
Report of the committee appointed to investigate the Electricity Supply Interruption in the country on the 17th August 2020 – Interim Report

1. Introduction

This report has been prepared by the committee appointed by the Secretary to the Ministry of Power in order to investigate the nationwide electricity supply interruption took place on the 17th August 2020. (Annex 01)

A nationwide electricity supply interruption had taken place around 12.30 pm on the 17th August 2020, involving all transmission lines, Power Stations and Grid Substations in the power system in Sri Lanka thereby disconnecting all the electricity consumers of the country from the electricity power supply. The said interruption is reported to have been initiated at Kerawalapitiya Grid Sub Station taking Yugadhanavi power plant out of the power system and almost concurrently other interruptions have also been reported at the Lakvijaya Power Station thereby triggering a total power system failure in the country. Consequent restoration of the entire system in spite all efforts by the utilities (Generation and Transmission Licensees) had taken 6 hours and 16 minutes by the time the transmission network fully energized.

Accordingly, the committee appointed for the task is comprised of:

1. Mr. K.H.D.K. Samarakoon – State Secretary, Ministry of Power – Chairman
2. Prof. Rahula Attalage - Dean, Sri Lanka Sri Lanka Institute of Information Technology – Member
3. Mr. E.A. Rathnaseela - Additional Director General, Department of Public Finance - Member
4. Dr. D.P. Chandima - Senior Lecturer, Department of Electrical Engineering, Faculty of Engineering, University of Moratuwa – Member
5. Dr. Lilantha Samaranayake - Senior Lecturer, Department of Electrical and Electronic Engineering, Faculty of Engineering, University of Peradeniya – Member
6. Eng. Mr. Janaka Rathnakumara – Chairman State Printing Corporation
7. Eng. Mr. G. J. Aluthge – Deputy General Manager (Asset Management – Thermal, Electrical), Ceylon Electricity Board (CEB)
8. Eng. Damitha Kumarasinghe, Director General, Public Utilities Commission of Sri Lanka
The Terms of Reference (TOR) was communicated to the members of the committee by the appointment letters. (Annex 01)

The Entities visited and officers interviewed / visited places and name of the committee members who visited each place

a) Kerawalapitiya Grid Sub Station
   1. Eng. Mr. G. J. Aluthge – Deputy General Manager (Asset Management – Thermal, Electrical), Ceylon Electricity Board (CEB)
   2. Eng. Mr. Janaka Rathnakumara – Chairman State Printing Corporation
   3. Mr. Sulakshana Jayawardena – Director, Renewable Energy Development, Ministry of Power
   4. Mr. E. A. Rathnaseela – Additional Director General, Department of Public Finance
   5. Eng. Dr. D.P. Chandima Department of Electrical Engineering, Faculty of Engineering, University of Moratuwa
   6. Eng. Dr. Lilantha Samaranayake – Department of Electrical & Electronic Engineering, Faculty of Engineering, University of Peradeniya

b) Met Control and Protection Branch Engineers of CEB at DGM/Transmission (Operation and Maintenance – South Office) /CEB office in Kent Road, Colombo on the 19th August 2020.
   1. Eng. Mr. G. J. Aluthge – Deputy General Manager (Asset Management – Thermal, Electrical), Ceylon Electricity Board (CEB)
   2. Eng. Mr. Janaka Rathnakumara – Chairman State Printing Corporation
   3. Mr. Sulakshana Jayawardena – Director, Renewable Energy Development, Ministry of Power
   4. Mr. E. A. Rathnaseela – Additional Director General, Department of Public Finance
   5. Eng. Dr. D.P. Chandima Department of Electrical Engineering, Faculty of Engineering, University of Moratuwa
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   1. Eng. Mr. G. J. Aluthge – Deputy General Manager (Asset Management – Thermal, Electrical), Ceylon Electricity Board (CEB)
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   4. Mr. E. A. Rathnaseela – Additional Director General, Department of Public Finance
   5. Eng. Dr. Lilantha Samaranayake – Department of Electrical & Electronic Engineering, Faculty of Engineering, University of Peradeniya
d) System Control Office / CEB on the 22nd August 2020.

1. Prof. R. Athalage – Sri Lanka Institute of Information Technology (SLIIT)
2. Eng. Mr. G. J. Aluthge – Deputy General Manager (Asset Management – Thermal, Electrical), Ceylon Electricity Board (CEB)
3. Eng. Mr. Janaka Rathnakumara – Chairman State Printing Corporation
4. Mr. Sulakshana Jayawardena – Director, Renewable Energy Development, Ministry of Power
5. Mr. E. A. Rathnaseela – Additional Director General, Department of Public Finance
6. Eng. Dr. Lilantha Samaranayake – Department of Electrical & Electronic Engineering, Faculty of Engineering, University of Peradeniya

2. Insight to the Issue and procedure adopted by the committee for the investigation

As the Generation and Transmission Licensees, the Ceylon Electricity Board (CEB) is responsible for the nationwide electricity supply interruption, disconnecting the electricity consumers from the national grid on the 17th August 2020 during the time period of 12.30 pm to 18.46 pm. The committee was appointed to look into this interruption.

The committee at its initial meeting decided for the purpose of investigation to adopt the procedure of visiting different branches related to the interruption, interviewing the key officers of the related branches, in view of ascertaining core information related to incident and any related issues that could have nucleated the incident and the situation thereafter.

Accordingly, the following branches were selected:
- Kerawalapitiya Grid Substation
- Lakvijaya Power Station
- Protection Branch of the CEB
- System Control Center of the CEB

The committee in addition to above decided to interviewed the Electrical Superintendent (ES) at the Kerawalapitiya Grid Substation who had been carrying out maintenance work at the said substation closely related to the incident where the first evidence of the said interruption has been reported.

The committee decided to make its deliberation on the following elements, focusing on:

- the key reasons for the nationwide power interruption on the 17th August 2020 at 12:30 pm onwards
- as to whether the CEB have taken precautionary actions and measures to prevent recurrence of interruptions that had been encountered in the recent past for which recommendations have been extended by similar committees that could have influenced the present incident
• recommendations for remedial measures that need to be taken by the CEB to prevent recurrence of the same and similar incident
• as to whether the CEB has taken the best professional practicing measures in handling the incident and the conditions that led to it employing proper planning, operational and administrative elements and had any constraint encountered CEB's intended professional actions
• as to whether the CEB had encountered similar incidents in the past and how the situation had been then handled
• as to whether the CEB could have handled the situation judiciously to minimize the implication and how this could be avoided in the future
3. Data Collected, Observations and Analysis of the Committee

1. Visit to Kerawalapitiya Grid Substation on the 19th August 2020

1.1 Relevant observations and findings of the committee during the visit to Kerawalapitiya Grid Substation (GSS)

Routine maintenance work on the 220 kV isolators of the Bus Coupler Bay had been carried out on the day of the incident by the Electrical Superintendent In Charge at Kerawalapitiya GSS, who apparently has been attending routine maintenance work at the Kerawalapitiya GSS for the past 5 years. The power in the Bus Bar 01 had been turned OFF for the maintenance, while the power of the Bus Bar 02 was ON. The Earth Switch 01 at Bus Bar 01 side had been OFF while the Earth Switch 02 at Bus Bar 02 side had been ON as shown in Fig. 1.2(a) at the time of incident. Under normal operations the Earth Switch and the relevant isolator are interlocked, so that the isolator can not be turned ON while the Earth Switch is turned ON. However, during maintenance, this interlock had been bypassed, so that isolator can be turned ON even with the Earth Switch is turned ON. At the end of the maintenance work of the 220 kV Bus Coupler Bay, while the interlock is bypassed, the Isolator on the Bus Bar 02 side had been turned ON as shown in Fig. 1.2(b), creating a 3 Phase to Ground fault. The fault had been isolated within 154 ms by tripping of all connected circuit breakers to the Bus Bar 2 by the operation of Busbar differential protection.

It was revealed that the Electrical Superintendent In Charge at Kerawalapitiya GSS had been carrying out the above maintenance work by himself with his team around. It was further revealed that this maintenance work had been carried out without being supervised by any of his superiors, which is the usual practice.

![Diagram of Busbar Configuration](image_url)

1.2 Analysis of the observations made during the visit to Kerawalapitiya GSS

The committee observed the total isolation time of 154 ms is too long on busbar protection operation. As per the report of Control & Protection branch also, the time to issue the trip command is 87 ms. Therefore,
the committee is on the view that, the fault detection time of the busbar protection relay has to be checked.

It is also noted that there is no robust maintenance protocol in place. The maintenance practices of high risk areas are to be identified and best practiced protocols in maintenance to be incorporated in particular in the said areas rather than having a general maintenance philosophy.

2. Meeting with the Protection Branch Engineers / CEB at DGM/Transmission/CEB office in Kent Road, Colombo on the 19th August 2020.

2.1 Relevant observations and findings of the committee during the meeting with the Control and Protection Branch Engineers

During the meeting, the Protection Branch Engineers showed various data associated with the incident using the data acquisition system in the CEB. Out of them, the bus voltage data shows that the 3 Phase to Ground fault had been so severe that for 7.5 cycles, the 220 kV bus voltage had been reduced to

1. 0V according to DDR record of Sub L bay of 220kV Kerawalapitiya GIS at 12:30:27 Hrs
2. 110 kV according to DDR record of Generator Transformer 2 bay of 220kV Lakvijaya GIS at 12:30:27 Hrs respectively. The corresponding voltages are reproduced from DDR in Fig. 2.1a and 2.1b respectively.

![Diagram](image)

**Fig. 2.1a**
Accordingly, in addition to the busbar voltage becoming zero at the fault location, reducing the voltages to 50% at far away bus bars such Lakvijaya Power Station Norechcholei shows the severity of the fault.

Further, the Disturbance Recorders (DDR) in the Control and Protection Branch / CEB shows

1. Busbar protection at Kerawalapitiya 220kV GIS operated and tripped all connected Transmission Lines and Transformers by at 12:30:27.172 Hrs, due to a busbar fault.
2. 220kV Circuit breaker of Generator Transformer 3 at Lakvijaya Power Station tripped at 12:30:27.359 Hrs
3. 220kV Circuit breaker of Generator Transformer 2 at Lakvijaya Power Station tripped at 12.30.27.390 Hrs
4. 220kV Circuit breaker of Generator Transformer 1 at Lakvijaya Power station tripped at 12.30.27.429 Hrs
5. Phase B to Ground fault of approximately 8.5 kA occurred in 220kV Bus section 1/3 at Lakvijaya Power Station 12:30:27.423 Hrs and all lines and Transformers connected to Bus Section 1 and Bus section 3 tripped due to operation of busbar protection by 12:30:27.491 Hrs
6. As per the DDR of Kotmale PS, the system frequency dropped below 47 Hz within 1.9s from the initial Busbar Protection fault at Kerawalapitiya Grid Substation.
2.2 Analysis of the observations made during the meeting Control and Protection Branch Engineers

The above reduction in voltage reduces the power to 25% of the power flowing before the initiation of the fault, meaning that the grid feels a loss of 75% of the generated power. The generated power at the time of incident had been 1983 MW and loosing 75% of it gives the grid, a feeling similar to a single generator suddenly loosing 75% of its load. In the single generator case, the generator frequency increases. Similarly, in this case the system frequency should increase. Once the fault is cleared, the frequency should stop increasing and settle. However, the above scenario leads to a total system failure and therefore the system frequency should start reducing. The system frequency waveform against time obtained by the Control and Protection Branch / CEB at 12:30:27.049 hrs on 17.08.2020 at Kotmale Power Station, reproduced in Fig. 2.2a confirms this hypothesis.

![Frequency plot at 12:30:27.049 hrs on 17.08.2020 at Kotmale PS](image)

**Fig. 2.2a Frequency Variation**

According to Fig. 2.2a, the increase in the system frequency is still within the statutory limits, i.e., does not exceed 50.5 Hz. However, the rate of the frequency rise \( \left( \frac{df}{dt} \right) \) is above 2.0 Hz/s threshold during the fault, for Fast – Cut -Back (FCB) to trigger in Steam Power Plants. Therefore, the root cause of tripping the 220kV Circuit breaker of Generator Transformers Lakvijaya Power Station as shown in Fig. 2.2b must be excess \( \frac{df}{dt} \).

3.1 Relevant findings of the committee during the visit to the LVPS

The committee visited the Power House, Switch Yard and the Control Centre of the LVPS. During the visit, the committee inspected the Switchyard layout, Voltage, Current, Power, Generator Frequency, System Frequency, Turbine speed plots and the operation of the digital logic circuits of the relevant protection relays against time, pre and post of the system power failure.

3.2 Analysis of the observations made during the visit to LVPS

In the High Speed Recorder (HSR) at the Control Centre, the committee observed Turbine Speed, Generator Power, Generator frequency and $\frac{df}{dt}$ recordings.

**LVPS Unit 03**: The activation of the $\frac{df}{dt}$ of Unit 3 had taken place first at LVPS and the corresponding the HSR record is shown in Fig. 3.1a. According to Fig. 3.1a, the Fast – Cut – Back (FCB) comes into operation (blue curve in the Fig. 3.1a), following the activation of the $\frac{df}{dt}$, resulting in a drastic reduction in the generated power (red curve in the Fig. 3.1a), which causes an overshoot in the turbine speed (light blue curve in the Fig. 3.1a).
LVPS Unit 02: The activation of the $\frac{df}{dt}$ of Unit 2 had taken place second at LVPS and the corresponding the HSR record is shown in Fig. 3.1b. Here also, FCB comes into operation (green curve in the Fig. 3.1b), following the activation of the $\frac{df}{dt}$. This is observed in the drastic reduction in the generated power (red curve in the Fig. 3.1b) and the overshoot in the turbine speed (light blue curve in the Fig. 3.1b).
LVPS Unit 01: According to Fig. 3.1c, the $\frac{df}{dt}$ of Unit 1 is activated (magenta curve in the Fig. 3.1c) which is confirmed by the overshoot in the Generator Frequency (light blue curve in the Fig. 3.1c) and the overshoot in the Turbine Speed (green curve in the Fig. 3.1c). This activation has tripped the 220kV Circuit breaker of Generator Transformer 1 for the protection of the Unit 01.
Simultaneously a Phase B - N fault has occurred in Bus Section 1/3 of LVPS, resulting in the operation of Busbar protection in both Bus 1 and Bus 3. The Busbar fault has got cleared within 61ms. Investigations on finding the exact reason for the Phase B - N fault is ongoing. However, Bus 2 remained stable until the system collapsed. Even if the Phase B - N fault did not occur in Bus Section 1/3 of LVPS, it is impossible to avoid the activation of $\frac{df}{dt}$ in any of the units because the cause of it is the rapid rise in the system frequency at 2.8 Hz$^{-1}$ exceeding the set value of 2.0 Hz$^{-1}$, which took place during the fault which took 154 ms to clear.

As per the observations made and the subsequent analysis of the findings during the visits and meetings with different stakeholders, it is very clear to the committee that the cause of the island wide power failure on the 17.08.2020 is the three phase to ground busbar fault at Kerawalapitiya Grid Substation. This severe three phase to ground busbar fault caused the system frequency to rise at a rate higher than the $\frac{df}{dt}$ relay settings of the steam power plants in the system, which effectively made the Generators at Lakvijaya Power Station disconnect from the system. The non-availability of LVPS 810 MW of power out of a 1983 MW demand may have caused under frequency in the system leading to the total power failure in the country.
The committee further notes the following timing information of the Units at LVPS shown in TABLE 3.1.

**TABLE 3.1**

<table>
<thead>
<tr>
<th>Unit</th>
<th>220 kV Transformer Circuit Breaker Opening Time</th>
<th>Unit Tripping Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>12:30:27.429</td>
<td>12:42</td>
</tr>
<tr>
<td>02</td>
<td>12:30:27.390</td>
<td>14:51</td>
</tr>
<tr>
<td>03</td>
<td>12:30:27.359</td>
<td>13:33</td>
</tr>
</tbody>
</table>

According to TABLE 3.1, after the severe three phase to ground busbar fault at Kerawalapitiya Grid Substation, though not connected, the LVPS has been feeding the house load for a substantially longer time than what can be expected from a steam power plant of its capacity. If the 220 kV busbars could have been energized by the Transmission network during this time, before all three Units tripped, the LVPS would not have come to a total shutdown. If the LVPS total shut down could have been prevented, the country would not have to go for subsequent scheduled power cuts since 18.08.2020 until LVPS comes back to normal operation.

4. Visit to System Control Office / CEB on the 22\(^{nd}\) August 2020.

4.1 Relevant findings of the committee during the visit to the System Control Office

The DGM, Chief Engineer and the Electrical Engineer at the System Control/CEB presented system failure they observed at the System Control as shown in Fig. 4.1a, where it is clearly seen that the bus bar voltages at the fault in Kerawalapitiya Grid Substation and the Kotugoda Grid Substation both drops to 0V from 220 kV.

System Control Engineers presented the procedure followed to restore the system subsequent to the system power failure. The same information titled “sequence of system restoration attempts” have been submitted to the committee. Restoration has started in Mahaweli Complex, Laxapana Complex and Samanalawewa Complex simultaneously. Out of them, the Samanalawewa Complex feeds mostly the rural loads. After a couple of over frequency failures, the Samanalawewa Complex stabilizes at 15:37. Hence, in 3 hours and 7 minutes, part of the Sri Lankan power network becomes live since the power failure at 12:30. After several attempts, at 18:08 Samanalawewa System & Kukule System synchronized via Ambalangoda- New Galle 132kV circuit 01. After a couple of over frequency failures, the Samanalawewa Complex stabilizes at 15:37. Hence, in 3 hours and 7 minutes, part of the Sri Lankan power network becomes live since the power failure at 12:30. After several attempts, at 18:08 Samanalawewa System & Kukule System synchronized via Ambalangoda- New Galle 132kV circuit 01.

However, the Mahaweli Complex and the Laxapana Complex feed urban and industry loads. Industry loads are typically large loads and therefore when energizing the network from a blackout, there is a higher probability to mismatch the generation to the dispatch. As a result, there can be more over frequency failures in stabilizing the Mahaweli Complex and the Laxapana Complex. At 18:46 Mahaweli Complex is stabilized and syncronized to Samanalawewa Complex via New Laxapana-Polpitiya 132kV circuit 1. Hence the transmission network has come back to operation fully 6 hours and 16 minutes from the system failure.
4.2 Analysis of the observations made during the visit to System Control

The restoration attempts in the Mahaweli Complex are taken for analysis because it contains unusual complications which were not seen in the other two complexes.

**Restoration Attempt 01:** The System Control had initiated the restoration with the Victoria Power Station Unit 02, which was ready at that time (12:57 pm). They had restored up to Biyagama Grid Substation in 7 minutes, and the Unit 02 had tripped due to excitation stage II failure, which is an internal fault in the generator, after 6 minutes at 13:10. This could be due to load turning OFF in the 33 kV feeder taken for restoration.

**Restoration Attempt 02:** The second attempt had been with the Victoria Power Station Unit 01 at 13:21 which had been dispatching for 3 minutes and failed at 13:27 due to over frequency tripping, which could be due to load tripping.

**Restoration Attempt 03:** The third attempt also with the Victoria Power Station Unit 01 at 13:33 which also had failed at 13:36 due to excitation stage II failure, which is an internal fault in the generator, a similar reason as in the first attempt, 3 minutes after restoring.

**Restoration Attempt 04:** Since there are lesser number of circuit breakers to Biyagama Grid Substation, the fourth attempt had been from the Kothmale Power Station Unit 03 at 13:36, which had energized Biyagama Grid Substation in 3 minutes at 13:41 and subsequently the Kotugoda, Aniyakanda and Sapugaskanda Grid Substations respectively by 14:05. However, Kothmale Power
Station Unit 03 had tripped due to over frequency after delivering 30 MW for 12 minutes. At this point a system frequency oscillating at a lower frequency than 50 Hz had been observed.

**Restoration Attempt 05:** The fifth attempt had been started from Kothmale Power Station Unit 01 and subsequently added Kothmale Power Station Unit 02 but again tripped due to over frequency after about one hour of dispatching power while delivering 85 MW with the system frequency oscillating at a lower variable frequency of approximately 8 Hz. The associated frequency variation against time is shown in Fig. 4.2b.

![Frequency oscillations during Restoration Attempt 05](image)

**Fig. 4.2b**

**Restoration Attempt 06:** The sixth attempt had been from Kothmale Power Station Unit 03, tripped the generator this time after 10 minutes delivering 23 MW due to over frequency.

**Restoration Attempt 07:** The seventh attempt had been successful, with the Kothmale Power Station Units 01 and 02 with the Unit 02 generator governor on manual mode, i.e., with the frequency control loop being open.

The failures in the restoration of the first and the third attempts were solely due to internal faults of the units 01 and 02 of the Victoria Power Station.
The failures in the restoration of the second and the sixth attempts can be attributed to over frequency caused by one or many of the large loads in the selected 33 kV feeders got tripped or a large solar PV system coming into operation, which is reflected at the generator as an over frequency.

The failures of the fourth and the fifth restoration attempts could be attributed to over frequency due to generator electrical frequency oscillating at a low frequency in the range of 10 Hz. This has happened with two generators in the same busbar. Hence it is an electrically tight coupled situation caused by reduced damping in the electrical governor of one or both of the generators. In this case, it must be Kothmale Power Station Unit 02 generator governor, because in the 5th attempt, Units had tripped when Unit 02 added and the 7th attempt was successful when the Unit 02 generator governor was put on manual mode., i.e., frequency control loop being open. Improving the damping in the Unit 02 generator governor of the Kothmale Power Station may be needed.

The 3 Phase to Ground busbar fault at the Kerawalapitiya Grid Substation busbar 2 at 12:30:27.172 Hrs caused the total system failure.
4. Review the study reports of similar incidents occurred in the past and report on reasons and action taken to prevent recurrence of such incidents in the future.

Whilst none of the previous power failures were exactly similar in nature to the recent island wide blackout, the Committee is of the view that certain previous recommendations made by the Expert Committees that have been appointed to investigate those power failures in the past, provide some useful insight as to the corrective action that has to be taken by the CEB as short to medium to long term remedial measures. Accordingly, the Committee has paid attention to some of the critical and relevant recommendations of the Expert Committee appointed subsequent to the 2016 country wide power failure. Given the critical role of Lakvijaya Power Plant (LVPP) as the major contributor of almost 50 per cent of county’s power generation, the protection capabilities and its ability in speedy power restoration after a failure, remedial measures that have been taken at the LVPP were specifically taken into consideration.

**Some of the important recommendations of the Expert Committees appointed to investigate Power Failure in 2009 and 2015**

1. Failed attempts while restoring from Kottmale, from Laxapana, and from Samanalawewa, has been the main reason for delay. However, if the running facility is tested and commissioned with Kelanitissa Combined Cycle Plant (KCCP) gas turbine, Colombo City restoration time would have been shorter. Whilst necessary upgradings should be made at KCCP to run it in frequency control mode.

2. In order to avoid a total system failure, the system has to be equipped with dynamic reactive power compensation devices or/and switching controls available at the System Control Centre. It is the responsibility of the CEB to ensure that system voltages and reactive power are maintained at acceptable levels under normal as well as abnormal situations, Dynamic and static power.

3. The blackout got triggered with the tripping of a generator and has spread into the rest of the systems due to inadequacy of reactive power support and system protection. A transmission line/component protection system failing to operate will most likely end up a total failure or at least a major partial failure.

4. It is recommended to consider to run KCCP in frequency control mode of operation during future major overhauls.

5. Proposals to be submitted within a month on how the CEB will address the Norochcholai restarting problem and the dynamic instability problem.

6. Commission a study on the use of OPC in the LVPS machines, preferably with manufactures and experts who have in-depth knowledge in the subject.
As per the information provided by the CEB, action taken to improve the performance of generating units at Lakviljaya Power Plant after the total grid failure in Oct 2016.

Self-Initiated Actions taken

Technical

1. Over speed Protection Control (OPC) scheme thoroughly studied and modified in three units.
2. Dissolved Gas Analyzers (DGA) were installed for three main transformers (that connect three generating units to the national grid) to improve the reliability of transformers.
3. Connecting two 3.125 MVA, 400 V Diesel Generators to two of Main Cooling Water (MCW) pumps – Equipment required to implement the work have been procured. System modification required to integrate new equipment is being done. Installation is to be commenced soon. This will enhance the support to operate generating units, No. 01 and 03 in house load operation.

Administration

1. Organization structure was restructured. New units were established under four Deputy Plant Managers namely, Operation & Maintenance, Heavy Maintenance & Ancillary Services, Commercial & Monitoring and Project & Developments. O&M activities of three generating units and auxiliary systems were assigned to DPM(O&M). Activities of Coal Handling system (which was carried out along with generating units) was assigned to DPM (HM&AS)
2. Condition Monitoring Unit was established under DPM(Commercial & Monitoring) to identify the possible failures of equipment in advance.
3. Shut Down Management Unit was established under DPM(Operation & Maintenance) to plan three types of overhauls (Level A – once in four years, Level B- once in tow years, Level C – yearly) carried out periodically.
4. New training program was introduced for Operation engineers to improve operation skills (This helped to keep two generating units on house load mode for one and half hours and two hours and twenty minutes).
5. Emergency Response Plan was established. All maintenance engineers are assigned to dedicated places in the power plant to support operation engineers in an emergency situation (This helped to keep two generating units on house load mode for one and half hours and two hours and twenty minutes).

Recommendations given in the reports and actions taken

1. Name of the report: Draft final report on total power failure on 27.09.2015

<table>
<thead>
<tr>
<th>No.</th>
<th>Recommendations</th>
<th>Actions taken</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Non-technical issues have arisen in the management of the LVPPs</td>
<td>Organization structure was restructured. New units were established under four Deputy Plant Managers namely, Operation &amp; Maintenance, Heavy Maintenance &amp; Ancillary Services, Commercial &amp; Monitoring and Project &amp;</td>
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Interim Report of the Committee on the Incident of the Nationwide Electricity Supply Interruption on 17th Aug 2020
Developments. O&M activities of three generating units and auxiliary systems were assigned to DPM(O&M). Activities of Coal Handling system (which was carried out along with generating units) was assigned to DPM (HM&AS).

2. The operation of the No3 has been contracted to Chinese Company and does not operate directly under the direction of the CEB. This affects the smooth operation of the power plant and resolved immediately. Operation of the unit was taken over by the CEB engineers in October 2017.


<table>
<thead>
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<tr>
<td>1.</td>
<td>Commission a study on the use of OPC in the LVPS machines, preferably with manufactures and experts who have in-depth knowledge in the subject.</td>
<td>Over speed Protection Control (OPC) scheme thoroughly studied and modified in three units to improve the stability.</td>
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3.Name of the report: Interim report on island wide blackout on 25th February 2016 with comments on island wide blackout on 13th March 2016

<table>
<thead>
<tr>
<th>No.</th>
<th>Recommendation</th>
<th>Actions taken</th>
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<tbody>
<tr>
<td>1.</td>
<td>Proposals should be submitted within a month on how the CEB will address the Norochcholai restarting problem and the dynamic instability problem.</td>
<td>A Technical Committee was formed and a study was carried out.</td>
</tr>
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Overall, it appears that the CEB has taken some meaningful remedial measures based on the recommendations made by the previous expert committees appointed by the Government to investigate island-wide power failures taken place in the past, alongside self-initiated actions.

However, CEB recent failure to avoid a country-wide blackout and longer duration taken to restore power to Colombo City in particular, indicates significant lapses in implementation of critical measures outlined in the previous expert committee reports.
5. Preliminary Conclusions

1. The key reason for the nationwide power interruption on the 17th August 2020 is due to the 3 Phase to Ground busbar fault due to incorrect operation of the Bus Bar 2 Isolator of the Bus Coupler Bay by the Electrical Superintendent – in Charge at the Kerawalapitiya Grid Substation busbar 2 at 12:30:27.172 Hrs.

2. Kerawalapitiya Grid substation tripping was due to not following the correct maintenance procedure by the relevant officials including the Electrical Superintendent. The committee also observed that there is no written maintenance protocol for this maintenance job inline with the current best practiced maintenance protocols.

3. The committee is on the view that due to the Kerawalapitiya Grid substation tripping, the system frequency has increased beyond the current setting of the rate of frequency tripping relay of the Lak Vijaya Power Station. As a result, the generator-transformer circuits breakers of all three units of the LVPS which made LVPS unavailable to the grid, subsequently the system failed in cascade.

4. The restoration of the Transmission network took 6 hours and 16 minutes, due to faults in the units, generation – dispatch mismatches during black start and system frequency oscillations during energizing the 220 kV and 132 kV systems.

5. CEBs recent failure to avoid a country-wide blackout and the longer duration taken to restore power to Colombo City in particular, indicates significant lapses in implementation of critical measures outlined in the previous Expert Committee Reports.

6. Recommendations
6. Recommendations

Recommendations for remedial measures that need to be taken by the CEB to prevent such incidents in the future.

1. The committee strongly recommends a standard compliant, systematic, foolproof, safe procedures and maintenance protocols to be instated in CEB during operation and maintenance. The implementation of these procedures will have to be continuously monitored and supervised by adequately qualified, professionally trained, knowledgeable, experienced and skilled personnel. The committee would like to propose a performance evaluating annual appraisal system which will help to improve the above attributes of the CEB staff.

2. The committee understands that there is no Operations & Maintenance related risk management mechanism in place. Therefore it is recommended to establish a risk management mechanism in order to determine the proper mix of preventive measures, mitigation levels, shift or retention of risks and consequent level of robustness of Operations & Maintenance protocols that would indicate the positive impact on the overall system.

3. The committee strongly recommends to implement the 2018-2037 CEB Long Term Generation Expansion Plan, as given in the plan, which clearly specifies the correct blend of technologies for the future requirements of the Sri Lankan power system to improve the system stability and reliability.

4. The committee recommends to review the existing protection strategy for frequency instability.

5. The committee recommends to study the protection arrangement in detail in the Fast Cut Back operation to see whether there can be an alternative protection arrangement which could be derived not solely from df/dt limit but df/dt limit together with some other parameters.

6. Cost of unserved energy will have phenomenal economic impact to the country. Apart from its direct impact, power interruptions of current nature will create adverse impacts to the investment climate of the country.

7. The committee recommends to investigate better means of using past daily loading records of the feeders to predict more accurate load demands. This would drastically reduce the time to bring the complete transmission network back to normal operation.

8. The committee recommends to study the governors in the Kothmale Power Station and see if the damping can be improved in the frequency control loop.

9. The committee recommends that staff involved in the control centres of the power plants used to bring back the transmission network as well as the system control centre of CEB, gets more professional training to become experts in their duties and to be proficient to follow and execute the restoration manual to the best.

10. The committee recommends to install and commission 70 to 100 MW gas turbines with the following capabilities: frequency control, black start, operating at sufficient leading and lagging power factors, stability at small loads such as 1 MW, line charging for capacitive loads, compliance with Sri Lankan grid code.

11. The committee recommends to use the existing dynamic transmission system model to perform dynamic response analysis on the reported case.
Signed by

K.H.D.K. Samarakoon
Addl. Secretary (Renewable Energy Development)
Ministry of Power

Eng. Janaka Rathnakumara
Chairman
State Printing Corporation

Prof. Rahula Attalage
Dean, Faculty of Graduate Studies & Research
Sri Lanka Institute of Information Technology

Eng. Damitha Kumarasinghe
Director General
Public Utilities Commission of Sri Lanka

G.J. Aluthge
Deputy General Manager (Asset Management - Thermal Electrical)
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Senior Lecturer
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E.A. Rathnaseela
Addl. Director General
Department of Public Finance

J.G.L.S. Jayawardena
Director (Renewable Energy Development)
Ministry of Power
Mr. K.H.D.K. Samarakoon
Addl. Secretary (Renewable Energy Development)
Ministry of Power

Dear Mr. Samarakoon,

**Total Power Failure in the Country on 17th August, 2020.**

An island wide power failure was occurred on 17th August 2020 at 1235 hrs and it took about 06 hours for CEB to restore the system. Hon. Minister of Power has decided to appoint an Independent Committee to investigate the reasons for this and to make recommendations on remedial measures to prevent such incidents in future.

We are pleased to invite you to serve as the Chairman of this committee. Further we have invited following officials to serve as the members of the committee.

1. Prof. Rahula Attalage  
   Dean, Faculty of Graduate Studies & Research, Sri Lanka Institute of Information Technology

2. Prof. Lilantha Samaranayake  
   Department of Electrical & Electronic Engineering, University of Peradeniya

3. Mr. Damitha Kumarasinghe  
   Director General, Public Utilities Commission of Sri Lanka

4. Eng. Janaka Rathnakumara  
   Chairman, State Printing Corporation

5. Mr. G.J. Aluthge  
   Deputy General Manager (Asset Management - Thermal Electrical), Ceylon Electricity Board

6. Mr. E.A. Rathnaseela  
   Addl. Director General, Department of Public Finance

7. Dr. D.P. Chandima  
   Senior Lecturer, University of Moratuwa

8. Mr. Sulakshana Jayawardena (Convener)  
   Director (Renewable Energy Development), Ministry of Power
The committee is expected to:

a) Identify the reasons for the island-wide power failure occurred on 17th August 2020 at 1235 hrs.
b) Review the study reports of similar incidents occurred in the past and report on reasons and action taken to prevent recurrence of such incidents in the future.
c) Make recommendations for remedial measures that need to be taken by the CEB to prevent such incidents in future.
d) Investigate whether this is an incident which could have been avoided by prior planning and risk assessment.

We shall be grateful if you could submit the report within one week.

Sincerely,

Wasantha Perera
Secretary
Ministry of Power

Copies:-

1. Hon Minister of Power
2. Hon. State Minister of Solar Power, Wind & Hydro Power Generation Projects Development
3. Secretary to HE the President
4. Secretary to Hon Prime Minister
5. Secretary to the Treasury
6. Chairman, Ceylon Electricity Board
7. General Manager, Ceylon Electricity Board