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Metering Code

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1 INTRODUCTION

J[1]**.** Introduction to the **Metering Code**. Setting out the technical Specifications and Standards for the metering of the energy flow at custody transfer points between areas for fiscal purposes and for operational purposes.

In the building of an efficient integrated **PAEM**, the **Metering Code** is fundamental in outlining a set of minimum requirements for the Metering Responsible parties operating in the Pan Arabic Electricity Market.

In **PAEM**, **Metering Data** from **TSOs** are required for the accurate settlement of the traded electricity. This **Code** sets the technical references (standards) for the measurement of power and energy import and export flows at each connection point identified as custody transfer points between the participating TSO's.

The **Metering Code** specifies the minimum technical, design and operational criteria to be complied with for the accurate metering of each point of interchange of energy between **TSOs**, or **Non-PAEM TSOs**. The metering at the Interchange Points is required for real-time operation of AGC systems and for the accurate accounting for fiscal purposes and possibly also: for the accounting of Inadvertent Deviations in meeting the **Scheduling & Dispatch Code**.

The **Metering Code** also specifies requirements for the associated **PAEM Data** and **Operational Data** related to metering procedures required for the compliant operation of the **Pan Arab Settlement Responsible Party,** by the **Market Secretariat,** as governed by **PAEM** for the **PAEM Electricity System**.

The **Metering Code** is not concerned with:

a) Metering of **Connection Points** between **Grid Users** and **National Systems**, and
b) Metering for commercial purposes.

These **Metering Systems** are subject to **National Grid Codes** or **Regulations** and or **Power Purchase Agreements**.

Further, the **Metering Code** is not concerned with:

a) The methodology to handle **Data Exchange** from **TSO**s or other **PAEM** actors, and
b) The responsibilities of the **Market Secretariat** in relation to the storage of **Metering Data** and the provision of the Common **Information** to Users.

These areas of responsibility are subject to the **Date Exchange Code** and **PAEM** Policies.

[1] **J.** : Justification

2 OBJECTIVE

J. The **Metering Code** establishes i) the applicable standards in the **Metering Equipment** in full; ii) the accuracy requirements and continuous activities to maintain the accuracy; iii) the approvals and certification requirements; iv) the Data responsibilities; v) the parties with which the **Metering Code** requirements applies to.

The objective of the **Metering Code** is both to outline common principles, and specify minimum technical and design requirements, as well as establishing the basic rules around the data collection for the **TSOs** and other actors in the **PAEM**.

3 TECHNICAL, DESIGN AND OPERATIONAL CRITERIA

J. The Fiscal **Metering Equipment** shall reliably record and store the relevant data in five-minute intervals at custody transfer points with other **Control Areas** or **External Systems**. The Operational Metering shall in real-time serve as the primary source of data between the relevant **TSOs**.

Metering Equipment shall be installed and maintained to measure and record the hourly active and reactive energy and active and reactive power transferred to and from a **Control Area** at its IP with other **Control Areas** and/or external **Electricity System**. This **Metering Equipment** will be the primary source of data for **TSOs** to operate AGC systems in real-time and to account for inadvertent deviations.

TSOs are responsible for the maintenance and operation of the **Metering Equipment** at each **Defined Metering Point** (**DMP**) and shall be responsible for the initial design, installation, testing and commissioning of the Metering and **Check Metering Equipment**.

Metering Equipment, including **Check Metering Equipment**, procured, installed, operated and maintained for the purpose of the **Metering Code** shall meet the accuracy standards in relation to meters and **Metering Equipment** as set out in this **Metering Code**.

3.1 General Technical Criteria

This Section defines the general technical requirements for the **Metering Equipment** for the measurement and recording of electricity energy transfer on the interconnections between **TSOs** and between **TSO's** and External Parties. The provisions of the **Metering Code** shall apply equally to **Main Meters** and **Check Meters**.

TSOs and the **Connection Code** shall establish metering related policies and, procedures based on common standards including, but not limited to, registration in the **Metering Database**, testing and certification, sealing, loss adjustments, data security, inspection, testing and audit of **Metering Equipment** and measurement error correction.

4 LEGAL FOUNDATION

J. The foundation of the metrology with agreed common standards and specifications is fundamental for the entire basis of the market principles.

The legal foundation is fundamental to ensure the accurate, proper and correct billing for the **TSO** members. The **Metering Code** outlines the requirements to ensure the application of uniform standards, specifications and outlines requirements for **Codes of Practice** underpinning the validity of data for billing purposes.

It is essential to ensure that Member States recognize and respect the **Information** and agree on the use of common standards, supporting the **PAEM**.

The Rules and Obligations, as required for the **TSO,** are set out in the **General Conditions**, including the framework to revise and adjust the **Code**s over time.

4.1 Applicable Metering Systems standards

The IEC Metering accuracy standards for metering at the highest accuracy level are proposed, for **Main** and **Check Metering Equipment** each. The highest accuracy CT and VT standards are proposed. Standards internally recognized with a legal bearing for the best possible metrology accuracy for the **Metering Code** references are suggested. The **PAEM** members may not all nationally recognize the IEC standards nor have completed its legal ratification. The latest IEC ratified standards are proposed as mandatory.

The below standards and versions serve as guidance only.

CT Standard	IEC 60044-1, or later as in force at the time of publication.
VT Standard	IEC 60044-2, or, IEC 60044-5, or later as in force at the time of publication.
Combined CT/VT	Clause 8 of IEC 60044-3, or later as in force at the time of publication.
Meter Standard	IEC 62056-11, or later as in force at the time of publication.

5 METER INFORMATION REGISTER

J. The Metering in the **PAEM** is proposed to be undertaken with the Interconnection entity in full being the legally and active responsible party for all metering from specifications; purchase; ownership carrying over into operations and verification and maintenance. This includes detailed and transparent asset management of all components in the **Metering System**, included but is not limited to all equipment documentation, certification and commissioning test reports. Further, the auxiliary consumption at the custody transfer points at the Interconnection equipment shall be separately measured and accounted for.

The **Metering Database** in both the national **TSOs** and the **PAEM Market Secretariat** shall maintain a **Meter Information Register** of all meters. This register will contain, but not be limited to:

a) A unique meter identification/serial number;
b) The location of the **Main Meters**, **Check Meters** and **Metering Equipment** including **Metering Data** recording systems;
c) The identification of the **TSO** concerned;
d) Meter manufacturer, type and model;
e) The specification of **Metering Equipment** including accuracy class;
f) CT manufacturer certificates;
g) VT manufacturer certificates;
h) The adjustment factors per meter, including circuit losses to be applied;
i) Detailed as installed documentation;
j) Date of installation, and
k) Accuracy verification certificates.

The **TSOs** and any other **non-PAEM TSO** are obligated to share the **Information** for the permanent record keeping of the **Market Secretariat**.

The **General Conditions** shall stipulate guidelines and procedures to ensure up to date record keeping at all times.

5.1 Main and Check Metering

Main and **Check Meters** shall be of different makes and shall be of identical accuracy class.

Main and **Check Meters** shall be connected to separate CT and VT windings. The operation of **Main** and **Check Meters** shall be separate in support of the scenarios of one being defective or out of service.

At all **Actual Metering Points**, continuous **Main** and **Check Metering** reading services shall be provided. **Main** and **Check Meters** shall operate from separate Current Transformer (CT) and Voltage Transformer (VT) windings.

CT and VT windings and cables connecting such windings to both **Main Meters** and **Check Meters** shall be dedicated for such purposes and such cables and connections shall be securely sealed.

5.2 Measurement Parameters

For each **Actual Metering Point**, the **Metering Equipment**, **Main** and **Check Meters** separately, shall be capable of measuring the following parameters in both import and export directions: MW, MVAR, MWh and MVARh. Data shall be provided by the **TSO** to the **Market Secretariat** in line with the requirements laid out in the **Data Exchange Code**.

For the purposes of the **PAEM,** the data shall be available with the time resolution of five minutes.

All **Metering Equipment** shall comply with the provisions set out in the **Metering Code**. These provisions may be revised from time to time in accordance with the provisions set out in the **General Conditions** to take account of changing technologies or new requirements of the electricity industry.

A CT, in accordance with the CT Standard, and a VT, in accordance with the VT Standard, shall be provided for metering as required.

Where a combined unit measurement transformer (VT & CT) is provided, the "Tests for Accuracy" in the Combined CT/VT covering mutual influence effects shall be met.

The meters' cumulative registers may not rollover more than once within a year of operation.

Further to the measurement units, additional Power Quality Parameters may be requested either from the **Main** and **Check Meters** or from separate Power Quality **Metering Systems**. These may be asked either for a **Bilateral Data Exchange** or in an agreed **Multilateral Data Exchange**. Details are left to the **PAEM** Members.

6 EQUIPMENT ACCURACY AND ERROR LIMITS

J. The accuracy shall be the highest technically possible. There are industry accuracies that may surpass the Standards requirements, and it is proposed to ensure the accuracy is the highest possible at the time of installation and apply a time schedule with the accuracy verification to lay out the timeline for subsequent consideration of revised performance requirements. The TC 38 under IEC is currently reviewing the Instrumentation Transformer standards. The reference is suggested to be applicable as per the IEC approved standard most likely the latest IEC standard. The details covering the installations; the details of combined CT & VT and test, including detailed commissioning, are outside the scope of the **Metering Code**.

The accuracy of the various items of **Metering Equipment** shall conform to the relevant IEC standards or equivalent national standards where agreed between the **TSOs** concerned. The accuracy limits set out in the **Metering Code** shall be applied after adjustments have been applied to **Metering Equipment** for compensation of the introduction of any errors due to any secondary equipment and connections. The accuracy of meters shall be verified by an independent accredited agency approved by the **Market Secretariat** for this purpose. The agency shall provide an **Accuracy Verification Certificate** with a validity expiry date.

6.1 Voltage Transformers (VT)

VTs shall be of the highest commercially available **Accuracy Class** and comprise three (3) single phase units each of which complying at a minimum with the provisions of the referenced VT Standard.

6.2 Current Transformers (CT)

The CTs shall be of the highest commercially available **Accuracy Class** and comprise three (3) units for a three-phase set, each of which complying at a minimum with the provisions of the referenced CT Standard.

6.3 Meters

Meters shall be of the three-element type independent for each phase, rated as appropriate and shall be complying at a minimum with the requirements of the Meter Standard.

In addition to the **Meter Standard**, the meters shall measure and locally display at least the MW, MWh, MVAR, MVARh, and cumulative demand. Additional features in support of the **Codes of Practices**, maintenance records and power quality monitoring are desirable.

Meters shall be digital and shall separately measure and store all parameters bidirectionally.

It is desirable that meters fulfill the industry practice of rack mounted Meters, allowing for automatic CT shorting ("Essailec Test Blocks") following a meter removal.

All requirements shall be fulfilled by **Main** and **Check Meters** separately, reference Section 5.1 above.

A cumulative register of the parameters measured shall be available on the internal storage facilities of the digital meters for a minimum of thirty (30) calendar days with five (5) minute values. The loss of auxiliary supply to the **Metering Equipment** shall not erase these registers.

The meters' registers in both **Main** and **Check Meters** shall be readable by the **TSO**'s **Data Collection System** (**DCS**) via the **Pan Arab Communication Network**. The minimum dataset from the **DCS** shall be shared in real-time with **Market Secretariat** utilizing the provisions of the **Data Exchange Code**.

It is desirable that the meter registers be read by the **TSO's SCADA** and additional **Information** is shared either Bilaterally or Multilaterally from the **TSO's DCS** or **SCADA**.

6.3.1 Compensation for Measurement Transformer Error

All Meters shall be compensated for the errors of their associated measurement transformers and the leads to/from the **Meters**.

The compensation calculations, and the values applied to the **Meters** shall be recorded by the **TSO** and shall be made available, along with the latest Meter and measurement

transformer test certificates, for the **Market Secretariat** at the time of commissioning and both normal operational activities and in case of any abnormality.

Such compensations shall be achieved within the **Meter** by either:

a) A single calculated error or 'offset' which is a single error programmed into the meter which is applied internally at defined test points on the error curve; or
b) A series of calculated errors programmed into the meter for each test point on the error curve and applied as such by the meter.

Where the **Actual Metering Point** and the **DMP** do not coincide, then the **Metering System** does not comply with the **Metering Code**. Where justified and approved in line with the General Conditions a dispensation may be granted which will require compensation for power transformer and/or line losses to be submitted and applied to meet the overall accuracy at the **DMP**.

The compensation may be achieved either within the **Metering Equipment** or by software within the **Data Exchange** System.

7 INSPECTION, TESTING AND ACCURACY VERIFICATION

J. The **Metering Code** outlines the principles serving initial Commissioning and ongoing verification business procedures. The details within the **Codes of Practice**, covering the installations, the details of combined CT & VT and test, including commissioning, are for consideration in National **Metering Codes**.

7.1 Commissioning

All new meters shall undergo relevant certification tests, and initial accuracy verification of meters, shall be performed in a recognized test facility. These tests shall be performed in accordance with the relevant IEC standards and shall confirm that the meter accuracy is within the limits stated in Section 6.3 of the **Metering Code**. A unique identifiable **Accuracy Verification** record shall be provided before the connection is commissioned.

VTs and CTs shall be tested in accordance with the relevant IEC standards prior to installation at the **Actual Metering Point**. The **TSO** shall provide the manufacturers' test certificates for CT, VT and Meters in line with the requirements for the **Metering Database**.

The commissioning shall include a system commissioning covering the operation of data collection from **Main** and **Check Meters** from both **DMP**.

The tests shall be undertaken for both Import and Export to the satisfaction of both the **TSOs** engaged in each connection.

7.2 Periodic Activities

The **TSO responsible and accountable** as owner of **Metering Equipment** shall undertake accuracy verification testing upon request by the **PAEM Market Secretariat** or another TSO. In addition, **TSOs** shall carry out routine Accuracy Verification of the meter systems every three (3) years, and the connections for the CTs and VTs shall be checked every five (5) years.

If the meters have been adjusted to compensate for errors in the CTs and VTs, then the CTs, VTs, and their connections, shall be checked at the same periodicity as the meters.

Where, following a test, the accuracy of the **Metering Equipment** is shown not to comply with the requirements of this **Metering Code**, the **TSO** shall take such measures as are required to restore the accuracy of the **Metering System** Equipment to the required standard.

The cost of routine testing shall be met by the **TSO** as owner of the **Metering Equipment**.

The cost of **Accuracy Verification** tests shall be borne by the **Party** requesting the test unless the test shows the accuracy of the **Metering Equipment** does not comply with the requirements of the **Metering Code;** in which case the cost of the tests shall be met by the **TSO responsible and accountable**.

TSOs shall ensure that all **Metering Equipment** at **DMPs** are physically inspected and a physical data reading is undertaken not less than once in every three (3) months. The purpose of this activity is to reconcile cumulative register readings on site with readings collected remotely. Physical checks shall be carried out at the same time to identify such things as missing seals or damage or any other issues for concern as may be raised.

Where a **Metering Equipment** is found to be faulty or to be non-compliant with the **Metering Code**, **Arab TSOs Committee** and the concerned **TSO** or **Non-PAEM TSO** parties affected shall be informed of the failure or non-compliance promptly. Such notification shall include the plans by the concerned **TSO** to restore the **Metering Equipment** to become compliant with the **Metering Code**.

The **Market Secretariat** shall be informed, alongside the **Arab TSO's Committee**, and in cooperation with the affected **TSOs,** assess the duration of the period where the **Metering Equipment** has been faulty. During that period, recorded data from the **Check Meter** shall be used.

7.3 Data Collection

The TSO shall collect all data relating to the parameters measured by the **Metering Equipment** at **DMPs** by remote or manual on-site interrogation in accordance with the terms of this **Metering Code**. For the purposes of remote interrogation, the **TSO responsible and accountable** may use its own data communications network. Failing this, it shall enter into, manage and monitor contracts to provide for the maintenance of all data links by which data is passed to the TSO and to the **Market Secretariat** in line with the provisions in the **Data Exchange Code**. In the event of any fault or failure on such communication links or any error or omission in such data, the TSO shall, if possible, retrieve such data by manual on-site interrogation.

7.4 Security

Each **TSO,** as the owner of the **Metering Equipment** at the **DMPs**, shall ensure that the equipment itself is sealed and that any links and secondary circuits are sealed where practically possible. The seals shall only be broken in the presence of representatives of the

Market Secretariat and the **TSO responsible and accountable** unless agreed otherwise by the parties involved.

8 DISPUTES

J. Disputes concerning the **Metering Code**, or any details related to any discrepancy as a result of a failure in the data shall be dealt with in accordance with the procedures set out in the **General Conditions**.

Disputes concerning this **Metering Code** shall be dealt with in accordance with the procedures set out in **General Conditions** of the **Arab Grid Code**.

9 METER DATA CONFIDENTIALITY

J. Collected data are confidential in nature. The data related to the metered units for the market shall be shared with the participants subject to the details as laid out in the **Data Exchange Code**. Data, as related to the performance and operations of the interconnected system, are sensitive and are subject to separate procedures for data sharing, as detailed in the **Data Exchange Code**.

Meter data may be commercially sensitive and confidential and appropriate measures shall be taken to ensure that the meter data cannot be divulged to, or obtained by, third parties.

The usage policies for the appropriate sharing of data are for the **Market Secretariat** to propose to the **Arab TSOs' Committee**.

10 OPERATIONAL METERING

J. Operational Metering serves to support the real time operation of the Transmission System. The operational Metering is focused on the real time **Information** for the Interconnection, with **Operational Data** passed on to the respective **TSOs** for the different **Control Areas**, sharing data among **TSOs' SCADA**.

An operational **Metering System** is required to support real time operation of the **PAEM**. Because operational requirements differ from Interchange Metering requirements, the operational **Metering System** does not necessarily have the same requirements for accuracy of measurement.

However, timely operational **Metering Data** is critical for the efficient, safe and timely operation of the **PAEM** Interconnected Transmission System.

TSOs are encouraged to bilaterally agree on the types of **Operational Data** subject to **Real-Time Data Exchange,** and shall ensure that appropriate systems in support of this are in place.