WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

Company Directive

STANDARD TECHNIQUE: SD8A/2

Relating to Revision of Overhead Line Ratings

Policy Summary

It contains all overhead line ratings used within WPD at all voltages from 132kV, 33kV, 11kV and Low Voltage (LV).

It is to be used when designing any overhead line WPD electricity distribution network.

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Approved by

Policy Manager

Date: 24 May 2013

Document Revision & Review Table		
Date	**Comments**	**Author**
19/03/2013	• Section 2 Conditions for Adopting Ratings – Clarification of when the ratings in this document should be used. • Section 4.3 Inclusion of 'conductor' in sentence.	Mike Chapman
16/04/2013	• New Section 5 covering dynamic line ratings	Sven Hoffmann

1.0 INTRODUCTION

1.1 The current rating of overhead lines operating at 132kV, 33kV, 11kV and LV are governed by five factors namely:

- ambient air temperature;
- wind speed;
- solar radiation;
- the maximum permissible conductor temperature;
- design ground clearance.

1.2 When applying the ratings in this Standard Technique the definitions of day and night are:

DAY	=	Sunrise to one hour after sunset
NIGHT	=	One hour after sunset to sunrise

and

SPRING/AUTUMN	=	March/April, September to November
SUMMER	=	May to August
WINTER	=	December to February

The criteria used presently for calculating 132kV, 33kV, 11kV and LV overhead line ratings have been examined and revised.

1.3 Exceedence means the percentage of time the conductor temperature will be above its maximum design temperature whilst running at the quoted rating.

1.4 Deterministic Rating - calculated from fixed arbitrary conditions. These are the worst likely combination of wind speed and ambient temperature.

1.5 Probabilistic Rating - derived from statistical observations based on actual meteorological conditions.

2.0 CONDITIONS FOR ADOPTING RATINGS

2.1 New Construction - The ratings contained within this document are applicable to any line designed and built to the minimum WPD clearances (which are greater than statutory clearances) detailed in STOH1A Table 1.

2.2 Existing Construction – Unless there is reason to suspect otherwise, it may be assumed that ratings already assigned to existing circuits are appropriate. These ratings should not be changed.

2.3 Where there is reason to doubt the validity of the ratings assigned to an existing line, or where no assigned rating can be found, then it should be assumed that the line was built to a 50 ºC design temperature and minimum, statutory clearances. Ratings in this case should therefore be obtained from P27.

2.4 The ratings in this document may be applied to existing overhead lines only after confirmation that clearances at the appropriate design temperature meet the minimum WPD clearances in STOH1A.

2.5 Also before adopting these ratings, for any overhead line conductors it will be necessary to check the ratings of any associated plant and protection. For example, it is possible that certain old model air break isolators may need to be replaced with modern 800 Amp units.

2.6 Some further expenditure on maintenance of overhead line joints and terminations may be required to achieve the ratings safely. Mechanical joints should be replaced with compression or wedge fittings.

3.0 CONDUCTOR OPERATING TEMPERATURES

3.1 All 132kV lines with Aluminium Conductor Steel Reinforced (ACSR) conductors are designed for 50°C operation. Some lines built, or reconductored with All Aluminium Alloy Conductors (AAAC) may operate at 65 or 75ºC. In the absence of information to the contrary, 50ºC operation ratings shall be used.

3.2 Lines built with 100 and 200 AAAC conductors after 1 January 1999 are designed for 75ºC operation. Some 150 HDC lines prior to this date have been designed for 75ºC operation. Ground clearances must be checked before using the 75ºC rating.

3.3 All other lines on wood poles are designed for 50ºC operation. Tables 2 to 10 are 50ºC ratings.

4.0 132kV LINE RATINGS

4.1 Continuous ratings are at 3% exceedence in line with (National Engineering Recommendation) NER P27.

4.2 After fault ratings are at 12% exceedence. Loads shall be reduced to the continuous rating as soon as practicable, and in any case within 24 hours.

4.3 ACSR lines with suspect conductor / joints shall be assessed to determine the level of deterioration and as a minimum de-rated to the **Restricted Ratings** in Table 1.

4.4 The ratings in Table 1 shall be applied for all 132kV tower lines, including when run at 33 or 11kV.

5.0 DYNAMIC LINE RATINGS

5.1 Line ratings are necessarily based on conservative assumptions about the cooling conditions that conductors are subjected to. As a result, there are numerous occasions when a line's rating may be safely increased when, for example, wind speeds are significantly higher than assumed in the rating calculation. The use of real-time data gathered at a specific line's location could therefore be used operationally to continually update that line's rating, allowing advantage to be taken of periods where the rating is enhanced. Such ratings are known as dynamic line ratings.

5.2 With increasing numbers of connections to the WPD network being sought by wind farm operators (both on- and off-shore), a line-specific dynamic rating methodology utilising real-time data is currently under development. Wind farm connections provide an ideal opportunity for the use of dynamic ratings, as their output is high when winds are high, and therefore when the real-time rating of a nearby line is also likely to be high.

5.3 A system based on real-time weather data has been successfully trialled on the Boston-Skegness 132kV line. This trial was conducted "off-line", and verified the potential gains as well as the performance of the weather stations and their associated data communications infrastructure.

5.4 Currently, approval for the implementation of a dynamic line rating system has been given only for the Boston-Skegness 132kV circuits. Once operational experience of the system has been gained, consideration will be given to allowing implementation on further circuits. Dynamic line ratings can only be applied following evaluation and approval by the Policy section.

6.0 WOOD POLE RATINGS

6.1 WPD ratings assume that the load curve is dominated by domestic and small commercial load. Where the load factor is greater than 70%, then 3% exceedence ratings from NER P27 shall be used.

Table 1

132kV (sustained) Overhead line ratings, Amps

175mm² LYNX ACSR				
Rating	**Rated Temp, Deg C**	**Season Rating, Amps**		
		Spring/Autumn	**Summer**	**Winter**
Continuous	50	500	435	540
After Fault	50	540	465	580

400mm² ZEBRA ACSR				
Rating	**Rated Temp, Deg C**	**Season Rating, Amps**		
		Spring/Autumn	**Summer**	**Winter**
Continuous	50	860	745	925
After Fault	50	925	800	1000

500mm² RUBUS AAAC (3.12 micro Ohms.cm resistivity)				
Rating	**Rated Temp, Deg C**	**Season Rating, Amps**		
		Spring/Autumn	**Summer**	**Winter**
Continuous	50	1000	865	1070
After Fault	50	1080	920	1170
Continuous	60	1160	1050	1220
After Fault	60	1270	1140	1340
Continuous	75	1250	1160	1310
After Fault	75	1380	1260	1450

300mm² UPAS AAAC (3.12 micro Ohms.cm resistivity)				
Rating	**Rated Temp, Deg C**	**Season Rating, Amps**		
		Spring/Autumn	**Summer**	**Winter**
Continuous	50	730	630	785
After Fault	50	780	675	845
Continuous	65	845	765	895
After Fault	65	915	820	970
Continuous	75	910	840	955
After Fault	75	995	905	1040

Table 1 (continued)

132kV (Restricted) Overhead Line Ratings, Amps

175 sq mm LYNX ACSR (50ºC)			
Rating	**Spring/Autumn**	**Summer**	**Winter**
Continuous	452	390	486
After Fault	510	440	550

400 sq mm ZEBRA ACSR (50ºC)			
Rating	**Spring/Autumn**	**Summer**	**Winter**
Continuous	700	650	800
After Fault	700	650	800

After fault ratings may be applied for up to 24 hours following a fault. Loads should be reduced to the continuous rating as soon as practicable.

Table 2

33kV, 11kV and LV Lines

Metric Hard Drawn Copper (Sustained) Overhead Line ratings, AMPS

CONDUCTOR TYPE	TIME	Season Rating (Amps)		
		Spring/Autumn	**Summer**	**Winter**
16 mm² HDC	Day Night	145 155	112 112	160 163
25 mm² HDC	Day Night	188 201	142 142	205 217
32 mm² HDC	Day Night	199 215	175 175	218 231
38 mm² HDC or 0.058 in² CU	Day Night	238 259	189 189	261 279
50 mm² HDC	Day Night	294 324	223 223	324 349
70 mm² HDC	Day Night	338 373	278 278	374 401
100 mm² HDC	Day Night	434 486	358 358	482 522
150 mm² HDC (at 50ºC)	Day Night	568 646	405 405	633 694
150 mm² HDC (at 75ºC)	Day night	783 826	655 655	831 864
175 mm² HDC	Day Night	624 714	452 452	697 767

Table 3

33kV, 11kV and LV Lines

Imperial Copper (Sustained) Overhead Line Ratings, AMPS

CONDUCTOR TYPE	TIME	Season Rating (Amps)		
		Spring/Autumn	**Summer**	**Winter**
0.025 in² HDC	Day Night	147 157	112 112	160 170
0.04 in² HDC	Day Night	191 207	150 150	210 224
0.05 in² HDC	Day Night	221 241	175 175	243 260
0.075 in² HDC	Day Night	271 297	218 218	299 321
0.1 in² HDC	Day Night	330 365	269 269	364 394
0.15 in² HDC	Day Night	419 470	350 350	466 508
0.2 in² HDC	Day Night	504 571	420 420	562 617

Table 4

33kV, 11kV and LV Lines

Aluminium Conductor Steel Reinforced (Sustained) Overhead Line Ratings, AMPS

CONDUCTOR TYPE	TIME	Season Rating (Amps)		
		Spring/Autumn	Summer	Winter
0.04 in² ACSR	Day	208	155	229
	Night	227	155	245
0.06 in² ACSR	Day	266	201	293
	Night	294	201	316
75 mm² ACSR or 0.075 in² ACSR	Day	306	234	338
	Night	340	234	366
100 mm² ACSR or 0.1 in² ACSR	Day	363	284	403
	Night	408	284	439
150 mm² ACSR or 0.15 in² ACSR	Day	463	382	516
	Night	527	382	566

Table 5

33kV, 11kV and LV Lines

Cadmium (Cad) Copper (Sustained) Overhead Line Ratings, AMPS

CONDUCTOR TYPE	TIME	Season Rating (Amps)		
		Spring/Autumn	Summer	Winter
16 mm² Cad CU	Day Night	135 144	90 90	147 155
19 mm² Cad CU or 0.025 in² Cad CU	Day Night	142 151	110 110	155 163
0.04 in² Cad CU	Day Night	191 206	150 150	210 222
0.058 in² Cad CU	Day Night	217 235	200 200	238 253
0.075 in² Cad CU	Day Night	281 308	230 230	309 331
0.1 in² Cad CU	Day Night	335 371	277 277	370 399
0.15 in² Cad CU	Day Night	430 482	364 364	477 518

Table 6

132kV, 33kV and 11kV Lines

Aluminium Alloy Conductor Core (Sustained) Overhead Line Ratings, AMPS (75ºC)

CONDUCTOR TYPE * Designated Size Copper Equivalent	**TIME**	**Season** **Rating (Amps)**		
		Spring/Autumn	**Summer**	**Winter**
100 mm² AAAC	Day Night	502 526	391 391	532 530
200 mm² AAAC	Day Night	780 830	638 638	831 868

NB These ratings **ONLY** apply to 11, 33 and 132kV wood pole lines built after 1 January 1999 for 75ºC operation using high conductivity (3.12 micro ohm cm) conductor.

Table 7

33kV, 11kV and LV Lines

Aluminium Alloy (Sustained) Overhead Line Ratings, AMPS (50ºC)

CONDUCTOR TYPE * Designated Size Copper Equivalent	**TIME**	**Season** **Rating (Amps)**		
		Spring/Autumn	**Summer**	**Winter**
25 mm² AL ALLOY or 0.025 in² *	Day Night	152 164	119 119	166 177
40 mm² AL ALLOY or 0.04 in² *	Day Night	201 220	160 160	221 238
50 mm² AL ALLOY or 0.05 in² *	Day Night	230 254	185 185	254 275
100 mm² AL ALLOY or 0.1 in² *	Day Night	349 395	294 294	389 426
150 mm² AL ALLOY or 0.15 in² *	Day Night	450 518	389 389	505 559

Table 8

LV Lines

Low Voltage Metric & Imperial Aluminium (Sustained) Overhead Line Ratings, AMPS

CONDUCTOR TYPE * Designated Size Copper Equivalent	**TIME**	**Season** **Rating (Amps)**		
		Spring/Autumn	**Summer**	**Winter**
50 mm² AL or *0.05 in² AL	Day Night	230 254	175 175	254 275
100 mm² AL or *0.01 in² AL	Day Night	351 396	260 260	391 428
150 mm² AL or *0.15 in² AL	Day Night	453 521	335 335	507 562

Table 9

LV Lines

Aerial Bundled Conductor (Sustained) Overhead Line Ratings, AMPS

CONDUCTOR TYPE	TIME	Season Rating (Amps)		
		Spring/Autumn	**Summer**	**Winter**
Per Phase for ABC	from ESI 41-13 issue 2 Pages 8 & 9	15ºC Correction Factor = 1.1		5ºC Correction Factor = 1.18
50 mm² 2 Core ABC	Day & Night	183	167	197
50 mm² 4 Core ABC	Day & Night	157	143	168
95 mm² 2 Core ABC	Day & Night	288	262	309
95mm² 4 Core ABC	Day & Night	250	228	269

All the above are for erection at pole top only and not under eaves.

APPENDIX A

DERIVATION OF RATINGS

1.0 132kV TOWER LINES

1.1 These lines were designed to minimum statutory clearance at maximum operating temperature.

1.2 The revised ratings in this document have been calculated in accordance with the methods used in NER P27.

1.3 Continuous ratings in this document are 3% exceedence ratings, and after fault are 12% exceedence ratings. This reflects recommendation of NER P27, and NGC policy respectively.

1.4 Restricted ratings in Table 1 are from CEGB Standard 99312 Issue 9.

2.0 33 & 11kV WOOD POLE LINES

2.1 Hitherto, all WPD overhead line ratings have been deterministic. These ratings represent exceedences of 12 to 15% when compared with NER P27 ratings.

2.2 All lines built in WPD since nationalisation, and most lines built before nationalisation have been constructed with additional ground clearance over the statutory minimum. It is considered that infringement of ground clearance is very unlikely given the system load curve and their additional clearance.

2.3 The ratings in this document use deterministic values for Spring/Autumn and Winter Ratings. Summer ratings are the NER P27 3% exceedence figures.

Criteria used are:-

		Windspeed	**ambient temperature**	**solar gain**
Winter	day	0.556 m/s	5ºC	670 W/m²
	night	0.42 m/s	0ºC	0
Spring/Autumn	day	0.556 m/s	10ºC	890 W/m²
	night	0.42 m/s	7ºC	0

Temperature and windspeed figures are unchanged from WPD Engineering Instruction P35. They were chosen following consideration of system demand and Exeter Weather Station meteorological data.

APPENDIX B

SUPERSEDED DOCUMENTS

This document supersedes ST:SD8A/1 dated January 2013 which should now be withdrawn.

APPENDIX C

ANCILLARY DOCUMENTS

CEGB Standard 99312, Issue 9
National Engineering Recommendation P27
EATS 43-13
ST:SD1A - Security of Supply

APPENDIX D

POLICY IMPLEMENTATION

Immediate.

APPENDIX E

POLICY IMPACT

None

APPENDIX F

KEY WORDS

Overhead Line, Sustained, Continuous, Rating, Conductor, Temperature, Spring/Autumn, Summer, Winter, Exceedence, Deterministic and Probabilistic.