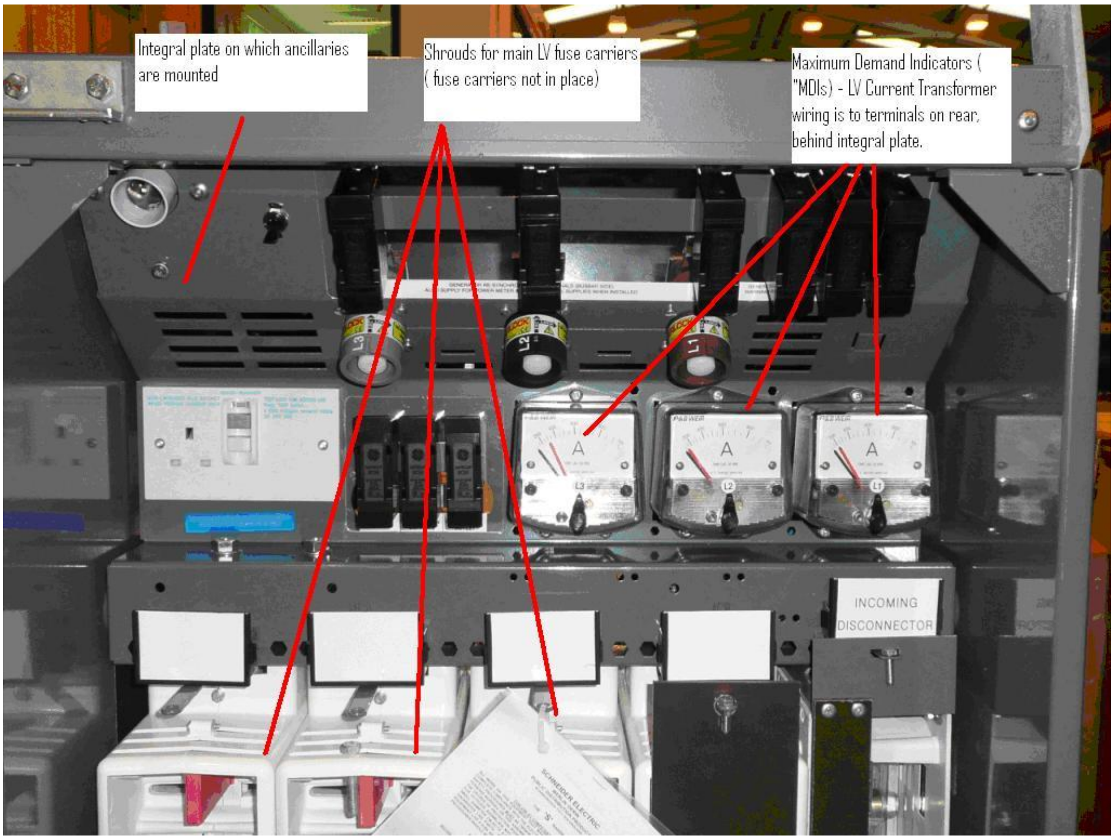
Appendix #	Subject	Reference in proforma
Appendix 1	University of Bath letter of engagement and support, and their data analysis methodology	Boxes 1, 18
Appendix 2	Memorandum of Understanding between WPD and npower	Box 25
Appendix 3	Customer communications pack	Box 2
Appendix 4	**Installing monitoring in LV substations**	**Box 4**
Appendix 5	Support letters – University of Bristol / WAG	Boxes 18, 23
Appendix 6	Sample extract of Arbed data (anonymised)	Box 23
Appendix 7	RFQ issued to meter installers re the installation of voltage sensors at end of feeders / Provisional design of end-of-feeder voltage monitors	Box 25
Appendix 8	An overview on the concept of network templates	Box 1

Appendix 4: Installing monitoring inside substations

The evidence below supports WPD's claim that monitoring equipment cannot be installed into LV substations without the substation being temporarily deactivated. This will incur CML/CI penalties, and WPD have applied for an exemption from this. Please consider this appendix as supporting evidence that installing this critical part of the 'smart grid' in to the UK's LV network will necessitate these outages, and not just for WPD, and that the exemption requested is therefore a requirement if the financial penalties are to be avoided and make this project, and those in the future requiring visibility into the LV network, viable.

The first part of this appendix shows the range of LV fuse cabinets that may need to be metered as part of the project.



Upper portion of modern LV transformer mounted fuse cabinet, showing the three maximum demand indicators ('MDIs' that look like meters) which are connected via terminals on their rear face to LV current transformers located under the lid. The MDIs are mounted onto steelwork forming part of the cabinet and near bottom of 'photo, the white shrouds for the LV feeder fuses (not in situ in this photo).

Modern LV transformer mounted LV fuse cabinet – in this photo two fuse carriers are in place. Under normal circumstances all LV fuse carriers would be in situ.

Stripped out interior of LV transformer mounted cabinet illustrating horizontal, forward facing and diagonal main copper connections, normally hidden behind shrouding and fuse carriers This copper work is live in service at 400 – 415 volts and rated for a short circuit level of 50,000 amps.

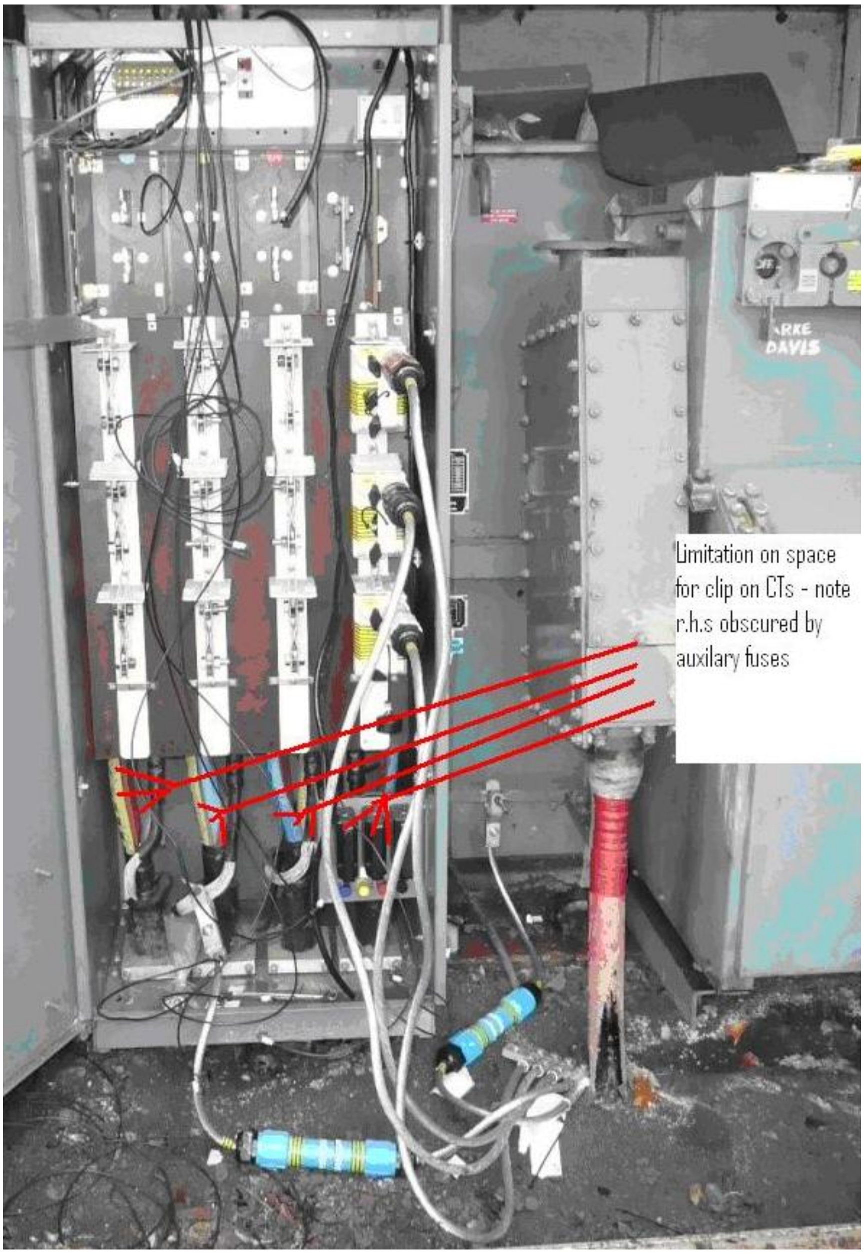
Old style outdoor LV fuse pillar. Fuse carriers are in place, but the older designs do not have the safety shrouding of modern designs

Another old style outdoor LV fuse pillar.

A typical old style indoor open type LV fuse board. It has no shrouding and all copper work is normally live.

WPD have explored the feasibility of using clip-on CTs instead of changing the MDI CTs. The fitting of such CTs would require sufficient space to be available between the 'break out' of each LV cable (where the phase cores separate), and the bottom of the lowest fuse carrier assemble. The phase conductors are already 'set' in position and present virtually solid metal bars, constrained at top and bottom. Very limited ability exists to bend the cores, and this would have to be undertaken with the circuits made dead.

The following photographs illustrate the sizing of typical clip-on CTs, and the space constraints limiting their use.


Limitation on space
for clip on CTs - note
r.h.s obscured by
auxilary fuses

No free space in this cabinet.

The outside diameter over one phase of modern LV 300 sq mm Wavecon cable is approx 35mm.This, and the 500A current rating dictates the physical size of a split core CT. The typical external diameter of such split core CTs is illustrated below, with each unit being some 36mm deep. In the typical arrangement shown in the above photo there is insufficient horizontal and vertical clearance to accommodate the 12 such clip on CTs.

DIMENSIONS (mm)