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# Trial Circuit Selection Methodology

Capacity to Customers (C<sub>2</sub>C) Project



This report was submitted to Ofgem on 29 June 2012

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Date: 29 June 2012

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## VERSION HISTORY

Version	Date	Author	Status (draft, etc)	Comments
d0.1	June 2012	G Williamson / P Turner	1 <sup>st</sup> draft	Draft for comment
d0.2	28 June 2012	G Williamson / P Turner	2 <sup>nd</sup> draft	Incorporation of review comments
v1.0	29 June 2012	C McNicol	First issue	Final amendments
v1.1	3 July	C McNicol	V1.1	Non material amendments

## GLOSSARY OF TERMS

Abbreviation	Term
ARS	Automated Restoration Sequence
CEP	Customer Engagement Plan
CRMS	Control Room Management System
C <sub>2</sub> C	Capacity to Customers
DPS	Data Protection Statement
ENWL	Electricity North West Limited
I&C	Industrial & Commercial
MPAN	Meter Point Administration Number
NOP	Normal Open Point
Ofgem	Office of the Gas and Electricity Markets
SDRC	Successful Delivery Reward Criteria milestone

All other definitions shown starting with a Capital letter are as per LCN Fund Governance Document v5.

## 1 EXECUTIVE SUMMARY

The Ofgem Project Direction (ref: ENWL/ Capacity to Customers/ 19-12-11) outlines certain SDRC against which the Capacity to Customer project will be judged for the purposes of Second Tier successful delivery reward. For each criterion the document defines the evidence that is required to demonstrate successful delivery. This document is one aspect of the first deliverable associated with the HV Circuit Selection SDRC. There are two HV Circuit Selection deliverables in total, these are:

1. **In June 2012, publish the HV circuits included within the C<sub>2</sub>C Trial, the HV Circuit Selection Methodology and the HV Circuit Variation Methodology on the C<sub>2</sub>C Project's website.**
2. In October 2012, publish information pamphlet on the HV circuits selected for Trial.

This report describes the methodology for the selection of circuits to run as closed / open rings and radials in the Capacity to Customers (C<sub>2</sub>C) trial. Circuits will normally operate as closed rings under the C<sub>2</sub>C operating regime which will increase network connection capacity. In the event of a fault, the network will automatically revert back to the traditional radial topology and the system will be maintained within limits by managing loads and generation with appropriate commercial contracts. The planned trial will test technical and commercial aspects of C<sub>2</sub>C operation.

The selection of circuits for the C<sub>2</sub>C trial was undertaken in three main stages, initial circuit screening, preliminary circuit selection and circuit simulation for refined circuit selection.

In order not to have an adverse impact on competition during the trial the designated circuits have to be selected and published at the onset. The initial screening identified circuits with a higher likelihood of attracting C<sub>2</sub>C connections during the trial period and would not be required for a full network roll out. The initial circuit selection used the following criteria:

- Circuit loading: circuits with the highest loading were chosen since they were considered to be the most likely to require reinforcement when making demand connections.
- Connection activity: circuits with the greatest recent connection activity were chosen since they were believed to be the most likely to attract customer connections during the trial period.

The detailed suitability of circuits was checked during the preliminary circuit selection when circuit types, the appropriateness of existing equipment for remote control, circuit topology, operation and location were all considered. Primaries with existing hand-charge springs were originally discounted due to the possibility of decreasing customer restoration performance in event of a fault. This would be a factor which limited the possible roll out of C<sub>2</sub>C so a decision was taken to select a number of hand-charge spring rings and run them open during the trial.

Circuits with an above average fault history were discounted from the ring selection to prevent an increase in customer fault disturbance but in order to gain an understanding of these circuits regarding C<sub>2</sub>C a selection of these circuits will be in the trial as radial feeders.

Finally the operation of the closed ring with additional demand connected was simulated to identify any likely thermal, voltage or fault level issues due to the revised operating regime.

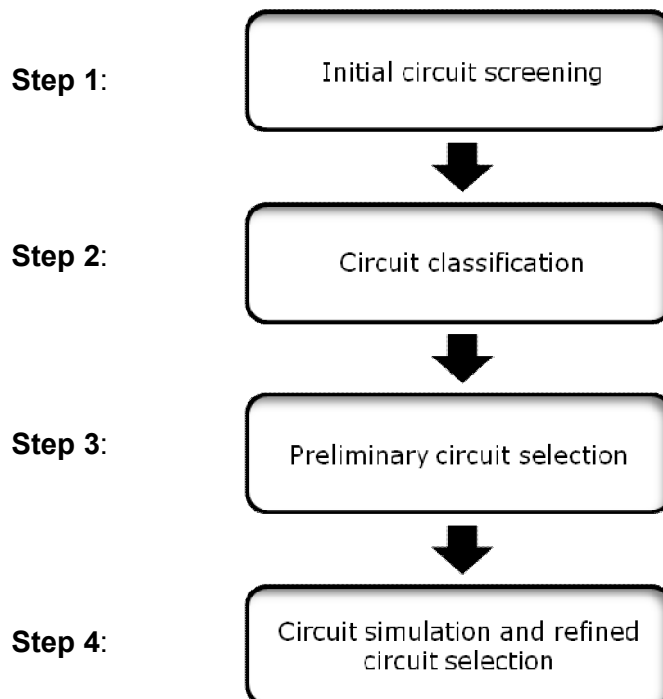
In addition the circuits were classified to check that the selection was representative of the whole Electricity North West (ENWL) network and could be applied to other distribution networks.

The C<sub>2</sub>C trial circuit selection originally included 180 closed rings and 20 radial circuits; this was modified to 153 closed rings, 27 open rings and 20 radial circuits.

It is considered that the selection methodology could be applied to other distribution networks.

## 2 DESCRIPTION OF CIRCUIT SELECTION METHODOLOGY

The steps of the circuit selection methodology are shown below.



Each of these steps is described in more detail in the sections of this report that follow.

## 3 INITIAL CIRCUIT SCREENING

One objective of the C<sub>2</sub>C trial is to agree at least 10 managed new connection agreements with I&C customers. The incentive for the customer is likely to be a reduced connection charge by avoiding reinforcement activities associated with a standard connection offer. In order to not have an adverse impact on competition during the trial the designated circuits have to be selected and published at the onset. This introduced the risk that during the trial no new C<sub>2</sub>C connections are made due to the fact that the selected circuits have no new connections which require reinforcement. The initial screening identified circuits with a higher likelihood of attracting a new C<sub>2</sub>C connection during the trial period to mitigate this issue and would not be required for a full C<sub>2</sub>C network roll out.

Consequently the full portfolio of approximately 3600 HV circuits within the ENWL network were screened to produce an initial selection of circuits for the trial based on the following criteria:

- Circuit Loading: circuits that were likely to require reinforcement when an increase in demand occurred during the trial period
- Connection Activity: circuits that were considered likely to provide the opportunities for C<sub>2</sub>C customer contracts

### **3.1 Circuit Loading**

High circuit loading leading to limited margin was considered within the initial circuit screening to identify the circuits most likely to require reinforcement for even a small demand connection.

The results of the HV system studies for a recent regulatory review (2004) were analysed to distinguish the Primary substations with the most highly loaded circuits.

Load flow study results for both normal configuration with maximum demand and abnormal configuration with maximum demand were considered.

The 40 Primary substations with the highest percentage of outgoing circuits more than 80% loaded for each condition (abnormal configuration with maximum demand and normal configuration with maximum demand) were taken forward for the next stage of the circuit selection methodology.

This list of Primary substations was supplemented by approximately 120 substations where more than 10 “High Amp Alarms” had been recorded during the period 2010 / 11, to ensure that locations where the load had grown significantly since the regulatory studies were included in the initial circuit selection.

### **3.2 Connection Activity**

Historic connections data and development information was also included in the initial circuit screening since it is considered important that new connections are probable on the circuits included in the trial.

HV system change records from January 2010 to March 2012 were analysed to identify applications for new connections greater than 100kVA which required new substations or system reinforcement. All circuits out of Primary substations with more than four such demand connection applications during the period of consideration were included in the initial selection.

Information with regard to anticipated regeneration and development areas was taken from a PPS Group Ltd engagement report commissioned by ENWL as part of the C<sub>2</sub>C bid preparation. The circuits on which increases in demand could be expected due to the developments identified in the report were included in the initial selection of circuits for the trial.

The PPS Group Ltd report provided information about development areas from the following Councils and County Councils:

Allerdale	Eden	South Ribble
Barrow-in-Furness	High Peak	St Helens
Blackburn with Darwen	Hyndburn	Stockport
Blackpool	Lancaster	Tameside
Bolton	Manchester	Trafford
Burnley	Oldham	Warrington
Bury	Pendle	West Lancashire
Cheshire East	Preston	Wigan
Chorley	Ribble Valley	Wyre
Copeland	Rochdale	
Craven	Rossendale	

### 3.3 Initial Circuit Selection Summary

The initial circuit selection included in the submission had a total of 396 circuits which it was envisaged would make 180 rings. The preliminary selection stage soon highlighted that this number of circuits would not make the required number of rings and the total number of circuits post the initial selection stage was increased to 1451 circuits. This number is significantly greater than the 360 circuits, corresponding to 180 rings, required in the final selection of circuits for the trial. The longer list than anticipated was required because of the number of circuits that were subsequently eliminated from the list when technical details were checked during the next stage of the selection process.

## 4 CIRCUIT CLASSIFICATION

The selected circuits for the trial were to be representative of the range of circuits within the whole ENWL system to maximise the learning outcomes of the trial and ensure the applicability to other UK distribution networks. All circuits were classified according to the following criteria to check the suitability of the selection:

- Voltage levels
- Circuit types
- Circuit reliability

### 4.1 Voltage Levels

The following circuit voltages were considered:

- 11kV
- 6.6kV

### 4.2 Circuit Types

The circuit selection methodology defined circuits as one of the five categories listed below, as defined by Ofgem for the Interruption Incentive Scheme, as a way of including a mix of overhead and cable circuit types:

- Very urban (Underground, UG)
- Urban (Mixed type A, MA)
- Semi-rural (Mixed type B, MB)

- Rural (Mixed type C, MC)
- Very rural (Overhead, OH)

It was judged that a representative mix of circuit types also ensured a distribution of circuits across the geographic area of the ENWL system and hence a representative mix of customer types, ie domestic, commercial, industrial and generation.

### **4.3 Circuit Reliability**

Circuits with a range of circuit reliabilities have been selected for inclusion in the trial.

Customers should not be adversely affected by the C<sub>2</sub>C trial because additional automation points will be installed on all selected circuits to ensure that customer interruptions are minimised as the system is segmented and returned to service after a fault. However, based on the average number of faults during the last five years being approximately three for the population of ENWL HV circuits, circuits with more than five faults in the past five years were removed as part of the initial circuit screening. This was to ensure that overall system performance was not decreased significantly by the C<sub>2</sub>C trial by avoiding interruptions to customers on circuits closed to make a ring with a particularly faulty circuit.

Circuits to which sensitive customers are connected (for example hospitals) were specifically excluded from the trial.

Twenty circuits with more than five faults in the last five years were included in the trial circuit selection to enable results to be gathered for circuits with lower reliability. In particular these circuits are likely to provide greater opportunities to test the technical operation and to observe the customers' response to interruptions.

## **5 PRELIMINARY CIRCUIT SELECTION**

Details of circuits identified for further consideration by the initial circuit screening were then examined to ensure that they were technically suitable for inclusion in the trial. The following criteria were checked for each circuit, mainly based on manual examination of data obtained through the CRMS system:

- Circuit topology
- Type of switchgear
- Use of hand-charged springs
- System operations

### **5.1 Circuit Topology**

The next stage of the circuit selection checked the present operating arrangement to ensure that the trial circuits were operating as radials. Also, checks were made that both ends of the proposed closed circuit loop were supplied from the same Primary substation and that Primary substations would not be interconnected by the C<sub>2</sub>C trial.

Circuits originating from Primary substations which operate a split busbar running arrangement at the HV side were also eliminated from the circuit selection to prevent the trial creating ring circuits which produce an inadvertent parallel between sides of the Primary via the HV network.



The C<sub>2</sub>C trial assumes that only one Normally Open Point (NOP) is closed to make a two ended loop and also that NOPs at connections to other circuits from the closed loop will remain open.

## 5.2 Switchgear Type

Remote control of switchgear at an existing NOP is required for the function of C<sub>2</sub>C, but it is not possible to fit Remote Control (RC) to all types of HV switchgear which exist in the ENWL system. The next stage of the circuit selection methodology checked that the necessary remote control device could be installed on the proposed circuits based on switchgear type information taken from the CRMS system.

Other Primary substation sites were excluded from the trial circuit selection because the switchgear is due to be changed soon and it was considered inappropriate to operate the trial in areas of the network where outages are being planned to facilitate the replacement works and there are uncertainties regarding the final system topology.

Installation of Switchgear Type RC devices was only considered possible to the following types of switchgear:

Manufacturer	Switchgear Type
Long & Crawford	J3, J4, R3, R4, T3GF3, T4GF3
Merlin Gerin	SE6, CE6, Ringmaster RN2, Ringmaster RN6
Lucy	Sabre VRN2, Sabre VRN2A

## 5.3 Hand-Charged Springs

Some Primary circuit breakers are charged via hand-charge springs meaning that they only have the ability to re-close on one occasion before requiring recharging by hand again. If a feeder with a circuit breaker with hand-charge springs is run in a closed ring, the ring could not be segmented after it is split due to a fault because of the inability to re-close the circuit breaker more than once. This would be detrimental to system performance and so circuits with hand-charged spring circuit breakers were originally excluded from the trial circuit selection based on information within the CRMS system. Circuit breakers with hand-charge springs are gradually being removed from the ENWL network, but there is still a sizable population to discount from a future C<sub>2</sub>C roll out. Consequently, 70 circuits corresponding to 35 open rings were included in the circuit selection, with the intension that these circuits will be classed as a ring but the NOP will remain open during the trial, to obtain learning relevant to roll out to a wider population of systems in the future.

## 5.4 System Operation

Some existing Operational Restrictions and Automated Load Reduction schemes mean that circuits are not suitable for operation within the C<sub>2</sub>C trial. These circuits were eliminated from the preliminary list based on information taken from the CRMS system.

## 5.5 Preliminary Selection Summary

The following table summarises the reasons why circuits in the initial list were removed by the preliminary circuit selection process.

Reason for removing from initial list	No. Of circuits
<b>Preliminary list screening</b>	<b>1451 circuits in the initial list</b>
Circuits do not have interconnection to make a ring	591 circuits removed
Circuit is already part of an automated load reduction scheme.	4 circuits removed
Circuits from a Primary which is operated split at HV	13 circuits removed
Circuits not suitable for the trial due to an operation restriction	30 circuits removed
Circuits with Primary Circuit breakers with hand-charged springs	474 circuits removed
Circuits which result in a very small ring	8 circuits removed
Circuits on which switchgear changes are planned within the trial period	15 circuits removed
<b>Circuit selection list for studies comprising</b>	<b>386 circuits in total</b>
Circuits in rings without hand-charge springs	316 circuits
Circuits in rings with hand-charge springs	70 circuits

The preliminary selection stage originally had a selection level of 22% (discounting switchgear changes / very small rings which are trial issues only) which would question the viability of a future C<sub>2</sub>C roll out. The inclusion in the trial of feeders with hand-charge spring circuit breakers at the Primary increases the selection level to 55% and caters for a period of time until these devices are gradually removed from the network. This inclusion tests the method of classing two circuits as a ring but keeping the NOP open. This method would make C<sub>2</sub>C a viable option for circuits which interconnect between Primaries and open bus-sections, increasing the possible preliminary selection level to 95%, making C<sub>2</sub>C viable for the majority of the network.

## 6 CIRCUIT SIMULATION AND REFINED CIRCUIT SELECTION

The circuits remaining in the preliminary list were simulated (using a network planning design tool ) to identify any thermal, voltage or fault level issues that may arise as a result of operating the two radial feeders as a closed loop with the addition of a 500kVA load which was considered typical of a large demand connection.

The historic evolution of parts of the ENWL distribution system, as well as previous design policies based on economic considerations and the number of customers requiring supply, means that some radial HV circuits are tapered from the Primary substation to the present NOP or have sections of smaller capacity somewhere along the circuit. The change to the network topology (and thus the change to impedance paths in the network) that result from the operation of the distribution network in closed loops could lead to the re-distribution of power flows.

Power flow studies of the selected closed loop circuits were required to identify those sections of the closed loop circuit that may become overloaded as a result of the network topology change from radial to closed loop.

Closing radial feeders to create a closed loop is likely to increase fault levels slightly, which may be problematic in the rare locations where fault levels are already close to equipment ratings, and particularly undesirable for the connection of new generation customers in urban networks when fault level margin is limited.

The studies assumed that the existing arrangement can presently supply the existing customers within network limits and that suitable alternative supplies are available for compliance with the applicable security of supply standards.

Only five rings corresponding to 10 circuits were removed from the preliminary trial circuit list as a consequence of the detailed studies showing circuits to be overloaded or voltages falling below statutory limits with the additional 500kW load connected.

## 7 SELECTION RESULTS

The following table summarises the circuit types included in the final list of circuits selected for the trial:

<b>Trial circuit selection</b>	<b>No. Of circuits/rings</b>
Closed rings	153 closed rings
Rings to be operated open due to hand-charged springs	27 open rings
Circuits with high fault rates	20 radials

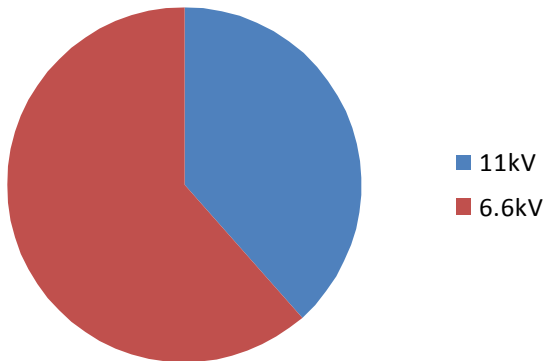
<b>Spare circuit selection</b>	<b>No. Of circuits/rings</b>
Rings to be operated open due to hand charged springs	8 open rings

A detailed list of the selected circuits can be found in Appendix A.

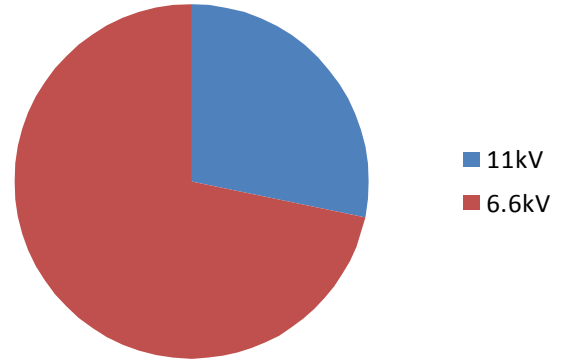
The split of the selected circuits compared to the total ENWL circuit population based on voltage and circuit type shown in the following figures indicate the adequate split of the circuits within the selection.

**Figure 1: Split of circuits in the total ENWL population and the list of circuits selected for the C<sub>2</sub>C trial based on voltage.**

A graph to show the voltage mix of all circuits in the ENWL network

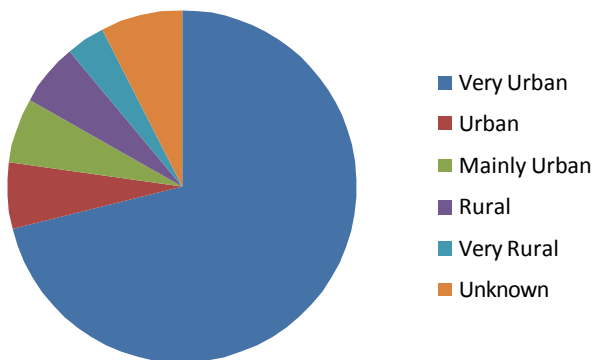


A graph to show the voltage mix of all circuits in the C<sub>2</sub>C trial

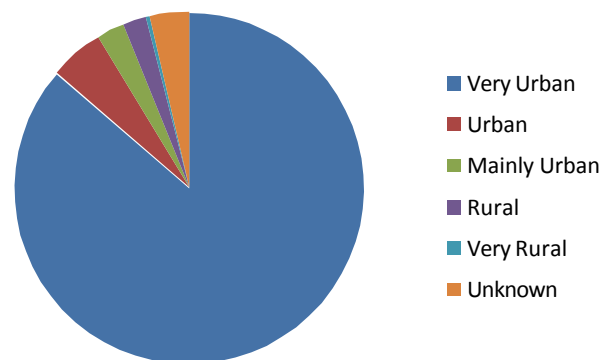


**Figure 2: Split of circuits in the total ENWL population and the list of circuits selected for the C<sub>2</sub>C trial based on circuit type.**

A graph to show the urban/rural mix of all circuits in the ENWL network



A graph to show the urban / rural mix of all circuits in the C<sub>2</sub>C trial



## 8 VARIATION METHODOLOGY

A variation methodology is required to include alternative rings/radials into the trial if it becomes apparent that the rings/radials included in the trial selection are no longer appropriate.

A circuit may become inappropriate for the C<sub>2</sub>C trial for various reasons, including:

- Equipment failure which effects the normal system operation making it impossible or unsuitable for C<sub>2</sub>C operation
- It becomes apparent that remote control equipment cannot be installed without significant plant modification costs being occurred
- New operational restrictions are applied which prevent ARS operation

Circuits will not be swapped out of the selection unless there is a reason that makes it inappropriate to remain in the trial. Circuits will not be swapped in to the trial selection

unless it is replacing an inappropriate circuit, specifically circuits will not be included in the trial should a commercial reason make it particularly attractive since this would be deemed to be anti-competitive.

The possibility of running the trial circuit split rather than closed should be considered before a ring is removed from the trial.

It is vital that if a C<sub>2</sub>C customer connection, avoiding reinforcement, has been made to a ring which is to be removed from the trial, that any necessary reinforcement is installed before the ring is taken out of the trial and operation reverts to normal radial running.

The final list of selected trial circuits includes 20 above average fault radials and 188 rings, 180 for the initial trial and 8 “spare” circuits that would be swapped into the trial should a problem be identified with any of the 180 circuits included in the initial trial selection. All selected circuits including spares are to be identified in C<sub>2</sub>C project publications.

Circuits should not be taken out of the trial or replaced if the problem with the ring only becomes apparent in the last three months of the trial and it is judged unlikely that there is sufficient time to gain learning from alternative circuits or to warrant the efforts necessary to include the alternative circuits.

## APPENDIX A – C<sub>2</sub>C CIRCUIT SELECTION

Primary/Location	Circuit Trial Type	Hand-charge spring	Circuit Name
ASHTON / BOLTON	Ring 1 Ring 1		ELLESMERE RD BURNS CL
ASHTON ON MERSEY/ ASHTON ON MERSEY	Ring 2 Ring 2 Ring 3 Ring 3		F1408 KENILWORTH RD F1412 HARBORO RD F1409 TAVISTOCK RD F1410 BUCKFAST RD
ASHTON UNDER LYNE / ASHTON UNDER LYNE	Ring 4 Ring 4		BOODLE ST WATER ST
ASHWOOD DALE / BUXTON	Ring 5 Ring 5 Ring 6 Ring 6 Ring 7 Ring 7		SEVERN TRENT DUKES DR HSL INTAKE BAKEWELL RD STADEN LN NO1 SAFEWAYS FOUNTAIN ST
ATHERTON TOWN CENTRE / ATHERTON	Ring 8 Ring 8		BRADSHAW ST THOMAS ST/HOLLAND ST
BAGULEY PRY / BAGULEY	Ring 9 Ring 9		L83 GLEBELANDS RD (BAGULEY) L372 ROTALAC PLASTICS
BAMBER BRIDGE / BAMBER BRIDGE	Ring 10 Ring 10 Ring 11 Ring 11		WHITEFIELD MEADOW PAUL & WHITES BAMBER BR LOCAL ST MARYS RC SCHOOL
BEDFORD / LEIGH	Ring 12 Ring 12		BEDFORD GR/BROOKLANDS MILL REGENCY GLASS
BISPHAM /BISPHAM	Ring 13 Ring 13		ILLUMINATIONS CLIFFS N HOLROYD CT
BLACKFRIARS / MANCHESTER	Ring 14 Ring 14		F753 RICHMOND HILL APTS F1181 TOWNBURY HS/BURY ST
BLACKLEY / BLACKLEY	Ring 15 Ring 15		F4013 LAKESIDE NO1 F4036 ROCHBANK RD
BLACKPOOL / BLACKPOOL	Ring 16 Ring 16 Ring 17 Ring 17		STANLEY TERR/CORAL ISLAND TOWER/HEYWOOD ST KING EDWARD PIER ST
BOW LN / LEYLAND	Ring 18 Ring 18		CHAPEL BROW TURPIN GRN

Primary/Location	Circuit Trial Type	Hand-charge spring	Circuit Name
BRADSHAWGATE/ BOLTON	Ring 19 Ring 19 Ring 20 Ring 20 Ring 21 Ring 21		COE ST N HENRY ST SILVERWELL SUN ALLIANCE BACK NEWPORT ST BOLD ST
BRAMHALL / BRAMHALL	Ring 22 Ring 22		BRAMHALL NETWORK SANDIWAY
BRIDGEWATER / MANCHESTER	Ring 23 Ring 23		F3550 CHEPSTOW HS/TRAFFORD ST F3552 THE RHINE
BROADHEATH / ALTRINCHAM	Ring 24 Ring 24		L3123 ATLANTIC ST NO3 L3088 ATLANTIC ST (MADANS)
BUCKSHAW / WHITTLE-LE-WOODS	Ring 25 Ring 25 Ring 26 Ring 26 Ring 27 Ring 27		DAWSON LN/MATRIX PK BUCKSHAW VILL COMM/WESTERN AVE MTX UNITY PLACE PERTSHIRE GR WOLSELEY REVOLUTION PK DEBUT 2 / WHITTLE LE WOODS
CANNON ST / MANCHESTER	Ring 28 Ring 28		F170 SHUDEHILL/MCR INT HANOVER ST 2 F305 THE PRINTWORKS WITBY GR
CARLISLE NORTH / CARLISLE	Ring 29 Ring 29		PARK HS CARLISLE N BSP LOCAL
CARR ST / SWINTON	Ring 30 Ring 30		INTEC HS ARTHUR ST
CASTLETON / CASTLETON	Ring 31 Ring 31		ENSOR CASTLETON CENTRE
CECIL ST / BLACKPOOL	Ring 32 Ring 32 Ring 33 Ring 33		DEANSGATE BACK HIGH ST/COCKER ST C AND S LAYCOCK GATE/SPENCER CT
CHAMBERHALL / BURY	Ring 34 Ring 34 Ring 35 Ring 35 Ring 36 Ring 36		HARVARD RD BURY GRAMMER SCHOOL CLARENDON ST PEEL WAY 'A' PEEL MILL NO 2 EUROPA HS BARCROFT ST
CHASSEN RD / URMSTON	Ring 37 Ring 37		F2722 FLIXTON VILL/WELLACRE TECH COLL/ F2719 BOWFELL RD

Primary/Location	Circuit Trial Type	Hand-charge spring	Circuit Name
CHATSWORTH STREET / BARROW	Ring 38 Ring 38 Ring 39 Ring 39 Ring 40 Ring 40		FURNESS BUS PK S NORTH SCALE WALNEY RD SW STN BATH ST FURNESS NEWS MFI
CHEADLE HULME / CHEADLE HULME	Ring 41 Ring 41	H H	L1715 HIGHFIELD RD/CHEADLE HULME SCH L1824 CHERRY TREE RD
CHEETHAM HILL / CHEETHAM HILL	Ring 42 Ring 42		F1328 WESTBURY RD F221 STATION RD/ARDERN RD
CHESTER RD / MANCHESTER	Ring 43 Ring 43		F567 BINGO HALL CHESTER RD/METROLINK F1480 CORNBROOK HS
CHORLEY SOUTH / CHORLEY	Ring 44 Ring 44		DUKE ST/RYLANDS RD PILLING LN
CLAYTON / CLAYTON	Ring 45 Ring 45		WELLINGTON ST RISHTON PAPER MILL/DUNKENHALGH
CLOVER HILL / NELSON	Ring 46 Ring 46 Ring 47 Ring 47		CLOVER MILL MARSDEN MILL 1 HIGHGATE BEAUFORT ST
COG LN / BURNLEY	Ring 48 Ring 48 Ring 49 Ring 49 Ring 50 Ring 50 Ring 51 Ring 51		ST JOHNS ST TUNNEL ST/HARGHER CLOUGH MILL BK HAROLD ST/BK 127 COG LN STOOPS BRUSH ST CLAYTON FOLD/SYCAMORE AVE PETER WARD/PHOENIX WAY FARRINGTON CL
COPSE RD / FLEETWOOD	Ring 52 Ring 52 Ring 53 Ring 53 Ring 54 Ring 54		ADDISON RD LINDEL RD NANSEN RD TRAMWAYS COPSE RD BREAKERS WHARF SIDING RD
CROWN LN / HORWICH	Ring 55 Ring 55		LODGE BANK EST ESSEX STONECRAFT
DENTON EAST / DENTON	Ring 56 Ring 56 Ring 57 Ring 57		F46 TOWN LN (52)/VICTORIA ST (DENTON) F92 BIRCH GR F132 MOUNT PLEASANT/KING ST F1285 AYLESBURY AVE
DICKINSON ST/ MANCHESTER	Ring 58 Ring 58 Ring 59 Ring 59 Ring 60 Ring 60		F386 TOWN HALL EXT/TUSCANY HS F387 MANCHESTER TOWN HALL F2296 CAMBRIDGE ST HULME/WILMOTT ST F88 HULME ST NO2 F577 CHEPSTOW HS/BISHOPSGATE NO2 F3628 ST PETERS SQ/THE PIAZZA



Primary/Location	Circuit Trial Type	Hand-charge spring	Circuit Name
DOUGLAS ST / ASHTON-ON-RIBBLE	Ring 61 Ring 61		PORT WAY KMI W/WATERY LN PUMP STN GOLD MEDAL TRAVEL
DROYLSDEN EAST / DROYLSDEN	Ring 62 Ring 62 Ring 63 Ring 63 Ring 64 Ring 64 Ring 65 Ring 65		F71 DROYLSDEN MARKET NO1 F1945 MARKET ST F1284 WEST DR F1040 LOCK KEEPERS CT F210 AUDENSHAW STANDBY PUMP STN F264 KERSHAW LN N F869 MEDLOCK LEISURE CTR F851 FOLD ST
EASTLANDS / MANCHESTER	Ring 66 Ring 66		F4131 ADVENT NO 1/CARRUTHERS METRO F4132 ALBION WORKS NO2
EXCHANGE ST / DARWEN	Ring 67 Ring 67 Ring 68 Ring 68 Ring 69 Ring 69		BEEHIVE MILL/BEDFORD ST BIRMINGHAM WASTE/COTTON HALL GILLIBRAND/WOLSTENHOLME BRONZE PDR POLICE ST/ICI DUCKWORTH ST MT PLEASANT ST/EXCHANGE ST NWK CHARLES ST/BK DUCKWORTH ST
FAILSWORTH / FAILSWORTH	Ring 70 Ring 70 Ring 71 Ring 71	H H H H	F1358 BEN BRIERLY WHARF F2551 ABBEY RD/LANDSBERG RD F315 PIFCO F249 SISSON ST RETAIL UNITS
FARNWORTH / FARNWORTH	Ring 72 Ring 72 Ring 73 Ring 73 Ring 74 Ring 74		BRIDGEWATER ST MOORFIELD CHASE WORSLEY RD / DARLEY ST ASDA FARNWORTH VICTORIA MILLS EDITH ST
GOLBORNE / GOLBORNE	Ring 75 Ring 75 Ring 76 Ring 76		SILCOCK ST ASHTON RD/GRIMSHAW ST LOWTON RD KNOWSLEY AVE
GREAT HARWOOD / GREAT HARWOOD	Ring 77 Ring 77 Ring 78 Ring 78		STATION RD HEYS LN IND EST MOUNT ST/HARTLEY ST/ALAN RAMS TESCO QUEENS ST
GREEN LN / HAZEL GROVE	Ring 79 Ring 79 Ring 80 Ring 80		L1032 HIGHFIELD RD/GREEN LN N L690 HOWARDS CT L1035 GROVE LN/OLD MEADOW LN L1033 GREEN LN SCH
GREEN ST / WIGAN	Ring 81 Ring 81 Ring 82 Ring 82		GAS WORKS RAVEN ST/RYEFORD CL BOUNDARY ST DOUGLAS FLATS/C & A MODES

Primary/Location	Circuit Trial Type	Hand-charge spring	Circuit Name
GREENHILL / OLDHAM	Ring 83 Ring 83 Ring 84 Ring 84 Ring 85 Ring 85 Ring 86 Ring 86		GREENGATE ST ELI LEES GREENHILL NETWORK ANDREW BARON OLDHAM DOUBLING LEES DISTRICT/ATHERTON ST RICHMOND WALK/ALEXANDRA IND EST DRONSFIELDS
GRIFFIN / BLACKBURN	Ring 87 Ring 87 Ring 88 Ring 88 Ring 89 Ring 89		GALLIGREAVES ST/STANSFIELD ST ST WILFREDS SCH GEORGE ST W REVIDGE RD/BEARDWOOD BROW NEW WITTON MILL REDLAM
HALL CROSS / FRECKLETON	Ring 90 Ring 90		HALL CROSS LOCAL HM PRISON KIRKHAM
HANDFORTH / WILMSLOW	Ring 91 Ring 91		DEANWAY TRADING EST/BROOKE PK NO2 MARKS & SPENCER (B)
HAYDOCK / HAYDOCK	Ring 92 Ring 92 Ring 93 Ring 93 Ring 94 Ring 94 Ring 95 Ring 95		BLUEBELL AVE KENYONS LN SENATOR PLASTICS S LOCKIE ENVELOPES ATLAS COPCO/WILCOCK RD NO2 SAINSBURYS (HAYDOCK) BAHAMA RD MILLFIELD LN NO2
HEYWOOD / HEYWOOD	Ring 96 Ring 96 Ring 97 Ring 97		BURNSIDE CL SEFTON ST/FIR ST CIVIC HALL HARESHILL BUS PK
HIGHER MILL / CHEADLE	Ring 98 Ring 98 Ring 99 Ring 99		F2816 BROWNLEY RD F1535 FOXLAND RD SCH F278 HIGH ST CHEADLE F1094 KINGSWAY GATLEY
HINDLEY GRN / HINDLEY GREEN	Ring 100 Ring 100	H H	LEDGARD AVE RAMADA HOTEL SALE WAY
HOLME RD / HOLME RD	Ring 101 Ring 101 Ring 102 Ring 102		PRIORY LN BLUNDELL LN/QUEENSWAY HOLME RD O/D PENWORTHAM GIS
HYDE / HYDE	Ring 103 Ring 103 Ring 104 Ring 104		ASDA HYDE HYDE SUPERMARKET WOOD ST/MOUNT ST HYDE NETWORK

Primary/Location	Circuit Trial Type	Hand-charge spring	Circuit Name
HYNDBURN RD / ACCRINGTON	Ring 105 Ring 105 Ring 106 Ring 106		CROWN ST CRAWSHAW ST FORT ST NAPIER ST
IRLAM / IRLAM	Ring 107 Ring 107 Ring 108 Ring 108 Ring 109 Ring 109		F1174 AMOCO F3145 TRAMWAY RD F1111 TESCO IRLAM F2504 DEAN RD EMBEDDED F1112 VICTORIA RD F1125 SOAPSTONE WAY/CWS BOTTLING
KIRKHALL LN / LEIGH	Ring 110 Ring 110	H H	PATAKS VICTORIA ST NORLEY RD/HULME RD
KNOTT MILL / MANCHESTER	Ring 111 Ring 111	H H	F2452 CITY GATE B/BASE ARUNDEL ST F967 POTATO WHARF
LAMBERHEAD / WIGAN	Ring 112 Ring 112		HIGHFIELD FOUNDRY LN
LANGROYD RD / COLNE	Ring 113 Ring 113		SAINSBURYS COLNE NORTH VALLEY RETAIL
LEVENSHULME / LEVENSHULME	Ring 114 Ring 114 Ring 115 Ring 115 Ring 116 Ring 116		F265 CLIFTONA WORKS F50 BARLOW RD F599 MANDERVILLE ST F803 BROOM LN F1528 ERRWOOD RD F1474 THE CRESCENT
LONGSIGHT / LONGSIGHT	Ring 117 Ring 117	H H	F223 VICTORIA HALLS F1417 BAX RD
LOSTOCK / LOSTOCK	Ring 118 Ring 118		HOLLYWOOD BOWL TESCO FILLING STN
LYONS RD / MANCHESTER	Ring 119 Ring 119	H H	F1523 GOVT TRAIN CTR/KIMBERLEY CLARK F2217 RICHMOND RD
MIDDLETON JUNCTION / MIDDLETON	Ring 120 Ring 120 Ring 121 Ring 121 Ring 122 Ring 122		J W LEES MARSDEN ST MOOR CL BRITISH VINEGAR/FERNDOWN AVE MIDDLETON JUNCT DIST MILLS HILL SW HS
MONTON / ECCLES	Ring 123 Ring 123 Ring 124 Ring 124		F2130 MONTON RD FLATS F2274 ALFRED ST ECCLES F714 ANSON RD F713 EDGEWARE RD

Primary/Location	Circuit Trial Type	Hand-charge spring	Circuit Name
MORTON PK / CARLISLE	Ring 125 Ring 125 Ring 126 Ring 126		NEWBY WEST MORTON PK O/D LYNDHURST GARDEN CASTLERIGG DR
MOSS LN / MANCHESTER	Ring 127 Ring 127	H H	MORLEY ST KARA FOODS
MOSS NOOK / MANCHESTER	Ring 128 Ring 128		L3664 CROSS RD/OUTWOOD FM/RAILTRACK L3657 GPO FINNEY LN/GREENCOURTS
MOUNT ST / ECCLES	Ring 129 Ring 129 Ring 130 Ring 130	H H H H	F706 REGINALD ST/LORNE ST F700 STANLEY RD ECCLES F702 SEI ECCLES NO 1 F704 ADELAIDE ST/TRAFFORD RD/CORP RD
MUSGRAVE RD / BOLTON	Ring 131 Ring 131 Ring 132 Ring 132		BENTINCK ST/WHITLAND AVE /STAPLETON OAKWOOD DR/CARLTON RD LONSDALE RD (NEW) MORRISONS MORNINGTON RD
NEWTON LE WILLOWS / NEWTON LE WILLOWS	Ring 133 Ring 133 Ring 134 Ring 134	H H H H	CROW LN E ACORN ST MILL LN/TUTOR BANK DR/HOPE ACADEMY BORRON RD/MAKERFIELD DR
NEWTONGATE / PENRITH	Ring 135 Ring 135 Ring 136 Ring 136		GILWILLY IND EST/BICC GILWILLY ALEXANDRA RD HAWESWATER RD NEWTONGATE O/D
NORTHENDEN / MANCHESTER	Ring 137 Ring 137	H H	F1886 POST HS HOTEL F1887 ROYLE GRN RD (25)
OPENSHAW / MANCHESTER	Ring 138 Ring 138		F2162 PRESBAR PROD CRABTREE LN F214 ASHTON OLD RD
ORMSKIRK / MANCHESTER	Ring 139 Ring 139		HATTERSLEYS MOORGATE
PADIHAM / BURNELY	Ring 140 Ring 140 Ring 141 Ring 141	H H H H	PADIHAM CEGB SITE MEADE WAY SIMPSON ST GRAHAM & BROWN
PEEL ST / CLITHEROE	Ring 142 Ring 142		QUEENS RD HOSTEL THORNBERS/PEEL ST YARD
PRESTON EAST / PRESTON	Ring 143 Ring 143		ASDA FULWOOD/MIDGERY LN HOSP FULWOOD ROW O.D.
PRESTWICH / PRESTWICH	Ring 144 Ring 144	H H	F2640 POPPYTHORN LN F1598 FAIRFAX RD

Primary/Location	Circuit Trial Type	Hand-charge spring	Circuit Name
REDDISH VALE / REDDISH VALE	Ring 145 Ring 145 Ring 146 Ring 146 Ring 147 Ring 147		LAMBETH RD HIGGINSON RD HOULDSWORTH MILL/HOULDSWORTH PK EMILY ST SAFEWAYS REDDISH CPA REDDISH/REDDISH VALE HS
ROBERT HALL ST / SALFORD	Ring 148 Ring 148	H H	F775 ROBERT HALL ST NWK F774 MANCHESTER LINERS/CUSTOM HS
ROMAN RD / BLACKBURN	Ring 149 Ring 149 Ring 150 Ring 150		FAIRHAVEN RD EVERTON PENDHILL ENGINEERING KINGSMERE/BE/GUIDE/WHITBREADS
ROYTON / ROYTON	Ring 151 Ring 151 Ring 152 Ring 152		TURF LN CUMBERLAND DR ROYTON DIST TRAVIS CT
SALE / SALE	Ring 153 Ring 153 Ring 154 Ring 154		F719 SALE NETWORK F2400 BROAD RD (NO 1) F2403 PARK AVE F1103 SAINSBURYS (SALE)
SKELMERSDALE / SKELMERSDALE	Ring 155 Ring 155	H H	RODCO STAVELEY RD
SOUTH EAST MACC / MACCLESFIELD	Ring 156 Ring 156		HAMMOND HS/VERTICA GEORGE ST
SOUTH WEST MACC / MACCLESFIELD	Ring 157 Ring 157		SYCAMORE CRES PARKMOUNT
SPA RD / BOLTON	Ring 158 Ring 158 Ring 159 Ring 159 Ring 160 Ring 160 Ring 161 Ring 161		BARK ST NO120 WHITE LION BROW NEW ST DEANE RD TECH SPA RD LOCAL PRINCE ST KAYS HANOVER ST MARSDEN HS/BOOTS CHEMIST/PADERBOR
SPRING GDN ST / LANCASTER	Ring 162 Ring 162	H H	THE MILL RACE/WHITE CROSS/WOODVILLE LANCASTER ATE
ST ANNES / LYTHAM ST ANNES	Ring 163 Ring 163 Ring 164 Ring 164		OXFORD RD/ST LEONARDS RD SCHOOL ST ANNES LOCAL SHARMAN AVE OLD LINKS/BLUNDELL RD
STRAWBERRY BANK / ACCRINGTON	Ring 165 Ring 165	H H	QUEENS RD PIONEER WKS/ADDISON CT

Primary/Location	Circuit Trial Type	Hand-charge spring	Circuit Name
STUART ST / MANCHESTER	Ring 166 Ring 166		F9 HELSTON ST HEALDS DAIRY LORD N CONS/HEALDS DA
UNION ROAD / BOLTON	Ring 167 Ring 167 Ring 168 Ring 168 Ring 169 Ring 169 Ring 170 Ring 170		D&S FOODS UNION RD UNION RD IND EST/BRITAX VERNONS FOLDS RD LH SW BOARD LEIGHS PAINT MULE ST/TURNER BRIDGE/ HEALTH & LEISURE CTR/ADCO SLATERS LITTLE BOLTON/WATERS MTG RD HILLFIELD DR/BRITANNIA WAY WALMSLEYS UNION RD/DENVALE MILL
URMSTON / URMSTON	Ring 171 Ring 171		F1681 CANTERBURY LOSTOCK F1682 LEWIS'S
VICTORIA PK / MANCHESTER	Ring 172 Ring 172		F4074 POLY CENTRAL BLDG/M/U CAMBRIDG F4071 BOOTH ST W
WARDLEWORTH / WARDLEWORTH	Ring 173 Ring 173		WARDLEWORTH DIST RUGBY RD/EASTGATE ST
WESTHOUGHTON / WESTHOUGHTON	Ring 174 Ring 174		DE LA RUE WIMBERRY HILL/WINGATES /FOURGATES
WHALLEY RANGE / WHALLEY RANGE	Ring 175 Ring 175 Ring 176 Ring 176 Ring 177 Ring 177		F958 DEMESNE RD/W RANGE HS/SPRINGB F1697 CLARENDON RD F1699 DUDLEY RD (ADJ NO51) F1696 CROMWELL AVE/BUCKINGHAM RD F1062 REGENTS CT F1700 VAUGHAN RD/WITHINGTON RD/ALE
WILLOWHOLME / WILLOWHOLME	Ring 178 Ring 178		LOWRY HILL NO3 ETTERBY RD
WOODBINE ST / ROCHDALE	Ring 179 Ring 179	H H	MOSS MILL CRAVEN HEIFER
WOODLEY / BREDBURY	Ring 180 Ring 180		HORSFIELD WAY NO3 TRAVELLERS CALL

# Radial Circuits

Primary/Location	Circuit Trial Type	Hand-charge spring	Circuit Name
AMBLESIDE / AMBLESIDE	Radial 1 Radial 2		BORRANS CT SKELWITH BRIDGE/CROFT COTT ABS
BURROWBECK / BURROWBECK	Radial 3		BAILRIGG LN END
DALTON / DALTON	Radial 4		Victoria St
FERODO / CHAPEL-EN-LE-FRITH	Radial 5		CHAPEL MAIN/WHITEHALL WKS
GREENFIELD / GREENFIELD	Radial 6		CARR BARN
HALL CROSS / FRECKLETON	Radial 7 Radial 8		KIRKHAM RD FRECKLETON ST SOUTH
HAVERTHWAITE / HAVERTHWAITE	Radial 9 Radial 10		GREENODD SW STN LEVENS GARTH/BREWER WOOD
HDA No2 / WINSCALES	Radial 11		WOODVILLE WAY
HILL TOP / WORSLEY	Radial 12		ARKHOLME
NEWTONGATE / PENRITH	Radial 13 Radial 14 Radial 15		WILDRIGGS AUCTION MART ABS FELLSIDE FOODS
ORMSKIRK / MANCHESTER	Radial 16		SAFEWAY (ORMSKIRK)
SOUTH EAST MACC / MACCLESFIELD	Radial 17		LONDON RD EAST
WHITTLE LE WOODS / WHITTLE LE WOODS	Radial 18		WHITTLE SPRINGS/ROYTON DR/TRUEMETA
WIGTON / WIGTON	Radial 19		GREENRIGG FM ABS / CHURCHRIGG ABS
WRIGHTINGTON /WRIGHTINGTON	Radial 20		BROADHEY LN/HILLDALE

# Spare Circuits

Primary/Location	Circuit Trial Type	Hand-charge spring	Circuit Name
CARR ST / SWINTON	Spare 1 Spare 1	H H	MORPETH ST MOORSIDE SCHOOL
COX GRN / BROMLEY CROSS	Spare 2 Spare 2	H H	DUNSCAR IND EST/HR RIDINGS TOPPINGS KIOSK
FAILSWORTH / FAILSWORTH	Spare 3 Spare 3	H H	F102 IVY MILL F222 BOSTON CL
INDIA ST / DARWEN	Spare 4 Spare 4	H H	SOUGH RD TURNCROFT RD / STARKIE ST
LITTLE HULTON / LITTLE HULTON	Spare 5 Spare 5	H H	LUCOZADE/MANCHESTER RD W HOPE HEY LN/BANK GR/NEWGATE DR
LONGSIGHT / LONGSIGHT	Spare 6 Spare 6	H H	F579 WILMSLOW PK SECT A F4067 Q3 APTS
LOWER DARWEN / LOWER DARWEN	Spare 7 Spare 7	H H	ROMAN RD BUS PK BLACKAMoor RD/MARTINS/LR DARWEN S
ROBERT HALL ST / SALFORD	Spare 8 Spare 8	H H	F326 EXCHANGE QUAYS NO 7 F2031 EXCHANGE QUAYS NO 2