

**Before the**  
**MAHARASHTRA ELECTRICITY REGULATORY COMMISSION**  
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**Case No. 84 of 2010**

**In the matter of Partial Grid Disturbance in Mumbai system on  
18<sup>th</sup> Nov-2010 at 17:40 hrs and 21<sup>st</sup> Nov-2010 at 17:05 hrs**

**Shri V. P. Raja, Chairman  
Shri Vijay L. Sonavane, Member**

**ORDER**

**Dated: December 01, 2010**

In exercise of the powers conferred by Section 181 Clause (zp) read along with clause (h) of Section 86 of the Electricity Act, 2003, the Commission has notified the MERC (State Grid Code) Regulations, 2006. These regulations apply to (i) the State Load Despatch Centre (SLDC); (ii) every Transmission Licensee in the State including State Transmission Utility; and every User who is connected to and/or uses the intra-State transmission system. The State Grid Code lays down the Rules, guidelines and standards to be followed by various agencies and participants in the Intra-State transmission system to plan, develop, maintain and operate the Intra-State transmission system, as a part of Western Regional Grid System, in the most efficient, reliable and economic manner, while facilitating a healthy competition in the generation and supply of electricity.

The Regulation 29.1.1 of the MERC State Grid Code Regulations 2006 specifies those events that are mandatorily required to be reported *inter alia* by Transmission Licensees to the State Load Despatch Centre. These events are: Violation of security standards; Cases of Grid indiscipline; Non-compliance of State Load Despatch Centre's instructions; System islanding/System split; Complete Black out/Partial system black out; Protection failure on any element of intra-State transmission system; Power system instability; and Tripping of



any element of the State Grid as per procedure and in the manner laid down in said Regulation.

2. As per report received from the Chief Engineer, State Load Despatch Centre (SLDC), Kalwa there was a Grid Disturbance on 18<sup>th</sup> November 2010 at around 17.40 hrs in Mumbai sub-system of the State Grid affecting power supply of large area of Mumbai suburban network. Consequently, power supply to large population of suburban areas served by Reliance Infrastructure Ltd. (RInfra) was disrupted.

3. Again on 21<sup>st</sup> November 2010, the Chief Engineer, (SLDC), Kalwa reported to the Commission about system disturbance which occurred on November 21, 2010 at 17.05 hrs in Central Mumbai area, wherein supply from Tata Power Company's (TPC's) 220 kV Dharavi S/S and associated areas fed from 220 kV Dharavi S/S namely 220 kV Backbay S/S, 110 kV Vikhroli S/S and 110 kV Mahalaxmi S/S was affected involving interruption in supply to large sections of Mumbai.

4. As both the above occurrences (in a short span of 3 days) severely affected the power supply of a large section of population of Mumbai City, the matter was required to be taken cognizance of for ascertaining evasion if any of system security, failure of protection and to achieve intended islanding of critical load-generation balance areas. Regulation 32 of the MERC (Conduct of Business) Regulations, 2004 provides that "*The Commission may initiate any proceedings suo motu, or on a Petition filed by any affected or interested person.*" The Commission, with a view to find the primary reasons for occurrence of such system disturbances and for identifying /taking preventive measures, conducted a *suo-motu* hearing of the concerned parties and other stakeholders including SLDC, Kalwa, which is the apex body in the State for System Operation. It is felt that the Regulatory investigations and hearing will lead to finding the primary reasons for occurrence of such system disturbances and preparing guidelines for taking preventive measures.

5. The Commission vide its order dated 27<sup>th</sup> June 2007 (Case No 16 of 2007) in the matter of Grid Disturbance and Disruption of Power Supply on 25<sup>th</sup> February 2007 had directed STU Kalwa, MSETCL and other Transmission Licensees in the State to review and revamp protection and relay settings and also to review and re-design for effective islanding of Mumbai System for salvage of major generation and isolating critical loads by preventing fault related disturbances from traversing into healthy area. The Commission also directed for formulating islanding schemes for rest of Maharashtra.



6. The Commission issued Notices dated November 19, 2010 and November 22, 2010 to SLDC, Kalwa, the concerned Licensees and to other Users of intra-State Transmission System regarding *suo-motu* hearing to be held in the matter on 25th November 2010 at 10.00 hrs at Meeting Hall, 7<sup>th</sup> Floor, Centre No. 1, World Trade Centre, Cuffe Parade, Mumbai-400 005. It was also decided to implead MSEDCL and BEST undertaking in the matter. The notices required the affected licensees for submission of information related to reportable event in compliance of Regulation 29 of State Grid Code Regulations, 2006 and they were directed to submit the following information:

- (i) System conditions prior to the occurrence (pre-fault).
- (ii) Brief description of the occurrence, sequence of events and the areas affected thereof.
- (iii) Generation loss and units tripped during Occurrence.
- (iv) Restoration of normalcy and the chronological steps taken therefor.

The Commission also decided to cover the following areas during hearing:

- (i) What are the details of the occurrence in Mumbai Suburbs on 18<sup>th</sup> November, 2010 at 17.40 hrs and on 21<sup>st</sup> November 2010 at 17.05 Hrs?
- (ii) Follow up action on the Order issued on 27<sup>th</sup> June, 2007 in Case No. 16 of 2007.
- (iii) Preventing recurrence of such events in Mumbai

7. The Commission in exercise of the powers conferred by Section 94(3) of the Electricity Act, 2003 has also decided to authorise following persons as Consumers Representatives in addition to the four previously authorised Consumers representatives

1. Shri N. Ponrathnam, Vel Induction
2. Shri Rakshapal Abrol, Bhartiya Udhami Awam Upbhokta Sangh
3. Shri Sandeep Ohri



8. The Commission also invited Professor Dr S. A. Khaparde and Professor Dr Soman/Dr Anil Kulkarni, Department of Electrical Engineering, Indian Institute of Technology (IIT) Mumbai as Special Invitees, for their expert advice in the matter.

9. Maharashtra State Load Despatch Centre, Kalwa submitted its report for grid disturbance which had occurred on 18-11-2010 and on 21-11-2010 in Mumbai system. Transmission Licensee TPC and RInfra also submitted their respective reports under Regulation 29 of the State Grid Code Regulations 2006 on the above occurrences. The Commission also received the comments from the Consumer Representatives a) Shri Rakshapal Abrol b) Shri N. Ponrathnam. The representations received from Shri Shirish Despande of Mumbai Grahak Panchayat, Shri Ashok Pendse of TIBA and Shri Sandeep Ohri were read-out during hearing.

10. Hearing in the matter was held on 25<sup>th</sup> November 2010 in the meeting Hall, 7th Floor, Centre No. 1, World Trade Centre at 10.00 Hrs Detailed presentations were made during the hearing by SLDC, MSETCL, TPC, REL and BEST on the system disturbances occurred on above two occasions.

11. As per the data provided by MSLDC, TPC, RInfra in the Reports and as per presentations made during hearing, the important observations of system occurrence on 18-11-2010 are given below:

- a. The system was normal prior to disturbance;
- b. Prior to occurrence the following network elements were not in service:
  - i. 220 kV Bus-coupler at TPC Salsette Receiving Station. It was reported that this bus-coupler is normally kept OPEN for most of the time, since 2007 to control over-loading of 220 kV Kalwa- Salsette D/C line.
  - ii. 220 kV Borivali (MSETCL) – Borivali (TPC) line was OPEN for controlling loading on 400/220 kV ICT at MSETCL Kalwa S/S from 19<sup>th</sup> October 2010.
  - iii. 220 kV Kalwa - Borivali (MSETCL) line was under planned maintenance for commissioning of numerical relay.
- c. 220 kV Trombay-Salsette Line-1, carrying 170 MW, tripped on phase to phase fault caused due to kite string in span 70-71 at Tagore Nagar, Vikhroli.



- d. At 17:44:43:868 Hrs (after a gap of 5 minutes) 220 kV Trombay-Salsette Line-2 carrying 290 MW tripped at 220 kV Salsette end only. There was a no relay action at Trombay end. Earlier both the lines were carrying 170 MW each.
- e. This caused cascade tripping of 110 kV Inter-connection between MSETCL Borivali to TPC Borivali (on Overload) and 220 kV inter-connection between MSETCL and R-Infra at Boisar (on Overload) and tripping of both the 250 MW units at Dahanu Generating Station (DTPS) one after another. This has resulted into total shut-down of R-Infra 220 kV network in North Mumbai.

The system was restored back to normal from 17.48 Hrs. and finally with the synchronization of DTPS Unit 2 at 20.14 Hrs. and Unit No. 1 at 21.18 Hrs.

12. The Commission observed that modifications carried out in the islanding scheme as per directions in Case No.16 of 2007 with regard to disturbance on 25<sup>th</sup> February 2007 proved to be inadequate to safe islanding of R-infra System and TPC system with proper load-generation balance. In view of the same the existing Under frequency (U/F) load shedding scheme and islanding scheme inclusive of frequency settings of Under frequency relays (UFRs) for system islanding and for activating the load trimming scheme which initiates on overloading on major 220 kV transmission lines, needs to be reviewed. The application and setting of df/dt relays operating on the rate of change of frequency due to system instability, in fault conditions, alongwith associated UFR for islanding, requires to be thoroughly examined.

13. Based on the facts of the issue submitted by various stakeholders, the Commission feels that the following points need detailed investigation;

- It was noticed that there was a time gap of more than 5 minutes between tripping of 220 kV Trombay-Salsette Line-1 and line-2. (At 17:39:17:852 Hrs and 17:44:43:868 Hrs) on 18-11-2010. It was further noticed that after the said tripping of the 220 kV Trombay-Salsette Line-1, neither did any auto-reclosure of the line take place nor was the line test charged, after first tripping at 17.39 Hrs The normal operating practice suggests that even after a faulty auto-reclosure, the lines may be test charged once after a reasonable time gap, for clearance of transient faults.
- There was a gap of more than 5 minutes between the tripping Trombay - Salsette Line No.1 and Line no. 2. If the bus-coupler breaker at Salsette would



have been in “CLOSED” condition before the tripping of Trombay- Salsette Line No.2, overloading of the healthy line could have been avoided. It appears that the Operators at TPC Salsette S/S Control Room Trombay have not immediately closed the bus-coupler breaker at Salsette subsequent to tripping of Trombay - Salsette Line No.1.

- The Commission directs TPC to issue suitable operating guidelines/procedures to take appropriate corrective actions in such situation. The Commission also directs TPC to investigate the matter and submit detailed report in this regard to the Commission.
- It was further observed 220 kV Borivali (MSETCL) and Borivali (TPC) line was kept “Open” due to planned outage of MSETCL 220 kV Kalwa – Borivali line for commissioning of numerical relay. Perhaps, if this activity would have been planned on a Sunday / holiday /off-peak period, there would have been no need to keep 220 kV Borivali (MSETCL) and Borivali (TPC) ”Open” and subsequent cascade tripping could have been averted. This needs to be looked into by MSETCL.
- The Commission feels that the matter regarding kite-string causing tripping of 220 kV Trombay – Salsette Line No.1 needs to be looked into seriously as any fine conducting / semiconducting material like kite string etc coming into the charged vicinity of 220 kV Line will burn and volatile matter may evaporate instantaneously before relay action is initiated to trip the line.
- During hearing, it was reported by TPC that 220 kV Trombay –Salsette Line No. 2 tripped at Salsette end only due to the overload alarm unit of the said relays was wrongly configured for “Trip”. It was also reported that while the line tripped at Salsette end, its breaker at Trombay end remained “Closed”. This needs to be investigated further by TPC.
- The Commission observed that return of Dahanu Units on bar was after about 2.5 hrs and 3.5 hrs respectively, which appears to be excessive delay. This needs to be looked into by RInfra-G.

14. There was another system disturbance in Mumbai Sub-system on 21-11-2010 at 17.05 hrs due to tripping of 220 KV Trombay-Dharavi-V & 220 KV Trombay-Salsette-Line 2 which are on one the same side of the Four Circuit Tower, on fault due to inclement



weather. It is reported later after a gap of 5 minutes i.e. 17.10 hrs 220 KV Trombay-Dharavi-VI tripped due to a coconut tree coming into arcing distance with the live conductors. This has resulted into cascade tripping of 110 kV lines on overload causing partial power supply interruption of TPC's Dharavi, Vikhroli, Mahalaxmi and Back-Bay sub-stations. By 18.01 hrs normalcy was restored by gradually resuming power supply to affected areas.

15. The important observations of system incident on 21-11-2010, as reported by various stakeholders, are as under:

- a. The power system prior to disturbance was normal. However the weather conditions were windy and rainy.
- b. The fault on 21-11-2010 at 17.05 hrs resulted into tripping of following lines:
  - i. 220 KV Trombay-Dharavi-V & 220 KV Trombay-Salsette-2 tripped on fault at 17.05 Hrs.
  - ii. 220 KV Trombay-Dharavi VI tripped at 17.10 Hrs due to coconut tree coming in arcing distance with live wires. This has resulted in failure of 220 KV supply to Dharavi S/s and tripping of other 110 KV lines on over load causing shut down to Dharavi S/S.
- c. Bhira Hydro plant of TPC was not operational due to ongoing work in Tailrace by Irrigation Department. Hence, no source to Dharavi on 220 KV Bhira-Dharavi D/C.
- d. 220 KV Dharavi-Backbay supply failed at Backbay.

16. The system was restored back to normalcy in the following sequence:

- i. At 17:14 hrs 110 KV supply extended to Mahalaxmi S/S from 110 KV Parel and load of about 40 MW restored.
- ii. At 17:20hrs 110 KV supply extended to Backbay S/S from 220 KV Carnac S/S and load of about 35MW including Mantralaya area was restored,
- iii. At 18:02 hrs 220 KV Trombay – Salsette Line-2 taken in-service.
- iv. Central Railway section from Chinchpokali to Mulund & Western Railway section from Dadar to Vile Parle was affected during 17:10 hrs to 17:32 Hrs for about 22 min.



- v. Gradually all loads were restored at Vikhroli & Dharavi S/S by 18:01 hrs thereby Normalcy was restored.

17. During the hearing on 25 November 2010, the Consumer Representatives advocated for suitable compensation to Mumbai consumers who are already paying standby charges, reliability charges for uninterrupted power supply. As per Standards of Performance of Distribution Licensee, the compensation is payable to consumers for failure of Distribution Licensee. However, in this particular case the failure is on account of transmission system. At present the Standards of Performance (SOP) for Transmission Licensee has yet not been formulated. The Commission has initiated a process to obtain initial and preliminary feedback and inputs from Maharashtra STU for formulating the Standards of Performance applicable for Transmission Licensee.

18. The Commission observed that in the past there were cases of severe inclement weather conditions and this is the first time that two nos. 220 kV circuits on a four circuit tower on the same side have tripped on coconut tree coming in arcing distance with live conductor which needs to be further analysed by TPC. The root causes for this occurrence on both occasions is not clearly explained and requires further investigation by experts.

19. In view of the above two occurrences it appears that Mumbai Network is operating without adequate margins and requires strengthening and augmentation of the existing transmission network. As a short term measures, the Commission directs the TPC-T and R-Infra-T to expedite the commissioning of various Transmission project investment schemes which are already approved by the Commission, especially those for strengthening of Mumbai EHV Transmission network, and complete the same within the time frame stipulated in "In-principle approval of the schemes".

20. The Commission directs for review of protection setting at all inter-connection points between two transmission licensees and also between Transmission- Distribution Inter-connection boundary points. The Commission directs that a Committee headed by Professor (Dr) S. A. Khaparde, IIT Bombay consisting of representatives from SLDC, WRLDC, STU, TPC, R-Infra and Commission's Officer be constituted for review of existing protection schemes, under frequency relay settings, Islanding scheme, Studies on compliance of (N-1) criteria and investigate the prime reasons for aforesaid two system disturbances. The Committee also directed to suggest remedial measures so that such occurrences can be avoided in future. The Chief Engineer (MSLDC), Kalwa is directed to





act as Member Secretary to the Committee & take all initiatives for holding the Committee meetings. The Committee is directed to submit its detailed Report to the Commission within a month from the issue of the Order.

21. The nature of the above system occurrence suggests that it would be desirable to carry out real time contingency analysis of the inter-connected grid at suitable intervals (say 15 min) at SLDC Kalwa and Control Centers of TPC and R-Infra. This would help in possible avoidance of such occurrences. .

22. Time synchronization of SLDC Control Room with that of Control Centers of other Transmission Licensee (TPC-T and RInfra-T) is essential requirement for any fault reporting and investigation process. This needs to be confirmed by SLDC, Kalwa, during the investigation.

23. The Commission directs that STU (MSETCL) may take up with the appropriate State and Regional Committees dealing with Grid management, to address the issues highlighted by the Commission during the hearing, for improving Grid performance.

Sd/-  
(Vijay L. Sonavane)  
Member

Sd/-  
(V. P .Raja)  
Chairman



(K. N. Khawarey)  
Secretary, MERC