Distribution & Commercial Committee Meeting

Presented by:
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Director Information & Coordination Center
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Contents

- Electricity in ECOWAS
- Generation & Transmission Priority Project
- Grid Operation
- Regional Electricity Market
- ECOWAS Energy Efficiency Initiative

ECOWAS Fact File

- Fifteen countries
- Population 340 million (4th)
- Area: 5,112,903 km² (7th)
- Density 49.2/km²
- Total available generation 10,000MW
- Av. Electricity Access: 70%

ECOWAS VISION

- develop interconnection and power exchange between Member States
- harmonize legislations and standards of the power sector operations
- create an open and competitive regional electricity market
- use gas flared in Nigeria to feed Power stations in neighbouring countries (WAGP)
- promote and protect private investments in energy projects

Establishment of WAPP

Rationale of the WAPP

Abundant Energy Resources within ECOWAS region
Inadequacy power supply - demand
Unequal geographic distribution of Resources

DEVELOPMENT OF A REGIONAL POWER MARKET (Optimization of resources use)
DEVELOPMENT OF POWER SUPPLY INFRASTRUCTURE
Hydro & Thermal Interconnection line
Supporting ECOWAS regional goals
- Increased access to energy
- Stable and reliable electricity supply – affordable and sustainable
- Achieving the Millennium Development Goals
- Peace and security
- Balanced development of the diverse primary energy resources of the ECOWAS member states for their mutual benefit
- Long-term cooperation in the energy sector
- Uninterrupted energy transit, and
- Increased cross-border electricity trade.

In 2004, the 1999 ECOWAS Energy Master Plan was revised in order to:
- Define the long-term vision and implementation strategy for the regional transmission system
- Establish the capital costs of the regional transmission investment program over the next 17 years (2020 horizon), more specifically over the first 4 years (2004-2007) and
- Establish the stability, reliability and operationality of the regional systems
- The Project were classified into WAPP Priority Projects

The vision of the West African Power Pool (WAPP) Organization is to integrate the operations of the national power systems into a unified, sustainable regional electricity market, with the ultimate goal of providing the ECOWAS Member States with stable and reliable electricity supply at affordable cost

Facilitate infrastructure development
- Transmission interconnections
- Exploit primary energy resources
  - Gas (Nigeria)
  - Hydro (Guinea, Sierra Leone, Liberia, etc.)

Develop common harmonised codes & standards to facilitate trade and development
- Operating manual (OSMP)
- Planning & design criteria

Develop and improve energy trading
- System monitoring & coordination
- Standard agreements (trading, wheeling, power purchase)
- Electricity market (rules, governance, metering, settlement)
Member Utilities in 2014 (25#)

ECG  CEB  EDG  NIGELEC

Organizational Structure

GENERAL ASSEMBLY
EXECUTIVE BOARD
GENERAL SECRETARIAT

Information & Coordination Centre
Administration & Finance Department
Planning, Investment Programming & Environmental Safeguards Department

WAPP DONORS’ Coordination Committee

Utilization of Diverse Primary Energy Resources

Huge Water Resource
Huge Coal Resource
Huge Oil and Gas Resources

Status of Power Supply in ECOWAS:
Supply Sources

Status of Power Supply in ECOWAS:
Demand-Supply Balance

WAPP Network Data
Benefits to be expected from developing interconnections and operating power pools

- Optimized generation resources with large units, gas and water
- Improved power system reliability with reserve sharing, more robust grid and shared responsibilities
- Enhanced security of supply through mutual assistance, assistance during crises
- Reduced capital and operating cost through improved coordination among power utilities, coordinated dispatch and maintenance
- Increase in inter-country electricity exchanges, regional integration
- Development of a regional market for electricity, regional competition
- Coordinated generation and transmission expansion

Major constraint / challenges to development and operation of power pools

- Lack of trust and confidence, Inter Governmental MoU
- Inadequate generation and reserve margin, regional expansion project
- Underdeveloped transmission network and tie lines, regional expansion project
- Difficulties of mobilizing investment for power projects, regional expansion plan
- Lack of legal framework for electricity trading, regional market rules
- Lack of rules for access to transmission grid, Energy Protocol
- Lack of regional regulation, regional regulator for cross border trading

Operational Risks and Effects

- **Operational Risks**
  - Gas Supply
  - Synchronization of Interconnection
  - N-1 Criteria
  - Cost Reflective Tariff
- **Effects**
  - PPA not being honoured
  - Shortages in all countries
  - Lack of liquidity (low revenue)
ECOWAS Revised Master Plan

- The first Master Plan for WAPP adopted by ECOWAS Council of Ministers in 1999 through Regulation C/REG.7/12/99
- Master Plan was revised in 2005 and adopted by the ECOWAS Heads of State and Government through Decision A/DEC.7/01/05
- The Revised Master Plan is being implemented as WAPP Priority Projects (Generation and Transmission)
- Utilizing diverse energy source in the region for generation
- Construct transmission lines to interconnect countries of West Africa

Project Implementation Strategy [1]

- 330 kV Sub-Me West (Nigeria) - Salate (Nigeria) - OPERATIONAL SINCE 2007
- 220 kV Sokoto-Dramme - Dogusapepe: OPERATIONAL SINCE DECEMBER 2009
- 220 kV Alabe (Guinea) - Nima (Guinea): OPERATIONAL SINCE SEPTEMBER 2005
- 220 kV Côte d'Ivoire - Mali: OPERATIONAL SINCE NOVEMBER 2005
- 535 kV Bafra (Côte d'Ivoire) - Lome (Togo): Salate (Nigeria) - IMPLEMENTATION - 2015
- 400 kV WAPP Fosso Hydro-energy: IMPLEMENTATION - 2015
- 220 kV Dogubay (Chad) - Dogubay (Chad): IMPLEMENTATION - 2015
- 167 MW WAPP Aboue Hydro-energy: FINANCING REQUIRED - 2019
- 382 kV Benin-N'Diara (The Gambia) - Matam (Gambia) - Matam (Nigeria) - Dogusapepe (Burkina Faso): FINANCING REQUIRED - 2019

Project Implementation Strategy [2]

- Côte d'Ivoire - Liberia - Sierra Leone - Guinea Interconnection Project - FINANCING SECURED - 2019
- 330 kV Alabe (Guinea) - Ponta (Guinea) - Kon-Sega (Guinea): FINANCING SECURED - 2019
- 400 kV WAPP Fosso Hydro-energy: FINANCING SECURED - 2019
- 154 MV WAPP Boukouba Hydro-energy: FINANCING SECURED - 2019
- 44 MV WAPP Mount Coffee Hydro-power: FINANCING SECURED - 2019
- 225 MV Fitali Imperial power Facility - 2019
WAPP Updated Master Plan

- Master Plan was revised in 2005 and adopted by the ECOWAS Heads of State and Government through Decision A/DEC.7/01/05
- Revised Master Plan was updated in 2012 and adopted by ECOWAS Heads of State and Government through Supplementary Act A/SA.12/02/12

Updated ECOWAS Revised Master Plan

- Adopted by ECOWAS Heads of State and Government in February 2012 through Supplementary Act A/SA. 12/02/12
- Outcomes (2012-2025):

<table>
<thead>
<tr>
<th>Project Type</th>
<th>No.</th>
<th>Cost (US$ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydropower Projects (7,092 MW)</td>
<td>24</td>
<td>13,803</td>
</tr>
<tr>
<td>Thermal Power Projects (2,375 MW)</td>
<td>5</td>
<td>4,263</td>
</tr>
<tr>
<td>Renewable Energy Projects (800 MW)</td>
<td>4</td>
<td>1,893</td>
</tr>
<tr>
<td>Transmission Line Projects (16,000 km)</td>
<td>26</td>
<td>6,457</td>
</tr>
</tbody>
</table>
- Total Investment Requirement = US$26.416 billion
POLICIES OF OPERATION MANUAL

- P1: Load Frequency Control
- P2: Interchange Scheduling and Accounting between Control Areas
- P3: Security of Interconnected System
- P4: System Operational Planning
- P5: Emergency Procedures and Measures
- P6: Communication Infrastructures
- P7: Information Exchange between Control Areas
- P8: Training of Operators of the Interconnected Systems

Status of Implementation of MV Cross Border Projects

1st ACP-EU Energy Facility

- Fully funded by EU together with SONAREL, VRA, ECG, CEB, CEET, CI-Enegie, ULC.
- Ghana - Togo: Completed and commissioned.
- Ghana - Republic of Benin: Completed.

Status of Implementation of 2nd ACP-EU Energy Facility

- Status:
  - Fully funded by EU together with ECG, CEB, and CEET.
  - Preparatory Studies (Line Route Survey, ESI and Technical Feasibility Studies) have been completed and Final Reports submitted.
  - Preparation of Bidding Documents being finalised.

- NEXT STEPS:
  - WAPP to launch Bidding Documents and conclude Contractor Selection process.
Information & Coordination Center

WAPP ICC – Objectives
- Promote operational coordination between Transmission and Generation WAPP Members and
- Actual day-to-day information sharing/exchange between WAPP Information & Coordination Center and Control Area Centers.
- Facilitate efficient trading of power between entities in the different countries that are interconnected in the region.

ICC Program & Activities
- Facilitate the development of technical norms and standards for the collection and treatment of useful information for the efficient operation of the national and interconnected electric networks;
- Support and monitor the technical performance of the electricity utilities;
- Publish and distribute printed reports as necessary;
- Develop and maintain electronic databases of relevant technical information.

Roles and Responsibilities

ICC Program & Activities
- Collection and analysis of country data
- Development regional operations manual & Implement procedures
- Development and harmonisation of regional technical operating and planning standard
- Specify infrastructure requirements for ICC Information & Coordination Centre (computing, equipment, telecommunications, GIS, physical environment)
- Establish Cooperation Agreement.
Missions of ICC – Additional Responsibilities

Support national and control area centres in operation of interconnected system
- Coordination Centre
- Information Centre
- Centre for simulation

Act as transparent and independent regional electricity market operator
- Coordination between the different actors in the region
- Monitor and dispatch the exchanges
- Manage financial transactions
- Put in place Market Rules

Strategy for System Reliability

- WAPP Operation Manual was developed with the support of a consultant from EDF under USAID Technical Assistant in 2008.
- The WAPP Operation Manual contains policies for operations security and mitigation plan.
- The WAPP Operation Manual governs the operation of WAPP interconnected network (Grid Code)
- A Gap Analysis of the Manual has been done to determine the equipment and programs required to fill the gap

WAPP Operation Manual

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- The WAPP Operation Manual governs the operation of WAPP interconnected network (Grid Code)
- A Gap Analysis of the Manual identified programs required for unified regional integration

Policies of Operation Manual

- P1: Load Frequency Control
- P2: Interchange Scheduling and Accounting between Control Areas
- P3: Security of Interconnected System
- P4: System Operational Planning
- P5: Emergency Procedures and Measures
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- P8: Training of Operators of the Interconnected Systems

GAP ANALYSIS OF OPERATION MANUAL

WAPP System Reliability
Reliability Condition Precedent

- Improve Generation
- Better Frequency Control
- Better Voltage Profile
- Harmonize of Protection
- Apply Specific Procedure and Operating Instructions at interconnections
- Kainji & Jebba Hydropower Stations to provide primary frequency control – rehabilitation NBA funding by World Bank
- Establish Control Area Centers

WAPP Integration Project - Status

- Scope of the Contract:
  - Phase 1: Studies, Bidding documentation for necessary additional equipment, Procurement services – 1 year
  - Phase 2: Owner’s Engineer mission – 2 years
- Detailed Scope Phase 1:
  - Review of Operating Rules in WAPP Interconnected Countries
  - Calibration of the existing system model – including measurement campaign on site
  - Static and dynamic system simulations
  - Back to Back DC link alternative in Sakété Substation
  - Proposals for adaptation of existing operating rules
  - Implementation Preparation
  - Competences development
  - Procurement services
- Project situation:
  - RFP issued to preselected consultants on 31st March 2014.
  - Proposals to be submitted on 26th May 2014.

Operations Hierarchy

Reliable Operations – Short term

- WAPP has secured $21million grant from the World Bank for Integration of WAPP Networks
- The objective is strengthen network reliability through
  - technical assistance and
  - Procurement and installation of equipment for the secured synchronization
- Implementation of harmonized Protection
- Implementation transmission priority project that facilitate the N-1 conditions
- Establish Reliability Management Committee

Reliable Operations – Medium & Long Term

- The long term strategy to ensure a more and reliable operations includes
- Implement smart grid solutions:
  - Power System Stabilizer (PSS) on generators
  - Phasor Measurement Units (PMU)
  - Wide Area Measurement Systems (WAMS)
  - Install Static Voltage Compensation (SVC) system
  - Develop system defence scheme

WAPP ICC Project
WAPP ICC PROJECT

- WAPP obtained a KOICA grant from South Korean Government and appointed KEPCO to do a study to design the communication and data infrastructure required for the implementation of ICC Project.
- KEPCO submitted the final reports on the Feasibility Study and Basic Design of the WAPP ICC Project in June 2009.
- The KEPCO proposed the project be implemented in three phases at an estimated cost of $135million
  - Phase 1 = $26.7;
  - Phase 2 = $83.5;
  - Phase 3 = $25.2

Implementation of ICC Project

- WAPP applied for €60 million EU grant to implement the ICC Project, which includes installation of equipment for communication network, SCADA, Metering, Data Center, Hardware & Software for ICC, Construction of WAPP Headquarters Complex in Calavi.
- Funding gap of $57.5million

WAPP Dark Fibre Project

- The World Bank sponsored a study to determine the viability of utilizing dark fiber installed on WAPP Utility’s member high voltage transmission line the following documents were developed.
  - Technical & Commercial
  - Management & Regulatory Structure
- The study was done to complement the communication requirement of the ICC Project.
- Investment cost to enhance the Western and Eastern Rings is estimated to cost $36.9 million

WAPP Integration Project -Status

- Scope of the Contract:
  - Phase 1: Studies, Bidding documentation for necessary additional equipment, Procurement services – 1 year
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  - RFP issued to preselected consultants on 31st March 2014.
  - Proposals to be submitted on 26th May 2014.
  - ICC Projects situation

Dark Fibre Implementation Strategy

- Form a WAPP Dark Fiber Leasing Consortium
- Appoint Management Consultant
- Provide services to GSM operators
- Provide reliable telecommunication medium for the WAPP ICC
**Development of Regional Electricity Market**

- There is a political decision and instruments for the development of the regional market.
- Resources are complementary in the region which suggests strongly the benefits of an integration in a regional market (oil and gas in the east mainly and hydro in the west).
- There are trades already ongoing in the region which demonstrates the capacity and willingness of countries to trade.
- There is infrastructure being developed for regional trading.

**LEGAL FRAMEWORK FOR REGIONAL MARKET**

- The ECOWAS Treaty
- The ECOWAS Energy Protocol
- Establish legal framework for securing competitive market
- Unbundling of the large Utilities
  (Nigeria, Ghana, Senegal)
- Supplementary Act 4/SA.2/1/08 Establishing the ECOWAS Regional Electricity Regulatory Authority ERERA
- Articles of Agreement of the West African Power Pool Organisation and Functions (October 2005) (WAPP)

**WAPP MARKET DEVELOPMENT**

- A consultant, Mercados, was selected to develop the WAPP Market Design and WAPP Market Rules
  - Road Map
  - WAPP Market Design;
  - WAPP Market Rules
  - Implementation Plan
  - WAPP Training Plan
- The Executive Board approved that the WAPP Market Design and WAPP Market Rules be submitted to ERERA for approval.

**JUSTIFICATION OF REGIONAL MARKET**

- There is a political decision and instruments for the development of the regional market.
- Resources are complementary in the region which suggests strongly the benefits of an integration in a regional market (oil and gas in the east mainly and hydro in the west).
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**MINIMUM REQUIREMENTS REGIONAL MARKET**

- Open access to the spare capacity in the transmission systems
- Agreement on a method for payment of wheeling services
- Agreement on which assets constitute the regional network and the manner to pay for the use of these assets (transmission tariff)
- Operation Rules
- Trading Rules
- Regional Regulations

**ELECTRICITY IMPLEMENTATION ROAD MAP**

1. Market Design
2. Market Rules
3. Market Model for WAPP
4. Implementation & Recommendations
5. Training Recommendations & Training Manual
MARKET DESIGN STRUCTURE

- The description of each Market Phase is made in an ordered manner following the next structure:
  - Market phase general description (introduction)
  - Conditions precedent to pass from one Phase to the following
  - Registration of Market Participants
  - Transactions in the market
  - The role of the Regional Market Operator during the implementation
  - The role of the domestic TSOs during the Phase
  - The Regional Transmission Network
  - Planning Regional Projects

MARKET PHASES

- **Phase 1**: From now and 2015 approximately when most regional transmission infrastructure is expected to be commissioned. Main characteristics of this phase would be:
  - The ICC has been appointed as the Regional System Market Operator begin developing market operation functions

- **Phase 2**: based on the preparations carried out during the first phase, activities will include but not limited to the following:
  - Short term exchanges through day ahead market (regional optimization model)
  - Independent Regional (System and) Market Operator

- **Phase 3**: a long term vision which would include:
  - A liquid and competitive market in the region.
  - Possibility of trading different product integrating other markets: market for some ancillary services, financial products.

WAPP Market Rules

- 9 Chapters & 72 Articles
  - Containing
  - Technical
  - Commercial
  - Financial
  - Settlement
  - Regulation
  - Legal
  - Operations Hierarchy:
    - WAPP ICC -> Control Area Center -> National Control

Chapter I: Introduction and Objectives
Chapter II: General Conditions
Chapter III: The SMO
Chapter IV: The Control Areas
Chapter V: The Domestic TSOs
Chapter VI: Market Phase 1
Chapter VII: Market Phase 2
Chapter VIII: Governance
Chapter IX: Miscellaneous

TYPICAL TRANSACTION IN THE MARKET

- Data Collection and Processing
- Scheduling
- Contracting
- Dispatching
- Billing and Settlement
- Market Reports
  - Info from Discos, Gencos, Bulk Bids
  - Matching and Agreements between market participants
  - Verification of contract requirements
  - Generation of periodic activity reports on market performance
  - Transmission by invoicing and payments by market participants
Supplying a Demand with Different Types of Contracts

Baseload Contract or “Long Term BA”

Medium Term BA- 6 months ahead

Medium Term BA- 1 month ahead

Short Term BA- 1 week ahead

Day ahead BA

- Day ahead BA
- Medium Term BA- 1 week ahead
- Medium Term BA- 6 months ahead
- Baseload Contract or “Long Term BA”

Time of day

8/25/2014

ELECTRICITY MARKETS

REGIONAL SYSTEM MARKET OPERATION

TRAINING NEEDS

Compulsory Training
- Implementation Road map
- WAPP Market Design
- WAPP Market Rules
- Operation Procedures
- WAPP Operation Manual

Additional Training
- International experience
- Microeconomics
- Power Pool & Market Operation

TRAINING PLAN

Model 1 – Establish an Independent Stand-alone Regional Centre for Training

Model 2 – Add-on a “Power Sector Trade Capacity Building Program” to an Existing Entity in the Region

Model 3 - Starting a “WAPP Capacity Building Program” as a Specific Program

Workshops – Dissemination of Operation Manual, Market Implementation Road & Market Rules (60 participants)

Certification Program – System Operation and Engineer
TRAINING CATEGORIES

- **Compulsory Training**: subjects that are compulsory for professional staff from WAPP Secretariat as well as staff from utilities involved in power trading in one manner or another should know in detail the subjects included in this category.

- **Additional Training Needs**: the subjects included in this category are basic and somehow necessary for a better comprehension of power trading in general terms and power trading at regional level.

TRAINING PLAN 1

**Compulsory Training**

- Implementation Road map
- WAPP Market Design
- WAPP Market Rules
- Operation Procedures
- WAPP Operation Manual

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**How can utilities go from the double crisis ...**

Supply = generation - losses

Demand

Revenues = bills - unpaid

Costs

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**... to a double equilibrium?**

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**ELECTRICITY VALUE CHAIN**

- GENERATION
- TRANSMISSION
- DISTRIBUTION
Specific targets

- Phase out inefficient incandescent lamps by 2020
- Reduce average losses in electricity distribution from the current levels of 15 - 40% to below 10%
- Achieve universal access to safe, clean, affordable, efficient and sustainable cooking for entire ECOWAS population by 2030
- Establish an ECOWAS technical committee for Energy Efficiency Standards and Labels; adopt initial region wide standards for lighting by 2014
- Improve energy efficiency in buildings

ECOWAS Energy Efficiency Policy

- Main objective
  - Double annual improvement in energy efficiency by 2020, to levels comparable to world leaders
- Six specific targets have been defined
- Five initiatives on: Lighting; Standards & Labels; Cooking; Electricity Distribution; Buildings

THANK YOU

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