



Registrar

National Electric Power Regulatory Authority Islamic Republic of Pakistan

NEPRA Tower, Attaturk Avenue (East), G-5/1, Islamabad.

Tel: +92-51-9206500, Fax: +92-51-2600026

Web: www.nepra.org.pk, E-mail: registrar@nepra.org.pk

No. NEPRA/SA(M&E)/LAG-23/ **20427**

November 25, 2025

General Manager
Hydel Operation, WAPDA,
186-WAPDA House
Lahore

SUBJECT: ORDER OF THE AUTHORITY IN THE MATTER OF EXPLANATION (DATED 22.09.2023) ISSUED TO M/S PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY UNDER REGULATION 4(1) & 4(2) OF THE NEPRA (FINE) REGULATIONS, 2021

Enclosed please find herewith the order of the Authority (total 09 Pages) in the matter of Explanation issued to M/s Pakistan Water and Power Development Authority under Regulation 4(1) & 4(2) of the NEPRA (Fine) Regulations, 2021.

Enclosure: As above


(Wasim Anwar Bhinder)

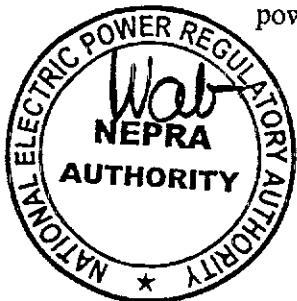


National Electric Power Regulatory Authority

In the matter of Explanation issued to M/s Pakistan Water and Power Development Authority under Regulation 4(1) & 4(2) of the NEPRA (Fine) Regulations, 2021

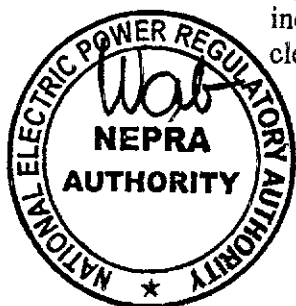
Order

1. This Order shall dispose of proceedings initiated under Regulation 4(1) & 4(2) of the NEPRA (Fine) Regulations, 2021 (hereinafter referred to as the "Fine Regulations, 2021") vide Explanation No. NEPRA/DG(M&E)/LAG-23/33781 dated September 22, 2023 issued to Pakistan Water and Power Development Authority for *prima facie* violation of Section 14B(4) of the NEPRA Act, Rule 10(6) of the NEPRA Licensing Generation Rules, 2000 and Clauses OC 8.1.1, 8.1.4, 8.2.1, 8.2.2 & 8.2.3 of the Grid Code in wake of the system restoration following the power system collapse occurred on 23.01.2023.
2. Pursuant to Section 15 of the NEPRA Act (now section 14B after promulgation of Regulation of Generation, Transmission and Distribution of Electric Power Amendment Act 2018), the Authority has granted a Generation License (No. GL(Hydel)/05/2004, dated 03/11/2004) to Pakistan Water and Power Development Authority (hereinafter referred to as the "Licensee") to engage in the generation business as stipulated in its Generation License.
3. Pursuant to Section 14B(4) of the NEPRA Act, in the case of a generation facility connecting directly or indirectly to the transmission facilities of the national grid company, the Licensee shall make the generation facility available to the national grid company for the safe, reliable, non-discriminatory, economic dispatch and operation of the national transmission grid and connected facilities.
4. According to Rule 10(6) of the NEPRA Licensing (Generation) Rules, 2000, the Licensee shall at all times comply with the provisions of the grid code, including, without limitation, in respect of the availability of the net capacity or in respect of the outages, maintenance and operation of its generation facilities, and shall provide the national grid company with all information reasonably required by the latter to enable it to dispatch the generation facilities of the Licensee.
5. Clause OC 8.1.1 of Operation Code-System Recovery of Grid Code deals with the procedures for the restoration of power supplies following a Total Shutdown or a Partial Shutdown of the System and the re-synchronization of specific parts of the System that have been Islanded.
6. Clause OC 8.1.4 of Operation Code-System Recovery of Grid Code states that OC 8 applies to the System Operator, NTDC, distribution companies, Operators of the power plants, and Users of the System. Contingency arrangements are required to be established by the System Operator with each Externally-connected Party/Consumers.
7. Clause OC 8.2.1 of Grid Code states that a Total Shutdown of the System is a situation when there is no internal generation online and operating; and there is no power supply available from external-connections. The restoration of power supply



from such a situation is a Black Start Recovery. A Partial Shutdown is when there is no online operating generation or External Connection to a part of the system that has become shutdown; and it is necessary for the System Operator to instruct Black Start Recovery procedures to restore supplies to that part of the system.

8. Clause OC 8.2.2 of Grid Code states that during restoration of power supplies following a Total Shutdown or Partial Shut Down of the System, it may be necessary to operate the system outside normal frequency and voltage as stated in OC 4. It may also be necessary for the System Operator to issue instructions that are contrary to the Balancing Mechanism or Code, and also to normal contractual obligations in order to ensure restoration of supplies.
9. Clause OC 8.2.3 of Grid Code states that following a Total Shutdown of the System designated power plants that have the ability to Start Up without any External Connection to the system shall be instructed to commence Black Start recovery procedures. These procedures, which are to be agreed in advance, may include the restoration of blocks of local load demand that can be restored in agreement with the local distribution company. Local procedures may include the restoration of power supplies via Embedded Generator. The System Operator has the responsibility for the re-energisation of the interconnected transmission system and the re-synchronization of the system blocks of islanded blocks of locally restored supplies.
10. The total power system collapse occurred on 23.01.2023 at 07:34:43:800 Hrs, which plunged the whole country into darkness, and the system was completely restored on 24.01.2023 after approximately 20 hours. NEPRA, being a regulator of the power sector, took cognizance of the above incident and constituted an Inquiry Committee (IC) to probe into the matter. During the course of inquiry, the IC visited power houses, grid stations, sites, offices, and obtained relevant documents to reach a just determination.
11. The IC noticed that black start facility from Tarbela power station was availed and generating unit # 3 synchronized at 08:10 Hrs and power supply to some of the grid stations in the jurisdiction of IESCO i.e., Islamabad and Rawalpindi was restored and generation was increased gradually. However, Tarbela generating units remained unstable as reported by NPCC, resulting in large frequency swings ranging from 45-55 Hz leading to tripping of generators at 0910 Hrs.
12. The IC observed that nine (09) similar startups were initiated from Tarbela with different combinations of transmission lines and different area loads, but all attempts failed and the island could not expand and could not synch with Mangla. As per NPCC the DG sets of AGL could not synch due to unstable behavior of high fluctuating Tarbela generating units.
13. The IC noted that Tarbela power house stance however was that the variation in load causes much stress and variation/fluctuation in frequency and eventually caused tripping of machines.
14. The IC observed that Mangla power station was also instructed for the black start, however, the power station could not start the units due to unavailability of IRSA indent (Indent = 0 cusecs) as per the report of Mangla power station. After getting clearance from IRSA for water discharge, the power station initiated the black start



activities and synchronized Generating Unit # 1 on 132 kV Bus Bar and restored its auxiliary supply with 132 kV Mirpur circuit at 10:10 Hrs.

15. In view of the above, the Authority observed that the Licensee was bound to follow the instructions of the NPCC, which it failed to do. Hence, the Authority observed that the Licensee has, prima facie, failed to comply with Section 14B(4) of the NEPRA Act, Rule 10(6) of the NEPRA Licensing Generation Rules, 2000 and Clauses OC 8.1.1, 8.1.4, 8.2.1, 8.2.2 & 8.2.3 of the Grid Code. In view of the foregoing, the Authority decided to initiate legal proceedings against the Licensee under Fine Regulations, 2021.

Explanation

16. Accordingly, an Explanation dated 22.09.2023 was issued to the Licensee under Regulation 4(1) & 4(2) of the Fine Regulations, 2021. The basis of Explanation included the following:

WHEREAS, the IC noticed that black start facility from Tarbela power station was availed and generating unit # 3 synchronized at 08:10 Hrs and power supply to some of the grid stations in the jurisdiction of IESCO i.e., Islamabad and Rawalpindi was restored and generation was increased gradually. However, Tarbela generating units remained unstable as reported by NPCC, resulting in large frequency swings ranging from 45-55 Hz leading to tripping of generators at 0910 Hrs; and

WHEREAS, the IC observed that nine (09) similar startups were initiated from Tarbela with different combinations of transmission lines and different area loads, but all attempts failed and the island could not expand and could not synch with Mangla. As per NPCC the DG sets of AGL could not synch due to unstable behavior of high fluctuating Tarbela generating units; and

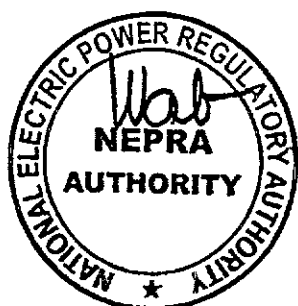
WHEREAS, the IC noted that Tarbela power house stance however was that the variation in load causes much stress and variation/fluctuation in frequency and eventually caused tripping of machines; and

WHEREAS, the IC observed that Mangla power station was also instructed for the black start, however, the power station could not start the units due to unavailability of IRSA indent (Indent = 0 cusecs) as per the report of Mangla power station. After getting clearance from IRSA for water discharge, the power station initiated the black start activities and synchronized Generating Unit # 1 on 132 kV Bus Bar and restored its auxiliary supply with 132 kV Mirpur circuit at 10:10 Hrs.

Licensee's Response

17. In response, the Licensee submitted its reply vide letter dated 09.10.2023. The same has been summarized as follows:

- i. Tarbela's black-start facility was utilized, with Unit 3 synchronized at 08:10 Hrs (37 minutes after system collapse) and Unit 2 at 08:52 Hrs. Warsak Units 6, 3, and 4 were also synchronized at 08:13 Hrs, 08:17 Hrs, and 08:18 Hrs, respectively, per NPCC instructions. Tarbela units were promptly brought online and operated in island mode but tripped due to severe frequency fluctuations (45-55 Hz) following the energization of the 220 kV Burhan circuits at 09:10 Hrs.



- ii. Subsequent restoration attempts from Tarbela failed due to significant load variations causing abnormal system frequency swings. Units tripped on ROCOF protection while operating in island mode.
- iii. WAPDA contests NPCC's claim that AGL's DG sets could not synchronize due to unstable Tarbela units, as Tarbela successfully synchronized five units under similar conditions, delivering 543 MW/228 MVAR before tripping at 10:24 Hrs due to system frequency fluctuations.
- iv. Unit 4 of Tarbela, with identical governor settings to other units, operated in island mode for auxiliary supply throughout the day without a single trip.
- v. Mangla initially could not commence black-start operations due to the absence of IRSA clearance. After approval was obtained, Unit 1 was synchronized to the 132 kV busbar at 10:10 Hrs. Subsequent restoration attempts, however, failed due to persistent frequency and voltage fluctuations, and system stability was only achieved once Mangla successfully synchronized with Tarbela at 18:58 Hrs.
- vi. Tripping incidents were due to abnormal system frequency swings beyond hydropower stations' control, as load management rests with NPCC.

NPCC's and CPPA-G's Comments

18. The response received from the Licensee was shared with NPCC and CPPA-G for their comments. The comments received from NPCC and CPPA-G are reproduced as follows:

NPCC:

"The frequency had to be maintained by the generators available in the Island during restoration which were Tarbela and Warsak as also mentioned in reply by WAPDA/Tarbela.

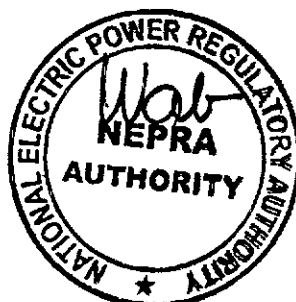
As far as plant contention on load variation is concerned, it is worth mentioning that load was increased gradually in close coordination with generating units in the island. Frequency variation mentioned by Tarbela was due to unstable governor response owing to unavailability of speed control mode of operation.

Whereas frequency range fluctuation mentioned by WAPDA is self-explanatory reason of AGL not getting synchronized."

CPPA-G:

"No comments, as the matter relates to System Operator."

19. Upon review of the Licensee's submissions and the comments received from NPCC and CPPA-G, the Authority observed mutual attribution of responsibility for the tripping. Accordingly, the Authority resolved to grant the Licensee an opportunity of hearing and directed that NPCC and CPPA-G be invited to participate.



Hearing

20. The hearing was conducted on 20.02.2025, wherein, the Licensee, and NPCC participated. Though CPPA-G attended the hearing, however, it had already submitted that it has no comments in the matter, as it relates to the system operator. The discussion during hearing and subsequent comments sought are summarized as follows:

Licensee

- i. The Licensee's generation facilities remained available to the System Operator in compliance with Section 14B(4) of the NEPRA Act, a fact acknowledged by the IC and reflected in the Authority's explanation letter. The Licensee also complied with Rule 10(6) of the NEPRA Licensing (Generation) Rules, 2000.
- ii. The Licensee stated that restoration was initiated per NPCC instructions, and units were gradually started. However, large system load variations and severe frequency fluctuations (45 to 55 Hz) caused repeated tripping nine times until Tarbela was synchronized with Mangla. The Licensee maintained this could have been avoided if both plants had been synchronized earlier to improve system inertia.
- iii. The unit operating in island mode for auxiliary energization remained stable, indicating that tripping was due to extreme load fluctuations rather than a governor malfunction.
- iv. The Licensee explained that machines are operated and synchronized manually following a collapse to ensure system integrity and safety. While governor response is similar in auto and manual modes, manual control is essential for safe and efficient operation during emergencies.
- v. The Licensee followed NPCC instructions throughout restoration, operated units in prolonged island mode under abnormal frequency and voltage conditions, which placed stress on equipment and structures. No compensation is provided for such uneconomic dispatch under Section 14B(4) of the NEPRA Act.
- vi. Between 0910 Hrs and 1024 Hrs, the Licensee synchronized five Tarbela units (543 MW) under unstable conditions, while AGL did not synchronize any units in the same period.
- vii. Despite PPA provisions allowing re-synchronization within 30 minutes after load rejection, the Licensee continued restoration efforts per SO instructions, even under unstable conditions.
- viii. In light of the foregoing, the Licensee respectfully denies the alleged violations and requests that its response be accepted and the case be closed.



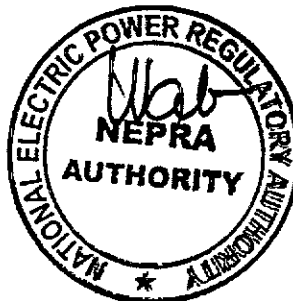
NPCC

- i. The load was raised in 2-4 MW blocks, but with the governor not in power control mode, the frequency spiked to 55 Hz. Thereafter, no further load adjustments were made, and the machine itself brought the frequency down to 45 Hz, with this fluctuation occurring repeatedly. Additionally, adding load takes considerable time, whereas unit behavior changes within seconds.
- ii. The speed control functionality, specifically the isochronous mode of operation, was not available in Units 1-10 of the Tarbela Power House following the digitization of their governor systems under a USAID project in 2014. The absence of isochronous control contributed to unstable oscillatory behavior during system restoration, resulting in repeated tripping of these units.
- iii. Similar limitations were found in the older Units 1-10 of the Mangla Power House, restricting their role in stable island formation and synchronization during blackout recovery.
- iv. In contrast, the UCH-I Power Plant units had fully functional speed control and isochronous mode, enabling effective island formation and stable system operation during restoration.

Licensee's Comments on NPCC Submissions

The foregoing comments of NPCC were referred to the Licensee for its views and feedback to facilitate a thorough case analysis and an informed, just decision. The Licensee views are summarized as follows:

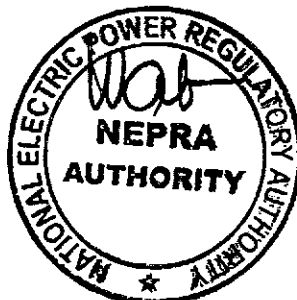
- i. The governor system of Tarbela Power Station Units 1-10 was upgraded by M/s GE from electromechanical to digital. The upgraded digital governors were equipped with only two modes of operation, namely Power Mode and Wicket Gate Opening Mode, and did not include isochronous control, as this was not part of the upgrade scope. Similarly, the isochronous feature was not included in the original scope of the Mangla refurbishment.
- ii. Tarbela Power Station has consistently provided black start capability over the years using the same Power Control mode. Furthermore, speed control mode was not a requirement of NPCC at the time of commissioning the upgraded governors for Units 1-10.
- iii. Both Tarbela and Mangla Power Stations have initiated cases to incorporate isochronous control in the digital governors of Units 1-10. Once implemented, this feature will enhance black start efficiency at both stations.
- iv. The governor system of Mangla Power Station Units 1-10 inherently lack real-time frequency regulation or isochronous (zero-droop) control. This is a design limitation rather than operational negligence by the Licensee. Furthermore, the PPA does not obligate upgrades or modifications beyond the original plant design.



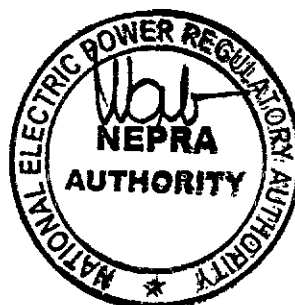
- v. During national grid restoration following a blackout, particularly when system inertia is low and grid frequency is unstable, units may experience oscillatory behavior and protective tripping. As per the PPA and Grid Code, it is NPCC's responsibility to maintain grid parameters within the design tolerances of generating units. Operating units beyond these tolerances results in protective tripping, complicating restoration efforts.
- vi. The Licensee also provided the generation and line loading data.

Analysis/Findings of the Authority

21. The Authority has gone through the Licensee's submissions in view of the comments received from NPCC, and observes as follows:
- i. Regarding the availability and operation of generation facilities, and compliance with Section 14B(4) of the NEPRA Act and Rule 10(6) of the NEPRA Licensing (Generation) Rules, 2000, the Authority notes that the Inquiry Committee, in its report, confirmed that the black start facility at Tarbela Power Station was utilized, with Generating Unit No. 3 synchronized at 08:10 hours. Power supply was subsequently restored to grid stations under IESCO's jurisdiction in Islamabad and Rawalpindi, and generation was gradually increased.
 - ii. Similarly, the Authority observes that the inquiry report highlights that, after clearance from IRSA for water discharge, Mangla Power Station initiated black start activities, synchronized Generating Unit No. 1 on the 132 kV bus bar, and restored auxiliary supply through the 132 kV Mirpur circuit at 10:10 hours.
 - iii. The Authority notes that restoration at Tarbela and Mangla included both active power loading and reactive power support to maintain system voltage, as required under Section 14B(4) of the NEPRA Act. The Authority further observes that the Licensee complied with NPCC instructions during restoration, operating units in prolonged island mode with uneconomic dispatch beyond normal frequency and voltage limits, despite adverse impacts on equipment, plant installations, and civil structures.
 - iv. The Authority, after reviewing the Licensee's submissions on repeated unit tripping, observes that restoration was initiated per NPCC instructions, with generating units brought online gradually. However, high load variations caused severe frequency fluctuations (45-55 Hz) at a rate the governors could not sustain, resulting in repeated tripping due to governor tracking error. The Authority further notes that earlier synchronization of Tarbela and Mangla could have increased system inertia and potentially prevented these trippings. The inquiry report also confirms that load at Tarbela was increased to 543 MW between 09:10 and 10:24 hours before the units tripped. Moreover, the Authority observes that the unit used to energize auxiliaries, operating in island mode, remained stable, indicating no inherent governor malfunction.



- v. Further, the Authority observes that the generating units were started, and the Licensee brought five Tarbela units on bar under unstable system conditions, with a load of 543 MW and supplying 228 MVAR at 1024 hours, before tripping occurred. During this period, AGL did not bring any unit on bar. It is, however, noteworthy that under stable system conditions, AGL should have brought at least one unit on bar, as highlighted by the Licensee.
- vi. The Authority notes that it sought information from NPCC regarding incremental load blocks of 2 MW and 4 MW, as submitted during the hearing, along with the corresponding time intervals, i.e., the frequency of load application and the behavior of Tarbela and Mangla generating units in terms of frequency (Hz). However, NPCC failed to provide any supporting documentation and stated that such data may be obtained from the relevant power plants. Subsequently, the Authority obtained generation and loading data from the Licensee. A review of this data revealed that generation at Tarbela increased gradually in response to incremental loads on the 220 kV Mardan-1, 220 kV ISPR, and 220 kV Burhan-II circuits. However, abnormal variations in load led to the tripping of Tarbela units. For example:
- a. The loading on the 220 kV ISPR circuit fell abruptly from approximately 450 A (~180 MW) to 230 A (~92 MW).
 - b. Simultaneously, the loading on the 220 kV Burhan-II circuit increased from approximately 100 A (~40 MW) to 300 A (~120 MW).
 - c. Load swings on the 220 kV Mardan-1 circuit also contributed to the tripping, as reflected in the Inquiry Committee report.
- vii. The Authority further observes that, during restoration events at Tarbela from 0916 Hrs to 1024 Hrs before tripping, five units were on bar, energizing two 220 kV bus bars, two 220/500 kV auto-transformers, and two 220 kV lines with a 543 MW load. Each unit maintained a period of stable operation before tripping, as highlighted in the Inquiry Committee report. In view of the foregoing, and in the absence of supporting documentation on load blocks, the Authority concludes that the tripping of Tarbela units cannot be attributed to a governor-related issue.
- viii. Additionally, the Authority observes that the speed control mode of operation at the time of digitalizing the governor system from the electromechanical system on Tarbela units #01-10 was not a requirement of NPCC, and notes that the Power Station has consistently provided black start capability whenever required, using the same Power Control mode, with comprehensive data submitted to the Inquiry Committee during each disturbance and restoration.
- ix. The Authority observes that, owing to inherent design limitations of the Mangla units with respect to real-time frequency regulation, any deviations in performance cannot be attributed to the Licensee's operational negligence.



Decision

22. In view of the above, the Authority is of the considered opinion that the Licensee has provided a satisfactory response to the Explanation issued to it. Accordingly, the Authority decides to accept the same, and the matter stands closed in terms of Regulation 4(6) of the Fine Regulations, 2021.

Authority

Rafique Ahmed Shaikh
Member (Technical)

(Did not Attend)

Engr. Maqsood Anwar Khan
Member (Development)

Amina Ahmed
Member (Law)

Waseem Mukhtar
Chairman

Announced on 25th Nov, 2025 at Islamabad.

