



## Electricity Specification 316

Issue 1

May 2012

# Shunt Connected Capacitor Banks for use on the 6.6/11kV System

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Approved for issue by the

**Technical Policy Panel**

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Issue and Amendment Summary

Amendment No. Date	Brief Description and Amending Action
<p>0 24/05/12</p>	<p>Issue 1 First Issue Prepared by: M A Kayes Approved by the Technical Policy Panel and signed on its behalf by: Paul Whittaker</p>



## SHUNT CONNECTED CAPACITOR BANKS

### 1. INTRODUCTION

This Electricity Specification (ES) details the installation of Shunt Connected Capacitor Banks on to the Electricity North West Limited Distribution system for the purpose of providing a source of reactive power to local demand centres.

### 2. SCOPE

This ES and attached schedules cover the general design specification of single busbar metal-enclosed Shunt Connected Capacitor Banks with integral switchgear for use on the 6.6kV or 11kV system of Electricity North West Limited, hereinafter referred to as Electricity North West. The integral switchgear shall comply with ES313.

### 3. DEFINITIONS

- Approval:** Sanction by the Electricity North West Plant Policy Manager that specified criteria have been satisfied.
- Contract:** The agreement between Electricity North West and the Contractor for the execution of the Works including therein all documents to which reference may properly be made in order to ascertain the rights and obligations of the parties under the said agreement.
- Contractor:** The person or person's firm or company, including personal representatives, successors and permitted assigns, whose tender has been accepted by Electricity North West.
- Specification:** The Specifications and schedules (if any) agreed by the parties for the purpose of the Contract.
- Sub-Contractor:** Any person (other than the Contractor) named in the Contract for any part of the Works or any person to whom any part of the Contract has been sub-let with the consent in writing of the Electricity North West Plant Policy Manager, and the legal representatives, successors and assigns of such person.
- Supplier:** Any person or person's firm or company who supplies goods to Electricity North West or to its contractor.
- Tender:** An offer in writing to execute work or supply goods at a fixed price.
- Tenderer:** The person or person's firm or company, including personal representatives, successors and permitted assigns, invited by Electricity North West to submit a Tender.
- Capacitor Bank:** The complete unit incorporating Capacitor units, control/protection, circuit breakers, busbars and all other ancillary equipment provided as a complete module
- Capacitor:** The individual capacitive elements installed inside a Capacitor Bank
- SCADA:** The SCADA unit provides the ability to control and monitor substation plant and equipment and other elements that form part of the Electricity North West system. The SCADA unit may also be referenced as a

telecontrol outstation, RTU, Microsol outstation or Scout outstation.

#### **4. GENERAL REQUIREMENTS FOR APPROVALS AND TESTING**

##### **4.1 Product not to be Changed**

No change in the product, packaging or labelling shall be made after Approval has been granted without prior notice to the Electricity North West Plant Policy Manager, and receipt of a written agreement to the proposed change from the Electricity North West Plant Policy Manager.

##### **4.2 Electricity North West Technical Approval**

4.2.1 The Tenderer shall submit, with this Tender, proposals for testing which will demonstrate, to the satisfaction of the Electricity North West Plant Policy Manager, compliance with this Specification. Such tests shall be carried out without expense to Electricity North West.

4.2.2 Alternatively, the Tenderer may submit technical reports and other data that he considers will demonstrate, to the satisfaction of the Electricity North West Plant Policy Manager, compliance with this specification. Acceptance of this evidence shall be at the discretion of the Electricity North West Plant Policy Manager but will not be unreasonably withheld.

4.2.3 Approval shall be 'factory specific' and is not transferable to another factory without the written approval of the Electricity North West Plant Policy Manager.

4.2.4 The supplier and product shall comply with all the relevant requirements of Electricity North West documents EPD311 and CP311.

##### **4.3 Quality Assurance**

4.3.1 The Tenderer shall confirm whether or not approval is held in accordance with a Quality Assurance Scheme accredited under ISO 9000. If not, he shall submit a statement of the quality assurance procedures employed to control the quality of the product, including the performance of Suppliers and Sub-Contractors.

4.3.2 The right is reserved for the Electricity North West Plant Policy Manager to require, from time to time, the repeat of such tests as he may deem to be reasonably necessary to demonstrate continued compliance with the Specification.

4.3.3 The Tenderer shall submit, with his Tender, a list of tests and inspections which are carried out on the product prior to despatch which shall demonstrate, to the satisfaction of the Electricity North West Plant Policy Manager, fitness for installation and service.

4.3.4 The Tenderer shall provide free of charge to Electricity North West such samples as may, in the opinion of the Electricity North West Plant Policy Manager, be reasonably required for inspection and/or retention as quality control samples. The Electricity North West Plant Policy Manager will confirm the requirement for samples at the time of Tendering.

- 4.3.5 The right is reserved for the Electricity North West Plant Policy Manager to make, from time to time, such inspections of the Tenderer's facilities as he may deem to be reasonably necessary to ensure compliance with this Specification and any Contract of which it forms a part.
- 4.3.6 The Tenderer shall submit, with his Tender, such details of product packaging disposal, as will enable Electricity North West to comply with the requirements of BS EN ISO 14001: 2004 - Environmental Management Systems.

#### **4.4 Formulation**

The Tenderer shall submit, with his Tender, such details of the formulation and use of the product and associated substances as will enable Electricity North West to comply with the obligations of the Health and Safety at Work Act 1974 and the Control of Substances Hazardous to Health Regulations 2002, in the use, storage and disposal of the product. The Tenderer may stipulate, prior to submission of such information, that he requires it to remain confidential and the Electricity North West Plant Policy Manager will, if requested, confirm his agreement to this prior to receipt of the information.

#### **4.5 Identification Markings**

- 4.5.1 The Tenderer shall submit, with his Tender, details of markings which it is proposed to apply to the product or packaging to identify manufacturing batches or items. The forms and content of such markings shall be subject to the Approval of the Electricity North West Plant Policy Manager, and shall in all cases include the Electricity North West Approved Description and Commodity Code Number.
- 4.5.2 The Tenderer shall submit, with his Tender, such details of marking gross weight on components, assemblies and packages, as will enable Electricity North West to comply with the Health and Safety Manual Handling Operation Regulations 1992, for components, assemblies and packages supplied with a gross weight over 1kg. The forms and content of such markings shall be subject to the Approval of the Electricity North West Plant Policy Manager.

#### **4.6 Minimum Life Expectancy**

The minimum life expectancy of all products covered by this Specification is 40 years.

#### **4.7 Product Conformity**

Preference will be given to those suppliers who can provide suitable Product Conformity Certification to a recognised or specified standard, or an equivalent certification.

## **5. REQUIREMENTS FOR TYPE AND ROUTINE TESTING.**

The Electricity North West Plant Policy Manager shall set out the requirement of the following tests to be carried out by the Supplier at the Supplier's cost.

Electricity North West reserves the right to witness any of the routine or type tests. This will comprise a minimum of all tests on the first of a new design from any factory will be witnessed by Electricity North West. The Contractor shall cover travelling, accommodation and other reasonable expenses incurred whilst two Electricity North West representatives are witnessing the type tests. The Contractor shall provide a minimum of four weeks notice of any intended type testing elements.

### **5.1 Requirement for Type Tests at the Supplier's Premises**

These are a series of one-off type tests, which are carried out to ensure the satisfactory performance of the product design, under extremes of operating stresses, and of endurance, as may be appropriate, to be determined by the Electricity North West Plant Policy Manager.

These may or may not be destructive tests.

Capacitor Bank type testing shall be as those detailed in IEC 60871-1:2005.

### **5.2 Requirement for Routine Tests at the Supplier's Premises**

These tests may be required to be carried out on every individual unit or component, as specified, or at some regular frequency to be determined by the Electricity North West Plant Policy Manager.

The results of these tests may be required to be supplied to Electricity North West with each unit purchased or retained for inspection, at a period to be determined by the Electricity North West Plant Policy Manager.

Capacitor Bank routine testing shall be as those detailed in IEC 60871-1:2005.

### **5.3 Requirement for On Site Tests**

These will normally be included within the scope of on site commissioning, but may be included if appropriate.

## **6. GENERAL REQUIREMENTS.**

The Capacitor Bank shall comply with the clauses within this ES and ES313. Electricity North West will complete the data Sheet - Schedule A in Appendix A. The Tenderer shall complete Appendix A Schedules B and C and Appendix B Clause Conformance Documentation and return with the Tender return. ES313 Clause Conformance Documentation shall also be completed and returned with this Tender return.

### **6.1 Enclosures**

All enclosures shall be suitably designed for installation outdoors or at the discretion of the Electricity North West Plant Policy Manager, indoors should the site conditions permit.

Outdoor enclosures shall protect the equipment from the full range of weather conditions prevalent within the northwest region of the United Kingdom. The enclosures shall protect the equipment from the ingress of vermin and shall have an IP3XDW rating as a minimum, the IP rating shall be subject to Approval.



The standard unit shall have a material and finish suitable for the minimum life expectancy and at least a 20 year periodicity until it needs re-coating. The requirement is for high durability in a typical environmental category of at least C3 urban and industrial atmospheres with moderate sulphur dioxide production areas, with high humidity as described in ISO 12944-2. All external components, fixtures, fittings and attachments shall be to the same environmental category as the main housing. The Tenderer shall specify the necessary maintenance schedule to meet this and the minimum life expectancy as in section 4.6.

Suitable locking facilities shall be provided to facilitate the security against forced entry. All locking facilities shall be capable of utilising Electricity North West locks as per ES319.

Interlocking facilities shall be provided to prevent the accidental access to the live housing by key holding personnel. Details of the interlocking facilities shall be given in section 6.6.

Any cooling required shall be achieved by natural cooling. The housing shall be designed so that forced ventilation to compensate for the effects of solar gain during the summer period or due to heat generated by the Capacitor Banks internal components is not required.

Internal and external earthing points shall be clearly provided and indicated on the housing. All external earthing points shall be kept to a minimum and effectively screened and protected from theft where used.

## **6.2 Capacitor Bank Configuration**

The Capacitor Bank enclosure shall be configured in a three compartment design with a High Voltage (HV) incoming compartment to house the HV cabling, circuit breaker, disconnectors and earthing switches/devices as detailed in the Integral switch gear section 6.4 and cabling section 6.9, the second compartment shall house the control and interface wiring for the unit. The control and interface compartment maybe a sub section of the incoming section to allow for a compact design unless this compromises the operational segregation of the HV cables and switchgear. The third compartment shall be the main housing for the Capacitor units and ancillary equipment, no means of direct access from the HV incoming or control and interface compartments shall be possible. Access to this compartment shall be controlled through interlocking with the HV Switchgear,

The Capacitor elements shall be configured in a double star configuration with the star points connected together to provide a common star point. This common star point shall be designed to allow for the inclusion of an out of balance protection scheme as detail in the protection section 6.3

## **6.3 Protection and Control**

Overall protection for the Capacitor Bank shall be provided by external protection provided by Electricity North West with facilities for over current, earth fault, over voltage, under voltage, out of balance protection and any other protection recommended by the Capacitor Bank supplier.

The Capacitor Bank overall protection relay as detailed above shall derive its current and voltage signals from Current Transformers (CT) and Voltage Transformers (VT) located inside the feeding switchgear embedded within the Electricity North West network with the exception of the out of balance CT signal as detailed below.

The Capacitor out of balance protection shall derive its current signal from a CT located in the connection between the Capacitor star points. The out of balance CT shall be supplied by the Tenderer with the Capacitor Bank.

Individual Capacitor elements shall be protected by independent HV fuses that shall allow the continued operation of the Capacitor Bank with minimal detriment to the remaining Capacitors; this shall proceed until the Capacitor Bank becomes sufficiently unbalanced as to operate the unbalance protection scheme.

The Capacitor Bank shall have facilities for electrically opening and closing of the integral circuit breaker either from the Electricity North West SCADA outstation or from a remote control panel, indication of the circuit breakers status shall also be provided by two sets of volt free auxiliary contacts.

Means for local mechanically opening and closing of the breaker shall also be provided.

#### **6.4 Switchgear and Circuit Earthing**

An integral circuit breaker shall be provided that is capable of breaking the full capacitive rating of the bank and be capable of breaking fault currents as detailed in section 6.7.

The circuit breaker shall be in accordance with Electricity North West ES 313 and Energy Networks Association Technical Specification (ENA TS) 41-36.

Circuit breaker auxiliary switches and facilities for a trip circuit supervision scheme shall be provided to allow for a remote control and protection panel as per ES313.

Electricity North West requires the facility to fully isolate and earth both the Incoming cable and the integral Capacitor Bank separately. The Tenderer shall clearly demonstrate within their Tender return how this shall be achieved using fully rated and tested devices.

If a staged Capacitor arrangement is required then the contactors necessary to facilitate the alteration of the capacitance shall be in addition to this circuit breaker.

Where earthing harnesses or earthing leads are required to maintain the Capacitor Bank, they shall be provided with the bank as part of the Tender in a secure storage container.

#### **6.5 Capacitor Bank Discharging**

The Capacitor Bank shall be provided with a means to discharge the Capacitor Bank, this could be by discharge reactors and/or resistors. The Tenderer shall clearly demonstrate the safe method of Capacitor discharging with their Tender.

The Tenderer shall clearly demonstrate the discharge time and the resulting temperature of the discharging resistors. Where the temperature poses a hazard it shall be adequately screened to remove the hazard to Maintenance Personnel.

## 6.6 Interlocking

Mechanical interlocking between the Capacitor Banks internal circuit breaker and earth switches shall be provided to prevent access to any chamber unless the Capacitor Banks earth switch has been applied.

Key interlocks shall be used within the switchgear, interlocking shall be provided by Castell type FS (or equivalent) for mechanical locking only.

## 6.7 Common Ratings

The Capacitor Bank and associated equipment shall have minimum nominal ratings as indicated below:-

Rated Voltage	7.2kV or 12kV
Rated nominal current – Circuit Breakers	630A, 1250A, 2000A, 3150A
Rated nominal current – Bus Bars	630A, 1250A 2000A, 3150A
Rated short circuit current	21.9kA minimum

## 6.8 Inrush Reactors

Inrush reactors shall be supplied to limit the maximum inrush current to less than half of the rated current of the bank

Tenderers shall provide adequate evidence to support this.

## 6.9 Cable Terminations

As per ES313 unfilled terminations are required. Unless previously Approved, drawings of the cable boxes complete with all relevant design information shall be provided for assessment by the Electricity North West Plant Policy Manager. Cable box bushings shall comply with BS EN 50180 Table 14 Type C suitable for use with separable connectors. The internal arc tested cable box shall be sized so that two cables per phase can be used

Provision shall be made for earthing individual copper screens. This shall take the form of a set of earth bars mounted on but insulated from the base of the cable box, the insulation shall be suitable for 10kV working isolation. This internal cable box earthing shall be connected to the external true earth bar via insulating bushings, which shall withstand a test voltage of 10kV dc.

Means shall be provided for fixing cable supports.

The expected type of cable to be installed and type of glands to be provided will be stated in the enquiry documents. The gland plate (non-ferrous) is preferred to be a minimum of 250mm from ground level.

## 6.10 Internal Arc Tested Equipment

All Switchgear offered shall have completed Internal Arc Testing in accordance with ENA TS 41-36 will be expected to be supported by test evidence, from a recognised Short Circuit Testing Station, of the ability of a unit to vent in a safe and predictable manner in the event of an internal arc occurring.

The entire Capacitor Bank Housing shall be fully Internal Arc Tested by a recognised Short Circuit Test Station. Supporting Test Evidence shall be provided by the Tenderer. It is preferred that the Capacitor Bank has full internal arc containment, however where blast relief flaps are used within the housing these shall be retained by chains allowing them only to open at a maximum of 45° to prevent injury to the any persons should a failure occur. Details of all blast relief panels shall be submitted with the Tender.

Manufacturers shall also be expected to provide guidance information on the correct positioning of the unit within the substation enclosure so as not to invalidate the tests. This guidance shall include the following for each type of switchgear offered.

- The arrangements of the enclosure in which internal arc testing was carried out, highlighting differences from those specified in ENA TS 41-36 section 1.5.101.
- Drawings showing the venting volumes required for fault ratings up to 21.9kA.
- A drawing of the interface trunking that should be attached to the vent on the switchgear suitable for connection to Electricity North West standard trunking with external cross section of 342mm by 342mm.
- The need for additional ducting is not desirable and tenderers shall indicate the circumstances under which they consider venting would be necessary, so that such situations can be avoided.

A copy of this information shall be included with the tender but an additional copy shall be sent to the Electricity North West Plant Policy Manager.

## 6.11 Housing Earthing

Suitably rated earthing points shall be provided on the housing to allow for the frame to be connected to the substation general earth, internal earthing bars shall also be provided to allow for internal connections to the substation earth and any auxillary earthing harnesses as may be deemed necessary for maintenance purposes.

Manufacturers shall demonstrate how the housing earth can be routed and connected to the housing to prevent it from being visible and theft resistant.

## 6.12 Capacitor Element Construction

Capacitor elements shall be constructed preferably from solid state materials with minimal or preferably no maintenance requirements.

Solid state components are also desired so as to reduce any risk of contamination to the surrounding environment and the requirement to bund the bank.

Polychlorinated Biphenyls (PCBs) shall not be used in any element of the banks construction.

All elements used in the capacitor banks construction shall be Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) compliant.

## 6.13 Current Transformers

Current Transformers (CT) shall in general comply with the requirements of BS EN 60044-1, but where required they shall also comply with the additional requirements of ENA TS 35-17 for Class X(PX) CT's.

The primary windings shall be of the bar type wherever the choice exists.

Magnetising curves of all CT's shall be submitted for Approval, to Electricity North West Protection Policy Manager, unless previously approved by Electricity North West as a standard. The manufacturer shall carry out mag curve tests on all installed CT's as part of the routine factory tests.

The thermal and mechanical rating of the CT's shall not be less than that corresponding to the rating of the switchgear to which they are connected.

The rating plate for the CT shall clearly show the serial number, primary and secondary rated current, output and accuracy class. In addition the rated continuous thermal current of the CT shall be clearly marked on the CT rating plate.

The manufacturer will provide copies of all test data for the CT's, this to include the type, routine, mag curves and any special test reports that have been carried out in accordance with BS EN 60044-1 or ENA TS 35-17 for Class X CT's to the Electricity North West Plant Policy Manager.

A set of CTs shall be provided in the Capacitor Bank circuit breaker these shall be utilised for protection or monitoring purposes as is deemed necessary. This set of CTs shall have the following particulars:

Ratio	Class
600/400/1	15VA 10P20

A CT shall be supplied within the connection of the capacitor banks star point; this CT shall be suitably rated and sized to allow for the out of balance currents to be monitored by a remote protection relay. The CT shall have a 1A secondary connection with a minimum ratio of 5/1A. The CT shall be capable of a rated burden of 15VA or greater to allow for the impedance to a remote protection relay. The accuracy class of the CT shall be sufficient to allow for the remote protection to operate with a multistage operation for alarm and trip or any other setting deemed necessary by the manufacturer or Electricity North West.

#### **6.14 Multicore Cables**

No multicore cabling is included in this contract. The multicore cables which shall be installed by Electricity North West shall normally be plastic insulated steel wire armoured, but rubber or paper insulated, lead sheathed and armoured as well as aluminium sheathed cables may also be used.

Electricity North West shall not normally use multicore/multi-pair cables with less than four or more than nineteen cores/pairs. In general, the multicores required will be selected from those detailed in ENA TS 09-6.

The Contractor shall provide undrilled removable gland plates to accommodate the multicore cables. The identification of the cores, terminating and connecting them to suitable terminal boards shall be excluded from the Contract.

Where the Manufacturer states adequate temperature control of the Capacitor Bank is required the gland plates shall be of the Roptec Block Type.

#### **6.15 Harmonics**

The Capacitor Bank shall be capable of withstanding the maximum level of planning harmonics as detailed in ENA Engineering Recommendation (ER) G5/4, also the harmonic characteristics as detailed in IEC 61000-3-6:2008 without any detriment to its operation or life span; additionally the Capacitor Bank shall not introduce any additional harmonics or amplify those already present in the system.

The Capacitor Banks shall be designed to prevent any resonance with the existing equipment and harmonic levels already present at the point of connection. The Electricity North West appointed designer will specify in Appendix A Schedule A, the impedance at the point of connection to allow for the design to be completed.

#### **6.16 Detuning Reactors**

The option to fit detuning reactors shall be provided if the point of connection presents harmonics or resonant points that would cause the Capacitor to fail or cause undesirable disturbances on the distribution network.

It is desirable that the detuning reactors do not require any form of active cooling to maintain their operation, if cooling is required then this shall be confirmed with the Electricity North West Plant Policy Manager.

## **6.17 Small Wiring and Ancillary Equipment**

The following additional requirements are to be met: -

### **Auxiliary Switches**

Auxiliary switches may be called for which will change position as the equipment is operated or any access panels are removed so as to indicate to any external protection or control equipment the condition of the equipment.

All auxiliary switches, whether they are in use or not, shall be wired up to a suitable Approved terminal block located in the common connections compartment.

The use of auxiliary relays to substitute for the inability to supply and connect sufficient auxiliary switches is strongly deprecated and is subject to Approval by the Electricity North West Plant Policy Manager in each individual case.

### **Wiring Looms and Terminal Blocks**

Where practical, secondary protection and control wiring looms shall be run in trunking. Wiring looms, bus wiring and terminal blocks shall not be located on the inside floor or roof of protection and control cabinets.

## **6.18 Auxiliary Supplies**

For the purpose of this specification, a nominal 110V battery and a 240V single-phase ac supply may be assumed as standard.

## **6.19 Terminals and Terminal Blocks**

Insertion clamp type terminals for CT wiring and Electricity North West multicores, labels, terminal covers and multicore terminal blocks shall comply with ENA TS 50-18. Terminals supplied for the termination of Electricity North West multicore cabling shall be Weidmuller RSF1 for CT circuitry and RSF3 all other protection and control circuitry.

## **6.20 Disposal of Capacitors Banks and/or its Components**

Tenderers shall provide details on how to dispose of the switchgear and/or its components to ensure compliance with the various waste management regulations [Environmental Protection Act 1990 (Part II); Special Waste Regulations 1996; Waste Management Licensing Regulations 1994; Control of Pollution (Amendment) Act 1989]

## **6.21 Failure, Modes, Effect and Cause Analysis (FMECA)**

Tenderers shall carry out a FMECA or equivalent study for each type of equipment offered. A copy of this study shall be provided with the tender documents.

## **6.22 Spare Parts and Tools**

A set of tools and a container as required for the operation and maintenance of the switchgear at any one substation shall be provided.

### **6.23 Operation and Maintenance Manuals**

Operation and Maintenance manuals shall be provided per individual Capacitor Bank.

The manuals shall be provided in paper and electronic format with three copies of each being supplied per Capacitor Bank.

All ancillary equipment required to maintain the bank shall be included in the tender.

A copy of all installation, operation and maintenance manuals shall be submitted with the tender. These manuals shall, preferably, be on a CD-ROM in an Adobe Acrobat and AutoCAD 2012 DWG formats. Tenderers can submit the Manuals via internet downloads and webstores if available.

### **6.24 Manufacturers Drawings**

All Drawings shall be in accordance with any Electricity North West individual Contract requirements and additionally with any applicable Electricity North West standards.

General arrangement drawings shall be submitted. These drawings shall include overall dimensions, headroom for erection and operation, withdrawal space where appropriate, and positions of main and multicore cables.

On receipt of an order the Contractor shall submit drawings at any early date on CD-ROM in an AutoCAD (.dwg) format and one paper print maximum size A1 of all diagrams and drawings to the Electricity North West Plant Policy Manager for Approval.

All equipment shall be in accordance with Electricity North West' current standard schematic drawings and multicore schedules, which shall be registered with the Contractor.

The Tenderer shall return all the drawings and in the format as detailed in Appendix A Schedule C.



## 7. DOCUMENTS REFERENCED

Health and Safety at Work Act 1974

Control of Substances Hazardous to Health Regulations 2002

Manual Handling Regulations 1992

Environmental Protection Act 1990

Special Waste Regulations 1996

Waste Management Licensing Regulations 1994

Control of Pollution Act 1989

Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)

ISO 9000	Quality Systems - Guide to Dependability Programme Management
BS EN ISO 14001	Environmental management systems. Requirements with guidance for use
ISO 12994-2	Corrosion Protection
IEC 60871-1:2005	Shunt capacitors for a.c. power systems having a rated voltage above 1000V. General.
IEC 61000-3-6:2008	Electromagnetic Compatibility (EMC) Limits. Assessment of emission limits for the connection of distorting installations to MV, HV and EHV power systems.
BS EN 60044-1	Instrument transformers. Current transformers
ENA ER G5/4	Harmonics
ENA TS 09-6	Auxiliary Multicore and Multipair Cables
ENA TS 35-17	Class X Current Transformers
ENA TS 41-26	Distribution Switchgear for Service up to 36kV (cable connected)
ENA TS 41-36	Distribution Switchgear for Service up to 36kV (cable and overhead conductor connected)
ENA TS 50-18	Design and Application of Ancillary Electrical Equipment
CP311	Equipment Approval Process
EPD311	Approval of Equipment
ES313	6.6kV and 11kV Single Busbar Indoor Switchgear (Cable Connected)

## 8. KEYWORDS

6.6kV; 11kV; CT; Capacitor Bank; Switchgear; Protection; VT

**APPENDIX A**

**SCHEDULE A**

**GENERAL REQUIREMENTS**

1.	Substation Name		
2.	System Voltage	kV	
3.	Network Impedance at Point of Connection		
4.	Circuit Breaker Rating	A	
5.	Circuit Breaker DC supply voltage.	DC	
6.	Capacitor Rating	MVar	
7.	Number of units		
8.	Date for delivery to site		
9.	Date for completion of erection		
10.	Date for commissioning		



## SCHEDULE C

### DOCUMENT SCHEDULE

#### 6.6KV AND 11KV CAPACITOR BANK DOCUMENT SCHEDULE (TO BE COMPLETED BY THE TENDERER)

Drawings	With Tender	Preliminary. Number of Weeks after Order.	Final. Number of Weeks after Order.
Capacitor Bank General Arrangement – Project Specific Dimensioned layout including details of the operating mechanisms and front mimic diagrams.	Typical.	-	12
Civil Interface Drawing – Project Specific Fully dimensioned plan and side elevation of switchgear showing – <i>Alignment profiles and floor openings</i> <i>Fixing points and details</i> <i>Weights and loads</i> <i>Floor tolerances</i> <i>Minimum clearances</i>	Typical	-	12
Panel Internal and External General Arrangement / Layout. <i>Showing –</i> <i>Relay types, sizes and locations</i> <i>Door cut outs</i> <i>Terminal blocks</i> <i>Resistors</i> <i>Switches</i> <i>Indicating lamps</i> <i>CTs</i> <i>Discharge Arrangements</i> <i>Earthing Arrangements</i>	Typical	-	12
AC and DC Schematics / Circuit Diagrams.	Typical	12	16
Wiring Diagrams <i>With enough information to allow point to point wiring checks to be carried out.</i>	Typical	12	16
CT Mag Curves	-	-	20
Erection & Commissioning and Operation & Maintenance Manuals	Typical	-	20

## General Notes

- 1) The above list is not exhaustive; the contractor (Capacitor Bank/switchgear manufacturer) shall provide all drawings and information that is required to fully understand the Capacitor Bank operation and design.
- 2) The above dates include 2 weeks for Electricity North West to comment on and approve drawings.
- 3) Common numbering system to be used on all drawings. Refer to Electricity North West key line diagram for numbers.

## Notes on drawings and drawing format

- (a) Orthographic drawings shall use metric units and be reproduced to a scale that is declared on each print. The scale for general arrangement drawings shall not be less than 1 to 50 and that for detail drawings shall not be less than 1 to 20, although in exceptional circumstances 1 to 33 may be acceptable, subject to prior agreement.
- (b) Drawings shall be monochrome black line on white paper, at least ISO A3 and not exceeding ISO A0 in size, with a clear margin on each edge of at least 25 mm. Multi-page drawing booklets are not acceptable.
- (c) Drawings shall be submitted for approval by the Purchaser on paper in duplicate (2 sets of A3 or full size as required.). They shall also be accompanied by equivalent AutoCad2012 .dwg format (rev 14) files on a CDROM or E-Mail as appropriate.
- (d) The name of the site, the drawing number and the date and number of revision shall be marked on all drawings. All drawings shall be numbered according to a logical scheme.
- (e) The drawings shall contain the Electricity North West' title block which will be provided at the contract stage.

## APPENDIX B

### SELF CERTIFICATION CONFORMANCE DECLARATION

#### CLAUSE BY CLAUSE CONFORMANCE WITH THIS ES

The manufacturer shall declare conformance or otherwise, clause by clause, using the following levels of conformance declaration codes.

Conformance declaration codes

- N/A = Clause is not applicable/appropriate to the product/service
- C1 = The product/service conforms fully with the requirements of this clause
- C2 = The product/service conforms partially with the requirements of this clause
- C3 = The product/service does not conform to the requirements of this clause
- C4 = The product/service does not currently conform to the requirements of this clause, but the manufacturer proposes to modify and test the product in order to conform.

Manufacturer:

Product/Service Description

Product /Service Reference:

Assessor

Name:	Company (s)	Signature	Date
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Clause/Sub-Clause		Requirement	Conformance Code	Remarks (Must be completed if Conformance Code is not C1)
3		Standards		
4	1	Product not to be changed		
4	2	Electricity North West Technical Approval		
4	3	Quality Assurance		
4	4	Formulation		
4	5	Identification Marking		
4	6	Minimum Life Expectancy		
4	7	Product Conformity		
5	1	Requirement for Type Tests at the Suppliers' Premises		
5	2	Requirement for Routine Tests at the Suppliers' Premises		
5	3	Requirement for On Site Tests		
6		General Design Requirements		
6	1	Enclosures		
6	2	Capacitor Bank Configuration		
6	3	Protection and Control		
6	4	Switchgear and Circuit Earthing		

6	5	Capacitor Bank Discharging		
6	6	Interlocking		
6	7	Common Ratings		
6	8	Inrush Reactors		
6	9	Cable Terminations		
6	10	Internal Arc Tested Equipment		
6	11	Earthing		
6	12	Capacitor Element Construction		
6	13	Current Transformers		
6	14	Multicore Cables		
6	15	Harmonics		
6	16	Detuning Reactors		
6	17	Small Wiring and Ancillary Equipment		
6	18	Auxillary Supplies		
6	19	Terminals and Terminal Blocks		
6	20	Disposal of Capacitor Banks and/or it's Components		
6	21	Failure Modes Effect Cause Analysis (FMECA)		
6	22	Spare Parts and Tools		



6	23	Operation and Maintenance Manuals		
6	24	Manufacturers Drawings		

Additional Notes: