 31.5, 40, 50, 63, 80, 100.

The use of the terms MVA or GVA to define circuit breaker breaking capacity will be discontinued and the rated short circuit breaking current and rated voltage used instead.

The IEC recommendations relate to a symmetrical short circuit current duration of 1 second which is unacceptable on the British system. Therefore BEAMA have agreed that in Britain, they will supply switchgear with a 3 second rating.

2.2 Nominal Voltages

This recommendation covers switchgear for use at nominal voltages of 6.6 kV, 11 kV, 33kV, 66kV, and 132 kV. Switchgear for use at 415 V was excluded because IEC 56-3 did not cover voltages below 1 kV; that for 22 kV and 110 kV was excluded because there was considered to be insufficient demand to justify inclusion in the document.

2.3 Standard Transformer Ratings

The transformer ratings shown by a recent survey to be those of present standards which most Area Boards expect to order in future, were regarded as the ratings against which the proposed switchgear ratings should be assessed for the purposes of the Recommendation. (The survey was made by the System Design and Planning Committee in April 1969). It was assumed that present CEGB practice with regard to supergrid transformers would continue. Transformer ratings which exist at present but would not be ordered in future have been excluded.

2.4 Switchgear Overload Rating

Electricity Supply Industry Standard 41-3, issued in November 1969, states that there is a permissible overload capacity of 12% where the average ambient temperature over any 24 hour period does not exceed 20°C and this has been assumed in arriving at the recommendations. This ambient temperature has been selected as an average for indoor switchgear which is unlikely to be exceeded under either summer or winter conditions.

2.5 Switchgear for Transformers

Switchgear normal current ratings, including the permissible overload capacity, have been selected to match the transformer ratings as follows:

(i) Continuous Emergency Rated Transformers - The switchgear current rating at 20°C average ambient temperature has been selected with a continuous rating at least equal to the transformer continuous emergency rating (which is based on 5°C ambient temperature).

(ii) Transformers Rated to BS 171 - The switchgear current rating at 20°C average ambient temperature has been selected to match a transformer overload of at least 30%. In those instances where the adoption of higher cyclic overload factors is postulated, further examination of the switchgear capability will be required.

2.6 Switchgear for Overhead Line and Cable Circuits

Overhead line and cable ratings have influenced the choice of the minimum rated normal current at all voltage levels except 132 kV. At 6.6 kV and 11 kV there appears to be design advantage in including the R 10 value of 500 A although it is a non-preferred IEC rating.

2.7 Busbars and Busbar Switchgear

It is considered that busbars rated not less than the largest incoming circuit will accommodate all likely out of balance conditions at two-, three-, or four-transformer substations. (At 132 kV, a feeder could be the largest incomer).

Similar considerations indicate that busbar section switches should be rated at not less than 75% of busbar rating. It is recommended that section switches be fully rated for 1250 A busbars.

2.8 Required Breaking Capacity

Two breaking currents were selected at most voltage levels (Table 2 col.5). The lower of the two will cover the common condition of two or three transformers of existing standard design connected in parallel. The higher value is intended to meet the most onerous conditions likely to occur in transmission/distribution practice.

An exception was made at 6.6 kV and 11 kV where three values were selected. The lower two together cover the common condition; the higher value is intended to meet the most onerous conditions likely to occur in distribution practice and will also be suitable for some industrial applications.

The making current for oil switches at 11 kV and 33 kV should be limited to the lower of the two breaking currents listed.

3. RECOMMENDED SWITCHGEAR RATINGS

Table 1 relates the preferred IEC current ratings to standard, transformer, busbar, and feeder equipments at each nominal system voltage.

Table 2 shows the recommended combinations of switchgear current and breaking capacity.

NOTE: It should be noted that the circulation of this Engineering Recommendation is restricted to Electricity Boards

TABLE 1

SELECTION OF PREFERRED IEC SWITCHGEAR CURRENT RATINGS TO MATCH TRANSFORMERS

TRANSFORMER				TRANSFORMER INCOMING SWITCHGEAR			BUSBAR	BUSBAR SWITCHGEAR	FEEDER SWITCHGEAR
Voltage		Rating							
Nominal Secondary Voltage (kV)	Equivalent IEC Rated Voltage (kV)	Continuous Emergency Rating (MVA)	BS 171 Continuous Rating (MVA)	Rating (A)	Switchgear Capability as % of (See Note (a)) Transformer Continuous Emergency Rating	Switchgear Capability as % of (See Note (a)) Transformer BS 171 Continuous Rating	Rating (A)	Rating (A)	Rating (A)
1	2	3	4	5	6	7	8	9	10
6.6	7.2	15 24		1,250 2,000	112% 112%	- -	1,250 2,000	1,250 2,000	) 400) 500(b) 630
11	12	15 24 40	 22.5 30 	1,250 1,250 1,600 2,000 2,000	186% 117% - - 112%	- - 152% 142% -	1,250 1,250 1,600 2,000(c) 2,000(c)	1,250 1,250 1,250 1,600 1,600	) 400) 500(b)) 630))
33	36		45 60 90 120	1,250 1,250 2,000 2,500	- - - -	178% 133% 142% 133%	1,250 1,250 2,000 2,500	1,250 1,250 2,000 2,000	) 630) 800))
66	72.5		120 180	1,250 2,000	- -	133% 142%	1,250 2,000	1,250 2,000	) 800)
132	145		240	1,250	-	133%	1,250 2,000	1,250 2,000	1,250 2,000

Note

(a) Columns 6 and 7 assume a 12% enhancement of the transformer incoming switchgear rating (based on 20°C) and the resulting capability is expressed as a percentage of transformer nameplate current. The transformer nameplate currents were calculated at the transformer nameplate voltage which may differ from the System Nominal Voltage:

System Nominal Voltage	(kV)	6.6	11.0
Transformer Nameplate Voltage	(kV)	6.95*	11.5*

*Continuous Emergency Rated Transformers only.

(b) 500 A is not an IEC preferred rating

(c) 1600 A busbars may be used if the disposition of incoming circuits is suitable

TABLE 2

PREFERRED IEC SWITCHGEAR CURRENT RATINGS AND BREAKING CAPACITIES FOR DISTRIBUTION AND SECONDARY TRANSMISSION

Nominal Voltage (kV)	IEC Rated Voltage (kV)	BREAKING CAPACITIES				Rated Normal Current (A)						
		BS 116		IEC 56-3								
		MVA	Equivalent Current at Nominal Voltage (kA)	Breaking Current (kA)	Equivalent Capacity at Nominal Voltage (MVA)							
1	2	3	4	5	6	7	8	9	10	11	12	13
6.6 (See Note (a))	7.2	150 250	13.1 21.9	12.5 16.0 25.0	143 183 286	400 500(b)	 630		1,250 1,250		2,000 2,000	
11	12	250 350 500	13.1 18.4 26.3	12.5 16.0 25.0	238 305 476	400 500(b)	 630		1,250 1,250	1,600	2,000 2,000	
33	36	1,000 1,500	17.5 26.3	16.0 25.0	913 1,430		630	 800	1,250 1,250		2,000 2,000	2,500 2,500
66	72.5	1,500 2,500	13.1 21.9	16.0 25.0	1,830 2,860			800 800	1,250 1,250		2,000 2,000	
132	145	3,500 5,000	15.3 21.9	16.0 20.0	3,680 4,560				1,250 1,250		2,000 2,000	

Note

(a) It is assumed that 11 kV equipment will be used at 6.6 kV.

(b) 500 A is not an IEC preferred rating

(c) 145 kV 16 kA circuit breakers will have a 20 kA single phase fault duty with high rates of rise of TRV (short line fault condition).

(d) 145 kV 20 kA circuit breakers will have a 25 kA single phase fault duty with high rates of rise of TRV (short line fault condition).

(e) For both 145 kV ratings, the associated TRV characteristic has been chosen to suit the future 132 kV system.

(f) The breaking currents in column 5 have a short time rating of 3 sec.instead of the 1 sec. IEC standard.