

**CENTRAL ELECTRICITY REGULATORY COMMISSION
NEW DELHI**

Petition No.2/2010 (Suo-motu)

Coram

1. Dr. Pramod Deo, Chairperson
2. Shri S.Jayaraman, Member
3. Shri V.S.Verma, Member
4. Shri M.Deena Dayalan, Member

DATE OF HEARING: 25.5.2010

DATE OF ORDER: 20.9.2012

In the matter of

Grid disturbance in the Northern Region on 2nd January, 2010.

Following were present:

1. Shri Rajiv Porwal, NRLDC
2. Shri Alok Kumar, NRLDC
3. Shri V.K. Aggarwal, NRLDC
4. Shri Rajesh Kumar, NRLDC
5. Shri P.S.Mhaske, NRLDC
6. Shri A.K.Agarwal, NRPC

ORDER

It was noted from press report that power supply in the Punjab, Haryana, Himachal Pradesh, Delhi, and Union Territory of Chandigarh was affected on 2nd January 2010 on account of grid disturbance in the Northern Region. The reasons for the grid disturbance were stated to be tripping of the several transmission lines on account of heavy fog. Accordingly, Commission vide its order dated 14.1.2010 in petition No. 2/2010 (Suo motu) directed the Central Electricity Utility (CTU) and Northern Regional Load Despatch Centre (NRLDC) to carry out a detailed study of the grid disturbances and submit and a report containing the reasons for

grid disturbances, preventive steps taken so far and to suggest remedial measures.

2. During the course of hearing on 25.5.2010, the representative of the NRLDC submitted that there were two incidents of grid disturbance, one at 0301 hrs and the second at 2154 hrs on 2.1.2010. The load loss on the first incident was about 7500 MW and on the second incident, it was about 9000 MW. He submitted that on 2.1.2010 there was high humidity and low temperature conditions causing outage of several 400 kV and 220 kV lines mainly due to insulator failure. At 03:00 hrs on 2.1.2010, there were 15 number of 400 kV lines and 80 number of 220 kV lines out due to fog related trippings. However, number of 400 kV line trippings was less as compared to incidences of grid disturbances in previous years.

3. With regard to violation of the provisions of the Grid Code by the Utilities, the representative of NRLDC clarified that there might be incidents of inadequate action in accordance with the provisions of Grid Code relating to under-frequency and df/dt relays, protection system and real time data transfer including installations of RTUs by the utilities. He further submitted that against the planned relief of 1140 MW and 2420 MW from UFR and df/dt relays, the actual relief was about 128 MW and 297 MW, respectively at 03:01 hours of 2.1.2010. Similarly, the load relief from these schemes was much less than planned in the second incident at 21:54 hrs. He stated that the actions by the

system operators in such incidents have to be taken in a very short span of time and emphasized the need of capacity building of the operators.

4. The Commission vide Record of Proceedings dated 25.2.2010, directed the NRLDC to submit the following details:

- (i) Actual vis-a vis- schedule replacement of insulator by the utilities;
- (ii) The details of non-operation/mal-operation of protection system;
- (iii) Details of the violation of the provisions of the grid code by the utilities, name of responsible utility; and
- (iv) Non-availability of Remote Terminal Units (RTUs) along with the name of the responsible utility.

5. NRLDC under its letter dated 6.7.2010 has filed the said information. According to the NRLDC, an Enquiry Committee was constituted under the Chairmanship of Member (GO&D), Central Electricity Authority to enquire into the grid disturbance occurred on 2.1.2010 and Committee submitted its report on 22.6.2010. Observation on NRLDC submission and the findings/recommendations of the Enquiry Committee are as under:

(i) **Replacement of insulators in Northern Region:**

(a) On perusal of the report submitted by utilities in special meeting taken by Member-Secretary, NRPC on 16.12.2009 with regard to the status of replacement of insulator prior to the grid incident, it is evident that Delhi Transco Limited, Haryana Vidyut Prasaran Nigam Limited, Uttar Pradesh Power

transmission Corporation Ltd., Power Grid Corporation of India Ltd., Punjab State Electricity Board and Rajasthan Rajya Vidyut Prasaran Nigam Limited did not adhere to the schedule. The Enquiry Committee observed that in addition to already identified lines for replacement of insulators other lines should also be identified and the work should be completed before next winter. The relevant portion of para 2 of Chapter 11 of the report is as under:

"In addition they should also identify additional lines which are getting frequently affected due to fog in winter season. The work of replacement of porcelain insulators with polymer/anti-fog insulators should be carried out on the complete stretches of the lines especially in case of the critical 400 kV and 200 kV lines and evacuation lines from the generating station. The replacement of insulators of these lines with preferably polymer may be completed before reoccurrence of fog in next winter season (by Nov, 2010). The respective utilities may prepare a time line and accordingly coordinate the activities of procurement and implementation of replacement of insulators so as to avoid shutdowns during peak period/season"

(b) The committee in its para 5.2.1 has also made following observation:

" It has also been ascertained that though in the stretch around Dadri the insulator replacement work has been completed, the auto-reclosure / tripping were in the sections beyond Dadri in the Mainpuri jurisdiction, where the insulators were not replaced with the polymer type of the insulators. This further justifies the requirement of replacement of the porcelain insulators in all the critical locations on priority basis"

(c) Keeping in view the importance of insulator replacement work, the concerned utilities are directed to complete the work before onset of next winter.

(d) Central Transmission Utility (CTU) and State Transmission Utilities (STUs) shall ensure development of an efficient, co-ordinated and economical system of inter-State and intra-State transmission lines for smooth flow of electricity from generating stations to the load centers in terms of sub-section (c) of Sections 38 and 39 Electricity Act, 2003 (hereinafter referred to as 'the Act'). Similarly, stipulations have been specified in clauses 2.4.1 (c) and 2.7.1 (c) of the Indian Electricity Grid Code, 2006 (hereinafter referred to as 'the IEGC') for CTU and STU respectively. Relevant portion of clause 2.4.1 (c) of the IEGC provides as under:

"(c) CTU has to ensure development of an efficient, co-ordinated and economical system of inter-State transmission lines for smooth flow of electricity from generating stations to the load centers;"

(e) Further, clause 2.7.1 (c) of the IEGC provides as under:

"(c) STU has to ensure development of an efficient, co-ordinated and economical system of intra-State transmission lines for smooth flow of electricity from a generating station to the load centers"

(f) In view of the above, The CTU and STUs are directed to replace the insulator to ensure development of efficient transmission system in terms of clauses 2.4.1 (c) and 2.7.1. (c) of the IEGC.

(ii) Non-operation/ Mal-operation of the Protection System:

(a) Tripping of 400 kV Khedar-Moga circuit on over current (O/C) protection due to undesired oversetting during 0301 hrs of 2nd January 2010 incident: Over current protection in 400 kV lines is not a desirable

feature. On 12.10.2007 the existence of such protection caused a grid disturbance in part of Northern Region. After this disturbance, the Protection Sub-Committee of NRPC specifically directed all the utilities to block the O/C protection on 400 kV lines.

(b) As per the report of the Committee constituted to enquire into the grid disturbance on 2.1.2010, it is pertinent to mention that Haryana Vidyut Prasaran Nigam Limited vide its letter dated 16.2.2010 had informed that the overload current setting on the distance protection of 400 kV Khedar-Moga and Khedar-Hisar transmission lines at Khedar has been disabled w.e.f. 3.1.2010.

(c) Non-clearance of fault on 400 kV Bamnauli-Ballabgarh-2 for two (2) minutes during 21:54 hrs event on 2.1.2010: As per submission made by NRLDC, the protection at Bamnauli i.e. line protection, LBB Protection etc. did not properly operate to isolate the fault. The fault was even not cleared from next node viz 400 kV Bawana due to non-availability of backup earth-fault protection. The fault appears to have been cleared by burning of the snapped earth wire and not due to any switching operation.

(d) Undesired setting (Zone-5) on 400 kV Dadri-Panipat-2 distance protection at Dadri NTPC end: During the course of hearing, the representative of the NRLDC submitted that the 400 kV Dadri-Panipat Ckt.-II tripped reportedly on account of zone-5. This tripping at Dadri

NTPC end is clearly mis-operation. This setting ought to have been blocked ideally but had been activated.

(e) In view of the above, it appears that a comprehensive check of all potential threat to the system from such unintended operations was not done leading to the present tripping on Zone-5. The Committee, vide para 6.2.7 of its report has observed as under:

“a similar threat for other Numerical relays in the system cannot be ruled out completely and a comprehensive check has to be made by all utilities to see that all intended settings or features available in Numerical relays are blocked or disabled”

(f) Protection issues at Muradnagar: It has been submitted by the NRLDC that tripping of all the 400 kV transmission lines emanating from 400/220 kV Muradnagar sub-station, a vital sub-stations in National Capital Region (NCR), occurred on 1.1.2010 during 2243 to 2339 hrs. During the tripping of lines some instances of protection system mal-operation came to the fore.

(g) The Committee in its report has also observed that the protection system mis-operations might be investigated in detail by Uttar Pradesh Power Corporation Limited (UPPCL) with respect to relay settings. No Disturbance Recorder (DR) or Numerical Relay Outputs or Event Logger (EL) outputs have been submitted by UPPCL. With regard to protection, clauses 4.7(c) and 5.2 (k) of the IEGC provides as under:

“4.7(c) Protection: Protection systems are required to be provided by all agencies and Constituents connected to the ISTS in coordination with CTU. In case of installation of any device which necessitates modification/

replacement of existing protection relays/ scheme in the network, such modification/ replacement shall be carried out by owner of respective part of network.

Protection systems are required to isolate the faulty equipments and protect the other components against all types of faults, internal/ external to them, within the specified fault clearance time with reliability, selectivity and sensitivity.

All agencies connected to the ISTS shall provide protection systems as specified in the connection agreement.

Relay setting coordination shall be done at regional level by RPC. The RPCs would also identify critical locations where bus bar protection needs to be provided, if not available"

5.2 (k). Provision of protections and relay settings shall be coordinated periodically throughout the Regional grid, as per a plan to be separately finalized by the Protection Committee of the RPC."

(h) In view of the submissions of NRLDC, it is observed that there were unintended/mal- operations of the protection system in the utilities. The Committee has also observed the protection system deficiency. As per IEGC provisions, the protection systems are to be provided by all agencies and constituents and the protection systems are required to isolate the faulty equipment and protect the other components.

(i) Since, in the above mentioned instances, the protection system did not function as per IEGC requirement, all the utilities of Northern Region including Haryana Vidyut Prasaran Nigam Limited, Delhi Transco Limited, NTPC Ltd. and UPPCL are directed to take necessary actions immediately for proper functioning of protection system.

(iii) Inadequate Response from Defense Mechanism:

(A)(a) **UFR and df/dt relay** : NRLDC has filed the details of relief from UFR and df/dt relays based on the information supplied by the constituent States. It is pointed out that the real time data regarding relief from UFR and df/dt relays was not available due to failure of telemetry and due to non-availability of telemetry at lower voltage level i.e. 132, 66 and 33 kV. On perusal of the details submitted by NRLDC, it is noted that the load shedding achieved was very less than planned from UFR and df/dt relays. The data for the relief from these relays has been given with respect to the States of Punjab, Haryana, Himachal Pradesh and Jammu and Kashmir only. During the enquiry committee meetings, it was pointed out by some utilities that the adequate relief was not received due to following two reasons:

- (i) Some of the feeders on which these relays are installed may have already tripped before the incident due to inclement weather; and
- (ii) Voltage become too low to allow operation of these relays.

(b) The Enquiry Committee in para 7.5 of its Report observed that voltage being a local phenomenon, under voltage blocking cannot be a sole reason for non-operation of UFR and df/dt relays in entire affected sub system.

(c) NRLDC has also cited the incidences prior to 2.1.2010 when the desired relief from UFR and df/dt relays was not achieved. To get the desired relief, Northern Regional Power Committee advise the Northern Region constituents to install UFR on any feeder having rotational load shedding scheme and to provide 30% additional UFR and df/dt relays in their system. Northern Regional constituents were also advised to provide the telemetry of the feeders having under frequency relays installed and map it to SCADA System.

(B) Under Voltage Load shedding Scheme (UVLS) : NRLDC has submitted that during the incident on 2.1.2010 at 0301 hrs, the system voltage dipped to critically low level due to very high loading of transmission system in the depleted network. The voltage dip at Dadri, Malerkotla, Kishenpur, Hissar, Sagarur and Srinagar was 25 to 67 kV. Such a low voltage persisted form about five minutes. Very low voltages were also observed in NCR region during the grid disturbance on 02.01.2010 at 2154 hrs. However, no instance of under voltage load shedding has been reported in the affected region during either of the incidents.

(C) Regarding the defense mechanism (UFR and df/dt relays, Under Voltage Relays and System Protection Schemes) enquiry committee, in para 13 of Chapter 11 of its report has recommended that the State utility should ensure the defense mechanism to be fool-proof,

telemetered with SCADA System and periodically tested to ensure its high quality performance. With regard to UFR, df/dt etc, clauses 5.2 (m) and (n) provides as under:

"(m) All Regional constituents shall provide automatic under-frequency and df/dt load shedding in their respective systems, to arrest frequency decline that could result in a collapse/disintegration of the grid, as per the plan separately finalized by the concerned RPC forum, and shall ensure its effective application to prevent cascade tripping of generating units in case of any contingency. All Regional constituents shall ensure that the above under-frequency and df/dt load shedding/islanding schemes are always functional. However, in case of extreme contingencies, these relays may be temporarily kept out of service with prior consent of RLDC. RLDC shall inform RPC Secretariat about instances when the desired load relief is not obtained through these relays in real time operation.

(n) "All regional constituents shall also facilitate identification, installation and commissioning of System Protection Schemes (including inter-tripping and run-back) in the power system to protect against situations such as voltage collapse and cascading. Such schemes would be finalized by the concerned RPC forum, and shall be kept in service. RLDC shall be promptly informed in case any of these are taken out of service."

(D) On perusal of submission of NRLDC and the findings by the Enquiry Committee, it is pointed out that the required load relief during the incidents on 2.1.2010 was not observed. As per the stipulation given in the Grid Code, the regional constituents have to ensure the effective application of the UFR and df/dt relays in case of any contingency. Further, in the IEGC, the System Protection Schemes have to be installed and kept in service by the regional constituents to protect against situations such as voltage collapse. Based on the reports from NRLDC, as discussed above, it is observed that these stipulations of IEGC were not followed which contributed to the grid incidents on 2.1.2010.

(E) From the data available in the report of Enquiry Committee and data submitted by NRLDC it is difficult to fix responsibility on particular utility.

(iv) Non-Availability of Telemetry:

(a) it is noted that the telemetry is an important aspect of the real time power system operation. Functioning of Remote Terminal Units (RTUs) and availability of data at control centre is of vital importance for the functioning of Energy Management System and also for proper visualization of the network. NRLDC has submitted that RTUs were not commissioned in many new generating stations/sub-stations and from existing RTUs telemetry were unavailable to the control centre due to communication problem or hardware/software problem in the RTUs. This issue was taken up in various meetings of NRPC and also by NRLDC with the responsible utilities i.e. Rajasthan, Haryana, Uttar Pradesh, Punjab, Uttarakhand, Himachal Pradesh, J&K and Power Grid.

(b) With regard to data and communication facilities, clauses 4.10 and 5.2 (p) of the IEGC provides as under:

“4.10 Data and Communication Facilities

Reliable and efficient speech and data communication systems shall be provided to facilitate necessary communication and data exchange, and supervision/control of the grid by the RLDC, under normal and abnormal conditions. All agencies shall provide Systems to telemeter power system parameter such as flow, voltage and status of switches/ transformer taps etc. in line with interface requirements and other guideline made available by RLDC. The associated communication system to facilitate data flow up to appropriate data collection point on CTU's system, shall also be established by the concerned agency as specified by CTU in connection agreement. All agencies in coordination with CTU shall provide the required

facilities at their respective ends as specified in the connection agreement."

"5.2 (p) Each Regional constituent shall provide adequate and reliable communication facility internally and with other constituents/RLDC to ensure exchange of data/information necessary to maintain reliability and security of the grid. Wherever possible, redundancy and alternate path shall be maintained for communication along important routes, e.g., SLDC to RLDC."

(c) It is observed that the above provisions of IEGC were not complied due to non-availability of data with NRLDC for proper analysis of the events. Non-availability of proper data from the sub-station/generating station is a serious matter. The constituents are directed to ensure availability of proper data to NERLDC.

(v) Non-availability of data/information:

(a) On perusal of Enquiry Committee Report and the submission by NRLDC, it is observed that the required data/output from Disturbance Recorder (DR), Event Logger (EL) and Numerical Relays had not been provided by UPPCL and HVPNL. The enquiry Committee has also recommended as under :

"The triggering of DR/EL, numerical relays for different analogue and digital inputs must be tested periodically so as to ensure its functioning at the time of any major tripping.

Clear labeling of DR/EL and Numerical Relay outputs which indicate the substation name, feeder date and time correctly is also important so as to facilitate proper analysis of events in the system. All the constituents may ensure these features are made functional/provided in their all 400kV & 220kV Grid Sub-stations."

(b) The stipulations regarding installation of DR/EL and supply of information to NRLDC has been given in clauses 4.11, 5.2 (q) and 5.9.4 b) of IEGC. Relevant portion are as under:

"4.11 System Recording Instruments:

Recording instruments such as Data Acquisition System/Disturbance Recorder/Event Logger/Fault Locator (including time synchronization equipment) shall be provided in the ISTS for recording of dynamic performance of the system. Agencies shall provide all the requisite recording instruments as specified in the connection agreement according to the agreed time schedule"

"5.2 (q) The Regional constituents shall send information/data including disturbance recorder/sequential event recorder output etc., to RLDC for purpose of analysis of any grid disturbance/event. No Regional constituent shall block any data/information required by the RLDC for maintaining reliability and security of the grid and for analysis of an event."

" 5.9.4 (b) All Regional constituents and the SLDCs shall be responsible for collection and reporting of all necessary data to RLDC and RPC Secretariat for monitoring, reporting and event analysis."

6. It is observed that number of times, the output of the DR/EL/Numerical Relays were not provided to NRLDC/NRPC for proper analysis of the events. From the above, it is established that the UPPCL and HVPNL did not comply with the directions given in IEGC.

7. It is also observed that the following utilities have not complied the provisions of the IEGC:

<i>Sr. No.</i>	<i>Deficiency in Action</i>	<i>Grid Code Provision (IEGC,2006)</i>	<i>Name of Utility</i>
1.	<i>Non-Completion of Replacement of Insulators work</i>	<i>2.4.1 (c) & 2.7.1 (c)</i>	<i>DTL, HVPNL, UPPCL, PGCIL, PSEB, RVPNL</i>
2.	<i>Non-operation / Mal-operation of Protection System</i>	<i>1.2 (c) & 5.2 (k)</i>	<i>HVPNL, DTL, NTPC and UPPCL</i>
3.	<i>Non-performance of UFR &</i>	<i>5.2 (m) & 5.2 (n)</i>	<i>PSEB, HVPNL, HPSEB,</i>

	<i>df/dt Relays and Under Voltage Load shedding Scheme</i>		<i>Power Deptt. of J&K, Chandigarh</i>
4.	<i>Non-Availability of Telemetry</i>	<i>4.10 & 5.2 (p)</i>	<i>RRVUNL, NPCIL, Raj West Power Ltd., RRVPNL, HPGCL, HVPNL, UPPCL, PSEB, PTCUL, HPSEB, Power Deptt. J&K, PGCIL</i>
5.	<i>Non-availability of Data/information</i>	<i>4.11, 5.2 (q) , 5.9.4 (b)</i>	<i>UPPCL, HVPNL</i>

8. We direct all the utilities to take remedial action and strictly comply with the provisions of the Grid Code. NRLDC is directed to submit a report in the status of compliance of the various directions given in the order by the constituents on or before 31.10.2012.

9. Petition No. 2/2010 (suo-motu) is disposed with above directions.

Sd/-

(M.DEENA DAYALAN)
MEMBER

sd/-

(V.S.VERMA)
MEMBER

sd/-

(S.JAYARAMAN)
MEMBER

sd/-

(Dr. PRAMOD DEO)
CHAIRPERSON