WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Company Directive

STANDARD TECHNIQUE : SD4T

Provision of HV Network Data to ICPs for Connection Design

Policy Summary

This document sets out the processes by which HV network data is provided to ICPs to enable them to design new network connections.

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Date:	24 September 2015

Document Revision & Review Table		
Date	**Comments**	**Author**
September 2015	• New document	Stephen Quinn

IMPLEMENTATION PLAN

Introduction

The extension to Contestability criteria set out within the ENA Competition in Connections Code of Practice (July 2015) enables suitably accredited Independent Connection Providers (ICPs) to determine the 'Point of Connection' onto Western Power Distribution's system. This Standard Technique specifies processes for provision of HV (11kV & 6.6kV) network data to ICPs who are determining connections to Western Power Distribution's (WPD's) networks.

Main Changes

This is a new document.

Impact of Changes

- Network Services teams may receive clarification requests from ICPs who are using WPD's network data.

- Primary System Design teams may receive additional data requests from ICPs who are using WPD's network data.

Implementation Actions

- Team managers to make planners and other relevant staff aware that this data is now available to ICPs.

Implementation Timetable

This Policy can be implemented with immediate effect.

1.0 INTRODUCTION

1.1 The extension to Contestability criteria set out within the ENA Competition in Connections Code of Practice (July 2015) enables suitably accredited Independent Connection Providers (ICPs) to determine the 'Point of Connection' onto Western Power Distribution's system. This Standard Technique specifies processes for provision of HV (11kV & 6.6kV) network data to ICPs who are determining connections to Western Power Distribution's (WPD's) networks.

1.2 WPD currently uses the Fujitsu DINIS package for the analysis of HV networks. HV network data will therefore be provided to ICPs in DINIS's External Data Format. Supporting data will also be provided in other formats, which are outside the scope of this document.

2.0 DATA FORMAT

2.1 DINIS External Data Format (.edf)

2.1.1 The DINIS External Data Format is described in ancillary document 1 (Extract from the "DINIS Utilities Guide version 6.3") and ancillary document 2 (Extract from the "DINIS Utilities Guide version 6.4.4"). It is a vertical bar ("|") delimited text file.

2.1.2 One .edf file is provided for each licence area. It describes the topology, impedance and rating of Western Power's network from the HV bar at each primary substation (i.e. after the primary transformers) to the HV bar at each distribution substation (i.e. before the distribution transformer) and HV-metered supply point.

2.1.3 Each record within a .edf file may be given in the format of the "DINIS Utilities Guide version 6.3" or the "DINIS Utilities Guide version 6.4.4". The two letter code in the record identifier identify the type of node, the following numbers identify the subtype and version. These are repeated in appendix B for convenience. Please note that interpreting a record according to the definition of another record subtype or version is likely to result in corrupted data.

2.1.4 The available symbols and their associated record types are listed in appendix C. Not all of the record types associated with a particular symbol will be included with every example of that symbol. For instance, not all NULL nodes have an associated Text record. Additional legacy symbols are used in the South Wales dataset. Please contact wpdpsdicpdata@westernpower.co.uk if you have difficulty interpreting these.

2.2 DINIS Linecode File (TlTab.Type)

2.2.1 The DINIS linecode file is described in ancillary document 3 (Extract from the "DINIS System Administration Guide").

2.2.2 Each type of overhead line and cable is identified by a linecode or 'TlType'. This is a unique string of up to 19 characters. The meaning of linecodes is explained in appendix A. Please note that this appendix does not currently apply to South Wales; please contact wpdpsdicpdata@westernpower.co.uk for assistance with linecodes in the South Wales dataset.

2.2.3 WPD's series and shunt, positive- and zero-sequence impedances per unit length for each linecode are included in the linecode file.

2.2.4 WPD's thermal ratings for each linecode for three key operating conditions are included in the linecode file. Please note that the ratings used in the South Wales dataset are assigned historic ratings.

2.2.5 A small number of uncommon overhead line and cable types are not fully described in the DINIS Linecode File. Where impedance or ratings data is unavailable, it will be set to zero or left blank in the DINIS Linecode File. If your study is affected by this, please contact wpdpsdicpdata@westernpower.co.uk for advice.

2.3 DINIS Enquiry File (Enquiry.dat)

2.3.1 It may be necessary in future for the format in which HV network data is provided to change. If this is the case, a new edition of this Standard Technique will be issued documenting the new format.

2.3.2 Where major changes are being made to the format, one edition of the dataset will be made available in both the incoming and outgoing formats to ease the transition.

3.0 RELATIONSHIP TO OTHER DATASETS

3.1 Missing or inconclusive data

3.1.1 Where data is missing or inconclusive in the provided data set, reference should be made to other datasets provided by WPD, including EMU and CIRT. If this does not resolve the issue, please contact wpdpsdicpdata@westernpower.co.uk.

3.1.2 Please report all identified missing or inconclusive data to wpdpsdicpdata@westernpower.co.uk.

3.2 Connectivity modelling

3.2.1 While the provided dataset is derived from WPD's prime data source for the length and composition of circuits (EMU, WPD's geographic data system), it is not derived from the prime data source for the connectivity of circuits and substations (PowerOn, WPD's SCADA system). The connectivity of all circuits and substations in the provided dataset should therefore be confirmed against the schematic view in EMU for Third Parties (which is directly derived from PowerOn) before beginning study-work.

3.3 Infeed from upstream network

3.3.1 The provided model starts at the HV bar at each primary substation (i.e. after the primary transformers), and does not include information about the infeed from WPD's upstream (132kV, 66kV or 33kV) network. Please contact wpdpsdicpdata@westernpower.co.uk to request this information for a primary substation. It will include automatic voltage control (AVC) settings (target voltage and bandwidth) and fault infeed data for normal and identified abnormal running arrangements.

3.4 Load allocation

3.4.1 Load data is not included in the provided datasets, so should be allocated to distribution substations before performing network analysis in accordance with Appendix D.

3.4.2 To request:

- Historic measured demand data for an HV circuit;
- Historic measured import data for any HV metered customers on that circuit; and
- Historic measured export data for any embedded generation on that circuit,

please contact the local team assigned to your enquiry in CIRT.

3.5 Embedded generation

3.5.1 Self-determination of generation connections is not currently available, so the details of existing embedded generators are not provided.

3.6 Additional data

3.6.1 Some components are not described in sufficient detail in the provided dataset to be modelled accurately.

3.6.2 Please contact wpdpsdicpdata@westernpower.co.uk for details of the following centrally managed items:

- Voltage regulators
- Protection settings
- Primary substation earthing

3.6.3 Please contact the local team assigned to your enquiry in CIRT for details of the following locally managed items:

- Tap settings of distribution transformers
- Inter-voltage (6.6kV to 11kV) transformers
- Fuses and sectionalising/sequence-switching schemes
- Distribution substation earthing arrangements

4.0 DATA PROVISION

4.1.1 The datasets are issued by WPD’s Mapping Centre on USB sticks alongside WPD’s EMU for Third Parties mapping dataset. There is one USB stick per WPD Licence Area.

4.1.2 WPD refreshes HV network data to a nominal six-month cycle, or more frequently where required. The latest issue of HV network data must be used for all new or substantially revised designs.

LINECODES

A.1 STANDARD NEW-BUILD CABLES

Linecode (cable laid in ground)	Linecode (cable laid in rigiduct)	Meaning
5_U_1c185_A_EPR	5_D_1c185_A_EPR	185mm^2 aluminium EPR triplex
5_U_1c300_A_EPR	5_D_1c300_A_EPR	300mm^2 aluminium EPR triplex
5_U_1c300_C_EPR	5_D_1c300_C_EPR	300mm^2 copper EPR triplex or single-core in trefoil
5_U_1c400_C_EPR	5_D_1c400_C_EPR	400mm^2 copper EPR triplex or single-core in trefoil, operating at 11kV
7_U_1c400_C_EPR	7_D_1c400_C_EPR	400mm^2 copper EPR triplex or single-core in trefoil, operating at 6.6kV
5_U_1c630_C_EPR	5_D_1c630_C_EPR	630mm^2 copper EPR triplex or single-core in trefoil

A.2 STANDARD NEW-BUILD OVERHEAD LINES

A.2.1 Single-phase (two-wire)

Linecode	Meaning
5_O_2x25_HDC	25mm^2 hard-drawn copper built to WPD standard construction
5_O_2x38_HDC	38mm^2 hard-drawn copper built to WPD standard construction
5_O_2x50_HAZ_SIL	50mm^2 ‘Hazel’ aluminium alloy built to WPD standard construction
5_O_2x60_PIN_SIL	60mm^2 ‘Pine’ aluminium alloy built to WPD standard construction

A.2.1 Three-phase (three-wire)

Linecode	Meaning
5_O_3x25_HDC	25mm^2 hard-drawn copper built to WPD standard construction
5_O_3x38_HDC	38mm^2 hard-drawn copper built to WPD standard construction
5_O_3x50_HDC	50mm^2 hard-drawn copper built to WPD standard construction
5_O_3x70_HDC	70mm^2 hard-drawn copper built to WPD standard construction
5_O_3x100_HDC	100mm^2 hard-drawn copper built to WPD standard construction
5_O_3x150_HDC	150mm^2 hard-drawn copper built to WPD standard construction
5_O_3x50_HAZ_SIL	50mm^2 ‘Hazel’ aluminium alloy built to WPD standard construction
5_O_3x60_PIN_SIL	60mm^2 ‘Pine’ aluminium alloy built to WPD standard construction
5_O_3x100_OAK_SIL	100mm^2 ‘Oak’ aluminium alloy built to WPD standard construction
5_O_3x150_ASH_SIL	150mm^2 ‘Ash’ aluminium alloy built to WPD standard construction
5_O_3x175_ELM_SIL	175mm^2 ‘Elm’ aluminium alloy built to WPD standard construction
5_O_3x200_POP_SIL	200mm^2 ‘Poplar’ aluminium alloy built to WPD standard construction
5_O_3x300_BUT_AAL	300mm^2 ‘Butterfly’ aluminium built to WPD standard construction
5_O_3x400_CEN_AAL	400mm^2 ‘Centipede’ aluminium built to WPD standard construction

A.3 UNDERSTANDING LINECODES

DINIS linecodes are a maximum of 19 characters long, so are written in shorthand as described below:

Cables

<voltage>_<buildcategory>_<cores>c<CSA>_<corematerial>_<cable type>

Overhead Lines

<voltage>_<buildcategory>_<wires>x<CSA>_<conductorname>_<conductormaterial>

Where:

<voltage>

Code*	Meaning
5	Cable or line is operating at 11kV
7	Cable or line is operating at 6.6kV

*Since DINIS works in percentage units, it is important to ensure that the correct operating voltage is set for all circuits.

<build category>

Code	Meaning
U	Underground – cable laid directly in ground
D	Ducted – cable laid in duct
O	Overhead – overhead line built to SWEB/WPD extended clearances
S	Statutory – overhead line built to statutory minimum clearances

<cores>

Code	Meaning
1	Single-core or triplex cable
3	Three-core cable

<wires>

Code	Meaning
2	Single-phase (two wire) overhead line
3	Three-phase (three wire) overhead line

<CSA>

Cross sectional area of each core/conductor, in either mm^2, square inches or steel wire gauge. No units are given, but it should be possible to infer the unit from the value – imperial cores or conductors are unlikely to be much larger than 1 square inch, metric cores or conductors are unlikely to be much smaller than $16mm^2$.

<core material>

Code	Meaning
A	Aluminium
C	Copper

<cable type>

Code	Meaning
EPR	Ethylene Propylene Rubber – triplex or single-core EPR
OILx	Oil-filled cable (EHV operating at HV), where x is 3 for 33kV design, 6 for 66kV design or 1 for 132kV design
PBS	Paper Belted Screened – belted PILC
PCA	Paper Corrugated Aluminium – belted PICAS or PISAS
PSCA	Paper Screened Corrugated Aluminium – screened PICAS or PISAS
PSL	Paper Screened Lead – screened (H or HSL) or single-core PILC
XLP	Cross-linked Polyethylene – three-core, triplex or single-core XLPE
WCC	Wavecon, copper neutral-earth

<conductor name>

Optional field – only used for named aluminium overhead line conductors. The first three letters of the name, capitalised, are used.

CSA [mm2]	**SIL name**	**SCA name**	**AAL name**
25	Almond	Gopher	
30	Cedar	Weasel	
40	Fir	Ferret	Ladybird
50	Hazel	Rabbit	
60	Pine	Mink	
70		Horse	
75	Willow	Racoon	
80		Otter	
100	Oak	Dog	
125	Mulberry		
150	Ash	Dingo	
175	Elm	Caracal	
200	Poplar		
250	Sycamore		
300	Upas	Goat	Butterfly
400	Yew	Zebra	
500			Scorpian

<conductor material>

Code	**Meaning**
AAL	All Aluminium (Al, AAC, All Aluminium Conductor, HDA)
AXC	AXCES – three-core aerial cable
CAD	Cadmium Copper
HDC	Hard-Drawn Copper
SCA	Steel Cored Aluminium (ACSR, Aluminium Conductor Steel Reinforced)
SIL	Silmalec (AAAC, All Aluminium Alloy Conductor, Al Al, Aluminium Alloy)
SWG	Steel Wire Gauge – solid hard-drawn copper

Ratings

This section currently applies to the West Midlands, East Midlands and South West datasets only.

Ratings are assigned to cables and overhead lines based upon their attributes in EMU. Where available, ratings from WPD policy are used.

Cables

It is assumed that all cables are laid directly in ground, unless EMU records them are laid in ducts. In that case, they are assumed to be laid in Rigiduct since that more onerous than PVC duct. Cable grouping is not taken into account, so should be considered by the planner.

Build Category U (Underground)

Cable laid directly in ground. The ratings are taken from ST:SD8B/3 (Part 2). The ratings for "CABLE IN GROUND" are used.

DINIS description	Season and load condition in ST:SD8B/3 (Part 2)
Hot	Summer SUSTAINED
Normal	Spring CYCLIC
Cold	Winter CYCLIC

Build Category D (Ducted)

Cable laid in duct. The ratings are taken from ST:SD8B/3 (Part 2). The ratings for "CABLE IN DUCTS", duct type "Rigiduct" are used.

DINIS description	Season and load condition in ST:SD8B/3 (Part 2)
Hot	Summer SUSTAINED
Normal	Spring CYCLIC
Cold	Winter CYCLIC

Overhead Lines

The following assumptions are made about overhead line construction:

Licence area	Clearances*	Design temperature
South West	WPD minimum	50 °C
South Wales	Statutory minimum	
East Midlands	Statutory minimum	
West Midlands	Statutory minimum	

*The WPD and statutory minimum clearances can be found in table 1 of ST:OH1A/1
Lines build to WPD minimum clearances are assigned build category O. Lines built to statutory minimum clearances are assigned build category S.

Build Category O (Overhead)

Overhead line built to SWEB/WPD extended clearances. The ratings are taken from ST:SD8A/2. The daytime ratings are used.

DINIS description	Season in ST:SD8A/2
Hot	Summer
Normal	Spring/Autumn
Cold	Winter

Build Category S (Statutory)

Overhead line built to statutory minimum clearances. The ratings are taken from Engineering Recommendation P27, as instructed by paragraph 2.3 of ST:SD8A/2. The ratings for "SINGLE CIRCUIT SYSTEMS AND SECONDARY DISTRIBUTION SYSTEMS" with a "DESIGN CORE TEMPERATURE °C" of 50 are used. Where P27 doesn't include a rating for a conductor, a rating is calculated to the same method as P27.

DINIS description	Season in ER P27
Hot	Summer
Normal	Spring/Autumn
Cold	Winter

RECORD TYPES

Record type	Record Identifier		Notes
	DINIS Utilities Guide, version 6.3	DINIS Utilities Guide, version 6.4.4	
Site	ST40	ST40	
Node	ND108	ND108	
Text	TX118	TX118	
Electrical Line	LN120	LN120	
Electrical Line with Time of Day data	LN126	LN126	
Graphical line	GL117	GL117	
Balanced Load	LD77	LD138	
Balanced Load with Time of Day data	LD123	LD140	
Unbalanced Load	LD115	LD139	
Unbalanced Load with Time of Day data	LD124	LD141	
Generator	GN129	GN129	
Transformer	TR88	TR146	
Banked transformer	TR117	TR147	
Auto-recloser	AU81	AU143	
Sectionalizer	SE80	SE142	
Switch	SW79	SW79	
Shunt impedance	SH82	SH144	
Unbalanced shunt impedance	SH116	SH145	
Series impedance	SR111	SR111	
Induction motor	IM130	IM130	
Representative induction motor	RM128	RM128	

APPENDIX C

SYMBOL TYPES

Symbol Name	Network component represented	Record types									Notes
		Site	Node	Load	Text	Switch	Sectionalizer	Auto-recloser	Transformer	Induction motor	
SWB-A,NA	Primary substation HV board	✓	✓	✓	✓		✓	✓			
TX.RMU	Ground-mounted distribution substation or HV-metered supply point	✓	✓	✓	✓						
P/M S/S	Pole-mounted distribution substation	✓	✓	✓	✓						
NULL	Branch joint, tee-off pole or other node with no other electrical function		✓		✓						
LINKS	Pole-mounted links		✓		✓	✓					
LOF	Pole-mounted Fuses		✓		✓		✓				

Symbol Name	Network component represented	Record types									Notes
		Site	Node	Load	Text	Switch	Sectionalizer	Auto-recloser	Transformer	Induction motor	
ASL	Auto sectionalising Link		✓		✓		✓				
PMAR	Pole-mounted auto-recloser		✓		✓		✓	✓			
PMS	Pole-mounted sectionalizer		✓		✓		✓				
ABL	Air Break Switch Disconnector (ABSD)		✓		✓	✓					
ABL-TC	ABSD with remote control		✓		✓	✓					
V_REG_YY	Voltage regulator		✓		✓				✓		
InterposTx	Interposing (6.6kV to 11kV) transformer		✓		✓				✓		
GEN	Embedded generator		✓		✓						
EQUIV.GEN	Infeed from upstream network		✓		✓						
Switch	Any type of switchgear		✓			✓					

Symbol Name	Network component represented	Record types									Notes
		Site	Node	Load	Text	Switch	Sectionalizer	Auto-recloser	Transformer	Induction motor	
PM_11_315	Pole-mounted 315kVA 11kV/LV transformer		✓						✓		
GM_11_315	Ground-mounted 315kVA 11kV/LV transformer		✓						✓		
GM_11_500	Ground-mounted 500kVA 11kV/LV transformer		✓						✓		
GM_11_800	Ground-mounted 800kVA 11kV/LV transformer		✓						✓		
GM_11_1000	Ground-mounted 1MVA 11kV/LV transformer		✓						✓		
InductMotor	Induction motor		✓							✓	

ALLOCATION OF AFTER-DIVERSITY MAXIMUM DEMANDS TO 11KV AND 6.6KV NETWORKS

The following load data is provided by WPD to ICPs on request:

- Historical measured half hourly MVA demand data for HV circuits (S_m).
- Historical measured half hourly MVA import data for HV metered connections (S_i)
- Historical measured half hourly MVA export data for generators (S_e).

Where more detailed data is not available, all demand should be assumed to operate at 0.95 lagging power factor, and all generation should be assumed to operate at unity power factor.

When carrying out HV studies load is allocated to substations and HV customer connections using the following steps:

STEP 1 Calculate Circuit Demand, Excluding Generation

For each half hour period calculate True Circuit Demand (S_t) connected to the circuit (excluding the impact of the generation). This is determined by adding the Measured Circuit Demand (S_m) to the aggregate of Generation Export (S_e) for each individual half hour.

The half hour with the maximum demand is then found, and its value, time and date recorded.

For example, if the maximum demand measured on the circuit for a particular half hour period is 2.5MVA during which two generators are operating at 1MVA and 0.5MVA respectively, the demand connected to that circuit during that half hour is 2.5MVA + 1MVA + 0.5MVA = 4MVA.

STEP 2 Determine HV Metered Demands at time of Circuit Maximum Demand

The import demand (S_i) for each HV metered customer at the time and date of the maximum demand of the circuit is determined. These values are allocated to the half hourly metered customers.

For the purposes of this example it is assumed that the maximum demand measured historically on the circuit (excluding generation) was 5MVA and this occurred at 18:00 on 23rd January 2015. The circuit has three HV metered customers and during this particular half hour they were importing 0.35MVA, 1.00MVA and 0.25MVA respectively.

STEP 3 Allocate Demands to HV Metered Customers

The demands obtained from Step 2 for the HV metered customers are allocated to those connections.

In this example 0.35MVA, 1.00MVA and 0.25MVA are allocated.

STEP 4 Allocate Demands to Distribution Transformers

The remaining demand is allocated to the distribution transformers in proportion to the transformer capacities.

In this case the remaining demand is 5MVA – 0.35MVA – 1.00MVA – 0.25MVA = 3.40MVA. If the aggregate capacity of the distribution transformers connected to the circuit is 10MVA the demand allocated to each transformer will be (3.4/10) x 100 = 34% of the transformer's capacity.

In this case a 500kVA transformer is allocated a demand of 0.34 x 0.5 = 0.17MVA and an 800KVA transformer is allocated a demand of 0.34 x 0.8 = 0.27MVA.

STEP 5 Adjustment of Demand Allocation by Running the Load Flow Package

Load flow packages such as DINIS iteratively adjust the demand values to take account of the losses / voltage drop within the network.

STEP 6 Manual Adjustment of HV Metered Demands

Often the highest half hourly demand determined from step 1 does not coincide with the time of the maximum demand of the HV metered customers. If this is the case there is a significant risk that the demand values at these sites will be understated. The demand at HV metered connections should normally be increased to the Agreed Supply Capacity (ASC) after Step 4 has been completed. Where there is clearly diversity between the maximum demands at different HV metered connections due to the nature of the connected load, this may be taken into account when allocating these maximum demands.

In this example, if the ASCs for the three HV connections are 0.5MVA, 1.2MVA and 0.3MVA respectively then the allocated demand for these three metered connections should be manually increased accordingly. This would increase the circuit maximum demand to approximately 3.40MVA + 0.5MVA + 1.2MVA + 0.3MVA = 5.4MVA.

The above steps are performed for all circuits that need to be studied, including those used as back-feeds.

APPENDIX E

SUPERSEDED DOCUMENTATION

This Standard Technique is a new document.

APPENDIX F

ANCILLARY DOCUMENTS

1. Extract from the "DINIS Utilities Guide, version 6.3", *utilities63_extract.pdf*
2. Extract from the "DINIS Utilities Guide, version 6.4.4", *utilities_extract.pdf*
3. Extract from the "DINIS System Administration Guide", *sysadmin_extract.pdf*
4. DINIS external data format *(*.edf*) file as revised for:
    - 4.1. West Midlands
    - 4.2. East Midlands
    - 4.3. South Wales
    - 4.4. South West
5. DINIS linecode file (*TlTab.Type.**) as revised for:
    - 5.1. West Midlands
    - 5.2. East Midlands
    - 5.3. South Wales
    - 5.4. South West
6. DINIS Enquiry File (*Enquiry.dat*) as revised for:
    - 6.1. West Midlands
    - 6.2. East Midlands
    - 6.3. South Wales
    - 6.4. South West

APPENDIX G

KEY WORDS

Design, ICP, DINIS, Data, New Connection.