Attachments

Attachment 1

Accreditation of Ancillary Service Providers

1.0 Purpose

1.1. This procedure establishes guidelines to be followed in the Issuance of Certification/Accreditation for Ancillary Service Provider who would like to provide Ancillary Services to ensure quality of power in the Grid.

2.0 Scope

2.1. This procedure covers only the Accreditation Process including Contracting for Ancillary Service Provider.

3.0 Definition of Terms/Acronyms

3.1 Definition of Terms

3.1.1 **A/S Provider**- a person or an entity-providing ancillary services and registered with the Market Operator.

3.1.2 **Ancillary Services**- Support services such as Frequency Regulating and Contingency Reserves, Reactive Power Support, and Black start capability, which are necessary to support the transmission capacity and Energy that are essential in maintaining Power Quality and the Reliability and Security of the Grid.

3.1.3 **Generator**- any person or entity authorized by the ERC to operate a facility used in the Generation of Electricity.

3.1.4 **TransCo/SO**- the party responsible for generation Dispatch, the provision of Ancillary Service, and operation & control to ensure safety, power quality, stability, reliability, and the security of the Grid.

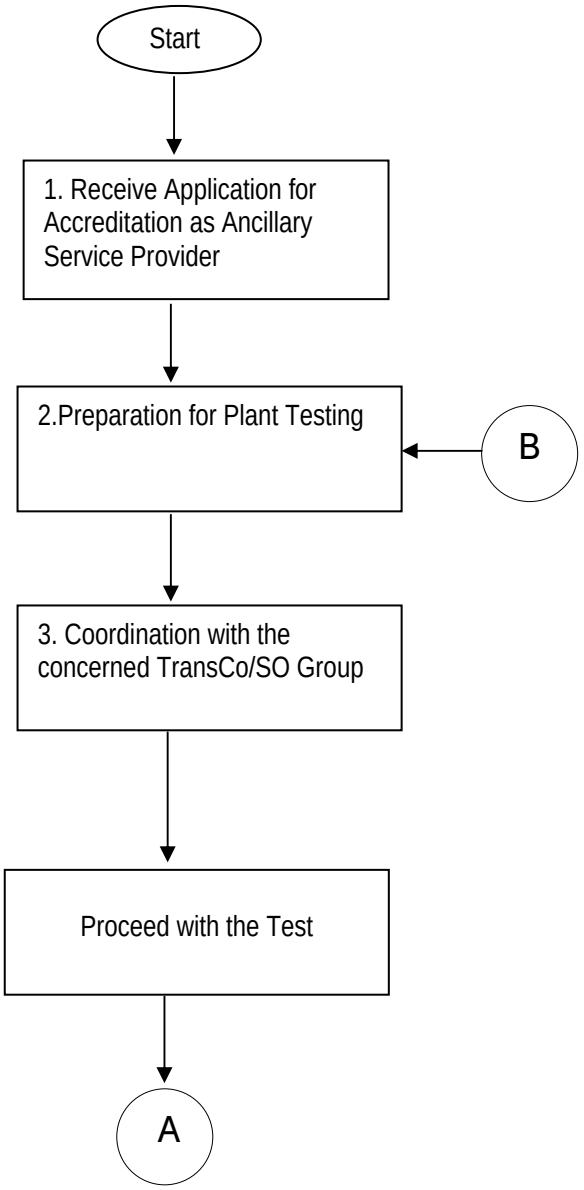
3.2 Acronyms

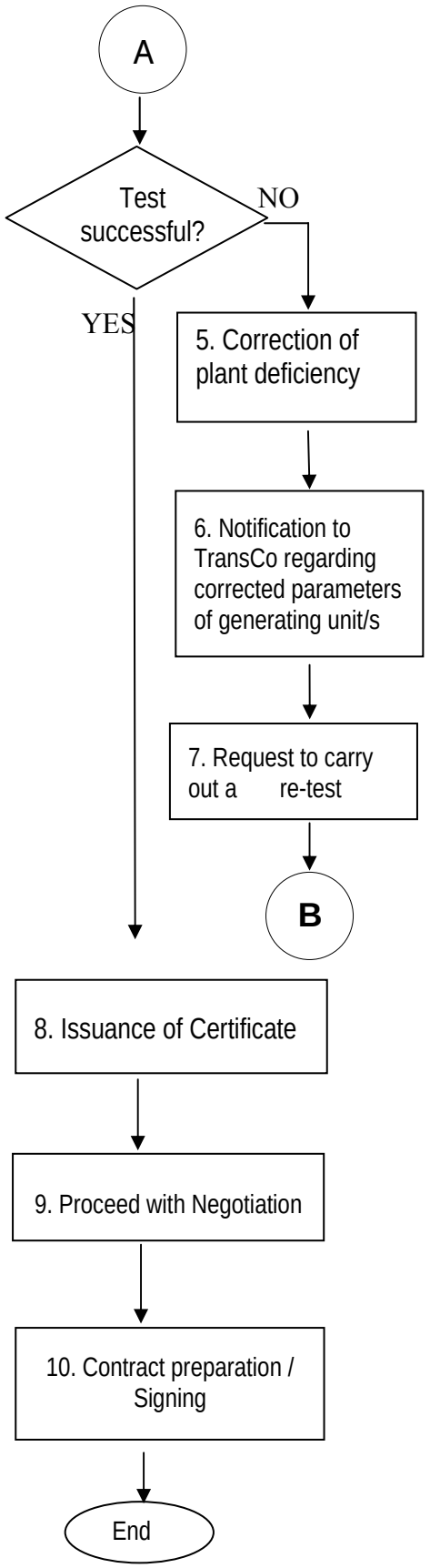
3.2.1	**ACC**	-	Area Control Center
3.2.2	**ASP**	-	Ancillary Service Provider
3.2.3	**A/S**	-	Ancillary Service
3.2.4	**NCC**	-	National Control Center
3.2.5	**OPD**	-	Operations Planning Division
3.2.6	**SCADA**	-	Supervisory Control and Data Acquisition
3.2.7	**SO**	-	System Operations
3.2.8	**TransCo**	-	National Transmission Corporation

4.0 **References**

4.1 Grid Code

5.0 **Procedure**

FLOWCHART	RESPONSIBILITY	DETAILS
	Transco/SO Transco/SO Transco/SO Generator	1 TransCo/SO upon receipt of application for accreditation and required documents will perform initial evaluation based on the Standard Technical Requirements. 2. Notify and coordinate with the plant regarding the test to be performed. Check the availability of test equipment and tools for testing. 3. Coordinate with NCC/ACC and OPD for the schedule of testing. 4. Conduct the test to be witnessed by the authorized representative of TransCo/SO.

FLOWCHART	RESPONSIBILITY	DETAILS
	Generator Generator Transco/SO Transco/SO Transco/SO Transco/Generator	5. Generator shall correct the deficiency of its generating unit/s within an agreed period to attain the relevant registered parameters for that unit/s. 6. The Plant shall immediately notify TransCo once the generating unit/s achieves the registered parameters. 7. Transco shall require the plant to conduct a retest in order to demonstrate that the appropriate parameter has already been restored to its registered value. 8. Issue Certification to Ancillary Service Provider/s. 9. Negotiate with Ancillary Service Provider/s regarding the details of the contract/agreement. 10. Prepare Memorandum of Agreement/Contract for signature of both parties concern.

Attachment 2

Method of Determination of Ancillary Service Levels

1.0 Load Following and Frequency Regulation

Several factors contribute to the fluctuations of system frequency over a short period of time. These are load forecast errors, load fluctuations, inability of some generators to maintain steady output, and the mismatch between the rate of load change and the average ramp rates of the generators.

In order to maintain the system frequency within the range of 59.85 - 60.15 Hz, there should be enough LFFR in the system. Load forecast errors and the rate of load change are the biggest contributors of frequency fluctuations. Based on the 2003 data (Please see attached Tables 1A to 1E), the average load forecast error is about 3.5% of the hourly system demand and the rate of load change is about 13.52 MW/min. The effect of load fluctuations in the Luzon and Visayas grids are minimal. The biggest load in Luzon is the Kalayaan pump storage, which at normal operation; a single unit consumes steadily 165MW of power. Cyclic loads (e.g. Steel Mills) in Luzon and Visayas grid have minimal effect in the system frequency as shown in the table. It is only in Mindanao grid that cyclic loads have significant effect in the system frequency.

With the above premise, the minimum amount of LFFR can then be set at 4% of the hourly system demand. This figure will provide enough load following and regulating reserve in an hourly basis. The generators that will provide LFFR should have enough ramp rate in order to address the rate of load change and load and generator fluctuations. Generators with Automatic Generator Control (AGC) are the preferable providers of LFFR.

2.0 Contingency Reserve

2.1 **Spinning Reserve**

In order to ensure reliability, adequacy, and security of the system, there must be enough Spinning Reserve and Backup Reserve at any given time. Reliability can be described in terms of adequacy and security. Historically, utilities determine adequacy by means of probabilistic analysis and security by deterministic method. Adequacy implies that there is sufficient generation and transmission resources available to meet projected needs plus reserves for contingency. While security implies that the system will remain intact even after outages or other equipment failures occur. In general, however, the required level of spinning reserve is currently based primarily on the magnitude of the largest single contingency (N-1 security criterion). The thinking behind this approach is that the system must be able to withstand such a contingency regardless of the probability of its occurrence. In other words, even if the largest

generator has an excellent reliability record (e.g., less than one forced outage a year), the consequences of such an outage are so severe that the system must be protected against its occurrence.

2.2 **Backup Reserve**

Prior to the deregulation of the electric industry, system planning engineers ensured that the system had ample system reserve to cover a certain level of lost of load probability (LOLP). NPC then had set this level as 1 day LOLP or an equivalent of 30% of the peak demand as system planning reserve. Backup reserve was determined as the difference between system planning reserve and spinning reserve (30% less10.4% or 19.6% of the system peak).

With the onset of deregulation, market forces now signal for additional investment for capacity and reserve. Hence, the backup reserve margin should be set at the optimum.

The optimum level of Backup reserve at any given hour must be set equal to the minimum level of Spinning reserve. The rationale of this is that not all reserve generators are capable for fast start and there should be enough backup reserve to replace the used up Spinning reserve. It is also assumed that there is enough non-backup (cold or replacement) reserve within the 8-hour period to put back the Backup reserve to its minimum level.

Non-backup (cold or replacement) reserves are not considered as ancillary reserves as these generators are the excess capacity that are not dispatched and are given ample time to start-up whenever needed in the system.

3.0 Reactive Power Support

The system voltage throughout the Grid shall be maintained within the ±5% of nominal value as required by the Grid Code. Transco shall control Transmission voltage with the timely use of reactive power control devices (switch reactors and capacitors) and purchase of additional MVAR (supply or absorption) from identified generators.

This type of service varies according to the system load and condition. The minimum absorption and generation can only be determined based on the day-ahead scheduling of dispatch. Generators are the biggest suppliers/absorbers of reactive power. In order to encourage generators to provide this service, they will be paid on the actual MVAR generation and/or absorption in accordance with the scheduled MVAR as determined by the System Operator.

4.0 Black start

Transco is required to immediately restart the grid after a total or partial system blackout. A number of power restoration highways are established to attain this mandate. The availability of fast start capacity at strategic locations and redundancy of black start generation were taken into consideration in the design of the restoration highways. Hydro power plants and diesel power plants are typically used as black start plants.

TABLE 1A

YEAR 2003 Percentage of Error between Actual and Forecast Demand in (%)

	DAILY AVERAGE																													Mo. Ave
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Jan	11.71	9.00	3.97	2.34	4.19	3.46	2.77	2.02	1.96	1.41	4.17	3.20	2.63	1.91	2.90	4.63	4.59	3.44	1.17	4.61	3.65	3.16	2.52	NDA	3.03	3.01	1.92	1.73	1.78	NDA	NDA	3.46
Feb	4.36	2.99	3.31	3.41	NDA	2.82	1.03	4.39	6.39	3.25	3.89	1.86	2.04	2.46	2.93	0.90	1.28	2.01	2.05	1.95	1.86	2.30	2.04	3.40	NDA	3.53	NDA	1.37	--	--	--	2.71
Mar	4.14	1.79	3.27	2.70	1.92	1.54	1.63	10.01	4.98	5.94	4.35	4.46	1.39	1.81	5.47	0.90	2.29	0.94	2.39	1.04	2.42	4.62	2.47	1.12	1.36	3.03	0.68	0.86	3.05	1.35	1.19	2.74
Apr	1.36	1.54	1.71	2.35	2.38	3.09	3.59	4.08	2.19	1.60	1.20	2.63	###	3.38	3.16	2.47	5.74	4.23	3.56	3.62	3.24	1.40	1.45	2.32	2.60	2.28	2.72	3.90	1.78	1.69	1.81	3.02
May	###	###	9.07	3.58	1.51	6.01	###	2.83	3.86	1.28	2.38	1.87	NDA	1.96	2.25	9.67	2.37	2.28	1.39	###	9.40	1.80	3.10	4.04	4.27	###	11.94	13.51	###	10.91	3.92	7.38
Jun	6.00	3.53	4.43	5.02	4.00	2.80	1.13	2.69	2.83	2.74	2.68	2.50	2.82	2.84	2.48	4.62	3.47	2.41	3.08	3.78	1.13	3.15	2.55	4.12	2.85	3.48	4.06	2.21	3.65	NDA	--	3.21
	1st sem Ave.																															3.76
Jul	4.53	4.72	3.02	6.73	2.21	6.73	1.82	NDA	3.03	NDA	3.77	3.81	1.50	2.14	5.37	2.56	2.99	2.59	2.33	1.32	1.12	16.47	6.58	3.44	2.17	3.40	5.74	3.90	2.80	1.86	2.05	3.82
Aug	2.39	2.69	2.35	2.03	2.18	2.61	2.33	2.01	2.87	4.04	3.28	1.16	1.43	1.83	2.78	3.63	1.45	2.69	NDA	3.58	5.63	4.22	2.62	2.04	2.13	3.31	2.36	3.16	1.62	2.79	4.53	2.72
Sep	2.23	5.58	5.11	1.24	1.42	3.35	1.98	1.21	3.12	3.83	2.30	1.85	4.52	2.11	1.42	3.42	2.03	3.37	2.37	4.85	1.13	2.08	3.05	1.59	2.87	1.82	4.06	5.00	2.98	2.06	--	2.80
Oct	1.33	1.33	1.60	1.85	1.19	1.62	3.03	0.95	1.71	NDA	3.43	5.50	4.11	1.65	2.05	1.79	3.63	2.32	2.89	NDA	1.64	1.25	2.61	5.45	1.44	2.33	3.97	2.36	0.72	1.31	5.18	2.42
Nov	6.69	2.92	1.96	3.07	1.34	2.14	1.95	2.03	1.75	2.34	1.87	3.45	2.74	7.00	3.17	5.17	1.96	2.07	0.99	0.92	1.36	3.06	3.19	0.92	1.45	4.06	1.95	1.62	3.79	7.90	--	2.83
Dec	6.87	3.06	4.45	1.12	1.90	9.56	NDA	NDA	NDA	4.22	NDA	2.15	3.26	4.83	2.82	2.61	1.47	1.17	1.94	4.69	6.32	5.56	4.33	5.33	4.66	5.31	5.50	2.47	4.21	3.81	11.91	4.28
	2nd sem Ave.																															3.14
	Annual Ave.																															3.45

Note: NDA - No data available

TABLE 1B

Summary of Rate of Load Change, MW/min

	MONTH											
	Jan 10 Fri	Feb 10 Mon	Mar 28 Fri	Apr 24 Thu	May 07 Wed	Jun 10 Tue	Jul 15 Tue	Aug 07 Thu	Sept 26 Fri	Oct 07 Tue	Nov 25 Tue	Dec 18 Thu
Time												
1:00AM	-2.70	-1.28	-3.12	-3.03	-5.68	-2.32	-2.08	-2.73	-4.65	-3.90	-4.57	-1.40
2:00AM	-1.40	-1.25	-2.05	-2.98	-2.73	-1.32	-1.95	-1.37	-1.00	-1.85	-2.52	-1.83
3:00AM	-1.45	-1.40	-2.10	-2.00	-2.82	-1.93	-0.77	-2.55	-1.23	-1.70	-1.43	-0.33
4:00AM	-0.92	-0.77	-0.87	-1.58	-0.98	-2.13	-2.88	3.12	-0.23	-0.45	-0.47	0.67
5:00AM	1.50	2.73	1.47	0.35	-1.53	-0.77	-0.33	3.73	1.63	2.10	1.92	1.25
6:00AM	3.37	4.88	0.85	-1.55	0.15	2.47	1.37	1.67	0.32	-0.20	0.98	2.67
7:00AM	0.45	0.43	1.07	2.77	1.03	0.07	0.20	2.10	1.97	1.73	0.78	0.27
8:00AM	7.35	7.43	11.33	11.05	10.68	12.18	12.60	8.53	9.40	9.17	8.78	6.70
9:00AM	8.27	9.87	7.70	8.57	9.88	8.33	8.32	8.87	9.40	9.57	10.68	9.53
10:00AM	6.20	7.08	5.98	5.62	6.02	6.92	7.03	5.98	6.88	6.58	7.05	5.32
11:00AM	3.87	3.27	3.42	4.22	3.05	2.97	3.08	5.22	3.05	3.05	2.62	2.25
12:00NN	-2.73	-0.73	-1.08	-2.00	0.02	-0.07	0.47	-6.32	-1.32	-0.17	-2.90	-1.78
1:00PM	1.32	0.70	0.95	1.05	0.17	-0.67	-0.55	-1.53	0.20	0.32	1.43	1.83
2:00PM	1.62	2.17	2.65	1.43	2.98	2.90	2.80	1.23	3.07	2.23	1.53	0.68
3:00PM	-1.68	-0.62	-2.52	-3.48	-0.18	-0.73	-0.53	-1.70	-2.42	-3.23	-1.62	-1.43
4:00PM	-1.90	-1.77	-1.93	-0.45	-1.88	-2.08	-2.27	-1.77	-1.75	-1.75	-18.27	-1.55
5:00PM	-2.00	-3.68	-4.45	-11.52	-1.32	-1.78	-2.48	-2.17	-3.35	-3.03	13.52	-1.10
6:00PM	3.97	0.05	-2.78	3.80	-6.27	-4.72	-2.72	0.52	2.88	5.60	11.25	11.32
7:00PM	2.82	6.30	8.77	8.62	4.52	4.63	2.15	4.47	3.42	0.53	-1.35	1.42
8:00PM	-3.33	-2.62	-1.60	-1.75	0.53	0.65	1.23	-1.97	-2.72	-2.78	-3.17	-3.12
9:00PM	-5.23	-4.13	-4.82	-2.73	-1.72	-0.67	0.55	-3.65	-4.80	-4.10	-5.97	-5.88
10:00PM	-5.98	-7.92	-5.72	-4.68	-2.07	-4.42	-3.08	-7.38	-6.10	-7.25	-6.97	-7.27
11:00PM	-4.87	-5.72	-4.25	-4.32	-5.82	-5.48	-9.40	-4.73	-5.25	-5.25	-6.53	-11.92
12:00PM	-5.53	-4.68	-6.80	-1.95	-5.42	-8.85	-9.30	-6.48	-4.32	-5.17	-4.35	-2.98
Max ramp-up	8.27	9.87	11.33	11.05	10.68	12.18	12.60	8.87	9.40	9.57	13.52	11.32
Max ramp-down	-5.98	-7.92	-6.80	-11.52	-6.27	-8.85	-9.40	-7.38	-6.10	-7.25	-18.27	-11.92

TABLE 1C

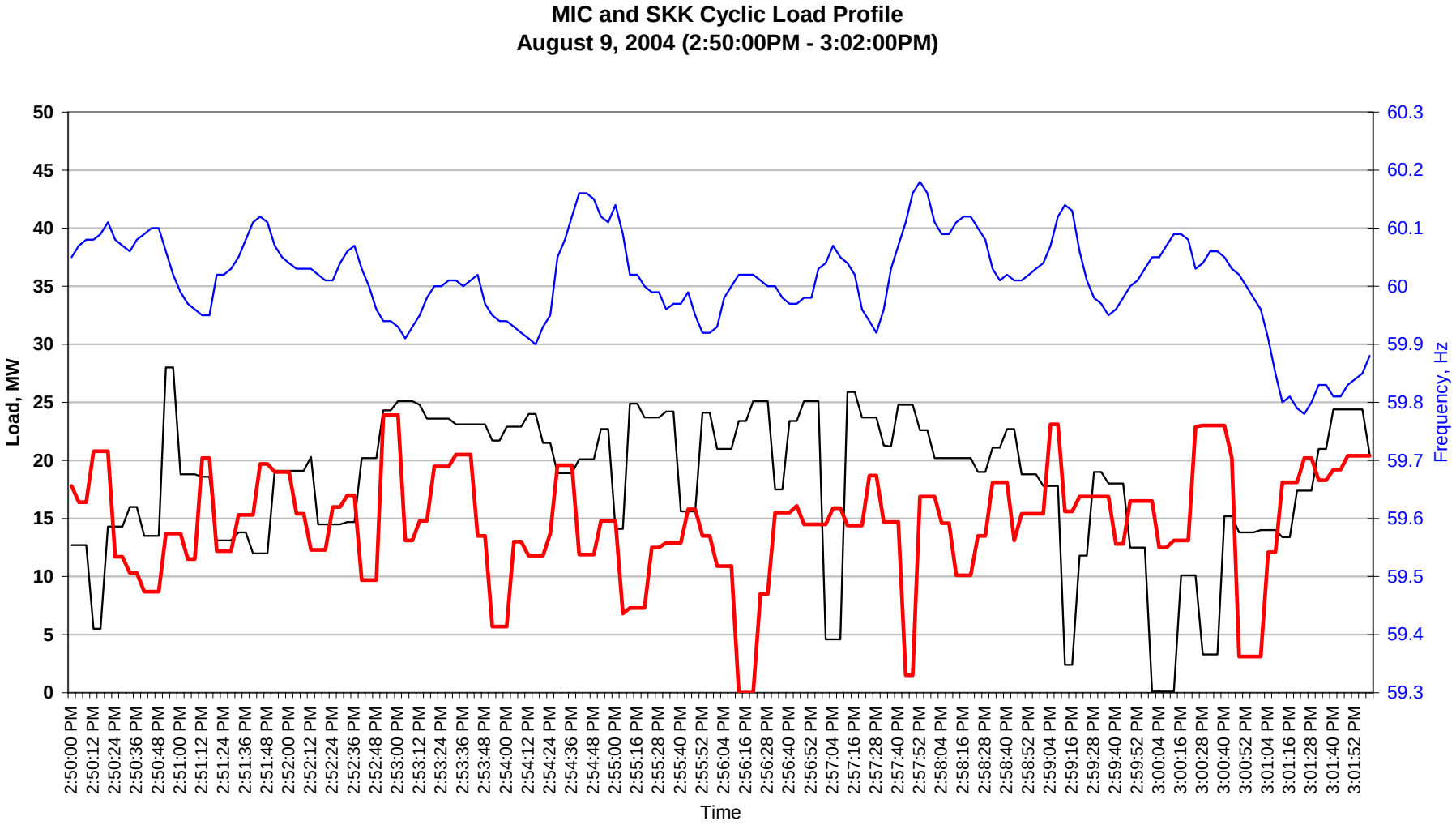

MIC and SKK Cyclic Load Profile
August 9, 2004 (2:50:00PM - 3:02:00PM)
Load, MW
Frequency, Hz
Time
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TABLE 1D

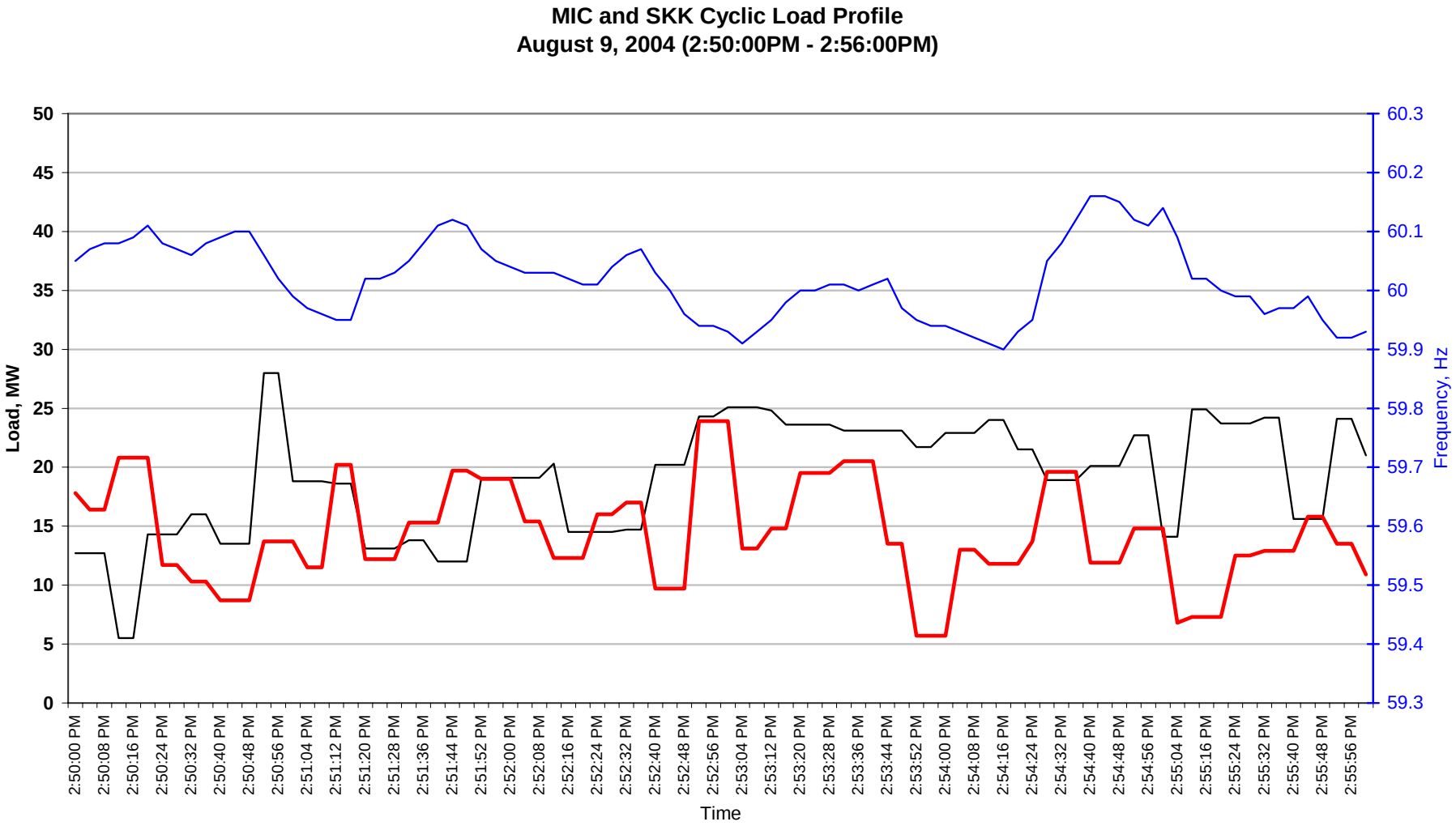
MIC and SKK Cyclic Load Profile
August 9, 2004 (2:50:00PM - 2:56:00PM)
Load, MW
Frequency, Hz
Time
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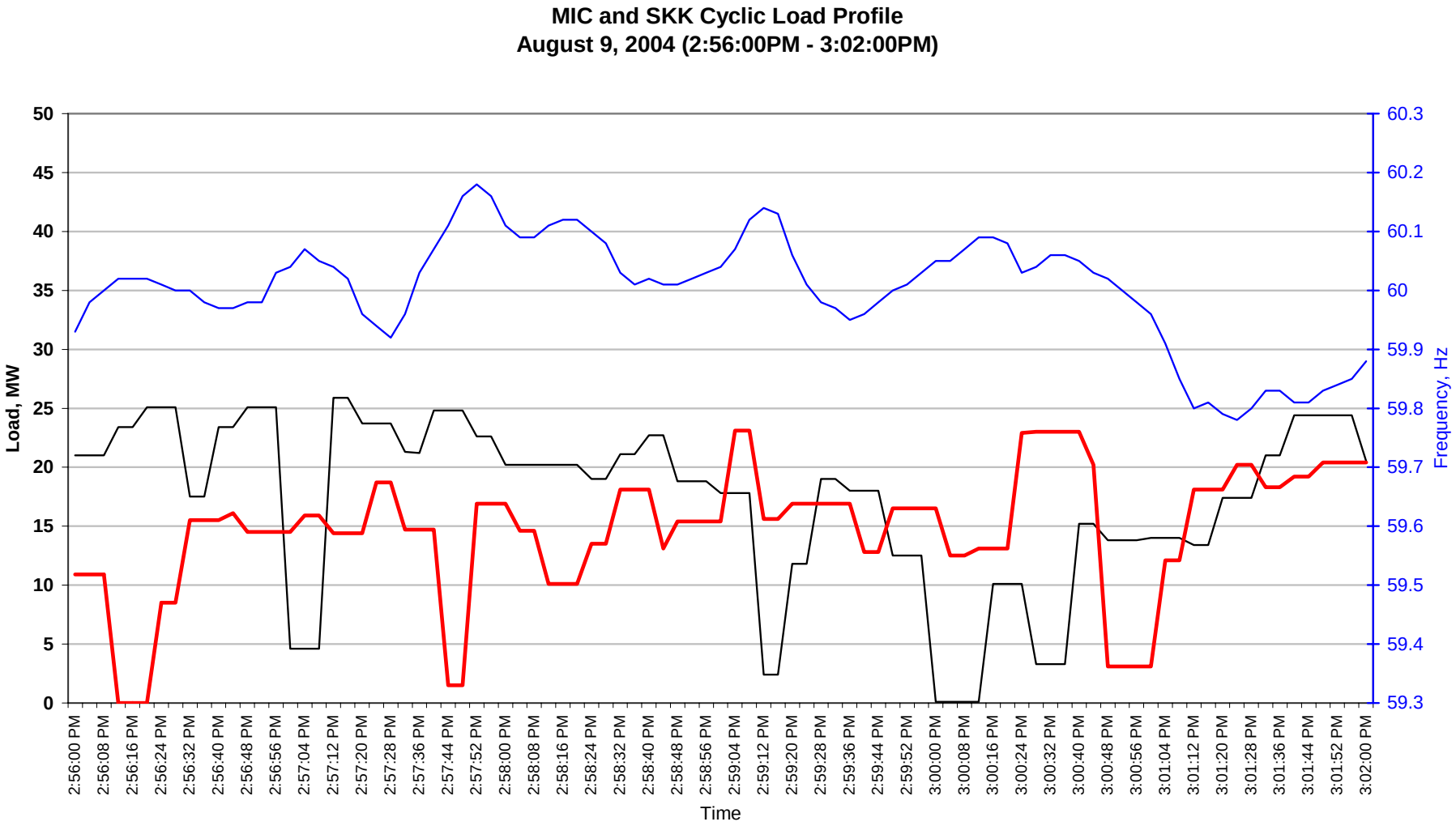
TABLE 1E


MIC and SKK Cyclic Load Profile
August 9, 2004 (2:56:00PM - 3:02:00PM)
Load, MW
Frequency, Hz
Time
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45
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Attachment 3

Ancillary Service Test and Measurement Procedures

1.0 Load Following and Frequency Regulation

1.1 Purpose

To establish the guidelines that TRANSCO shall use to test plant/generator to be contracted for Load Following and Frequency Regulation (LFFR).

1.2 Scope

This procedure covers the Load Following and Frequency Regulation type of Ancillary Service that qualified generation companies can provide to ensure the provision of regulating capacity necessary to adjust total system generation to match system load changes.

1.3 Definition of Terms/Acronyms

1.3.1 Definition of Terms

- Frequency is the number of complete cycles of alternating current or voltage per unit time, usually measured in cycle per second or Hertz.

- Frequency Control is a strategy used by the System Operator to maintain the frequency of the Grid within the limits prescribed by the Grid Code by the timely use of Frequency Regulating Reserve, Contingency Reserve, and Demand Control.

- Frequency Regulating Reserve refers to a generating unit that assists in Frequency Control by providing automatic Primary and/or Secondary frequency response. *[Grid Code]*

- Frequency Regulation addresses the temporal variations in load and unintended fluctuations in Generation. FR responds to rapid load/generation fluctuations on the order of few seconds to one minute.

- Load Following and Frequency Regulation Service is a service that provides Generation Capacity necessary to adjust total system generation over short periods of time to match system load changes that result from random fluctuations in total transmission system load.

- Load Following Reserve Margin is the required reserve margin expressed as a percentage of average monthly maximum system peak demand (net of plant station use). *[OATS Rules]*
- Primary Response is the automatic response of a Generating Unit to Frequency changes, released increasingly from zero to five seconds from the time of Frequency change, and which is fully available for the next 25 minutes.

- Secondary Response is the automatic response to Frequency which is fully available 25 seconds from the time of Frequency change to take over from the Primary Response, and which is sustainable for at least 30 minutes.

1.3.2 Acronyms

- LF – Load Following
- FR – Frequency Regulation
- MW- Mega Watt
- PF- Power Factor
- NCC – National Control Center

1.4 Precautions

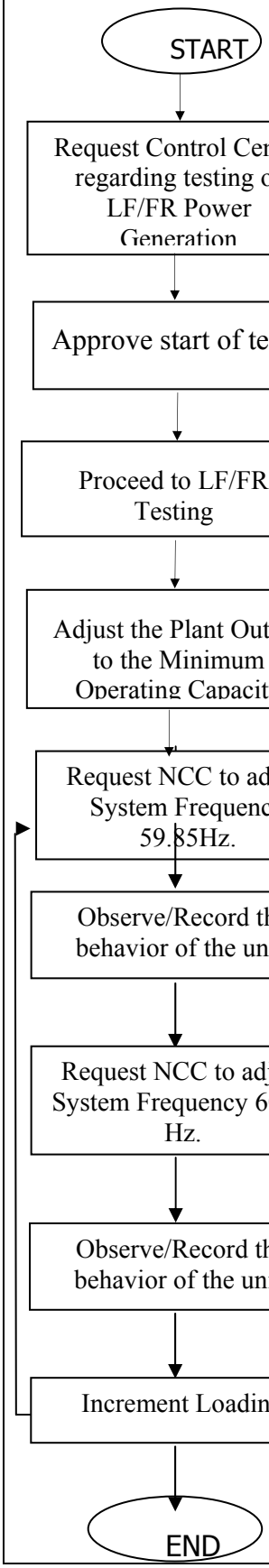
- The unit is online and at least 10% of its rated capacity is allocated for free governor operation mode.
- The test equipment is installed to monitor the unit output MW and the system frequency.
- NCC is informed of the scheduled test.
- For thermal plants, the following parameters should also be monitored:
    - Steam temperature.
    - Governor valve position.

- Utmost safety of the plant is a priority. Abort the test if conditions will lead to plant tripping.

1.5 Reference

- Grid Code

1.6 Flowchart

FLOWCHART	RESPONSIBILITY	DETAILS
	Plant Control Engineer NCC/ACC Personnel Test Coordinator / Witness Plant Control Engineer Plant Control Engineer / Test Coordinator Plant Control Engineer / Witness Plant Control Engineer / Test Coordinator Plant Control Engineer / Witness Plant Control Engineer	Request NCC/ACC Personnel regarding the test to be done. Approve the request taking into consideration the security of the system. To start the test, record the status and operating parameters ,e.g., load and system frequency for the start of the test. Adjust the plant output to the minimum operating capacity. Take note of the unit's frequency deadband. Request NCC to adjust the System Frequency to 59.85Hz, if possible request NCC to maintain the system frequency for 10 minutes to determine the maximum regulating capacity of the plant. Observe/Record the data to be obtained. Request NCC to adjust the System Frequency to 60.15Hz, if possible request NCC to maintain the system frequency for 10 minutes to determine the regulating capacity of the plant. Observe/Record the data to be obtained. Repeat the testing until the load increment reached the maximum operating capacity of the unit for free governor.

1.7 Test Report of Load Following and Frequency Regulation

National Transmission Corporation

SYSTEM OPERATIONS

LOAD FOLLOWING AND FREQUENCY REGULATION

TEST REPORT

Date: _____

Generating Unit: _____
Nameplate Rating: _____ Plant Type: _____
Test Authorized By: _____
Test Supervised By: _____
NCC/RCC Clearance Given By: _____
Date of Testing: _____
Governor Deadband Setting: _____ Hz Rated Power Factor _____
Droop Setting: _____ % Load Clipping (MW) _____
☐ Governor Control Operation Mode ☐ With AGC capability

DECLARED CAPABILITY

Ramp-up Rate (MW/min) _____

Ramp-down Rate (MW/min) _____

Required Governor Deadband = ± 0.0 to 0.15 Hz (LF/FR)

☐ High Limit _____ MW ☐ Low Limit _____ MW
☐ Availability Status ☐ Rate Limit _____ MW/min
☐ Monitor AGC Status

Time Started: _____ Time Finished: _____

Time	***Load***	**System Frequency**

Plant Representative	**NPC Representative**	**TransCo Representative**

2.0 Spinning Reserve

2.1 Purpose

To establish the guidelines that TRANSCO shall use to test plant/generator to be contracted for Spinning Reserve (SR).

2.2 Scope

This procedure covers the Spinning Reserve type of Ancillary Service that qualified generation companies can provide to ensure the provision of generating capacity necessary to respond immediately to sudden and unexpected loss of large synchronized Generating unit.

2.3 Definition of Terms/Acronyms

2.3.1 Definition of Terms

- Frequency Control is a strategy used by the System Operator to maintain the frequency of the Grid within the limits prescribed by the Grid Code by the timely use of Frequency Regulating Reserve, Contingency Reserve, and Demand Control.

- Spinning Reserve is a component of Contingency Reserve which is synchronized to the Grid and ready to take on load. *[Grid Code]*

- Spinning Reserve Service is a service that provides Generation Capacity necessary to respond immediately to infrequent, but usually large, failures of generating units and/or transmission tie lines.

- Primary Response Generating units that operate in an automatic frequency sensitive mode or Free Governor mode with deadband setting of between –0.15Hz and 0.30Hz..

- Secondary Response Generating units that operate in an automatic generation control (AGC) of the SCADA/EMS of the National Control Center (NCC) or manual adjustment of load with specific dispatch instructions from system operator with maximum time to full capacity of ten (10) minutes and is sustainable for at least thirty (30) minutes.

2.3.2 Acronyms

- SR – Spinning Reserve
- AGC – Frequency Regulation
- DSM – Dynamic System Monitor
- NCC – National Control Center

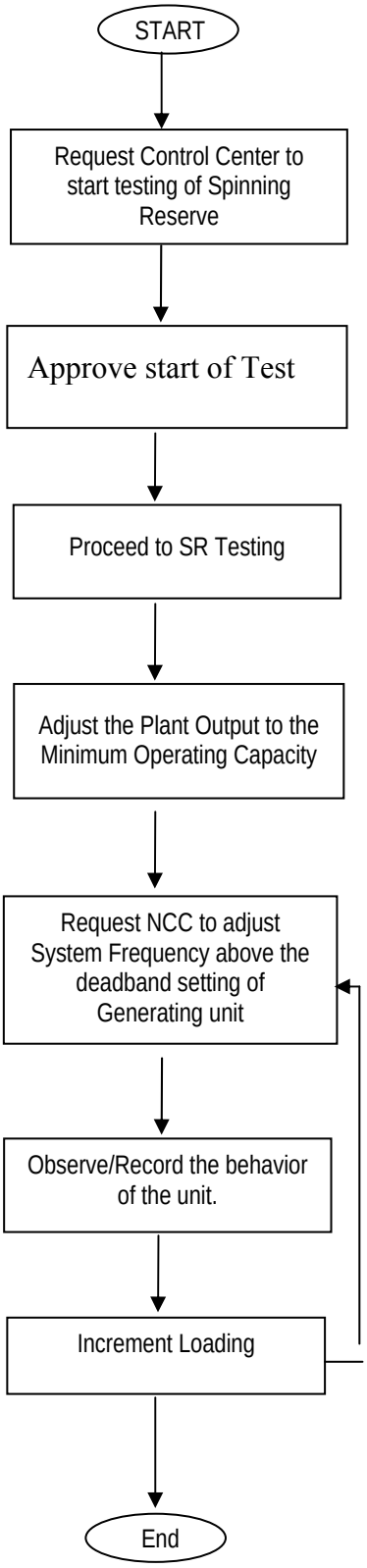
2.4 Precautions

- The unit is online/synchronized.
- The test equipment is installed to monitor the unit output MW and the system frequency.
- NCC is informed of the scheduled test.
- For thermal plants, the following parameters should also be monitored:
- Steam temperature.
- Governor valve position.
- Utmost safety of the plant is a priority. Abort the test if conditions will lead to plant tripping.

2.5 Reference

- Grid Code

2.6 Flowchart

FLOWCHART	DETAILS	RESPONSIBILITY
	Plant Control Engineer NCC/ACC Personnel Test Coordinator / Witness Plant Control Engineer Plant Control Engineer / Test Coordinator Plant Control Engineer / Witness Plant Control Engineer	Request NCC/ACC Personnel regarding the test to be done. Approve the request taking into consideration the security of the system Record the status and operating parameters ,e.g., load and system frequency for the start of the test. To start the test, adjust the plant output to the minimum operating capacity. Take note of the unit's frequency deadband. Request NCC to adjust the System Frequency above the deadband setting of the Generating unit. Observe/Record the data to be obtained. Repeat the testing with a load increment halfway its minimum & maximum generating capacity, and then, with a load equal to its maximum generating capacity.

2.7 Spinning Reserve Test Report

National Transmission Corporation

SYSTEM OPERATIONS

SPINNING RESERVE

TEST REPORT

Date: _____

Generating Unit: _____
Nameplate Rating: _____ Plant Type: _____
Test Authorized By: _____
Test Supervised By: _____
NCC/RCC Clearance Given By: _____
Date of Testing: _____
Governor Deadband Setting: _____ Hz Rated Power Factor _____
Droop Setting: _____ % Load Clipping (MW) _____

☐ Governor Control Operation Mode ☐ With AGC capability

DECLARED CAPABILITY

Ramp-up Rate (MW/min) _____
Ramp-down Rate (MW/min) _____

Required Governor Deadband (-)Hz = Greater than 0.15 but less than 0.30 (SR)

☐ High Limit _____ MW ☐ Low Limit _____ MW
☐ Availability Status ☐ Rate Limit _____ MW/min
☐ Monitor AGC Status

Time Started: _____ Time Finished: _____

Time	**Load**	**System Frequency**

Plant Representative	**NPC Representative**	**TransCo Representative**

3.0 Reactive Power Generation/Absorption

3.1 Purpose

To establish the guidelines that TRANSCO shall use to test plant/generator to be contracted for Reactive Power Support Ancillary Service.

3.2. Scope

This procedure covers the Reactive Power Support type of Ancillary Service that qualified generation companies can provide to ensure the safe operating level of the Grid voltage in consideration with the generating unit's capability curve.

3.3 Definition of Terms/Acronyms

3.3.1 Definition of Terms

- Voltage- the electromotive force or electric potential difference between two points, which causes the flow of electric current in an electric circuit.

- Reactive Power Capability Curve- A diagram which shows the Reactive Power Capability limit versus the Real Power within which a Generating Unit is expected to operate under normal condition.

- Reactive Power- the component of electrical power representing the alternating exchange of stored Energy (inductive or capacitive) between sources and loads or between systems, measured in VAR or multiples thereof. For AC circuits or systems it is the product of the RMS value of the voltage and the RMS value of the quadrature component of the alternating current. In a three phase system, it is the sum of the reactive power of the individual phases.

- Power Factor- the ratio of Active Power to Apparent Power.

3.3.2 Acronyms

- MVAR- Mega Volt-Ampere Reactive
- MW- Mega Watt
- MEX- Maximum Excitation Level
- PF- Power Factor

3.4 Precautions

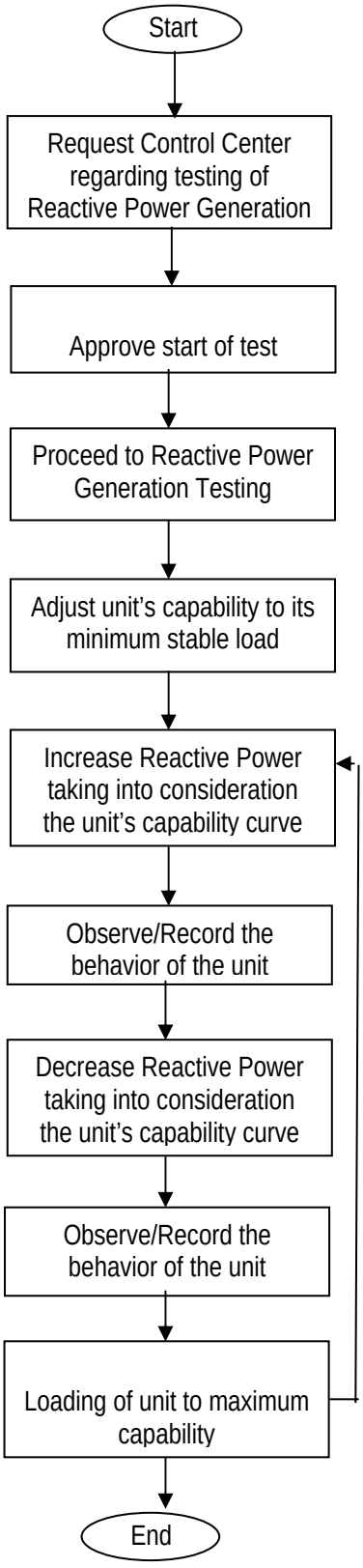
System at Normal condition

- Test will not place the security of the system and generating units at risk. Abort testing if damage or risk of tripping the generating units exists during the progress of testing.
- Voltage variation to the system will not exceed the ±5% at the connecting point.
- Approval from the Control Center
- Readily available compensation from other generating units to limit voltage within the prescribe limits.

3.5 Reference

- Grid Code

3.6 Flowchart

FLOWCHART	RESPONSIBILITY	DETAILS
	Plant Control Engineer NCC/ACC Personnel Test Coordinator / Witness Plant Control Engineer Plant Control Engineer Plant Control Engineer/Witness Plant Control Engineer Plant Control Engineer/Witness Plant Control Engineer	Request NCC/ACC Personnel regarding the test to be done. Approve the request taking into consideration the security of the system. To start the test, record the status and operating parameters ,e.g., load and system frequency for the start of the test. Unit load set at minimum stable load Using the Capability Curve of the unit, increase the Reactive Power Generation (over excitation or lagging power factor) until maximum value is achieved. Record the MW, MVAR, pf, Rotor and Stator Temperature, of each increment and maintain value for 5 to 15 minutes, taking consideration of ±5% terminal voltage. Observe/Record the data to be obtained Using the Capability Curve of the unit, decrease the Reactive Power Generation (under excitation or leading power factor) until maximum value is achieved. Record the MW, MVAR, pf, Rotor and Stator Temperature, of each increment and maintain value for 5 to 15 minutes, taking consideration of ±5% terminal voltage. Observe/Record the data to be obtained Unit load set at maximum capability and repeat the procedure from increasing the Reactive Power Generation.

3.7 Reactive Power Support Capability Test Report

National Transmission Corporation

SYSTEM OPERATIONS

REACTIVE POWER SUPPORT CAPABILITY

TEST REPORT

Date:_____

Generating Unit: _____

Plant Type:_____

Nameplate Rating:_____MW _____MVAR_____ MVA

Test Authorized By: _____
Test Supervised By: _____
NCC/RCC Clearance Given By: _____
Date of Testing: _____
Governor Deadband Setting:_____ Hz Rated Power Factor:_____
Droop Setting: _____ % Gen. Terminal Voltage (kV)_____
☐ Governor Control Operation Mode ☐ With AGC capability

(Please attach copy of the Generator Reactive Power Capability Curve)

Time Started:_____ Time Finished:_____

Time	**MW**	**MVAR**	**Power Factor**	**Terminal Voltage (kV)**	**Temperature (degC)**	
					Rotor	**Stator**

Plant Representative **NPC Representative** **TransCo Representative**

4.0 Black Start Capability

4.1 Purpose

To establish the guidelines that TRANSCO shall use to test plant/generator to be contracted for Black Start Ancillary Service.

4.2 Scope

This procedure covers the Black Start type of Ancillary Service to be able to determine the ability of Generating units to recover from a shutdown condition to an operating condition, without assistance from the Grid or other external power supply, in order to energize the Grid and assists other generating units to start.

4.3 Definition of Terms/Acronyms

4.3.1 Definition of Terms

- Dispatch Instruction- refers to the instruction issued by the System Operator to the Generators with scheduled Generating units and the generating units providing ancillary services to implement the final generation schedule in real time.
- Central Dispatch- the process of issuing direct instructions to the electric power industry participants by the System Operator to achieve an economic operation while maintaining Power Quality, Stability, Reliability and Security of the Grid.
- NCC Specialist- System Operator personnel responsible for generation Dispatch, the provision of Ancillary Services and operation and control to ensure safety of the Grid.
- Control Center- a facility used for monitoring and controlling the operation of the Grid, Distribution System, or a User System.

4.3.2 Acronyms

- NCC- National Control Center
- S/S- Substation
- PRH- Power Restoration Highway

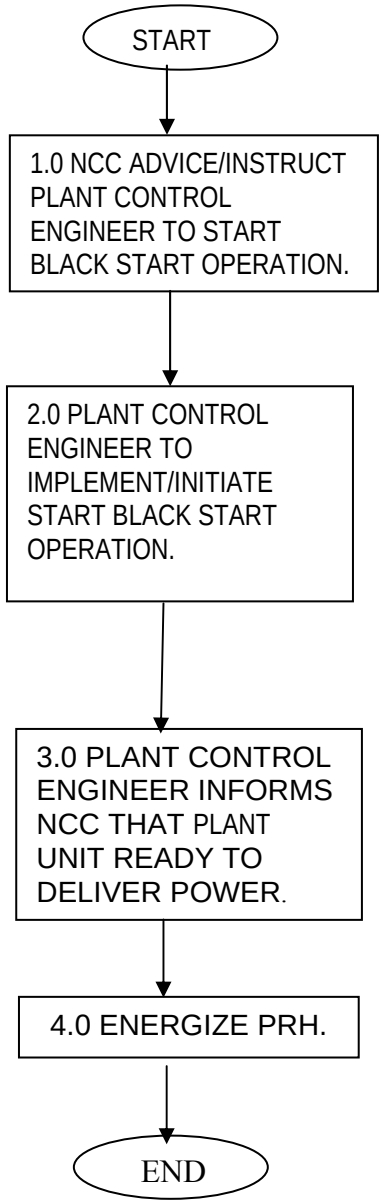
4.4 References

- Grid Code

4.5 Appendices

- QF 266A – Record of Time
- QF 266B – Black Start Test Report

4.6 Flowchart (NCC)

FLOWCHART	RESPONSIBILITY	DETAILS
	NCC Specialist Plant Control Engr Plant Control Engr NCC Specialist	1.1 NCC Specialist to activate/ issued Plant Unit Black Start @ XA 21 (display 6.500). Fill-up form QF 266B 2.1Refer to individual Power Plant testing procedures. To record the actual time for each completed activity. Fill-up form QF 266A 3.1 Inform NCC that Plant Unit is dispatchable and ready to extend power thru PRH.Fill-up form QF266B. 4.1 Coordinate with S/S operator and Plant Control Engineers to accept & extend power to adjacent S/S. Refer to individual PRH.

4.7 Flowchart (Plant)

FLOWCHART	RESPONSIBILITY	TIME
START		
2.1 DE-ENERGIZE MAIN TRANSFORMER AND STATION SERVICE. OPEN BREAKERS:	Plant Control Engr	_____
2.2 START BLACK START _____ GENERATOR AND _____ BUS ENERGIZE.	Plant Control Engr	_____
2.3 ENERGIZE STATION SERVICE DISTRIBUTION CENTER , CONTROL AND START AUXILIARY EQUIPMENT.	Plant Control Engr	_____
2.4 START _____(ENGINE OR PLANT UNIT)	Plant Control Engr	_____
2.5 ON FULL SPEED NO LOAD (FSNL) UNIT READY TO SYNCHRONIZE. CLOSE BREAKERS:	Plant Control Engr	_____
2.6 NORMALIZE STATION SERVICE POWER SUPPLY.	Plant Control Engr	_____
END		

Attachment 4

Accreditation of Ancillary Service Providers

1.0 Purpose

1.1 This procedure establishes guidelines to be followed in the Issuance of Certification/Accreditation for Ancillary Service Provider who would like to provide Ancillary Services to ensure quality of power in the Grid.

2.0 Scope

2.1 This procedure covers only the Accreditation Process including Contracting for Ancillary Service Provider.

3.0 Definition of Terms/Acronyms

3.1 Definition of Terms

3.1.1 **A/S Provider**- a person or an entity-providing ancillary services and registered with the Market Operator.

3.1.2 **Ancillary Services**- Support services such as Frequency Regulating and Contingency Reserves, Reactive Power Support, and Black start capability, which are necessary to support the transmission capacity and Energy that are essential in maintaining Power Quality and the Reliability and Security of the Grid.

3.1.3 **Generator**- any person or entity authorized by the ERC to operate a facility used in the Generation of Electricity.

3.1.4 **TransCo/SO**- the party responsible for generation Dispatch, the provision of Ancillary Service, and operation & control to ensure safety, power quality, stability, reliability, and the security of the Grid.

3.2 Acronyms

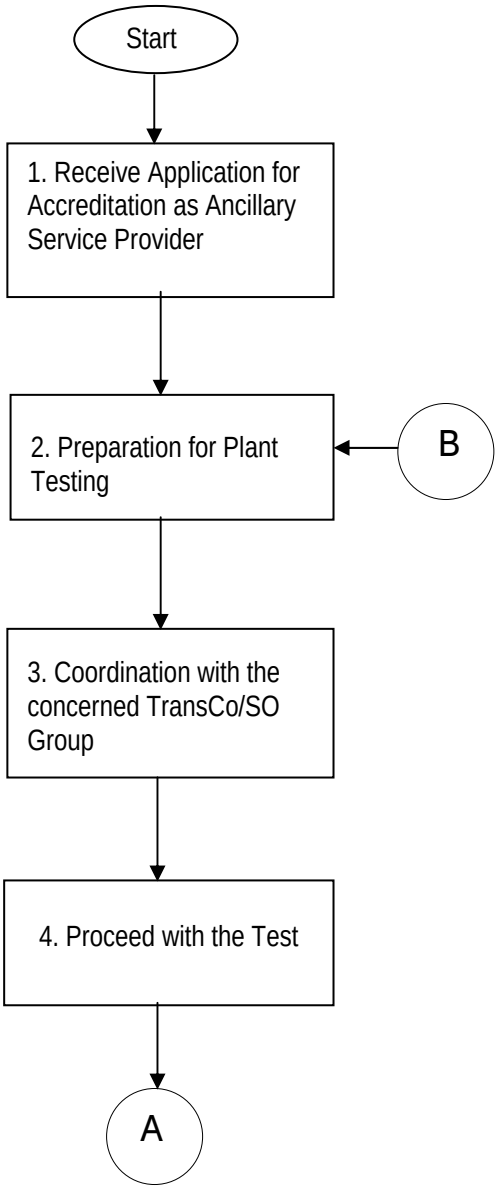
3.2.1 **ACC** - Area Control Center
3.2.2 **ASP** - Ancillary Service Provider
3.2.3 **A/S** - Ancillary Service
3.2.4 **NCC** - National Control Center
3.2.5 **OPD** - Operations Planning Division
3.2.6 **SCADA** - Supervisory Control and Data Acquisition

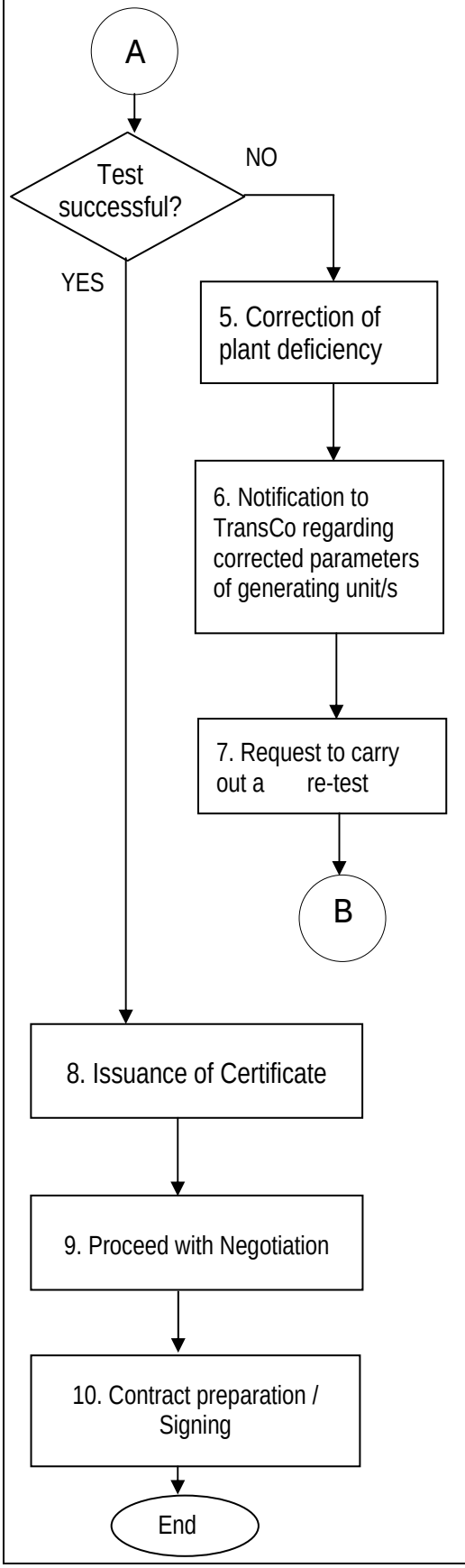
3.2.7 **SO** - System Operations
3.2.8 **TransCo** - National Transmission Corporation

4.0 References

4.1 Grid Code

5.0 Procedure

FLOWCHART	RESPONSIBILITY	DETAILS
	Transco/SO Transco/SO Transco/SO Generator	1 TransCo/SO upon receipt of application for accreditation and required documents will perform initial evaluation based on the Standard Technical Requirements. 2. Notify and coordinate with the plant regarding the test to be performed. Check the availability of test equipment and tools for testing. 3. Coordinate with NCC/ACC and OPD for the schedule of testing. 4. Conduct the test to be witnessed by the authorized representative of TransCo/SO.

FLOWCHART	RESPONSIBILITY	DETAILS
	Generator Generator Transco/SO Transco/SO Transco/SO Transco/Generator	5. Generator shall correct the deficiency of its generating unit/s within an agreed period to attain the relevant registered parameters for that unit/s. 6. The Plant shall immediately notify TransCo once the generating unit/s achieves the registered parameters 7. Transco shall require the plant to conduct a retest in order to demonstrate that the appropriate parameter has already been restored to its registered value. 8. Issue Certification to Ancillary Service Provider/s. 9. Negotiate with Ancillary Service Provider/s regarding the details of the contract/agreement. 10. Prepare Memorandum of Agreement/Contract for signature of both parties concern.

Attachment 5

Compliance Monitoring

Load Following and Frequency Regulation Service Providers

1.0 Responsible Person

Principal Engineer

2.0 Instructions

2.1 Get the list of all Ancillary Service Providers scheduled to provide the service from the Daily Generation Schedule (DGS) and its respective LFFR quantity from the Reserve profile. Evaluate each Provider based on the Actual MW Generation obtained from SCADA.

2.2 For every dispatch period, evaluate and analyze the data through the following:

2.2.1 For every two (2) seconds compare the generator MW output with the Generator schedule operating limits.

2.2.1.1 Frequency at 60Hz

2.2.1.1.1 Delivered LFFR equals zero (0) MW:

Scheduled Generation = Actual Generation

2.2.1.1.2 For undesired operation:

Scheduled Generation $\neq$ Actual Generation

Allowable Load Variation = $\pm$1MW or $\pm$1.5% of Scheduled Generation, whichever is higher

2.2.1.2 Frequency between 59.85Hz and 60Hz

2.2.1.2.1 Delivered LFFR = Actual Gen - Scheduled Gen

2.2.1.2.2 For Undesired operation:

Actual Gen - Scheduled Gen < zero (0)

2.2.1.2.3 For failure to deliver LFFR:

Actual Gen - Scheduled Gen = zero (0)

2.2.1.3 Frequency between 60Hz and 60.15Hz

2.2.1.3.1 Delivered LFFR = Scheduled Gen – Actual Gen

2.2.1.3.2 For Undesired operation:

Scheduled Gen - Actual Gen < zero (0)

2.2.1.3.3 For failure to deliver LFFR:

Scheduled Gen - Actual Gen = zero (0)

Spinning Reserve Service Providers

1.0 Responsible Person

Principal Engineer

2.0 Instructions

2.1 Get the list of all Ancillary Service Providers scheduled to provide the service from the Daily Generation Schedule (DGS) and its respective SR quantity from the Reserve profile. Evaluate each Provider based on the Actual MW Generation obtained from SCADA.

2.2. For every dispatch period, evaluate and analyze the data through the following:

2.2.1 Every time the frequency is below 59.85Hz

2.2.1.1 Delivered SR = Actual Generation - Scheduled Generation

2.2.1.2 For Undesired operation:

Actual Generation - Scheduled Generation < zero (0)

2.2.1.3 For failure to deliver SR:

Actual Generation - Scheduled Generation = zero (0)

Reactive Power Support Service Providers

1.0 Responsible Person

Principal Engineer C

2.0 Instruction

2.1 Get the list of all Ancillary Service Providers scheduled to provide the service from the Daily MVar Generation Schedule. Evaluate each Provider based on the Actual MVar Generation obtained from SCADA.

2.2 For every dispatch period compare Scheduled Reactive Power with Actual Reactive Power

2.2.1 If bus voltage is within 5% of nominal

2.2.1.1 For delivered Reactive Power Support:

Scheduled Reactive Power = Actual Reactive Power

2.2.1.2 For Non-delivered Reactive Power Support:

Scheduled Reactive Power $\neq$ Actual Reactive Power

Black Start Service Providers

1.0 Responsible Person

Principal Engineer C

2.0 Instruction

2.1 in from SCADA the Alarm Event data and the Dispatch Instruction from NCC. Use the existing Restoration Highways as reference, to get the list of Generating plants with Black start capability.

2.2 During Actual Black out and test scenario

2.2.1 Provider delivered Black start when ready to pick-up load within thirty (30) minutes from dispatch instruction for Black start and it can extend its power and sustain it for twelve (12) hours.

Back-up Reserve Service Providers

1.0 Responsible Person

Principal Engineer

2.0 Instruction

2.1 Get the list of all Ancillary Service Providers scheduled to provide the service from the Daily Generation Schedule (DGS) and its respective BUR quantity

from the Reserve profile. Evaluate each Provider based on the Actual MW Generation obtained from SCADA.

2.2 From the Dispatch Instruction and Alarm Event data, evaluate the provider base on the requirement stated below:

2.2.1 Back-up Reserve is delivered on time if the unit is synchronized within 15 minutes from
dispatch instruction to start-up for Back-up power and can sustain up to eight (8) hours continuous.

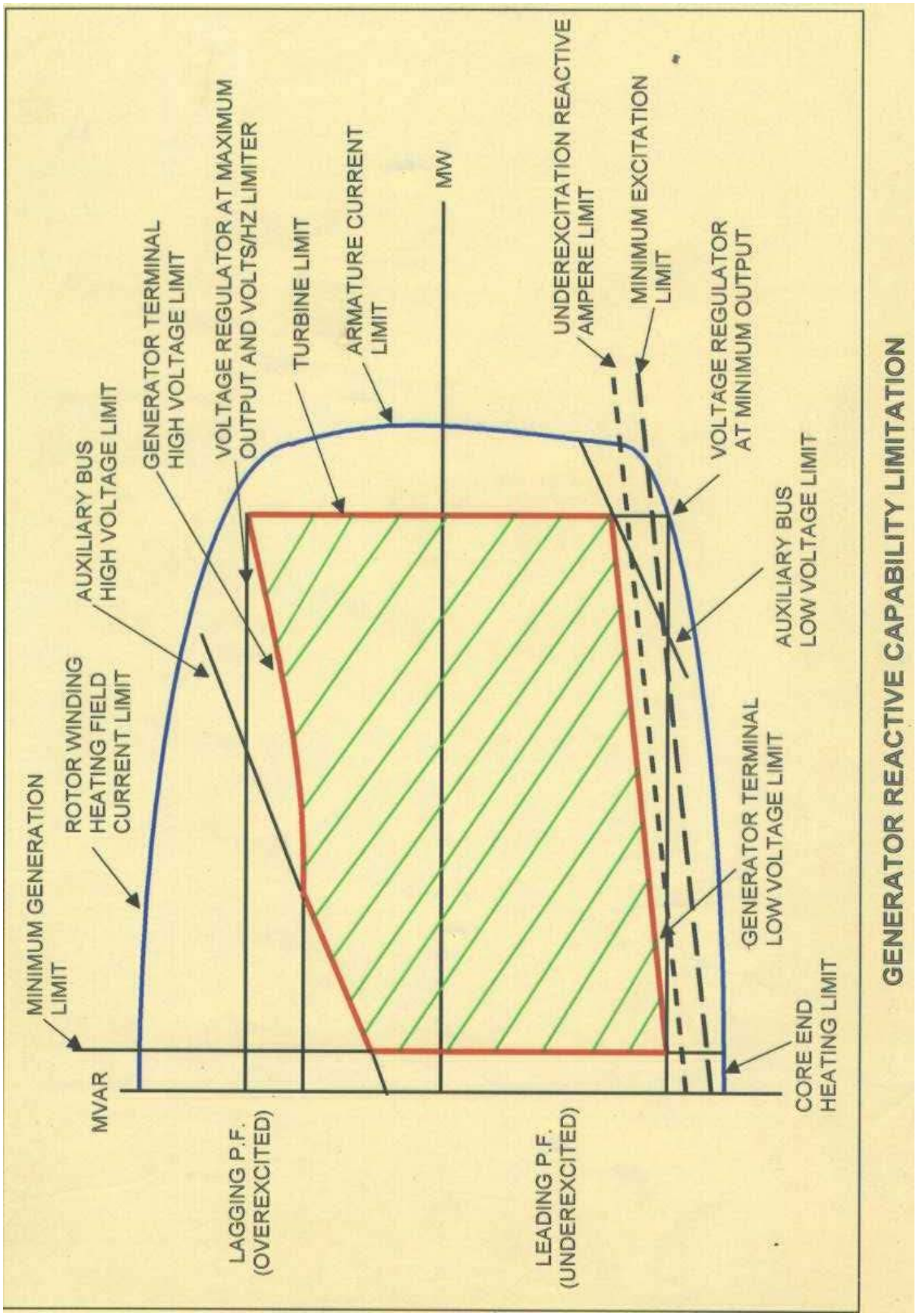
Attachment 6
Ancillary Services Standard Technical Requirements

	Performance Measures	Performance Criteria	Monitoring Scheme
Load Following & Frequency Regulation	Primary Response (Speed Governor)		**Monitored from EMS/SCADA**
	Regulating Capacity, ±MW	Within ±1% declared	1. Continuous monitoring
	Static Gain, MW/Hz	Within ±5% declared	
	Speed droop setting	5% or less	
	Response time	5 seconds maximum	
	Dead band setting (±) Hz	Within 0.15	
	Secondary Response (AGC or Manual)		
	Regulating Capacity, ±MW	Within ±1% declared	
	Ramping Rate, ±MW/min	Less than ±10% declared	
	Response time	25 seconds maximum	
	Dead band setting (±) Hz	Within 0.15	
Spinning Reserve	Primary Response (Speed Governor)		Monitored from EMS/SCADA triggered by:
	Reserve Capacity, MW	Within ±1% declared	1. Actual restoration of spinning reserve
	Speed droop setting	5% or less	
	Static Gain, MW/Hz	Within ±5% declared	2. Spot check
	Maximum time to full reserve capacity	10 minutes	
	Dead band setting (-) Hz	Greater than 0.15 but less than 0.30	
	Secondary Response (AGC or Manual)		
	Reserve Capacity, MW	Within ±1% declared	
	Maximum time to full reserve capacity	10 minutes	
	Dead band setting (-) Hz	Greater than 0.15 but less than 0.30	
	Ramping Rate, ±MW/min	Less than ±10% declared	
	Sustainable time	At least 30 minutes	

Attachment 6
Ancillary Services Standard Technical Requirements

	Performance Measures	Performance Criteria	Monitoring Scheme
Back-up Power	Back-up Capacity, MW	Within ±1% declared	Monitored from EMS/SCADA triggered by: 1. Actual restoration of spinning reserve 2. Spot check
	Synchronizing time	Within 15 minutes	
	Ramping Rate, ±MW/min	Within ±10% declared	
	Sustainable time	Minimum of 8 hours	
Black-Start Capability	Black start Capacity, MW	Within ±1% declared	Monitored from EMS/SCADA triggered by: 1. Actual system restoration 2. Simulated emergency exercises 3. Spot check
	Maximum time to Synchronize	Within 30 minutes	
	Maximum time at no load, min	Within 10% declared	
	Load Pick-up Rate, MW/min	Within ±10% declared	
	Overload Capacity, MW	Within ±1% declared	
	Sustainable time	At least 12 hours	
	Reactive Power Range, ±MVAr	Within ±5% declared	
Reactive Power	Reactive Power Capability	Within ±5% declared	***Monitored from EMS/SCADA***
	Power Factor within Capability Curve	Less than 0.85 lagging and less than 0.90 leading	

Attachment 7



Glossary

Active Power – The time average of the instantaneous power over one period of the electrical wave measured in Watts (W) or multiple thereof. For AC circuits or Systems, it is the product of the root-mean-square (RMS) or effective value of the voltage and the RMS value of the in-phase component of the current. In a three phase System, it is the sum of the Active Power of the individual phases.

Ancillary Service – Support services such as Frequency Regulating and Contingency Reserves, Reactive Power Support, and Black Start Capability which are necessary to support the transmission capacity and Energy that are essential in maintaining Power Quality and the Reliability and Security of the Grid.

Automatic Generation Control (AGC) – The regulation of the power output of Generating Units within a prescribed area in response to a change in system Frequency, tie line loading, or the relation of these to each other, so as to maintain the System Frequency or the established interchange with other areas within the predetermined limits or both.

Back-Up Reserve – Refers to a Generating Unit that has Fast Start capability and can Synchronize with the Grid to provide its declared capacity for a minimum period of eight (8) hours. Also called Cold Standby Reserve.

Black-Start – The process of recovery from Total System Blackout using a Generating Unit with the capability to start and synchronize with the System without an external power supply.

Contingency Reserve – Generating Capacity that is intended to take care of the loss of the largest Synchronized Generating Unit or the power import from a single Grid interconnection, whichever is larger. Contingency Reserve includes Spinning Reserve and Back-Up Reserve.

Customer – Any person/entity supplied with electric service under a contract with a Distributor or Supplier.

Demand – The Active Power and/or Reactive Power at a given instant or averaged over a specified interval of time, that is actually delivered or is expected to be delivered by an electrical Equipment or supply System. It is expressed in Watts (W) and/or VARs and multiples thereof.

Dispatch – The process of apportioning the total Demand of the Grid through the issuance of Dispatch Instructions to the scheduled Generating Units and the Generating Units providing Ancillary Services in order to achieve the operational requirements of balancing Demand with generation that will ensure the Security of the Grid.

Embedded Generating Unit – A Generating Unit within an Embedded Generating Plant

Frequency – The number of complete cycles of a sinusoidal current or voltage per unit time, usually measured in cycles per second or Hertz.

Grid – The high voltage backbone System of interconnected transmission lines, substations, and related facilities for the purpose of conveyance of bulk power. Also known as the Transmission System.

Load Following and Frequency Reserves –

Market Operator – An independent group, with equitable representation from the electric power industry participants, whose task includes the operation and administration of the Wholesale Electricity Spot Market in accordance with the Market Rules.

Power Quality – The quality of the voltage, including its frequency and resulting current, that are measured in the Grid, Distribution System, or any User System.

Reactive Power – The component of electrical power representing the alternating exchange of stored Energy (inductive or capacitive) between sources and loads or between two systems, measured in VAR or multiples thereof. For AC circuits or systems, it is the product of the RMS value of the voltage and the RMS value of the quadrature component of the alternating current. In a three-phase system, it is the sum of the Reactive Power of the individual phases.

Reliability – The probability that a System or Component will perform a required task or mission for a specified time in a specified environment. It is the ability of a power System to continuously provide to its Customers.

Security – The continuous operation of a power system in the Normal State, ensuring safe and adequate supply of power to End-Users, even when some parts or Components of the System are on Outage.

Spinning Reserve – The component of Contingency Reserve which is Synchronized to the Grid and ready to take on Load. Also called Hot Standby Reserve.

Spot Market – Has the same meaning as the Wholesale Electricity Spot Market.

System Operator – The party responsible for generation Dispatch, the provision of Ancillary Services, and operation and control to ensure safety, Power Quality, Stability, Reliability, and Security of the Grid.

Total System Blackout – The condition when all generation in the Grid has ceased, the entire System has shutdown, and the System Operator must implement a Black Start to restore the Grid to its normal state.

User – A person or entity that uses the Grid or Distribution System and related facilities.

User System – Refers to a System owned or operated by a User of the Grid or Distribution System.