



Final v.1

Balancing Mechanism

(To be included in the
Scheduling and Dispatch Procedure
Annexure A3 of the System Operator Guidelines)

[Date]

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1. Preamble

Balancing in the IPS is essential for maintaining stability, reliability, and security. It involves the continuous adjustment of generation and load to ensure that key system parameters, such as voltage and frequency, remain within acceptable limits. For instance, in Zambia, the system frequency is maintained at $50 \pm 0.15\text{Hz}$, with only minor deviations permitted. Any imbalance between generation and consumption can lead to frequency fluctuations, which, if not promptly corrected, may result in system instability, blackouts, or equipment damage.

To achieve this balance, power system operators rely on real-time adjustments, ancillary services, and reserve power capacities. For real power balancing, ancillary services, such as frequency regulation, operating reserves, and load following play a crucial role in maintaining the equilibrium. These services can be provided by **Balance Service Providers (BSPs)** including **Generators**, **End Users**, or **Energy Storage Systems (ESS)**, by reserving a certain amount of active power which must always be available to ensure that the balance between generation and consumption is maintained moment-to-moment. Additionally, sufficient reserves must be in place to allow the **System Operator** to respond to the most severe contingencies, such as the sudden loss of a large generator.

The **System Operator** is responsible for procuring and dispatching these services, utilizing advanced tools including real-time monitoring, forecasting, and automated control systems.

The roles of **Participants** roles are summarised in the table below.

Participant	Service Provided	Determination of Service	Imbalance Calculation	Compensation/ Penalty
Generators	Frequency regulation, reserves, Load Following	Based on their capacity and availability, as per Balancing Agreements.	Deviation from scheduled generation.	Compensated for services provided; penalized for deviations.
End Users	Load shedding	Based on their ability to adjust consumption, as per Balancing Agreements.	Deviation from scheduled consumption and provide demand response services as per balancing agreements.	Compensated for load adjustments; penalized for deviations.
Energy Storage Systems (ESS)	Reserves, frequency regulation, Load Following	Based on their storage capacity and response time, as per Balancing Agreements.	Deviation from scheduled charging/discharging.	Compensated for services provided; penalized for deviations.

2. Glossary of Terms

2.1 Definitions

- 1.1.1. Unless the context otherwise requires, relevant definitions stated specifically in this mechanism are as set out in the Governing Documents. In the event that any definition in the Governing Documents is amended, such amended definition shall, from the effective date of the amendment, be deemed to apply to this mechanism, until this mechanism is expressly amended to reflect such change.
- 1.1.2. References in this mechanism to any document (including this mechanism) are references to that document as amended, consolidated, supplemented, novated or replaced from time to time, and to all annexes, schedules, attachments and supplements which form part of such document;
- 1.1.3. A term in this mechanism that uses the singular includes the plural and vice versa, and a term that imports gender includes both the masculine and feminine.
- 1.4. In this mechanism, headings are for reference purposes only and shall not affect the construction or interpretation of this mechanism.

Affiliate	means in relation to any a Party, (a) any entity controlled, directly or indirectly, by that Party, (b) any entity that controls, directly or indirectly that Party or (c) any entity directly or indirectly under the common control of a Party; in this context "control" means the ability to direct the management and policies of an entity through ownership of voting securities, by contract, or otherwise;
Balance Responsible Party (BRP)	means a Market Participant that assumes responsibility for maintaining real-time balancing at specified metering points by submitting day-ahead forecasts and trading nominations and is held accountable for any imbalances through the Balancing Mechanism.
Balancing Services Provider	means a Participant that can supply Balancing Services to the BRP or SO;
Balancing Agreement	means the agreement between the System Operator and a Balance Responsible Party and or Balancing Party that establishes the terms and conditions for maintaining real-time balancing at specified metering points in the Zambian electricity grid, including the responsibilities, obligations, performance standards, and any applicable sanctions and remedies for a Balance Responsible Party and/or Balancing Party.
Balancing Energy	means the additional energy supplied or curtailed by the Participants on the instruction of the SO to address imbalances between real time supply and demand;

Balancing Mechanism	has the meaning assigned to this term in the Market Guidelines, being the operational framework tool used by the System Operator to balance electricity supply and demand in real-time by calling upon additional generation or consumption, or reducing generation or consumption, in order to maintain system balance on a minute-by-minute and second-by-second basis.
Balancing Party	means: (a) an End User with consumption of at least than 1 MW with a dedicated meter at its Point(s) of Withdrawal, unless that End User's only supplier is a Distributor; (b) a Generator with a generating capacity of at least one (1) MW and a dedicated meter at its Point(s) of Injection; (c) an Energy Storage Operator with storage capacity of at least one (1) MW and a dedicated meter at its Balancing Point; or (d) a Distributor, with metering at each Point of Connection where it connects to a Transmission Network.;
Balancing Point	means a Point of Injection or a Point of Withdrawal;
Balancing Point Imbalance Quantity BPIQ	has the meaning set out in Clause 3.5;
Balancing Services	means services that are used to balance an injection or withdrawal on the IPS;
Balancing Services Provider (BSP)	means a Participant that can supply Balancing Services to the BRP or SO;
BRP Chargeable Imbalance Quantity	means the arithmetic sum of the Balancing Point Imbalance Quantities for all Balancing Points where it is the BRP registered with the MOU as set out in Clause 3.5;
Business Day	means a day other than a Saturday, Sunday or public holiday in Zambia;
Chargeable Imbalance Quantity	has the meaning set out in Clause 3.6;
Chargeable Imbalance Tariff	means the tariff in USD/kWh approved by the ERB and included in the Balancing Agreement to determine the charge for Chargeable Imbalance Quantities ;

Contestable Consumer	means a Market Participant who is eligible to purchase electricity from any Eligible Seller and includes an Embedded Consumer, Mining Consumer, Industrial Consumer, End-use Consumer, Commercial Retailer, Exporter, Battery Energy Storage System Operator and Intermediary Power Trader;
Day	has the meaning assigned to this term in the Grid Code being a period of 24 consecutive hours commencing at 00:00 hours;
Delivery Day	means the day on which electricity is delivered;
Delivery Hour	means each hour of the Delivery Day;
Delivery Month	means the calendar month in which a Delivery Day occurs;
Dispatch	means to issue to Balancing Parties specific instructions to achieve specific active and reactive power outputs within registered data parameters or declared availability and by stated times;
Distribution Service Network Provider (DNSP)	has the same meaning assigned to this term in the Electricity Act being a licensee responsible for operating, maintaining and developing a distribution system in an area and, where applicable, the distribution system's interconnection with other systems;
Distribution System	has the meaning assigned to this term in the Electricity Act being, a portion of an electricity network which delivers electric energy from transformation points on the transmission network of bulk power system to an enterprise at a voltage whose upper limit is sixty-six kilovolts;
Distributor	has the meaning assigned to this term in the Grid Code being, a person or entity that owns, operates or distributes electricity through a distribution system;
Dynamic Containment	means rapid response to large frequency deviations by quickly adjusting generation or load;
Electricity Act	means the Electricity Act No. 11 of 2019;
Energy Regulation Act	means the Energy Regulation Act No. 12 of 2019;
Eligible Seller	has the same meaning assigned to this term in the Market Guidelines, being a Supplier or licensee that holds a Licence to trade in electricity as defined in the Electricity Act, including but not limited to an independent power producer, importer, embedded power producer, battery energy storage system operator and intermediary power trader;
Emergency	has the meaning assigned to this term in the Electricity Act being, an occurrence where an unplanned loss of generation or transmission facilities, or an occurrence beyond a licensee's control that impairs or affects the licensee's ability to supply that licensee's system demand;

Emergency Energy	means energy procured by the SO to maintain system security during emergency conditions;
End User	means an entity that withdraws power from the IPS at a Point of Withdrawal for its own consumption or the consumption of its Affiliates and not for the resale to third parties;
Energy Regulation Board (ERB)	means the Energy Regulation Board established under the Energy Regulation Act, 2019;
Energy Storage Operators	means operators of equipment that captures energy, stores it, and then releases it when needed;
Firm Daily Nomination	has the meaning set out in Clause 6.3;
Generator	has the meaning assigned to this term in the Grid Code being, an entity operating a generating unit or power station;
Governing Documents	means, collectively, the Electricity Act, the Energy Regulation Act, the Open Access Regulations, the Market Guidelines, the Grid Code, the System Operator Guidelines, and any other rules, procedures, or codes issued by the ERB;
Grid Code	means the Electricity (Grid Code) Regulations, Statutory Instrument No. 79 of 2013;
Imbalance	means a difference between the Scheduled Quantity and the Metered Quantity at one or more Balancing Points;
Inadvertent Energy	means energy procured by the SO to accommodate variations in flows within the Tolerance Band while maintaining the system balance;
Inadvertent Energy Tariff	means the tariff in USD/MW/month approved by the ERB and included in the Balancing Agreement to determine the charge for Inadvertent Energy ;
Indicative Monthly Nomination	has the meaning set out in Clause 6.2;
Inertial Response	means the immediate response to frequency changes due to the inertia of rotating masses. This service is mandatory for synchronous generators and can be provided by Variable Renewable Energy Systems (VRES) and Energy Storage Systems, equipped with the synthetic inertia capability;
Interconnected Power System (IPS)	has the meaning assigned to this term in the Electricity Act being, means a number of transmission and distribution lines, and includes associated power generation systems that are linked together for the purpose of transmitting or distributing electricity;
Load Following	means adjustments to match predictable changes in demand over time;

Load Frequency Control (LFC)	means a control system that automatically maintains grid frequency within acceptable limits by continuously adjusting power generation and consumption in response to load variations;
Market Guidelines	means the Open Access Market Guidelines for the Electricity Sub-Sector, 2025;
Market Operator Unit (MOU)	means the Ringfenced unit under the System Operator which shall be responsible for the operations of the Markets in accordance with the Market Guidelines and shall also act as the single operator of the Markets.
Metered Quantity	means the quantity of energy in kWh registered at a meter at a Balancing Point as having been injected or withdrawn at the Balancing Point in a Delivery Hour ;
Nominated Quantity	means the quantity of energy included in a Nomination made by a BRP for delivery at a Balancing Point and included in the SO's day-ahead schedule
Nomination	has the same meaning assigned to this term in the Market Guidelines, being the formal declaration of a Market Participant of a quantity of power to be delivered or taken during specific time periods
Non-Spinning Reserve	means non-synchronized generation capacity that can be brought online quickly;
Open Access	has the meaning assigned to this term in the Electricity Act being, the availability of spare transmission or distribution capacity to any qualifying participant on non-discriminatory terms and conditions;
Open Access Management System (OAMS)	has the meaning assigned to this term in the System Operator Guidelines, being the System Operator's electronic communication system for the publication of Information by the System Operator and the submission of Information to the System Operator by Participants. has the meaning assigned to this term in the System Operator Guidelines, being the System Operator's electronic communication system for the publication of Information by the System Operator and the submission of Information to the System Operator by Participants.
Open Access Regulations	means the Electricity (Open Access) Regulations, Statutory Instrument No. 40 of 2024;
Open Access User	has the meaning assigned to this term in the Open Access Regulations being, a person who is granted access to a transmission system or distribution system by a transmission network service provider or distribution network service provider in accordance with the Electricity Act or the Open Access Regulations;

Participant	Means; an Eligible Seller or Contestable Consumer ; · a Generator; · a Trader; · the Public Service Trader (PST); · a Distributor; · a Supplier; · an Energy Storage Operator; - an Importer; and/or · an Exporter;
Participation Agreement	The agreement between the System Operator and a Market Participant governing obligations established under the Market Guidelines;
Point of Connection	of has the meaning assigned to this term words in the Grid Code being, the electrical node in a transmission substation or distribution substation where a customer's assets are physically connected to the TNSP's or DNSP's assets;
Point of Injection	means a metered point where electrical energy is injected into a Transmission System or a Distribution System ;
Point of Withdrawal	of means a metered point where electrical energy is uplifted from a Transmission System or a Distribution System ;
Primary Frequency Control	means automatic response to frequency deviations by adjusting generation or load. This service is mandatory for all Generators and must be available at all times;
Primary Reserve	means the reserve capacity available to provide Primary Frequency Control, being the fastest-acting Balancing Service that responds automatically and immediately to frequency deviations;
Qualifying Participant	has the meaning assigned to this term in the Open Access Regulations being a person who is eligible to apply for open access in accordance with regulation 5 of the Open Access Regulations;
Regional Operator	has the meaning assigned to this term in the Grid Code being, an entity subordinate to the SO and independent from other market participants responsible for short term reliability of the IPS which is in charge of controlling and operating part of the Transmission system in real time.
Replacement Energy	has the meaning set out in Clause 6.4.1;
Replacement Energy Tariff	means the tariff in USD/kWh approved by the ERB and included in the Balancing Agreement to determine the charge for Replacement Energy ;

SAPP Operator	Market	means the SAPP body responsible for managing the SAPP Physical Markets ;
SAPP Rules	Market	means the current Markets Book of Rules published by SAPP ;
SAPP Physical Markets	Physical	means any monthly forward physical markets, weekly forward physical, markets, day-ahead markets, intra-day markets and balancing markets operated by the Southern African Power Pool on behalf of its members;
Secondary Frequency Control		means an automatic or manual coordinated response to restore frequency and correct mismatches between supply and demand;
Secondary Reserve		means a slower response balancing service to maintain long-term grid stability;
Spinning Reserve		has the meaning assigned to this term in the SAPP Agreement Between Operating Members (ABOM);
Supplier		has the meaning assigned to this term in the Electricity Act being, a person who supplies electricity;
System Balance Energy	Balance	means energy procured by the SO to maintain the system balance in response to Imbalances in excess of the Tolerance Band ;
System Operator (SO)		has the meaning assigned to this term in the Electricity Act being, an entity responsible for the short-term reliability of an interconnected power system, which is in charge of controlling and operating the transmission system and dispatching generation or balancing the supply and demand in real time in a non-discriminatory manner
System Operator Agreement		means an agreement between a Participant and the SO for the provision of services as set out in the System Operator Guidelines other than those services provided under the Balancing Agreement and the Participation Agreement;
System Operator Guidelines		means the System Operator Guidelines for Open Access to Transmission and Distribution Systems, 2025 of which this mechanism is an Annexure;
Tertiary Frequency Control		means manual adjustment of generation or load to restore reserves (i.e. in response to a dispatch instruction);
Tertiary Reserve		means a reserve capacity that is capable of providing Tertiary Frequency Control ;
Tolerance Band		has the meaning set out in Clause 3.6;
Trader		means the holder of a licence to trade in electricity issued by the ERB under the Energy Regulation Act;

Transmission Service Network Provider (TNSP)	has the meaning assigned to this term in the Electricity Act being, a licensee responsible for operating, maintaining and developing a transmission system and, where applicable, the transmission system's interconnection with other system;
Transmission System	Has the meaning assigned to this term in the Electricity Act being, part of the interconnected power system which supplies power in bulk from a generating station to a distribution system and other consumers and includes: (a) transmission lines and sub-station equipment on the interconnected power system where the nominal voltage is above sixty-six kilovolts; and (b) associated equipment at a transmission network service provider substation belonging to a transmission network service provider;
Variable Renewable Energy Systems (VRES)	means renewable energy sources that are not dispatchable due to their fluctuating nature including wind power and solar power;
Zambian Balancing Market	means a market to be established in Zambia for the trading of Balancing Energy and Balancing Services between BRPs and BSPs ;

2.2 Abbreviations

BRP	Balance Responsible Party
BSP	Balancing Service Provider
DNSP	Distribution Network Service Provider
ELACT	Electricity Act
IPS	Interconnected Power System
OAMS	Open Access Management System
OAREGS	Open Access Regulations
SAPP	Southern African Power Pool
SCADA	Supervisory Control and Data Acquisition
SO	System Operator
TNSP	Transmission Network Service Provider
VRES	Variable Renewable Energy Systems
ZGC	Zambian Grid Code
ZGC Ch4	Zambian Grid Code, Chapter 4, System Operation

3. Introduction

This procedure establishes the framework by which the **System Operator (SO)** schedules and dispatches plant and equipment across the **Interconnected Power System (IPS)** in coordination with relevant Balancing **Participants** for the purpose of:

- a) maintaining real-time balance between energy injection and withdrawal on the Transmission System;
- b) ensuring the procurement and availability of necessary system services required for secure electricity generation and transmission; and
- c) coordinating with Regional Operators on interconnected systems to ensure secure and efficient operation in accordance with Section 10 of the Electricity Act.

This procedure is established pursuant to Chapter 4, Section 8 of the Grid Code, which mandates that the SO *shall "in liaison with relevant participants develop and maintain operating procedures for the safe, secure and reliable operation of the Transmission System and for assets connected to the Transmission System."*

3.1 Balancing Mechanism

The **Balancing Mechanism** is the process used to address deviations that occur when a **Generator's** actual output, or an **End User's** actual consumption, in any **Delivery Hour** differs from their respective **Nominated** Quantities.

The **Balancing Mechanism** addresses the balancing of active power (balancing energy) in the **IPS**. Reactive power management and other ancillary services (including voltage control) are managed by the **SO** under separate procedures.

The purpose of the **Balancing Mechanism** is to:

- (a) Enable the **SO** to maintain continuous real-time balance between energy supply and demand on the **IPS**;
- (b) Define the Balancing Services required to maintain energy supply and demand balance;
- (c) Establish the methodology for determining reserve capacity requirements for Balancing Services;
- (d) Identify eligible Balance Service Providers and specify how Balancing Services will be delivered;
- (e) Establish alternative mechanisms for **Balance Responsible Parties** to fulfil their balancing obligations;
- (f) Define the **SO's** responsibilities both as a national system operator and as a control area operator within the **Southern African Power Pool (SAPP)**;
- (g) Establish the methodology for settlement of **Imbalances** whilst preventing double-charging of market participants.

3.2 Balancing Parties

To maintain the frequency of the **IPS** within its safe operating bounds the **SO** must

ensure that the quantity of energy injected into the **IPS** continuously matches the quantity of energy withdrawn from the **IPS**. To do this it relies on **Generators, End Users** and **Energy Storage Operators** to arrange ahead of time that their injections and withdrawals have balancing withdrawals and injections for each **Delivery Hour**.

End Users, Generators and **Energy Storage Operators** with capacities less than one (1) MW are required to have a contract with a **Distributor** under the terms of which that **Distributor** ensures that there are matching flows for each injection or withdrawal.

In accordance with the **Open Access Regulations, End Users, Generators, Energy Storage Operators and Traders** with capacities greater than or equal to one (1) MW [OAREGS §5(2)] may qualify as **Qualifying Participants** able to buy or sell power from or to entities other than **Distributors**. Such entities may themselves be **Generators, End Users** or **Energy Storage Operators**, they may be **Traders**, or they may be anonymous counterparties trading through the **SAPP Physical Markets**.

Every entity that withdraws power from or injects power into the **IPS** affects the balance of supply and demand across the **IPS**.

A Balancing Party is an entity that is :

- a) an **End User** with consumption of at least one (1) MW with a dedicated meter at its Point(s) of Withdrawal;
- b) a **Generator** with generating capacity of at least one (1) MW with a dedicated meter at its Point(s) of Injection;
- c) an **Energy Storage Operator** with storage capacity of at least one (1) MW with a dedicated meter at its **Balancing Point**; or
- d) a **Distributor**, with metering at each **Point of Connection** where it connects to a **Transmission System**.

Every **Balancing Party** that has a contract to buy or sell power at its **Balancing Point** with a Participant that is not a **Distributor** must enter into a **Balancing Agreement** with the **SO**.

Subject to Clause 3.3 below, every **Balancing Party** that contracts to buy or sell power with counterparties other than a **Distributor** at a **Balancing Point** is also the **Balance Responsible Party** for that **Balancing Point**, with the responsibility to:

- (a) ensure that in every **Delivery Hour** the Nominated Quantity at their **Balancing Point** is balanced by corresponding Nominated Quantities at other **Balancing Points**; and
- (b) ensure that a **Nomination** for the quantity of power to flow at its **Balancing Point** is made in accordance with Clause 6.3; and
- (c) ensure that the **Metered Quantity** at its **Balancing Point** matches its **Scheduled Quantity** at the **Balancing Point** in every **Delivery Hour**.

3.3 Balance Responsible Parties

Every **Balancing Point** must have a single **Balance Responsible Party** registered with the **MOU**.

Where a **Balancing Party** has a **Power Supply Agreement** with a **Distributor**, then the **Distributor** is the **Balance Responsible Party** for that **Balancing Point**.

A Balancing Participant may agree to assume the role of **Balance Responsible Party** on behalf of a **Balancing Party** at any **Balancing Point** that is not connected to a **Distributor**.

3.4 Imbalances

Prior to each **Delivery Hour**, a **Scheduled Quantity** is determined for each **Point of Connection** in accordance with Clause 6.3. An **Imbalance** occurs when, during the **Delivery Hour**, the **Metered Quantity** does not match the **Scheduled Quantity**. That is:

$$Q_{mtr} \neq Q_{sch}$$

Where:

Q_{mtr} is the **Metered Quantity**; and

Q_{sch} is the **Scheduled Quantity**.

3.5 Balancing Point Imbalance Quantities

The **Balancing Point Imbalance Quantity** at each **Balancing Point** in each **Delivery Hour** is determined as follows:

- (a) For a **Point of Withdrawal**, the **Balancing Point Imbalance Quantity** is the **Scheduled Quantity** minus the **Metered Quantity** at that **Point of Withdrawal**, that is:

$$BPIQ_B = Q_{Bsch} - Q_{Bmtr}$$

where:

$BPIQ_B$ is the **Balancing Point Imbalance Quantity** for the **Balancing Point B**;

Q_{Bsch} is the **Scheduled Quantity** for the **Balancing Point B**;

Q_{Bmtr} is the **Metered Quantity** for the **Balancing Point B**.

- (b) For a **Point of Injection**, the **Balancing Point Imbalance Quantity** is the **Metered Quantity** minus the **Scheduled Quantity** at that **Point of Injection**:

$$BPIQ_B = Q_{Bmtr} - Q_{Bsch}$$

where:

$BPIQ_B$ is the **Balancing Point Imbalance Quantity** for the **Balancing Point B**;

Q_{Bsch} is the **Scheduled Quantity** for the **Balancing Point B**;

Q_{Bmtr} is the **Metered Quantity** for the **Balancing Point B**.

The value of the **Balancing Point Imbalance Quantity** may be positive or negative.

From the **SO's** perspective, across the entire **IPS** the net Imbalance Quantity will be the sum of the **Balancing Point Imbalance Quantities** at the **Points of Connection**. A negative net Imbalance Quantity means that the **SO** has had to provide energy from its contracts with **BSPs** or purchases on the **SAPP Physical Markets** or curtail energy consumption.

3.6 Chargeable Imbalance Quantities

Where the **Balancing Point Imbalance Quantity** fall outside the **Tolerance Band** then it is a **Chargeable Imbalance Quantity**.

That is, if the **Balancing Point Imbalance Quantity** is either:

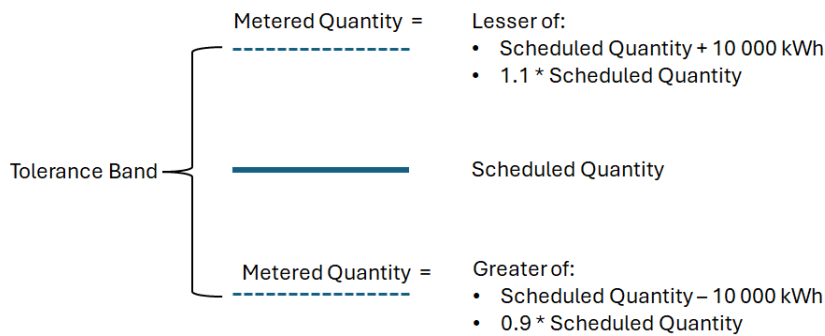
- (a) higher than the highest tolerance, where the highest tolerance is the lesser of:
 - i. ten thousand (10 000) kW; or
 - ii. the Nominated Quantity plus 10%:
- (b) lower than the lowest tolerance, where the lowest tolerance is the greater of
 - i. minus ten thousand (10 000) kW; or
 - ii. the Nominated Quantity minus 10%;

that is, if either

- (a) $BPIQ_B > \text{Minimum } (10\,000, 0.10 * Q_{sch})$; or
- (b) $\text{Maximum } (-10\,000, -0.10 * Q_{sch}) > BPIQ_B$

then the **Balancing Point Imbalance Quantity** is a **Chargeable Imbalance Quantity**.

The **Tolerance Band** is the range from the lowest tolerance to the highest tolerance.



For any **BRP**, the **BRP Chargeable Imbalance Quantity** will be the arithmetic sum of the **Chargeable Imbalance Quantities** for all **Balancing Points** where it is registered as the BRP with the **MOU**.

4. Roles of Participants

Balancing Participants that inject or withdraw power from the **IPS** are responsible for ensuring that their **Metered Quantities** injected and/or withdrawn at each **Balancing Point**:

- (a) match the **Nominated Quantities** to be injected or withdrawn at each **Balancing Point**; and
- (b) ensure that the **Nominated Quantities** to be injected or withdrawn have corresponding balancing **Nominated Quantities** for withdrawal or injection respectively.

The **MOU** shall aggregate **Nominated Quantities** to determine the net **Nominated Quantity** at **Points of Connection** and confirm that **Nominated Quantities** for injection and withdrawal are balanced across the **IPS**.

The **SO** confirms that the aggregate **Nominated Quantities**, together with power flows not subject to nominations (such as transmission losses across **TNSP** networks), do not result in constraints on the **IPS**, and may request the **MOU** to coordinate with **BRPs** to adjust their **Nominated Quantities** accordingly.

In real-time, the System Operator takes responsibility for balancing energy flows between **Points of Connection** across the entire **IPS**.

4.1 Role of the SO

4.1.1 Prior to Dispatch

The System Operator shall forecast system demand and generation availability to determine the required balancing reserve requirements. The forecast shall take into account aggregate **Nominated Quantities** at **Points of Connection** as advised by the **MOU**.

Historical data, real-time monitoring, and advanced forecasting tools shall be used to estimate potential imbalances on an annual basis for reserve contracting purposes.

The **SO** shall determine the requirements for **Primary Reserves**, **Secondary Reserves**, and **Tertiary Reserves** based on system conditions and potential contingencies.

4.1.2 Real time Dispatch

The **SO** shall maintain real-time balance between energy supply and demand on the **IPS**.

During real-time operations, the **SO** shall have the absolute right to activate any Balancing Services:

- that the **SO** has contracted from any **Balance Service Provider**;
- that has been contracted from a **Balance Service Provider** by a Balance Responsible Party; or
- from the **SAPP Physical Markets**;
- based on system conditions.

This authority shall be limited to contracted **Balancing Services** available for the day and/or the **SAPP Physical Markets**, which

should be used when sourcing from the market. Provided that such sources:

- are more cost-effective; or
- provide better system security than reserves from **Balance Responsible Parties**; or
- are only accessed if the Balance Responsible Party reserves may not be provided or accessed).

In case of an **Emergency**, where the **SO** cannot source **Replacement Energy**, the **SO** may procure **Emergency Energy**. Where the **SO** can identify the Participant that is causing the **Emergency**, the **SO** shall contact the Participant to:

- (a) seek information as to the likely duration of the **Emergency**; and
- (b) notify that Participant that it will be liable for the costs of **Emergency Energy** and give the Participant the opportunity to either:
 - i. remedy the **Emergency**; or
 - ii. procure an alternative source of energy;

4.1.3 Post Dispatch

The **SO** shall notify the MOU of the **Metered Quantities** recorded at each **Balancing Point** and **Point of Connection**.

4.2 Role of the MOU

4.2.1 Months Prior to Dispatch Month

The **MOU** shall maintain a register of every **Balancing Party** that identifies:

- (a) their **Balancing Point(s)**;
- (b) the **Point of Connection** to which each **Balancing Point** is connected;
- (c) the **Balance Responsible Party** for each **Balancing Point**;
- (d) the details of any contract under which power physically injected or withdrawn at any such **Balancing Point** including:
 - i. the counterparties to the contract;
 - ii. the tenor of the contract;
 - iii. the contracted quantities and delivery profiles;
 - iv. **the Points of Injection** and/or **Points of Withdrawal** under the contract;
- (e) the **Balance Responsible Party** for the associated **Balancing Points** where power is either injected for supply under the contract or withdrawn for sale under the contract; and
- (f) the order established by the **BRP** in which contracts at the **Balancing Point** are to be reconciled.

4.2.2 Prior to Dispatch

The **MOU** receives nominations from the **BRPs** for each contract or SAPP approved trade at each **Balancing Point**, and:

- a. confirms that the **Nominated Quantities** are in accordance with the associated contract;
- b. confirms that the aggregate **Nominated Quantities** at **Points of Injection** and at **Points of Withdrawal** by each **BRP** are matched;
- c. resolves any discrepancies in **Nominations**;
- d. aggregates **Nominated Quantities** at each **Point of Connection**;
- e. notifies the **SO** of the aggregated **Nominated Quantities** at each **Point of Connection**; and
- f. coordinates with **BRPs** to adjust **Nominated Quantities** where the **SO** has notified that they cannot be scheduled on the **IPS**.

BRPs shall also notify the **SO** of any **Balancing Services** contracted from **BSPs** or from the **SAPP Physical Markets**.

4.2.3 Post Delivery Reconciliation

Following the Delivery Day the MOU carries out the reconciliation process as set out in Clause 7.

4.3 Role of Balance Responsible Parties

Under the **Market Guidelines**, all **Open Access Users** above a specified threshold (defined as **Eligible Sellers** and **Contestable Consumers**) are **Balance Responsible Parties**.

A **Balance Responsible Party** is a Participant that has responsibility for specific **Balancing Points** to:

- (a) ensure that in every **Delivery Hour** the Nominated Quantities for injection and withdrawal at its **Balancing Points** are balanced; and
- (b) ensure that Nominated Quantities for the quantity of power to flow at its **Balancing Point** are made in accordance with Clause 6.3;
- (c) ensure that the **Metered Quantity** at its **Balancing Point** matches its **Scheduled Quantity** at the **Balancing Point** in every **Delivery Hour**; and
- (d) settle any payments due to the **SO** for **BRP Chargeable Imbalance Quantities**.

Generators and **End Users** that are **Open Access Users** have the primary responsibility for balancing their respective injections and withdrawals but may contract this responsibility to a third-party Participant such as a **Trader**. Every **Balancing Point** must have a designated **Balance Responsible Party**.

BRPs may contract with **Balance Service Providers** (BSPs) for the provision of Balancing Services. Such contracts may be standing bilateral arrangements, or purchases may be made on a short-term (intra-day) basis on the **SAPP Physical Markets** or any **Zambian Balancing Market** that may develop.

4.4 Role of Balance Service Providers (BSPs)

Generators, End Users, Energy Storage Systems, Variable Renewable Energy Systems, and Intermediary Power Traders which are contractually entitled to control the energy generated or consumed by any of the foregoing, may act as **Balance Service Providers (BSPs)** and contract to provide **Balancing Services** to **BRPs** or the **SO**.

BSPs shall provide the services in accordance with their allocated responsibilities as set out below.

- (a) **Generators** other than **Variable Renewable Energy Systems** shall have the capability to provide inertial response and make available adequate **Primary Frequency Control, Secondary Frequency Control, Tertiary Frequency Control**, and time error correction, as are mandatory under the **Grid Code**.
- (b) **End Users** with fast response capabilities shall provide **Primary Frequency Control** and participate in Load Following. Dispatchable loads shall be equipped with under-frequency load shedding schemes, and all **Balancing Parties** shall notify the **System Operator** of the number of dispatchable loads as a percentage of their total load.
- (c) **Energy Storage Systems** shall provide fast response services, including primary and secondary frequency control, Spinning Reserve, and load following.
- (d) **Variable Renewable Energy Systems (VRES)** shall provide synthetic inertia and participate in Load Following, provided they have the necessary control systems.

Mandatory reserves shall be provided to the **SO** by all **BSPs** as required in Section 8, by the Grid Code and applicable regulations.

While some requirements may be mandatory (connection or operational requirements), **BSPs** will have the option to provide non-mandatory services through contractual arrangements, subject to prior approval by the **SO**.

BSPs that have additional capacity available may offer such Balancing Services to other parties through:

- bilateral contractual arrangements;
- the **Zambian Balancing Market** (if it is established); or
- to the **SAPP Physical Markets** (either directly or through the **MOU**).

All **Participants** shall declare to the **SO** the reserves they have available, specifying the periods of availability, and shall provide technical details including ramping rates, technologies, and whether the reserves are spinning or non-spinning.

BRPs shall declare to the **SO** the source of Balancing Services and identify which **BSPs** will meet their balancing obligations on their behalf.

Unless system security requirements require otherwise, the **SO** shall seek to procure **Balancing Services** at the lowest marginal cost, whether from **Zambian BRPs** or from the **SAPP Physical Markets**.

5. Registration and Prequalification of BRPs and BSPs

Balance Responsible Parties are financially responsible for ensuring that power quantities injected at **Points of Injection** or withdrawn at **Points of Withdrawal** for which they are responsible are in accordance with **Nominations** and have balancing withdrawals elsewhere on the **IPS**. They can achieve this through physical control of generation and/or consumption and/or through contractual arrangements with other **Participants**. **BRPs** obligation is to balance over an hourly time interval.

Balance Service Providers have physically controllable assets that enable them to inject or withdraw power in response to variations in power flows by other **Participants**. Control may be provided to adjust power flows over a range of time intervals from instantaneous up to hourly.

Since they are connected to the **IPS**, all **BSPs** are also **BRPs** for their **Balancing Points**. Depending on the controllability of the power flows for which they are responsible, **BRPs** may also be **BSPs**.

5.1 Registration of BRPs

All **Balancing Participants** and **Balance Responsible Parties** shall be registered by the System Operator. The process to register as a **Balancing Participant** and/or **Balance Responsible Party** shall involve submitting an application in the approved form, providing proof of company registration, and completing a questionnaire to verify suitability.

5.1.1 Financial guarantees

Balance Responsible Parties may be required to provide payment security in accordance with the Balancing Agreement based on the Balance Responsible Party's expected imbalance exposure and credit rating.

5.1.2 Contracts

Balancing Participants must execute:

- (a) a **System Operator Agreement** with the **SO**; and
- (b) a **Balancing Agreement** with the **SO**.

BRPs must execute a **Balancing Agreement** with the **SO**.

BRPs may also execute contracts for the provision of **Balancing Services** from **BSPs** registered with the **SO**.

5.1.3 Other requirements

Balance Responsible Parties that are not otherwise licensed as Generators, Traders, or Suppliers must register with the **ERB**.

Balance Responsible Parties must:

- (a) have a clearing account approved by the **MOU**;
- (b) have the ability to receive invoices from the **MOU**.

5.1.4 Additional information

Balance Responsible Parties are financially responsible for imbalances between planned and actual power production,

consumption, and trade, as established by the difference between **Scheduled Quantities** and **Metered Quantities**.

Balance Responsible Parties can participate in both the **Balancing Agreement** framework and balancing markets.

Balance Responsible Parties must notify the **SO** as soon as practicable, and no later than fifteen (15) minutes prior to the **Delivery Hour**, of any purchase of **Balancing Services** from Balance Service Providers or from the **SAPP Physical Markets**.

5.2 Prequalification of BSPs

Potential Balance Service Providers must demonstrate their technical capability to the System Operator and meet specific requirements before they can contract to provide **Balancing Services**, whether through **bilateral contracts** or through any market for **Balancing Services**, essentially proving they can reliably adjust power generation or consumption to maintain grid stability.

This requires submitting documentation regarding their facilities, technical capabilities, and operational procedures to the **SO** for evaluation before being permitted to register contracts with the **MOU** or participate in any Zambian balancing market.

5.2.1 Assessment Requirements:

(a) Technical capabilities:

The capacity of generating units or demand response assets that can be used to provide Balancing Services.

(b) IT Systems:

The ability to communicate with the System Operator's market platform and systems for receiving balancing dispatch orders.

(c) Financial stability:

Proof of adequate financial resources to meet contractual obligations and potential liabilities arising from the provision of Balancing Services.

(d) Operational experience:

Demonstrated track record in providing reliable Balancing Services and managing power system operations system or equivalent technical operations.

5.2.2 Prequalification process:

(a) Application submission:

Potential BSPs shall submit the necessary documentation and information regarding their facilities to the **SO**.

(b) Technical evaluation:

The **SO** shall assess the technical capabilities and compliance with the requirements set out in Clause 5.2.1.

(c) Operational testing:

This may involve live testing of the provider's systems to verify

their ability to respond to system imbalances and provide Balancing Services as required.

(d) Approval or rejection:

Based on the evaluation, the **SO** shall decide whether to qualify the Balance Service Provider.

6. Scheduling Prior to the Delivery Day

6.1 Determination of Reserve Requirements

The **SO** shall be responsible for determining Reserve requirements by considering the following:

6.1.1 System Requirements:

(a) Load Variability:

Analyse historical load data to understand daily, seasonal, and unexpected load variations.

(b) Generation Variability:

Assess the variability and uncertainty of Variable Renewable Energy Systems (such as solar and wind generation).

(c) Contingency Events:

Consider potential generator or transmission line outages and their impact on system balance.

6.1.2 Regulatory and Reliability Standards:

(a) **Grid Code** and Power Quality and Reliability Standards ZS387:

Comply with regulatory guidelines that specify reserve requirements.

(b) Reliability Criteria:

Maintain compliance with reliability standards, including maintaining frequency within acceptable limits.

6.1.3 Reserve Requirements:

Reserve Type	Typical Percentage of System Load
Primary Reserve	1-2%
Secondary Frequency Control Reserve	3-5%
Tertiary Frequency Control Reserve	5-10%
Spinning Reserve	5-10%
Non-Spinning Reserve	5-10%

The reserve requirements shall be determined before the beginning of each year and the **SO** shall ensure it has procured sufficient quantities of each type of reserve, noting that **Primary Reserves** and some Secondary Reserves will be provided by Participants through mandatory obligations under the **Grid Code**.

The SO shall prepare an annual forecast of the costs for each type of

reserve.

The **SO** shall allocate the costs according to the following categories:

(a) **Inadvertent Energy:**

the costs of maintaining system frequency while allowing Balance Responsible Parties to incur **Imbalances** within the **Tolerance Band**; or

(b) **System Balance Energy:**

the costs of maintaining grid security where aggregate Imbalances exceed the amount provided for **Inadvertent Energy**;

(c) **Replacement Energy:**

the costs of energy of providing Replacement Energy; and

(d) **Ancillary Reserves:**

reserves required for reasons other than those set out in paragraphs (a), (b) and (c) above.

The **SO's** forecast costs associated with the procurement of **Inadvertent Energy** shall be recovered from all BRPs through the **Inadvertent Energy Tariff** in the **Balancing Agreement**.

The **SO's** forecast costs for **System Balance Energy** shall be recovered from **BRPs** through the **Chargeable Imbalance Tariff** in the **Balancing Agreement**.

The **SO's** forecast costs for **Replacement Energy** shall be recovered from **BRPs** through the **Replacement Energy Tariff** in the **Balancing Agreement(s)**.

The **SO's** forecast costs for **Ancillary Reserves** shall be recovered through a regulated tariff under the **System Operator Agreement(s)**.

6.1.4 Monitoring and Adjustment:

The **SO** shall continuously monitor system conditions and adjust Reserve requirements as needed.

The **SO** shall use real-time data from the SCADA system to ensure that Reserves are available when needed.

6.2 Month-ahead Nominations

An indicative **Nomination** of the energy to be injected or withdrawn at **Balancing Points** during each calendar month (the **Indicative Monthly Nomination**) shall be delivered to the **SO** by the **BRP** for that **Balancing Point** no later than 09:00 hours on the 24th day of the month prior to the **Delivery Month**.

The **Indicative Monthly Nomination** shall specify the following:

- (a) for bilateral transactions, the relevant **Balancing Points** for the energy;
- (b) for transactions on the **SAPP Physical Markets**, the **Balancing Point** at which the energy will be delivered; and
- (c) for all transactions, the volumes of electrical energy.

6.3 Day-Ahead Scheduling

No later than 15:00 hours on the day prior to delivery (D-1), the **BRPs** shall provide **SO** with a firm **Nomination** (the **Firm Daily Nomination**) of the electrical energy to be transferred in each **Delivery Hour** of the **Delivery Day** at each **Balancing Point** for which they are responsible, specifying:

- (a) The quantity to be purchased or sold at each **Balancing Point** for which it is the **BRP**; and
- (b) the quantity (if any) confirmed to be purchased or sold through the **SAPP Physical Markets**.

The **SO** shall notify the **MOU** of the **Scheduled Quantities** after taking into consideration the impacts of any system constraints. Firm quantities traded through SAPP shall not be subject to amendment since the SO will have approved the available capacity to SAPP.

By 16:00 hours, the **MOU** shall confirm to the **BRPs** their **Firm Daily Nomination** that has been included in the **SO's** daily **Schedule** (the **Scheduled Quantity**).

Where the **SO** notifies the **MOU** that the aggregate **Firm Nominated Quantities** at a **Point of Connection** require amendment to match the **Scheduled Quantity** at that **Point of Connection**, then:

- (a) the **MOU** shall advise the **BRPs** whose **Nominations** are affected; and
- (b) liaise with the affected **BRPs** to establish **revised Firm Daily Nominations** that align with the **Scheduled Quantity** for that Point of Connection.

Table 1: Day-Ahead Nomination and Schedule Timelines

Time	Action
09:00	System Operator publishes load forecasts for day and week-ahead [<i>GC Chapter 4 §16.3</i>]
12:00	SAPP Day-Ahead Market order gate closure
14:30	SAPP confirmation of trades
15:00	BPs/BRPs submit Firm Daily Nominations to MOU
15:30	MOU notifies SO of aggregate flows at Points of Connection
16:00	SO confirms Scheduled Quantities to MOU and advises of any amendments required. MOU notifies affected BRPs.

6.4 During the Dispatch Day Prior to Dispatch Hour

If a **BRP** becomes aware that power injected or withdrawn at **Dispatch Points** in a **Dispatch Hour** later in the **Dispatch Day** for which it is responsible will vary from the Scheduled Quantity in a manner that will result in an **Imbalance**, then it shall provide the **SO** with:

- (a) an amended Firm Notified Quantity that will remove the forecast Imbalance; or
- (b) if the BRP has been unable to source power to correct the imbalance, a request

for Replacement Energy.

Where a **BRP** enters into an intra-day contract on the **SAPP Physical Markets**, the **BRP** shall notify the **SO** not less than fifteen (15) minutes prior to the **relevant Delivery Hour**.

6.4.1 Replacement Energy

Replacement Energy means energy provided by the **SO** from its BSP Contracts upon request from a **BRP** during a **Dispatch Day**, subject to the following provisions:

- (a) A **BRP** may request Replacement Energy from the **SO**, provided such request is made not less than fifteen (15) minutes prior to the relevant Dispatch Hour.
- (b) The request shall specify the **Dispatch Hours** during which **Replacement Energy** is to be provided and the quantity of **Replacement Energy** required for each such **Dispatch Hour**;
- (c) the **Balancing Points** to which the **Replacement Energy** is to be allocated to during reconciliation;
- (d) Upon agreeing to provide Replacement Energy, the **SO** shall use all reasonable endeavours to do so from the sources available to it, provided that the **SO** shall not be required to utilise **Emergency Energy** for such purpose; and

The **BRP** shall pay for such **Replacement Energy** at the **Replacement Energy Tariff**.

6.5 Real-time Dispatch

The **SO** shall continuously monitor the **IPS** and identify **Points of Connection** where flows do not accord with the **Scheduled Quantity** for that point of connection shall activate reserves to keep the **IPS** in balance.

Primary Reserves shall be activated automatically in accordance with the **Grid Code**.

Where a **BSP** for a **Point of Connection** has established a contract with a **BRP** to manage **Imbalances**, and that **Point of Connection** has an observed Imbalance contributing to an imbalance between supply and demand across the **IPS**, the **SO** shall, to the extent it considers practicable and efficient, dispatch that **BSP** to align the flow at the **Point of Connection** with its **Scheduled Quantity**.

7. Reconciliation and Settlement

7.1 Day Following the Dispatch Day

On the **Day** following the **Dispatch Day**, the **MOU** shall:

- (a) receive the metered data for each **Balancing Point** and **Point of Connection** for each **Delivery Hour** of the previous **Day**;
- (b) determines the **Balancing Point Imbalance Quantity** in each **Delivery Hour** of the previous **Day** at each **Balancing Point** and **Point of Connection**;
- (c) aggregates the **Chargeable Imbalance Quantities** for each **BRP** for each **Delivery Hour**;
- (d) notifies all **BRPs** of the **Chargeable Imbalance Quantities** for each **Delivery Hour** for the **Balancing Points** for which the **BRP** is responsible, together with the **BRP's** aggregate **Chargeable Imbalance Quantity**.

Where the **BRP** disputes the **MOU's** calculation the **BRP** and the **MOU** shall endeavour to resolve the dispute through amicable negotiation prior to the **SO** issuing invoices under the **Balancing Agreement**.

The **MOU** shall also evaluate whether **Firm Nominations** submitted in respect of **Balancing Points** demonstrate a bias in their relationship with the **Metered Quantities**: specifically, whether **Firm Nominations** are consistently lower or higher than **Metered Quantities**. Where such a bias is observed at a **Balancing Point** the **MOU** shall seek an explanation from the **Balancing Responsible Party** at the **Balancing Point**.

7.2 Monthly Reconciliation and Settlement

Within 5 business days following the end of each month, the **SO** shall provide each **BRP** with a **Monthly Reconciliation Statement** that sets out:

- (a) for each **Balancing Point** for which the **BRP** is responsible:
 - i. the **Metered Quantity** and **Scheduled Quantity** for each **Delivery Hour** of the previous month;
 - ii. the **Chargeable Imbalance Quantity**;
- (b) for each **Balancing Point** for which the **BRP** is responsible, the **Transacted Quantity** attributed to each contract registered at that **Balancing Point**, where:
 - i. the **Transacted Quantity** is the portion of the **Metered Quantity** for the **Balancing Point** that is allocated to each contract, up to the **Nominated Quantity** for that contract; and
 - ii. the allocation is performed in the order of contract reconciliation as registered with the **MOU**.
- (c) For each **BRP**, for each **Delivery Hour** of the previous month, the **BRP Chargeable Imbalance Quantity**;

Balancing Parties will be notified via email, and the **OAMS** shall be used to publish the results.

A complaint window of five (5) **Business Days** following receipt of the **Monthly Reconciliation Statement** shall be provided for participants to raise concerns regarding the accuracy of the reconciliation data or calculations. After this period, the results shall be deemed final save for manifest errors, which are defined as obvious

computational or clerical mistakes that are apparent on the face of the reconciliation statement.

Dispute Resolution Process:

1. **Initial Review Period:** BRPs shall have five (5) Business Days following receipt of the Monthly Reconciliation Statement to review the reconciliation data and raise any concerns regarding the accuracy of such data or the calculations contained therein.
2. **Dispute Notice:** Any dispute must be submitted in writing to the SO and shall specify:
 - a. the specific items in dispute;
 - b. the factual and legal basis (if any) for the dispute;
 - c. all relevant supporting documentation; and
 - d. the BRP's proposed correction and supporting calculations.
3. **Negotiation Period:** Upon receipt of a dispute notice, the BRP and the SO shall endeavour to resolve the dispute through good faith negotiation within five (5) Business Days.
4. **Payment Suspension:** Payment obligations for disputed amounts shall be suspended pending resolution. Undisputed amounts shall remain payable.
Determination by an Expert: If negotiation fails, the parties may refer the dispute to an independent expert with relevant technical expertise in power system operations and balancing, jointly appointed by the parties, whose determination shall be final and binding on both parties. The determination by the independent expert shall be made within five (5) Business days
5. **Manifest Errors:** Manifest errors, being obvious computational or clerical mistakes that are apparent on the face of the reconciliation statement, may be corrected at any time upon discovery by either party.

7.3 Liabilities and Compensation

BRPs that are out of balance shall be liable for costs incurred by the **SO** in managing such **Imbalances**.

Costs incurred by the **SO** from purchasing **Balancing Energy** under contracts with **BSPs** or through the **SAPP Physical Markets** shall be allocated to the **BRP(s)** who caused the **Imbalance**.

The following table sets out how BRPs shall be charged:

Table 2: BRP Charges

Category	Description	Settlement Mechanism	Calculation Method
<i>Inadvertent Energy</i>	Minor deviations between Scheduled Quantities and actual energy delivery due to forecasting uncertainties or operational variations within normal system parameters.	Settled at the Inadvertent Energy Tariff , comprising a fixed monthly rate per MW of maximum capacity at Balancing Point connections and a variable kWh rate based on the hourly Tolerance Band.	Calculated based on the hourly Tolerance Band as specified in Clause 3.6.

Category	Description	Settlement Mechanism	Calculation Method
<i>Balancing Energy</i>	Energy deployed to correct system imbalances through activation of Primary, Secondary, or Tertiary Reserves as part of normal grid balancing operations.	Settled at the Chargeable Imbalance Tariff , a rate per kWh of BRP Chargeable Imbalance Quantity .	Measured as the energy dispatched by balancing services during the imbalance period. Applies to energy imbalances outside of the Tolerance Band
<i>Replacement Energy</i>	Energy supplied by the SO to a BRP when circumstances prevent the BRP from maintaining its balance between supply and demand.	Settled at the Replacement Energy Tariff rate per kWh.	Quantity is the difference between the metered quantity injected and withdrawn across the BRP's Balancing Point(s).
<i>Emergency Energy</i>	Energy used during severe grid emergencies (e.g., sudden loss of generation or transmission failure) to prevent blackouts. Requires activation only after all available reserves, including non-Spinning Reserves, have been utilized.	Settled at the price paid by the SO in procuring the Emergency Energy , with costs allocated to the responsible Balancing Party.	Measured as the quantity of Emergency Energy during the relevant Delivery Hours.

7.4 Invoicing

Within five (5) Business Days following the end of every Delivery Month, the SO shall prepare and deliver to each **BRP** by email or at the address specified in the **Balancing Agreement**, an invoice for the Balancing Service Charge, setting out the amounts payable for:

- (a) the **BRP Chargeable Imbalance Quantity**; and
- (b) any **Replacement Energy** provided by the **SO** during the previous month.

The **SO** shall issue an invoice to each BRP in accordance with the **Balancing Agreement**, setting out the payment due for any quantity of **Emergency Energy** procured by the **SO** to address an **Emergency** caused by that BRP.

7.5 Payment Security

If the **BRP** fails to pay an invoice under this Agreement by the due date in respect of three consecutive months, it shall provide payment security in the form of either:

- (a) a shareholder guarantee [in a form satisfactory to the **SO** acting reasonably taking into account the financial strength of the proposed guarantor];
- (b) an irrevocable standby letter of credit in favour of the SO issued by a bank with a credit rating of at least investment grade, in a form acceptable to the SO and denominated in USD or ZMW;
- (c) an Escrow account established with an escrow agent acceptable to the SO, funded in USD or ZMW and subject to terms acceptable to the SO]; to cover the following amounts for the **Balancing Points** for which the **BRP** is responsible:
- (d) three (3) months of estimated **Inadvertent Energy** Charges calculated in accordance with the Balancing Agreement;
- (e) payment for ten (10) hours of a Chargeable Imbalance Quantity equivalent to thirty percent (30%) of the maximum for the Balancing Points for which a BRP is responsible.

7.6 Compliance

The **SO** shall monitor **BRPs'** compliance with their obligations under this Balancing Agreement through real-time data from the SCADA system.

8. Procurement of Services

The table below provides a detailed overview of the services to be procured from BSPs by the **SO**, including their activation times, sustenance and duration.

Table 3 Services to be Procured by SO from BSPs

<i>Service</i>	<i>Description</i>	<i>Category</i>	<i>Procurement Mechanism</i>	<i>Activation Time</i>	<i>Sustenance Duration</i>	<i>Replacement Energy</i>	<i>Penalties</i>	<i>Role of VRES & ESS</i>	<i>Who Can Provide?</i>	<i>Design/ Connection or Operational Requirement</i>
<i>Inertial Response</i>	Immediate response to frequency changes due to the inertia of rotating masses.	Frequency Response	Mandatory	Instantaneous	Seconds	Not required	ERB Penalty for non-compliance with ZGC	VRES with synthetic inertia; ESS can provide synthetic inertia.	Synchronous generators, VRES with synthetic inertia, ESS.	Design/ Connection
<i>Primary Frequency Control</i>	Automatic response to frequency deviations by adjusting generation or load.	Frequency Response	Mandatory	<30 seconds	15 minutes	Not required	ERB Penalty for non-compliance with ZGC	VRES can provide limited primary control; ESS can provide fast response.	Generators, Loads with fast response capabilities.	Design/ Connection
<i>Secondary Frequency Control</i>	Automatic and coordinated response to restore frequency and correct mismatches.	Frequency Response	Contracts, SAPP Market	<15 minutes	As required	Required	Contractual penalty for non-compliance	VRES can participate with proper control systems; ESS can provide fast regulation.	Generators, Loads with control systems.	Operational Requirement

Balancing Mechanism

<i>Service</i>	<i>Description</i>	<i>Category</i>	<i>Procurement Mechanism</i>	<i>Activation Time</i>	<i>Sustenance Duration</i>	<i>Replacement Energy</i>	<i>Penalties</i>	<i>Role of VRES & ESS</i>	<i>Who Can Provide?</i>	<i>Design/ Connection or Operational Requirement</i>
<i>Tertiary Frequency Control</i>	Manual adjustment of generation or load to restore reserves.	Operating Reserves	Contracts, SAPP Market	<15 minutes (fast), <30 minutes (slow)	As required	Required	Contractual penalty for non-compliance	VRES can provide slow tertiary control; ESS can provide fast and slow tertiary control.	Generators, Loads with manual control capabilities.	Operational Requirement
<i>Spinning Reserve</i>	Synchronized generation capacity ready to respond to sudden changes.	Operating Reserves	Contracts, SAPP Market	<10 minutes	As required	Required	Contractual penalty for non-compliance	VRES can provide limited Spinning Reserve; ESS can provide fast response.	Synchronized generators, ESS.	Operational Requirement
<i>Non-Spinning Reserve</i>	Non-synchronized generation capacity that can be brought online quickly.	Operating Reserves	Contracts, SAPP Market	<30 minutes	As required	Required	Contractual penalty for non-compliance	VRES can provide non-Spinning Reserve; ESS can provide fast start-up.	Generators, ESS.	Operational Requirement
<i>Load Following</i>	Adjustments to match predictable changes in demand over time.	Load Following	Contracts, SAPP Market	Minutes to hours	As required	Required	Contractual penalty for non-compliance	VRES can participate; ESS can provide flexible load following.	Generators, Loads with flexible capabilities.	Operational Requirement

Balancing Mechanism

<i>Service</i>	<i>Description</i>	<i>Category</i>	<i>Procurement Mechanism</i>	<i>Activation Time</i>	<i>Sustenance Duration</i>	<i>Replacement Energy</i>	<i>Penalties</i>	<i>Role of VRES & ESS</i>	<i>Who Can Provide?</i>	<i>Design/ Connection or Operational Requirement</i>
<i>Time Error Correction</i>	Ensures that the system frequency is maintained over time to prevent cumulative time errors.	Frequency Response	Contracts, SAPP Market	Minutes to hours	As required	Required	Contractual penalty for non-compliance	VRES can participate; ESS can provide flexible time error correction.	Generators , Loads with flexible capabilities .	Operational Requirement

