CODE OF PRACTICE FOR THE METERING OF ELECTRICITY TRANSFERS BETWEEN THE NATIONAL GRID COMPANY PLC AND EXTERNALLY INTERCONNECTED PARTIES OVER DIRECT CURRENT INTERCONNECTIONS, USING THE NATIONAL INTERIM METERING SCHEME

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Code of Practice for the Metering of Electricity Transfers between The National Grid Company plc and Externally Interconnected Parties over Direct Current Interconnections using the National Interim Metering Scheme

FOREWORD

This document is one of a suite of Codes of Practice which supersedes Engineering Recommendation M24 - "Code of Practice for the Metering of Supplies from the Central Electricity Generating Board", issued in April 1973.

Details of the National Interim Metering System (IMS) are provided in a Functional Description issued by CEGB Transmission Division in November 1988. The IMS will ultimately be replaced by a new National System (FMS), and an alternative Code of Practice will then apply for Electricity transfers in this category.

NGC Settlements Limited as Settlement System Administrtor (as such term is defined in the PSA) shall retain copies of, inter alia, all Codes of Practice in this suite, together with copies of documents referred to in them, in accordance with the provisions of the PSA.

1. SCOPE

This Code of Practice determines the practices that shall be employed, and the facilities that shall be provided for the measurement of Electricity transfers between The National Grid Company plc (NGC) and Externally Interconnected Parties (EIPs) and for recording measured quantities for Settlement.

It refers particularly to the arrangements of metering on the current Anglo-French Direct Current (DC) link.

It complements and expands on the Metering provisions (Clause 56) of the Pooling and Settlement Agreement (PSA), to which reference should be made. In particular, it complements provisions relating to accuracy of measurement and the corresponding Metering Equipment Performance Specifications set out in Schedule 15 of the PSA. It should also be read in conjunction with the relevant Agreed Procedures for, inter alia operation of the data collection systems as specified in Schedule 16 of the PSA.

In the event of inconsistency between the provisions of this Code of Practice and the PSA, the provisions of the PSA shall prevail.

2. REFERENCES

The following documents may be referred to in the text:

British Standard BS 3938: 1973	Current Transformers
British Standard BS 3941: 1975	Voltage Transformers
CEGB Standard 993619 (TPS 6/19) 1985	Application of Metering to Tariff Circuits

CEGB Standard 993908 (TPS 9/14) 1983	Test Facilities for Current and Voltage Transformer Secondary Circuits
CEGB Specification EM21 (1982)	Electricity Meters, Induction Type
CEGB Specification EM24 (1980)	Cubicle for Accommodating Metering Equipment and Transducers
CEGB Specification EM27 (1986)	Static Energy Meters
CEGB Specification EM28 (1980)	Metering Information Tape Recording Equipment (MITRE)
CEGB Design Memorandum 099/101 (TDM 6/5) 1979	Definitions of Import and Export in Relation to Instrumentation and Metering
ESI STANDARD 50-18	Design and Application of Ancillary Electrical Equipment
ENGINEERING RECOMMENDATION M24	Code of Practice for the Metering of of Supplies from the CEGB
METERING FOR THE 2GW DC CROSS CHANNEL LINK - CEGB	Document dated March 1985
CEGB FUNCTIONAL DESCRIPTION (Issue 1, November 1988)	The National Interim Metering Scheme
CEGB SPECIFICATION	Modified MITRE Unit
CEGB SPECIFICATION	OSME Unit
CEGB SPECIFICATION	CM 10 Unit
CEGB SPECIFICATION (Issue 1, 17 March 1989)	Communication Protocol Definition for links between the IMS Projects and the Central Data Connection System
PTS261	Technical content of CEGB Primary Transmission Scheme 261, which sets out the IMS
PTS271	Technical content of CEGB Primary Transmission Scheme 271 which sets out the FMS

NOTE: All references to standards given in the text are to current versions. Where equipment is in use which was designed and built to earlier versions of these standards, there is no implied requirement to update this equipment.

3. DEFINITIONS

Except where otherwise specified herein the definitions in British Standards 205, 1991 and 4727 Part I, and British Standards for equipment shall apply as appropriate. The following definitions, which also apply, supplement or complement those in the PSA and are included for purposes of clarification.

3.1 Electricity

Active Energy and/or Reactive Energy

3.2 Active Energy

Active energy is that part of the Electricity supply capable of performing work. Unless otherwise stated it includes energy flows in both directions.

3.3 Reactive Energy

Reactive Energy is that part of the Electricity supply which cannot perform work, (the reactive voltampere hours). Unless otherwise stated it includes reactive energy flows in both directions. (Note: There is no flow of reactive energy over a DC link so this quantity is not metered).

3.4 Active Power

Active Power is the rate at which Active Energy is supplied.

3.5 Reactive Power

Reactive Power is the rate at which Reactive Energy is supplied.

3.6 Demand Period/Integrating Period

The Period over which Active Energy and Reactive Energy are integrated to produce Demand Values. For Settlement purposes at the Effective Date the demand period shall be 30 minutes.

3.7 Demand Values

Average values of Active Power and Reactive Power over a Demand Period. The demand values are half hour demands and these are identified by the time of the end of the Demand Period.

3.8 Meter Demand

A demand registered by a single Meter.

3.9 Total Demand

A demand derived either from the Summation of one or more Meter Demands of similar quantities or from other total demands.

3.10 Import

An Electricity flow to the External System of the EIP from the Transmission System of NGC. The verb "Import" and its respective tenses shall be construed accordingly. (See also Appendix A).

3.11 Export

An Electricity flow from the External System of the EIP to the Transmission System of NGC. The verb "Export" and its respective tenses shall be construed accordingly. (See also Appendix A).

3.12 Summation

Summation means the algebraic addition of two or more flows of Electricty, either simultaneously, or for impulse summation, within the minimum number of impulses for correct operation.

For the purpose of addition, Import flows are termed positive and Export flows are termed negative.

3.13 Commercial Interface

For the purposes of this code, the relevant physical locations at which commercial interfaces occur are as follows:-

At the defined commercial interface for Electricity exchange (in the case of the EdF link this is the busbar side of the busbar disconnectors at Sellindge 400 kv substation).

3.14 Metering Point

The physical location at which Electricity is metered.

3.15 Meter

A device for measuring Electricity.

3.16 Meter Register

A device, normally associated with a Meter or summator, from which it is possible to obtain the amount of Active Energy, or the amount of Reactive Energy that has been supplied in a circuit or circuits.

3.17 Raw Data

Demand Values collected from the Outstations and which have <u>not</u> been altered.

The Demand Values may have had automatic checks applied to them and be marked with flags describing their status relative to the checks.

3.18 Processed Data

Demand Values which have been amended by basic mathematical processes according to agreed algorithms.

3.19 Verified Data

Demand Values which, having been automatically checked, are considered satisfactory for commercial use.

3.20 Modified Data

Demand Values which are edited or substituted values where the Raw Data has been established as incorrect or missing.

3.21 Reconciled Data

Demand Values upon which monthly Settlements will be made, and which may include Validated Data which Meter reading is carried out monthly.

3.22 Validated Data

Demand Values which are ultimately regarded as being correct on the basis of aligning with the Meter Register advances.

3.23 Outstation

The site equipment which receives and stores pulses from the individual Meters, may perform some processing of the data and transmits the metering data to the Collector Station on request.

3.24 Interfacing Unit

A unit which interfaces between the Meter output and the Outstations to provide two (or more) outputs (eg to provide an additional output from a Meter with only one set of output contacts).

3.25 Interrogation Unit

A hand held unit which can extract information from the Outstation and store this for later retrieval.

3.26 Collector Station

The computer based equipment located at a few selected sites in the country, which collects data from the Outstations. Normally, this is carried out automatically each night but manual interrogation during the day is also possible.

The metering data are stored, tested, modified when necessary and transmitted on a daily basis to the central station.

3.27 Central Data Collection System (CDCS)

The computer system located at a central point which contains a national data base which is regularly updated from the Collector Stations to which it has dedicated communications links.

3.28 PSTN/CTN

The Public Switched Telephone Network/The appropriate Corporate Telephone Network.

3.29 The National Interim Metering Scheme (IMS)

The National Metering scheme as set out in PTS 261, in effect as at the Effective Date and continuing until the FMS Date (as defined in the PSA).

3.30 The National Final Metering Scheme

The National Metering Scheme as set out in PTS 271, coming into effect at the FMS Date.

4. METERING OVERVIEW

In general, metering for settlement purposes should be placed as close as practical to the point of supply or Commercial Interface between the parties involved.

After careful consideration, DC metering was adopted for the 2GW DC. link, believed to be the first time that DC metering at high voltages has been used for tariff metering.

5. PRIMARY VOLTAGE MEASUREMENT

HV resistive voltage divider using epoxy-coated thick-film resistors have been used for this purpose.

The overall resistive divider has a nominal value of 270Mohms with the specification dictating an accuracy requirement of $\pm$ 0.1% of this value.

6. PRIMARY CURRENT MEASUREMENT

Direct current CTs (or transductors) are used for this purpose. The design of these units is such that the error in the transfer characteristic is always less than $\pm$ 2% and less than $\pm$ 0.2% over the 75% - 100% load current range. Calibration of these errors allows a correction table to be incorporated in the metering system.

7. METERING - Electricity Measurement

To achieve the high level of integrity required, a main and check philosophy has been employed. Voltage dividers and DC CTs are duplicated as are the complete secondary measuring and processing equipment.

Main and check metering are separate systems with separate inputs, power supplies and separate output to the point where one is selected for use. Each system is capable of providing all the facilities necessary even if the other is unavailable owing to maintenance or a fault.

The Metering Systems are digital and are arranged to sample, digitise and average the input signals. Subsequent software multiplication of pole values for voltage and current produces power (which can be integrated to produce Active Energy values).

The systems have a metering accuracy overall of 0.5% (including primary measurements) over the load range 10% to 120%.

The long term timekeeping accuracy shall be based upon the Outstation receiving a timing signal from the Collector Station which is synchronised to true time by using a "Rugby" (Warwickshire) Radio clock.

The overall limits of error for the timekeeping which must allow for failure to communicate with the Outstation for an extended period of 10 days shall be:

(a) The commencement of each Demand Period shall be at a time which is within ± 10 seconds of the true time.

(b) The duration of each demand period shall be within ± .03% of the true duration.

In the case of DC CT input signals, a software look-up table of corrections is incorporated. After digitising and averaging input values are modified prior to multiplication for the power calculations.

A high degree of software checking and hardware redundancy is employed in order to have a system of high fundamental integrity.

Metered Active Energy values per pole are continuously incremented in software registers and on conventional mechanical counters. The pulse output from the loss-adjusted Meter Registers is fed to a CM-10 data collector to provide ½ hourly integrated power values for Settlement purposes.

Metering data is also provided direct from the DC metering systems to the NGC area and National Control Centres and to Electricité de France via the DC link's power line carrier communication link.

8. LOSSES AND COMPENSATION

Historically, metering on the cross-Channel link has been arranged to relate metered values to a point in mid-Channel. Since primary measurements and metering Active Energy values are made at the converter station, compensation for losses to the mid-point are required.

The value of the compensation term applicable to a given pole metering depends on the link operating condition. The factors involved are the number of poles in operation, the number of cables used and the position of the earthing for monopolar operation. Digital inputs are provided from the DC plant to the Metering Equipment to enable the software to determine the link operating status and hence apply the correct loss correction. The loss correction can be up to approx 0.7% of the full load link transfer value.

Since the Commercial Interface for Settlement purposes (as defined in Clause 3.13) does not accord with the mid-Channel point, an agreed compensation factor will be applied to the collected metered values, prior to their use in Settlement, to reflect the values as if measured at the Commercial Interface.

9 CALIBRATION AND TESTING OF EQUIPMENT

9.1 Initial Tests

All records of initial testing and calibration of primary measurement equipment, metering and data collection systems will be retained and made available by the Operator (as defined in the PSA). The opportunity will be given, through the Settlement System Administrator (as defined in the PSA), to witness comparable tests on any new or replacement equipment.

9.2 Periodic Tests/Maintenance

Routine maintenance of the Metering Equipment and data collection system will be carried out by the Operator and the Schedules used will be available for inspection.

9.3 Calibration

Being digital systems, the metering equipments associated with the DC link are not subject to periodic calibration checks.

The DC voltage dividers and DC CTs (transductors) are subject to a 6 yearly frequency of re-calibration.

9.4 Testing Procedures

A programme of any periodic tests shall be agreed between the Registrant and the Operator. The intention to conduct particular tests shall be notified to the Settlement System Administrator by the Operator in accordance with the provisions of the PSA.

9.5 Tests on Replacement Equipment

The opportunity will be given to witness comparable tests on replacement equipment in accordance with the provisions of Clause 56.9.2(a) of the PSA.

10 DATA TRANSMISSION ROUTES AND PROCESSING

10.1 Meter(s) to Site Outstations

Data from Meters will be fed continuously and either directly or, where necessary, via a Meter interface unit, to the respective site Outstation.

Logic calculations carried out on the data by the Outstations may include

i Summation of two or more inputs.

ii Subtraction of one input or one Summation from another input or Summation.

iii Division of an input, a Summation, or an output, by an integer, generally 15 or less.

iv Multiplication of an input, sometimes associated with a division to give a fraction.

v Coding of the output, generally into 11 bit Teletype code, with even parity and parity checking.

vi Counting in demand and/or cumulative logic.

vii Scaling to convert each impulse to an appropriate count consistent with its impulse value.

Not all these forms will occur in any one equipment, and other forms may be required. Details shall be recorded in relevant Agreed Procedures. The result of the Raw Data and Processed Data collected is stored in memory and remains stored on site after interrogation by the Collector Station depending upon the capacity of the equipment, for a minimum of 9 days after collection (generally a longer time period obtains) after which it may be overwritten. During this period it can be retrieved.

10.2 Site Outstation to Collector Station

Data from Outstations will be collected by the respective Collector Station by daily dial up. Further data transfers may take place, initiated manually. Automatic checking procedures are carried out on the data collected from Outstations and the results are reported at the Collector Station.

10.3 Collector Station to Central Data Collection System

Data from Collector Stations is transferred automatically each day. This data will normally relate to the previous day, but on occasion might cover two or more days in particular cases. If necessary, further data transfers may take place on any day, initiated manually, following investigation of reports.

CEGB Specification: Communication Protocol Definition for links between the IMS Projects and the Central Data Connection System includes details of requirements for data transmission.

The Central Data Collection System holds data collected, and these will be available to the respective parties as provided for in Schedule 9 to the PSA. The data will also be used by the Settlement System Administrator for the purposes of Settlement.

11 ACCESS TO DATA

11.1 General

Access to data and physical access to Metering Points, Data Collection Stations and the Central Data Collection System shall be in accordance with the provisions of the PSA and the Agreed Procedures referred to therein under Schedule 16, save as below.

11.2 Access at Metering Points

The Operator shall have physical access to the metering system which it operates which will include the ability at the Metering Point to interrogate the data Collection Outstation using a portable computer known as an Interrogation Unit (IU).

The IU can be used as a fault finding tool and, in exceptional circumstances, when communications from the collector station fail for an extended period (BT line fault) can be used to retrieve the stored data.

Only staff both nominated by the Operator and authorised by the Settlement System Administrator may operate an IU and interrogation of a given Outstation requires use of a unique Outstation identification number.

13. MISSING OR DEFECTIVE DATA AND CONTINGENCY ARRANGEMENTS

Schedule 16 to the PSA specifies Agreed Procedures which cover the following operational considerations of the Data Collection systems:-

- Sources of missing or defective data
- Detection of defects
- Validation of Data
- Reconciliation of discrepancies
- Estimation Procedures

14 NOTIFYING/SETTLING OF DISPUTES

The relevant clauses of the PSA shall govern the procedures for notifying and settling of Disputes.

APPENDIX A

LABELLING OF METERS FOR IMPORT AND EXPORT

A1 The terms Import and Export are defined in sub-clauses 3.10 and 3.11 and it is considered desirable to recommend a standard method of labelling Meters (or suitable labelling panels etc), and to establish the relationship between Import and Export Active Energy.

A2 Active Energy

Active Energy is considered to be Imported when it flows from the NGC Transmission System to the External System of an EIP. The Meters registering this Active Energy should be labelled "Import".

Active Energy is considered to be Exported when it flows from the External System of the EIP to the NGC Transmission System. The EIP Meters registering this Active Energy should be labelled "Export".

This convention is based on"Import" and "Export" being from the viewpoint of the Registrant of the Metering System.