ANNEX 12: Table on Functions for ECOWAS Power System Reliability (PSR) and the Associated Indicators for Market Surveillance (MS)

| **Functions** | **Tasks & Indicators** |
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| PSR-1: Drafting and Approving of WAPP Operation Manual(Regulation C/REG.27/12/07, Section e.18) | Tasks* Set out the standards to be complied with by every user of the Regional network
* Provide procedures for monitoring compliance with the standards
* Provide procedures for carrying out Operational Planning of the interconnections

Indicator* **Compliance with the Market Design Provisions**
 |
| PSR-2: Operational Planning of Interconnectors(WAPP OM, P4) | Tasks* Evaluating the ability of the power system to supply power and energy demand at the delivery points at any time within acceptable standards
* Conducting generation adequacy for the region to establish a power balance forecast
* Conducting transmission system adequacy for the WAPP interconnected system
* Conduct system analysis to assess the reliability of the interconnected system and determine the investments needs

Indicator* **Compliance with approved Procedures for Operational Planning of the Interconnectors**
 |
| PSR-3: Addressing issues of Force Majeure Events (FME) in the Electricity Market(RMR, Art.11) | Tasks* SMO to be promptly informed by the party affected by the FME of the impossibility to meet obligations
* Suspension of the terms and conditions of the RMR
* SMO to inform all Market Participants of the Event
* SMO verifies the scope of the FME and informs all unaffected participants to continue with trades
* TSOs of the relevant countries to mitigate the consequences of the Event on the regional transmission network

Indicator* **Compliance with the approved Procedures for addressing issues of Force Majeure**
 |
| PSR-4: Interconnector Scheduling(WAPP OM, P3.3) | Tasks* Determination of transmission capacity between Control Areas based on reliability criteria in order to ensure security of the WAPP Grid
* Communicating the transmission capacity to the Information and Coordination Centre (ICC)
* Assessing and publishing of the capacity on the WAPP website by the ICC
* Scheduling and implementing interchange between Cas
* Real-time monitoring of the cross-border power flow between Control Areas

Indicator* **Compliance with the approved Procedures for Interconnector Scheduling**
 |
| PSR-5: Congestion Management(WAPP OM, P2.2.5) | Tasks* Determine the maximum load ability of the network systems
* Manage the power transmission and distribution among valuable customers, priority-wise
* Installation of transformer taps for voltage regulation and loss control
* Generation rescheduling and curtailment of transactions
* Develop and impose congestion charges on the network users
* Enhance the maximum load ability limits of the network by improving the reactive power level
* Develop and enforce the use of area prices on some parts of the transmission network to control load on the network

Indicator* **Compliance with the approved Procedures for Congestion Management**
 |
| PSR-6: Coordination with neighbouring Control Areas and TSOs in cases of emergency (RMR, Art.23) | Tasks* All conditions deviating from normal operation to be considered as emergencies
* The system operator of the affected system to take all necessary measures to prevent any disturbance from spreading, and to ensure efficient restoration of supply
* A System Operator experiencing or anticipating operation under abnormal conditions to communicate its current and expected status to other neighbouring system operators and notify the SMO
* Other Power Systems capable of providing assistance to declare their capabilities
* As soon as a system anticipates that it could face operation under abnormal conditions, power station, distribution and transmission operators should be informed so that they can respond quickly and appropriately to the situation
* In case of an emergency, the main task for all systems is to maintain the stability of the WAPP Interconnected Power System. The system operator in whose system the emergency occurs should immediately take all possible measures to restore normal operating conditions

Indicator* **Compliance with approved Operation Procedures in emergency conditions**
 |
| PSR-7: Communication between the Control Areas, Domestic TSOs and the SMO(RMR, Art.25) | Tasks* Each power system and Control Area should be equipped with adequate and reliable communication facilities internally and with other power systems and Control Areas to ensure exchange of information necessary to maintain the reliability of the interconnected power system
* Procedures for Control Centre to Control Centre communication to be established by Power System and Control Area Operators to ensure that communications between operating personnel are consistent, efficient, and effective during normal and emergency conditions

Indicator* **Compliance with the approved Communication Procedures between Market Institutions**
 |
| PSR-8: Maintaining inter and intra-area flows(RMR. Art.23) | Tasks* Ensure that inter and intra-area energy flows are maintained in the Regional Electricity Market, both in quantity and quality (voltage and frequency)

Indicator* **Compliance with the approved Procedures for Maintaining Inter and Intra-flows**
 |
| PSR-9: Maintaining flows agreed at the regional level in the Interconnector(RMR, Art.25) | Tasks* Each Control Area is physically demarcated by the geographical position of the delivery points
* Ensure that in each Control Area, the difference between the Day-ahead schedule and the real-time dispatch measured at the tie-lines between adjacent Control Areas (i.e Area Control Error) must be close to zero at all times
* Make the control automatic in order to keep the Area Control Error (ACE) close to zero
* Ensure that each Control Area operator utilizes subsystems such as Automatic Generation Control (AGC) to automatically direct the loading of regulation reserve
* Ensure the use of the AGC to limit the magnitude of the Area Control Error (ACE).
* In case of deficiency of the AGC, the concerned Control Area Operator to use manual control to adjust generation to maintain scheduled interchanges (flows)

Indicator* **Compliance with the approved Operation Procedures on flows in the interlinks**
 |
| PSR-10: Transmission Planning | Tasks* Maintain and develop, in cooperation with adjacent and overlapping Transmission Planners, methodologies and tools for the analysis and simulation of the transmission systems, and the evaluation and development of transmission expansion plans.
* Define, consolidate, and collect or develop information required for transmission planning purposes
* Maintain transmission system models (steady state, dynamics, and short circuit) to evaluate Bulk Electric System performance.
* Evaluate, document, and report on expansion plans for the Transmission Planner area. Assess whether the integrated plan meets reliability needs.
* Notify Generator Owner, Resource Planners, Transmission Planners and Transmission Owners of any planned transmission changes that may impact their facilities.
* Define system protection and control needs and requirements to meet reliability needs.

Indicator* **Compliance with the approved Procedures for Transmission Planning**
 |
| PSR-11: Interconnection Capacity Allocation to Contracts(RMR, Art.30, & WTSAUP, Art. 2) | Tasks* Determine the Total Interconnector Capacity available to be allocated in respect of the Interconnector in question. Total Interconnector Capacity so determined shall form the basis of Interconnector Capacity allocation.
* Publish on the website the available Interconnector capacity determined.
* Accept all requests on pro-rata, if additional capacity is available on the Interconnector after all the requests have been satisfied.
* Notify each Participant to whom capacity on the Interconnector has been granted based on Interconnector Capacity Entitlement, of the extent of the access granted provided that such notification shall be indicative only
* Approve Participant’s request to assign all or part of its Interconnector Capacity Entitlement for a short-term
* Receive Interconnector Capacity Charge in respect of actual Interconnector Capacity to which the Participant is entitled and an Interconnector Usage Charge on the basis of the metered units of Energy imported or exported across the Interconnector

Indicator* **Compliance with the approved Procedures for Interconnector Capacity Allocation**
 |
| PSR-12: Generation & Load Nomination | Tasks* Participants with interconnector capacity entitlement and daily interconnector capacity allocation to submit interconnector Energy Trade Nomination, in respect of their imports or exports of energy, to the SMO, a day-ahead to the dispatch day
* Participants for the same transactions to submit separate Nominations for imports and experts in the same dispatch day
* Nomination to identify the Seller and its location in the adjacent Control Area, where Nomination is in respect of import
* Nomination to identify the Buyer and its location in the adjacent Control Area, where Nomination is made in respect of an export
* Energy amount nominated not to be greater than total interconnector capacity allocated to the participant

Indicator* **Compliance with the approved Procedures for Generation and Load Nomination**
 |
| PSR-13: Protective Relay Coordination(WAPP, OM, P3.5) | Tasks* Each power system to implement a protective system to enhance the system reliability in the event of any adverse occurrence on the interconnection
* Coordinating all protective systems in the interconnected system
* Supervising the status of protective systems of each power system and notification of all relevant neighbouring parties of every change in status
* Recalibration of each protective device at least once in a year
* Reviewing the protection setting when required
* Investigating improper operation of a protective device and rectifying promptly
* Advance notification of neighbouring systems of changes in generating sources, transmission, load, or operating conditions that may require changes in their protection systems

Indicator* **Compliance with approved protection procedures for Protective Relay Coordination**
 |
| PSR-14: Reactive Supply and voltage Control on Tie-lines (WAPP OM, P3.6) | Tasks* Each Control Area Operator to operate its reactive resources to maintain voltages within established limits
* Limit voltage drop on tie-lines by maintaining reactive power flows at a minimum level
* Allocate total transfer capacity of the tie-lines mainly to active power
* Maintain voltage difference between the two ends of the tie-line at a minimum, as much as possible
* Make specific bilateral agreement to transfer reactive power through tie-lines if reactive power cannot be produced or absorbed in a Control Area
* Implement reactive generation scheduling, transmission line and reactive resource switching and load shedding to maintain appropriate voltage levels

Indicator* **Compliance with approved Voltage Control Procedures for Reactive Supply and Voltage Control on the Tie-lines.**
 |
| PSR-15: Coordination of Maintenance Scheduling(WAPP, OM, P4.3) | Tasks* WAPP interconnected Power Systems mutually agree on the most suitable schedule for maintenance work on tie-lines, generating units and facilities having impact on the interconnected power system
* When maintenance schedules are defined and agreed upon between WAPP interconnected Power Systems, each shall confirm weekly (and daily in case of changes) the outages of important power plants and transmission lines to affected neighbouring Power Systems.
* Scheduled generating unit outages that may affect the reliability of interconnected power systems to be planned and coordinated among the WAPP interconnected Power Systems of affected Control Areas
* Each WAPP interconnected Power System collect relevant information on scheduled outages of power plants and transmit it to neighbouring WAPP interconnected Power Systems.
* Routine maintenance of telemetering, control equipment and associated communication channels also to be coordinated between the WAPP interconnected Power Systems.

Indicator* **Compliance with approved Maintenance Procedures for coordinating Maintenance Schedules.**
 |
| PSR-16: System Restoration(WAPP OM, P 5.3) | Tasks* Restoration of system to normal operation after a system-wide collapse is to be realized as fast as possible in line with the approved procedures
* Each Control Area to develop and periodically update a plan to restore its power system to normal conditions in the event of any collapse
* Such plans to be coordinated with neighbouring systems to ensure effective restoration of the WAPP system
* Such plans to include restoration of supply to plant auxiliaries from generating sources with black start capability
* Different parts of the WAPP interconnected system to be synchronized after restoration of frequency and voltage levels in each part

Indicator* **Compliance with the approved System Restoration Procedures.**
 |
| PSR-17: Transmission Service(WTSAUP, Art. 13) | Tasks* Transmission Customer to request for Firm Point-to-point Transmission Service through a written application to the SMO
* Include all the relevant information on the application, such as, particulars of the delivery and receiving points of power, description of supply characteristics, etc
* SMO to treat information in the Application confidentially, as required by the RMR
* Include a deposit of two month’s charge for capacity reserved, in the Application
* SMO reject Application if it does not meet the conditions for service, as set forth in WTSAUP, Deposit to be returned if Application is rejected
* SMO to notify the Applicant of the reasons for the rejection

Indicator* **Compliance with the approved Procedures for the provision of Transmission Service.**
 |
| PSR -18: Operating Reserve -Spinning Reserve Services and Frequency Control of the System(WTSAUP, Schedule 5) | Tasks* Spinning Reserve is provided to serve the load immediately in the event of a system contingency
* Spinning Reserve service may be provided by generating units that are on-line and loaded less than maximum output
* Transmission Customer to purchase the service from the SMO or make alternative arrangement to satisfy the obligation
* The SMO to obtain the service from the affected Control Area and provide same to the Transmission Customer
* The SMO to pass through the revenues it receives for the service to Control Area Operator or to other suppliers providing the service

Indicator* **Compliance with the approved Procedures for providing Spinning Reserve Service.**
 |
| PSR-19: Transmission Loss Compensation(WTSAUP, Attachment M) | Tasks* An amount of energy is usually lost in a transmission network whenever it is involved in a transaction
* The lost energy is the transmission energy loss that the Transmission Customer is required to replace or compensate the Transmission Operator for
* The SMO to calculate a loss matrix once a year to show the composite loss factors for each transaction, as a percentage of the transactions
* ERERA to approve the schedule of losses
* Each Transmission Operator to maintain a schedule showing its allocation of loss energy for the provision of transmission service on its system
* The SMO to allocate the replaced loss energy, as well as revenues from sale of losses, among the Transmission Operators using an ERERA approved procedure

Indicator* **Compliance with the approved Procedures for Transmission Loss Compensation**
 |
| PSR-20: Curtailment of Firm Transmission Service(WTSAUP, Art. 13.6) | Tasks* If a curtailment is required on the WAPPITS to maintain a reliable operation, curtailment will be made on a non-discriminatory basis to the transactions that effectively relieve the constraints
* Transmission customer to make the required reduction upon request by the SMO, in the event of an emergency
* SMO can curtail any Firm Transmission Service, if in its opinion, an emergency condition exists which can impair the reliability of the transmission system
* Notification of all the affected transmission customers in a timely manner, by the SMO of any scheduled curtailment
* Payment of applicable charges by the transmission customer upon failure to reduce service in response to directive by the SMO

Indicator* **Compliance with the approved Procedures for Curtailment of firm Transmission Service.**
 |
| PSR-21: Provision of Ancillary Services(WTSAUP, Art. 3) | Tasks* Reactive Power Regulation Services: to control the reactive power flows in order to keep determined voltage levels.
* Frequency Regulation Services: to control the system frequency by maintaining the real time balance between generation and demand of the active power
* Spinning Reserve Services: designed to respond to uncertainties and for maintaining the integrity of the transmission system and for maintaining the balance between supply and demand.
* Black Start Services: to be provided at the strategic parts of the grid to restart the grid after collapse.

Indicator* **Compliance with the approved Procedures for the Provision of Ancillary Services.**
 |
| PSR-22: System Operator Certification(WAPP OM, P8.2) | Tasks* Ensure an Authorization to Test (ATT) is obtained. The ATT is necessary for the candidate to schedule an examination.
* Schedule an examination appointment. Once the ATT number is acquired, an appointment for testing can be scheduled for the candidate.
* Ensure the relevant examination is passed to obtain a Certificate.
* Ensure that Certified Operator retain appropriate documentation for proof of credential maintenance to continue working for the System Operator

Indicator* **Compliance with the approved Procedures for the certification of System Operators**
 |
| PSR-23: Generation Adequacy Analysis(WAPP OM, P4.1.2) | Tasks* Generation Adequacy Assessment involves evaluating the ability of the generating units to match system demand growth
* Every year, each interconnected power system to establish a power balance forecast that has to be included in the system reliability Report
* The power balance forecast to be for a 10-year horizon
* Each interconnected system to determine the difference between the reliable available capacity and the demand (Remaining Capacity)
* The Remaining Capacity to be available for use to cover loads above forecast demand or plant unplanned outages greater than expected

Indicator* **Compliance with the approved Procedures for the Preparation of Generation Adequacy Report**
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