**SYSTEM OPERATIONS**

**OPERATIONAL PROCEDURE No. 3**

**TITLE: GENERATION DISPATCH AND FREQUENCY CONTROL PROCEDURE**

Issue: 1 Date: January, 1993

Review: 1 Date: January, 1995

Review: 2 Date: January, 1997

Review: 3 Date: July, 2003

Review: 4 Date: May, 2010

Issue: 6 Date: October, 2013

Approved by:

**ED(SO)- Dipak Sarma**

**SYSTEM OPERATOR CHQ, ABUJA**

Last Review Date: October 2013

Originator: ED SYSTEM OPERATIONS

**SYSTEM OPERATIONS**

**OPERATIONAL PROCEDURE No. 3**

Issue no. 6

**GENERATION DISPATCH AND FREQUENCY CONTROL PROCEDURE**

Contents

[1. BACKGROUND, PURPOSE AND SCOPE 3](#_Toc367323249)

[1.1. PURPOSE 3](#_Toc367323250)

[1.2. SCOPE 4](#_Toc367323251)

[1.3. GENERAL 4](#_Toc367323252)

[1.4. LEGAL LINKAGE 4](#_Toc367323253)

[2. ISSUANCE, RESPONSIBILITY AND USE 4](#_Toc367323254)

[2.1. ISSUANCE 4](#_Toc367323255)

[2.2. RESPONSIBILITY 4](#_Toc367323256)

[2.3. USERS 4](#_Toc367323257)

[2.3.1. Scheduling Duty 5](#_Toc367323258)

[2.3.2. Generator Duties 5](#_Toc367323259)

[3. TECHNICAL 5](#_Toc367323260)

[4. INPUTS 6](#_Toc367323261)

[5. DAY-AHEAD SCHEDULE 6](#_Toc367323262)

[5.1. OUTPUTS 7](#_Toc367323263)

[6. ON-THE-DAY SCHEDULING AND DISPATCH 8](#_Toc367323264)

[6.1. OUTPUTS 8](#_Toc367323265)

[7. FREQUENCY CONTROL 8](#_Toc367323266)

[8. REPORTING 8](#_Toc367323267)

[9. DEFINITIONS AND ACRONYMS 8](#_Toc367323268)

[10. STATUS AND ASSOCIATED PROCEDURES 9](#_Toc367323269)

**SYSTEM OPERATIONS**

**OPERATIONAL PROCEDURE No. 3**

Issue no. 6

**GENERATION DISPATCH AND FREQUENCY CONTROL PROCEDURE**

# BACKGROUND, PURPOSE AND SCOPE

## PURPOSE

1. The purpose of this procedure is to establish the means by which satisfactory frequency control can be obtained on the Power System using the plant available with due regard to the security of the System (Operational Procedure 1) and economy.
2. The System Operator (SO) has a licence duty to schedule the generation on the system which is enshrined in the Act.

## SCOPE

This procedure describes the process whereby the SO shall schedule the generation on the system and covers:

1. Required data inputs
2. Day-ahead scheduling process
3. On the day scheduling and dispatch
4. Control of system frequency
5. This procedure only covers scheduling day-ahead and on the day:
6. monthly and annual hydro-thermal optimisation is not considered as TCN does not have a hydro-thermal scheduling program.

## GENERAL

1. This current version of the procedure is written in terms of the current NESI environment, hence assumes generation is generally insufficient to meet demand.
2. All users shall submit the relevant information as required under the Grid Code.
3. Any discussion of price below is in terms of generator variable price (i.e. energy plus variable O&M).

## LEGAL LINKAGE

The legal power is through Grid Code clause 2: Scheduling and Dispatch and clause 15: Frequency Control and Operating Reserve.

# ISSUANCE, RESPONSIBILITY AND USE

## ISSUANCE

This procedure shall be issued to all Users of the system, Participants in the market and system operators.

## RESPONSIBILITY

The ED SO is responsible for reviewing, revising and reissuing this procedure. It shall be reviewed whenever the reference in clause 1.3 or the procedures listed in clause 9 are amended and when the scheduling software discussed in section 3.

## USERS

1. The General manager (S/O) National Control Centre is responsible for the operation of this procedure.
2. The MO shall appoint a manager to be responsible for MO duties under this procedure.
3. NBET shall appoint a manager to be responsible for NBET duties under this procedure.
4. Each Generator shall appoint a manager responsible for generator duties under this procedure.

### Scheduling Duty

1. The National Control Centre (NCC) is responsible for scheduling and dispatch of generation output instructions to meet the demand on the Transmission Grid System and maintain the frequency within Grid Code limits.
2. The N.C.C. will schedule the necessary Generation to meet the System demand forecast with due consideration for:
	1. Generator variable costs
	2. System Security (Operational Procedure 1)
	3. Primary response, Secondary response and 5 minute reserve.
	4. MX (MVAR) production and reserves.
	5. Water Management.
	6. Generator shut down time, and other station constraints.
3. NCC shall specify the target frequency to all Power Stations.
4. The security of the System shall take precedence over economic and water management considerations.

### Generator Duties

1. Generators are responsible for generating MW outputs based on NCC instructions.
2. Difficulties in achieving such instructions MUST be reported to the NCC without delay; stating reasons.
3. The capacity to carry reserves or frequency response MUST also be reported to the NCC.
4. A restoration time of generation shortfalls to full availability shall be given whenever possible.

# TECHNICAL

1. A hydro-thermal power system should be scheduled using water valuation scheduling software.
2. When this is purchased this procedure should be revised.

# INPUTS

1. Demand in the two generation export zones:
	1. Export zone A: the demand fed from Afam 330kV and Alaoji 330kV
		1. Sum the previous day’s sub-station demands for each hour
	2. Export zone B: the demand fed from Onitsha 330kV and New Haven 330kV
		1. ditto
2. Variable costs for all thermal power stations
	1. From NBET
3. Daily water flow for Kainji and Shiroro
	1. From NBET
	2. Daily hydro efficiency for Kainji and Shiroro
4. For Jebba the Hydro efficiency at 103m head
	1. From Power Station or NBET
5. Power Station Availabilities
	1. From Power Stations
	2. The availability must take into account their gas supply availability
6. Power Station reserve capabilities
	1. From power stations
7. Transmission Constraints
	1. Alaoji Onitsha = 220MW
	2. Onitsha Benin = 220MW
		1. This will increase to at least 500MW once another Onitsha Benin Circuit is commissioned

# DAY-AHEAD SCHEDULE

1. Until there is more than 250MW of reserve, schedule all offered reserve fully
	1. Hence schedule the generating unit to Availability minus reserve
2. Schedule the generation in Export A:
	1. Set the hourly total generation = zone A demand plus 220MW
	2. De-load the most expensive power station(s) to match this requirement
3. Schedule the generation in Export B:
	1. Set the hourly total generation = zone B demand minus 220MW plus 220MW (or 500MW later)
	2. De-load the most expensive power station(s) to match this requirement
4. Joint Schedule Export A&B
	1. If generation in Export B is lower cost than that in Export A
	2. Increase Export B generation until full load and de-load Export A generation by the same amount.
5. Shiroro PS spread the water flow evenly over the day
	1. (some day night shape may be politically sensible)
	2. Calculate the hourly MW from the hydro efficiency
6. Kainji PS operate at full generator availability
	1. Calculate water flow from hydro efficiency
	2. Subtract form total water flow and instruct this as spill
		1. Evenly over the day (it may be sensible to time this so that more flows into Jebba in daytime)
7. Jebba PS operate reservoir at 103m
	1. The efficiency drop between top dam at 103m and bottom dam at 99m is 12%
	2. Calculate hourly MW from the inflow and the hydro efficiency
8. Instruct all other generating units to operate at full availability
9. If the total generation sent out in any hour is greater than 4,500MW:
	1. Consider reducing the output of the most expensive generators
	2. Above this level stress on the transmission system may be too great

## OUTPUTS

1. In accordance with OP 19 instruct Power Stations
	1. Inform NBET
	2. Inform MO

# ON-THE-DAY SCHEDULING AND DISPATCH

When circumstances change on the day update the Day-ahead schedule in line with clause 5 above.

## OUTPUTS

1. In accordance with OP 19 instruct Power Stations
2. Inform NBET
3. Inform MO

# FREQUENCY CONTROL

1. Generators and the SO shall obey the GC frequency limits and requirements.
2. The N.C.C. shall broadcast the target frequency to all Generators. The Generators shall adjust Generator output to assist with the frequency control, using manual adjustment as necessary.
3. All Generating units shall operate in the frequency sensitive mode of operation except where the Generators CEO and the GM (NCC) have agreed otherwise.

# REPORTING

SO shall record the schedule (both day-ahead and final) for each generating unit in an Excel spreadsheet. The spreadsheet shall be issued to the power station on D+1 (for confirmation) and for the full month to the power station, the MO and NBET the first business day after month end.

# DEFINITIONS AND ACRONYMS

Refer to the Grid Code, Market Rules and Ancillary Service contracts as necessary.

There are significant differences in meaning of the terms in this area between North America and Europe. The Nigerian Grid Code Definitions are:

|  |  |
| --- | --- |
| “Dispatch” | means the process by which the System Operator directs the operation of the Facility to cause a specified amount of Energy or Ancillary Services to be provided to or taken off the Power System. Inclusive of curtailment of Demand and Interchange Transaction Schedules in real time, to relieve congestion, to maintain the Reliability of the Power System and to comply with Applicable Reliability Criteria, as more particularly described in the Grid Code; |
| “Dispatch Schedule” | means the schedule developed by the System Operator in accordance with the Grid Code for a Dispatch Period not later than two hours prior to the commencement of the relevant Dispatch Period; |

# STATUS AND ASSOCIATED PROCEDURES

Status: Draft V6

As an Operating Procedure this procedure derives its legal power from the Grid Code.

The following procedures interact with this procedure.

|  |  |
| --- | --- |
| OP no. | Description of interaction |
| OP 1: OPERATIONAL STANDARDS OF SECURITY OF SUPPLY ON THE TRANSMISSION GRID SYSTEM | Reference for security decisions |

Any changes to the above policy references will mean that the procedure must be reviewed and if necessary updated.

Annexes

The following proformas should be used where specified.

|  |  |  |
| --- | --- | --- |
| Proforma | Purpose | Timing |
| Scheduling output spreadsheet | Monthly Report to MO/NBET | First business day of month |