



Your ref:

My ref: GM/AGM(CS)/DGM(CS&RA)

Date: December 19, 2023

Director General
Public Utilities Commission of Sri Lanka,
6th Floor, BOC Merchant Tower,
St. Michael's Road, Colombo 3,



Total System Failure on 09th December 2023

This refers to PUCSL letter No: PUC/LIC/2023/TL/22 dated 2023-12-11, requesting information related to Total System Failure occurred on 2023-12-09. (A copy of PUCSL letter is enclosed as Annex 1)

Accordingly, I am herewith forwarding the Total System Failure Report prepared by the Control & Protection Branch of the Transmission Division please. (A copy of Report is enclosed as Annex 2)

Further a detailed report on the above failure will be submitted in due course.

Eng. (Dr.) Narendra De Silva

Actg. General Manager

Eng. (Dr.) Narendra De Silva
Actg. General Manager
Ceylon Electricity Board

Copy to: Addl. General Manager (Tr. W.O)

Addl. General Manager (Tr. N.W.O.)

Addl. General Manager (CS)

DGM(CS&RA)

- f.i. pl.

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இலங்கைப் பொதுப் பயன்பாடுகள் ஆணைக்குழு
PUBLIC UTILITIES COMMISSION OF SRI LANKA

ANNEX 1



ඔබේ අංකය }
உமது இல. }
Your No. }

අපේ අංකය }
எமது இல. } PUC/LIC/2023/TL/22
Our No. }

දිනය }
திகதி } 11th Dec 2023
Date }

Authorized officer
For License No. EL/T/09-002
Additional General Manager - Transmission
Ceylon Electricity Board,
Sir Chittampalam A. Gardiner Mawatha,
Colombo 02.

Total System Failure on 09th December 2023

This refers to the Islandwide power failure occurred on 09th December 2023.

Reference to Condition 3(1) and 30(1) of Electricity Transmission and Bulk Supply Licence, the following information shall be submitted to the Commission at your earliest;

1. Causes for the system failure
2. Causes for the delays in restoring the system

Further, under the condition 30(10) of Electricity Transmission and Bulk Supply Licence a detailed report on the above failure including the actions taken to avoid similar failures in future, shall be submitted to the Commission on or before 09th January 2024.

Kanchana Siriwardena
Deputy Director General - Industry Services

Copy: General Manager, CEB

ANNEX 2

**PRELIMINARY REPORT ON TOTAL SYSTEM
FAILURE
AT 17:03:50 HRS ON 09th DECEMBER 2023**

Control & Protection Branch,
Transmission Division,
Ceylon Electricity Board,
Kent Road,
COLOMBO 00900
Date: 10.12.2023

PRELIMINARY REPORT ON TOTAL SYSTEM FAILURE
AT 17:03:50 HRS ON 09th DECEMBER 2023

1. INTRODUCTION

A total failure occurred at 17:03:50hrs on 09th December 2023 involving all transmission lines, Power Stations and Grid Substations in the power system in Sri Lanka.

2. DATE/TIME OF THE FAILURE

Date : 09th December 2023
Time : At 17.03:50 hrs

3. OVERVIEW

Refer Figure 1 in page 2

4. EQUIPMENT TRIPPINGS AND RELAY INDICATIONS

Equipment Trippings	Relay Type	Relay indications	Trip Time
Biyagama GSS - Kothmale 220kV Line 01	SIEMENS 7SL87 MiCOM P546	Line Differential Operated	17:02:48 hrs
Kothmale PS - Biyagama 220kV Line 01	SIEMENS 7SL87 MiCOM P546	Line Differential Operated	17:02:48 hrs
Biyagama GSS - Kothmale 220kV Line 02	SIEMENS 7SL87 MiCOM P546	Line Differential Operated	17:02:48 hrs
Kothmale PS - Biyagama 220kV Line 02	SIEMENS 7SL87 MiCOM P546	Line Differential Operated	17:02:48 hrs
New Habarana GSS – Kothmale 220kV Line 01	MiCOM P546	Over Current Protection Operated	17:03:49 hrs
New Habarana GSS – Kothmale 220kV Line 02	MiCOM P546	Over Current Protection Operated	17:03:50 hrs

Table 01: Equipment Trippings and Relay Indications

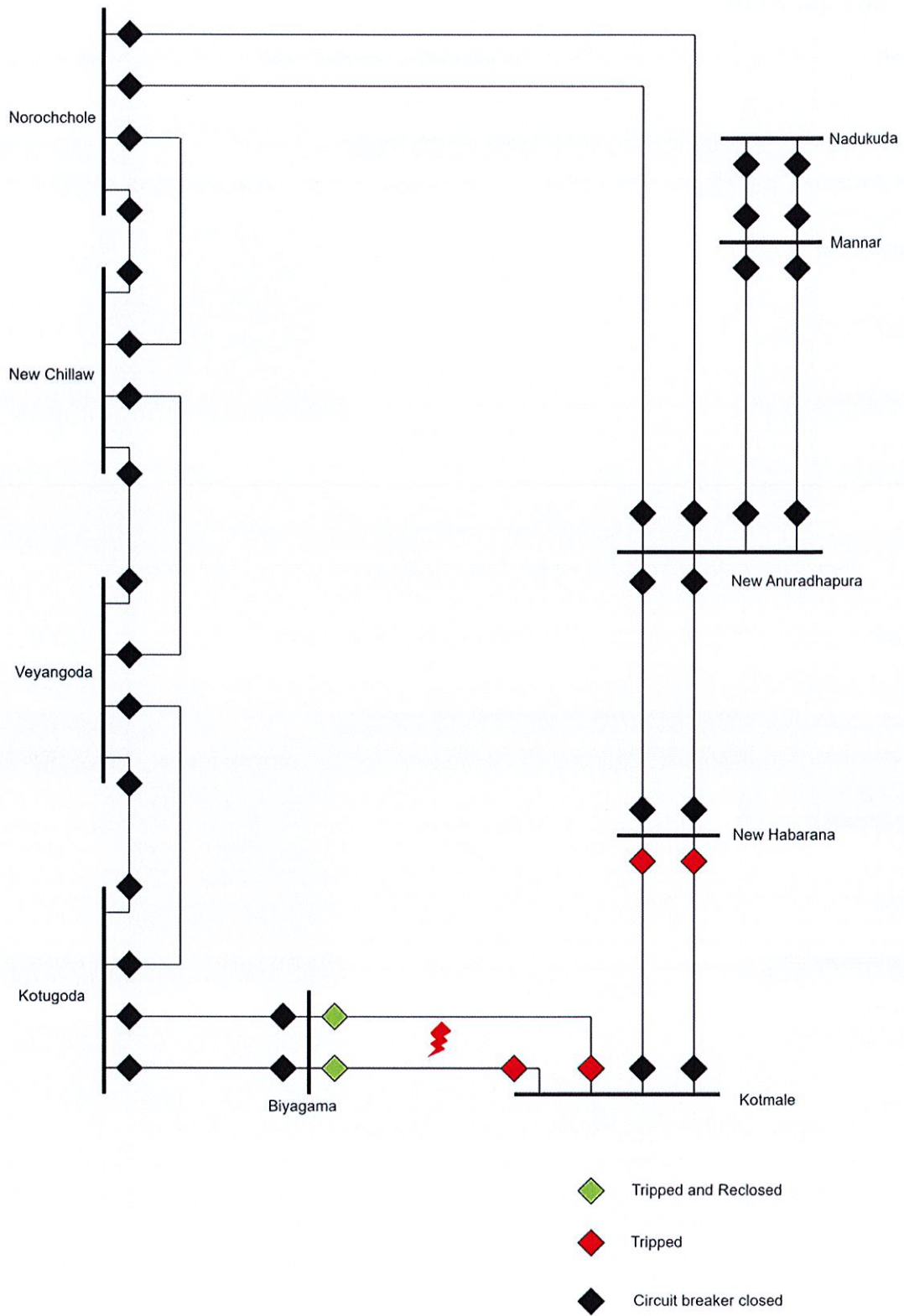


Figure 01: Overview diagram of tripped circuits

5. DDR RECORDS

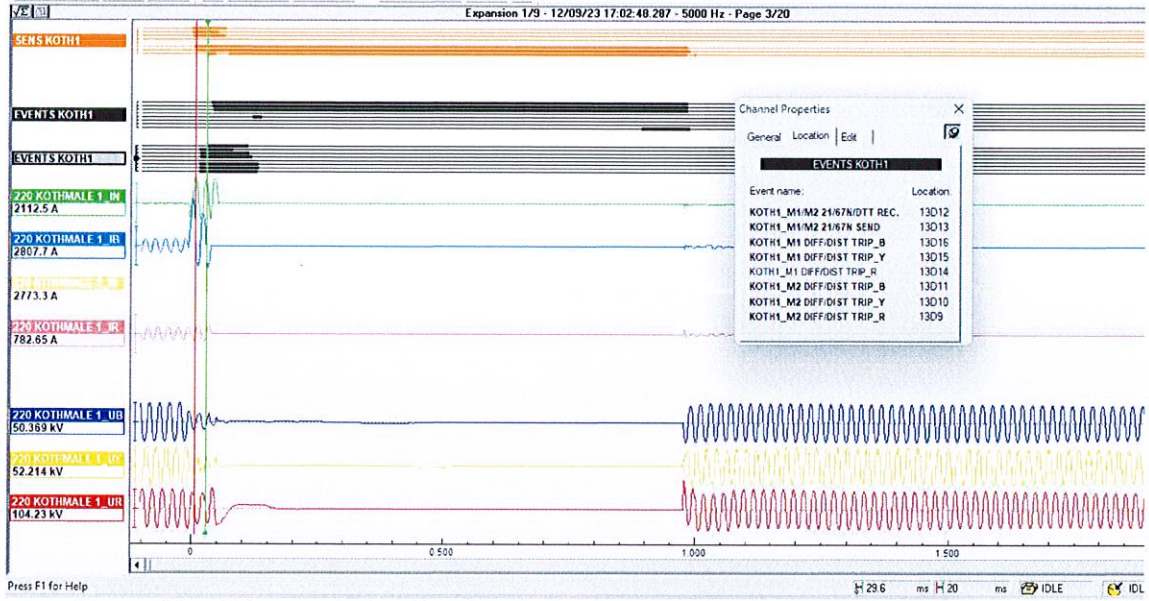


Figure 02: DDR record of Kothmale Line 1 of Biyagama GSS at 17:02:48 Hrs

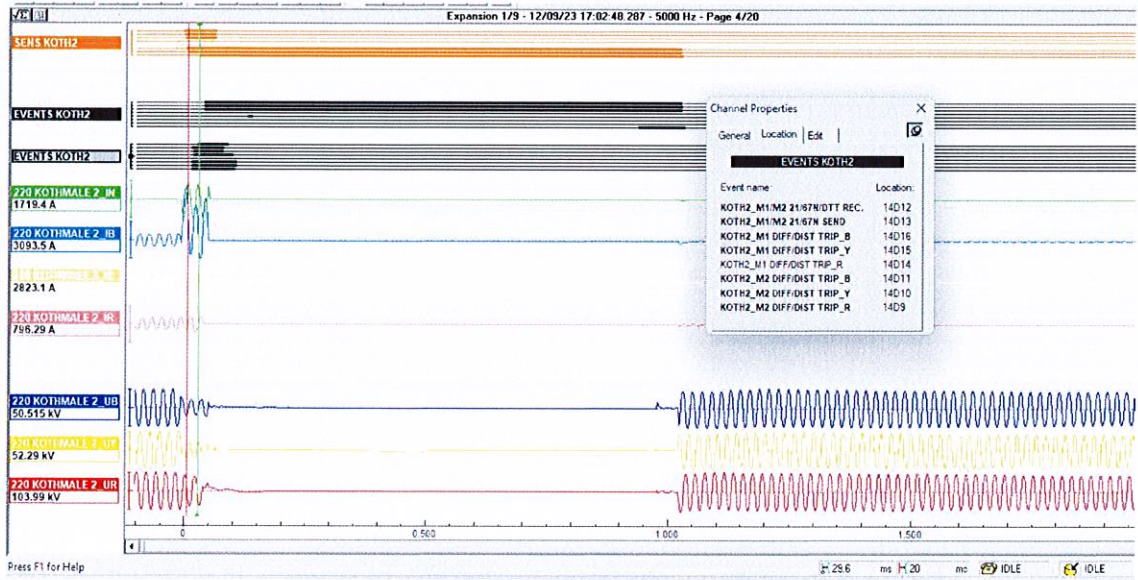


Figure 03: DDR record of Kothmale Line 2 of Biyagama GSS at 17:02:48 Hrs

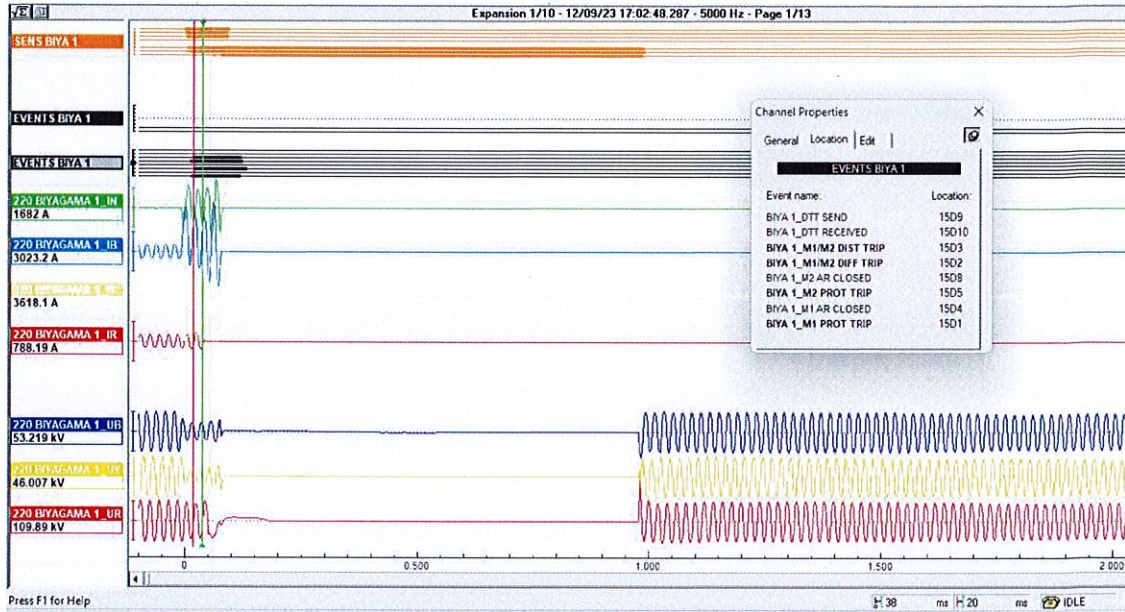


Figure 04: DDR record of Biyagama Line 1 of Kothmale GSS at 17:02:48 Hrs

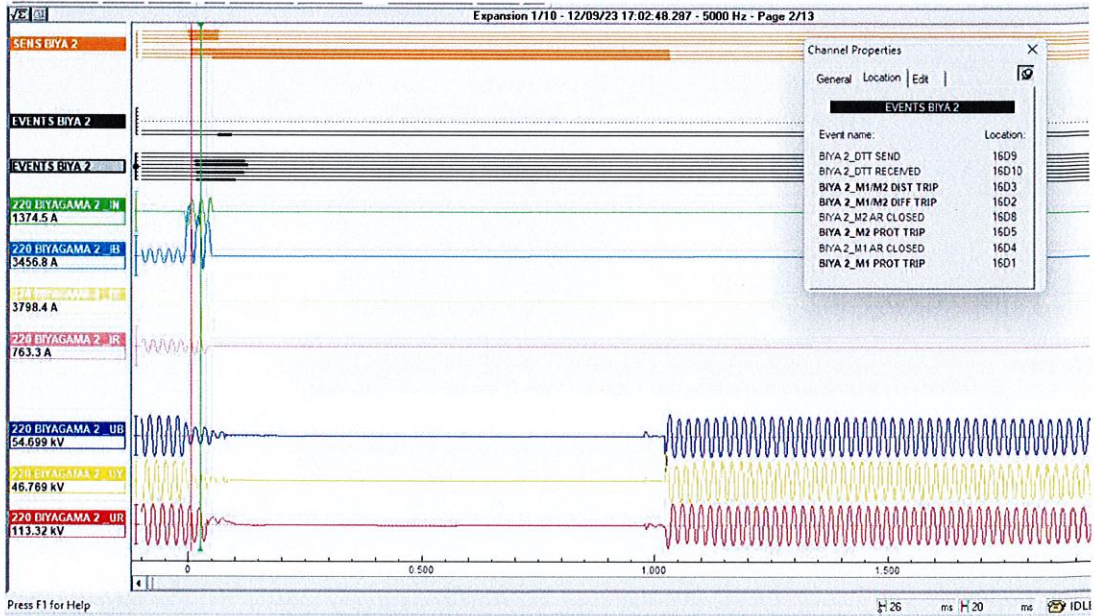


Figure 05: DDR record of Biyagama Line 2 of Kothmale GSS at 17:02:48 Hrs

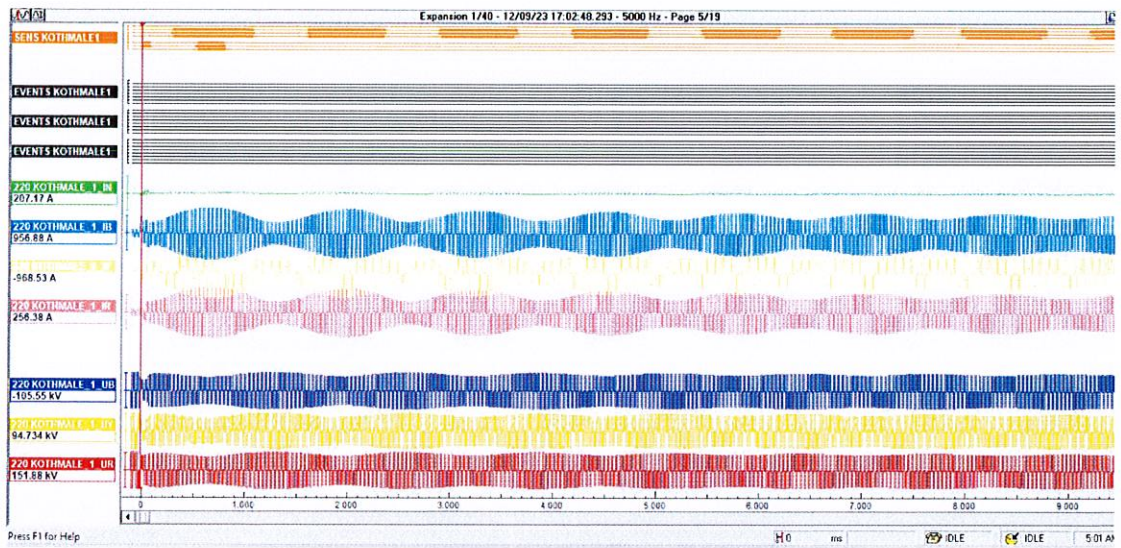


Figure 06: DDR record of Kothmale line 1 of New Habarana GSS at 17:02:48 Hrs

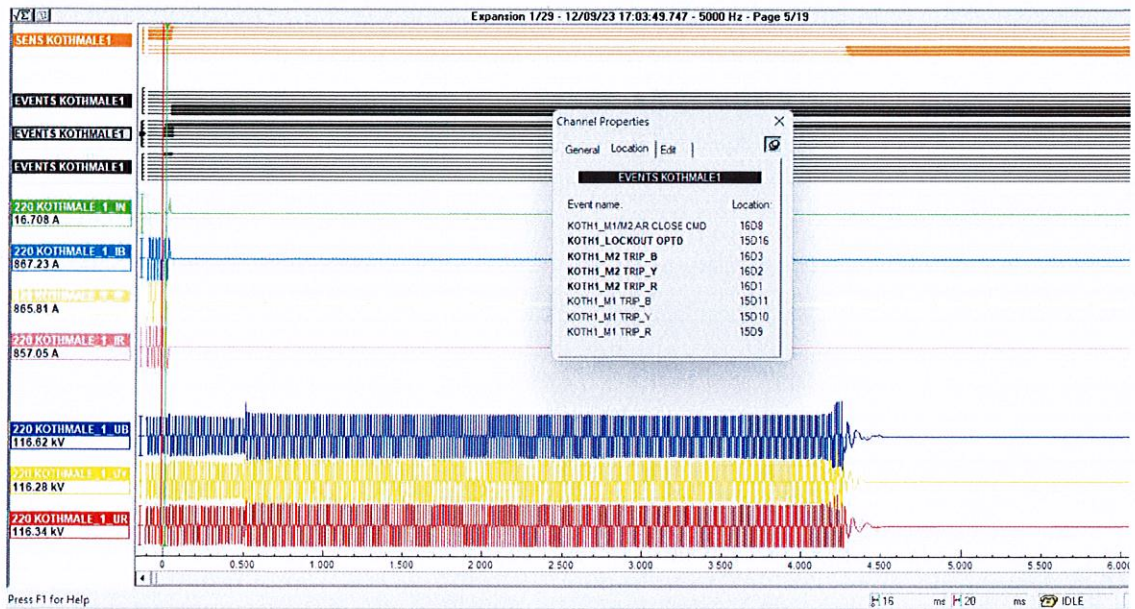


Figure 07: DDR record of Kothmale line 1 of New Habarana GSS at 17:03:49 Hrs

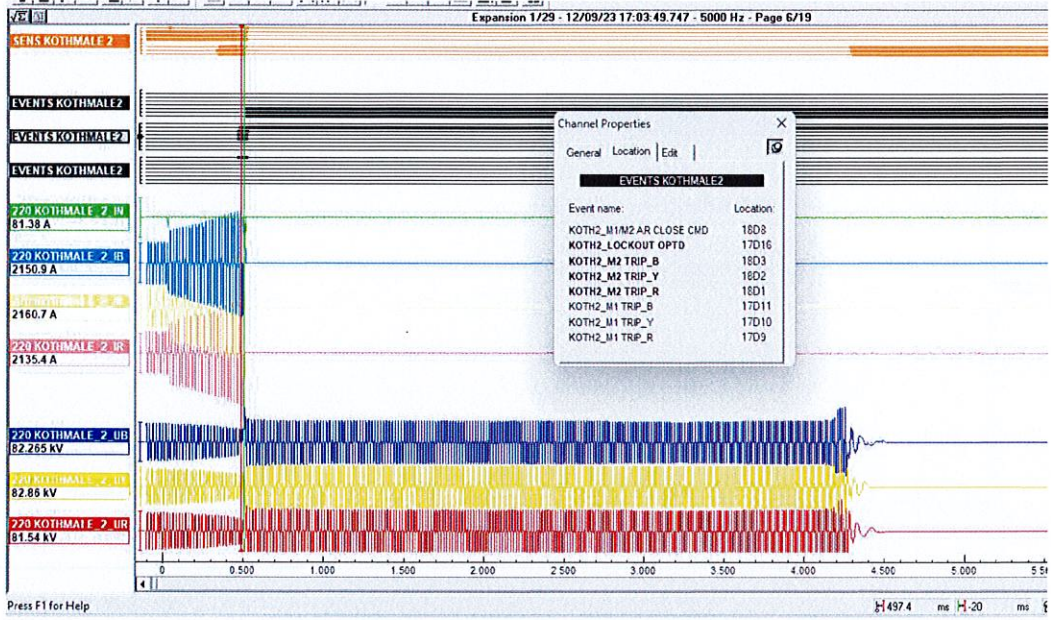


Figure 08: DDR record of Kothmale line 2 of New Habarana GSS at 17:03:49 Hrs

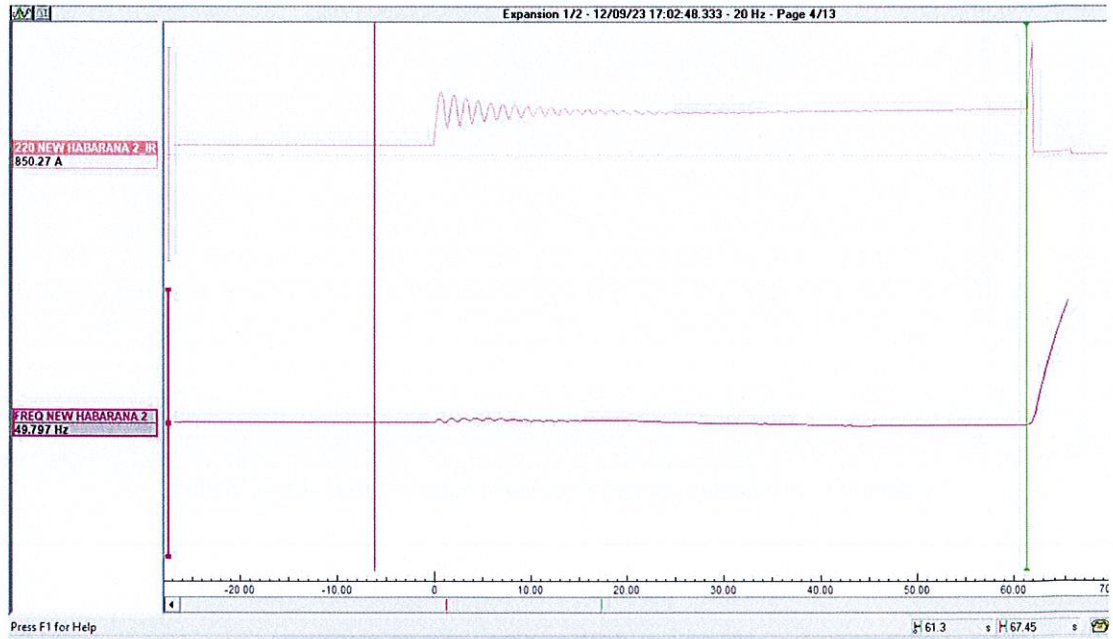


Figure 09: Frequency variation at Kothmale 220kV Bus

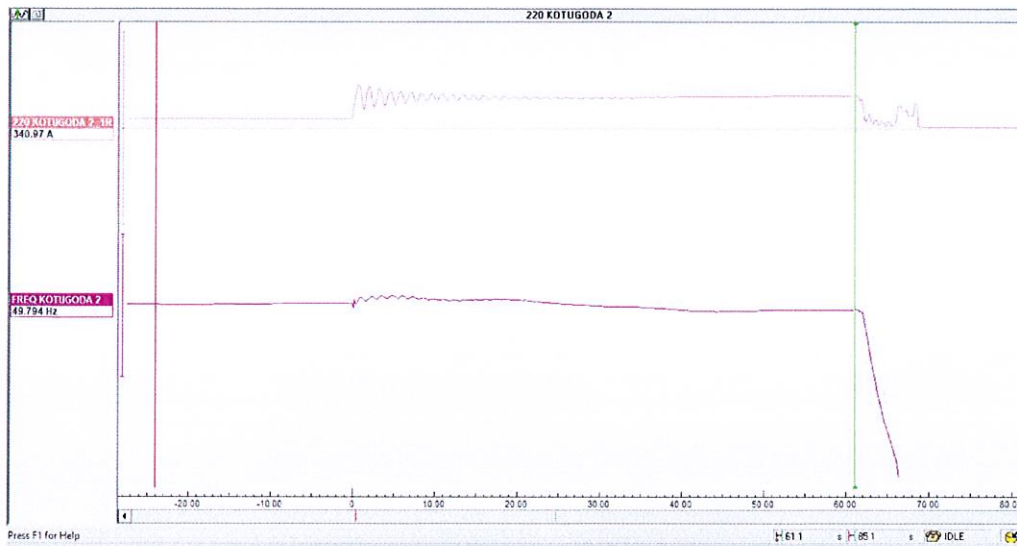


Figure 10: Frequency variation at Biyagama 220kV Bus

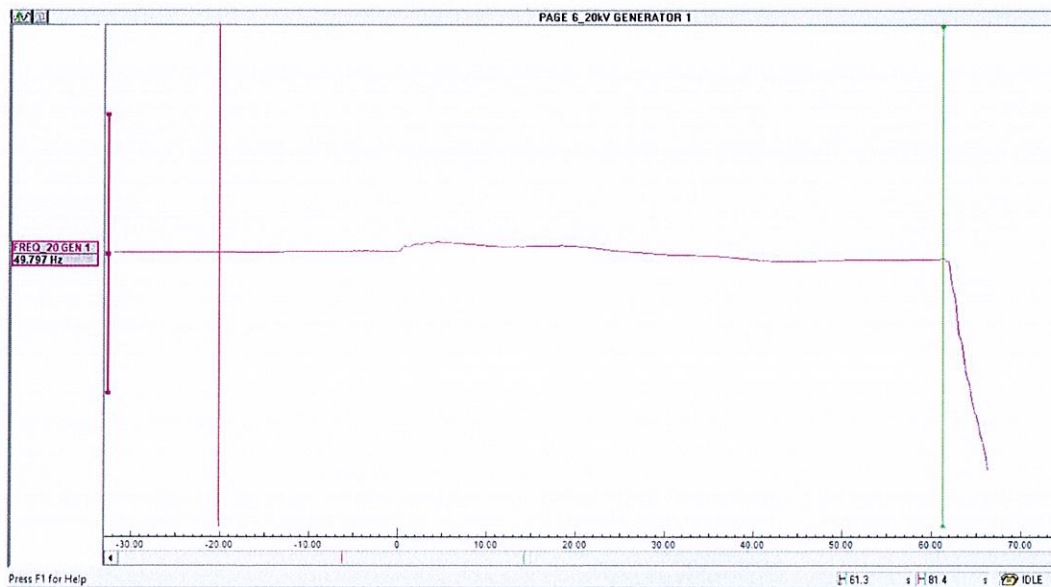


Figure 11: Frequency variation at Norochcholai 20kV side of Unit 1

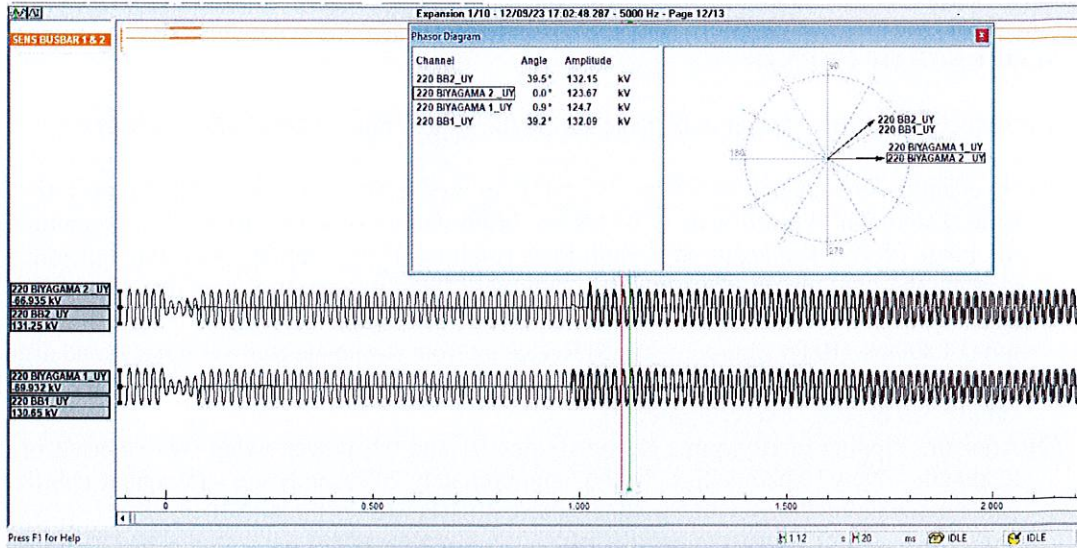


Figure 12: DDR record of Biyagama line 1 & 2 voltages with Kothmale busbar voltages at the time of synchronism check (1.1 seconds after tripping)

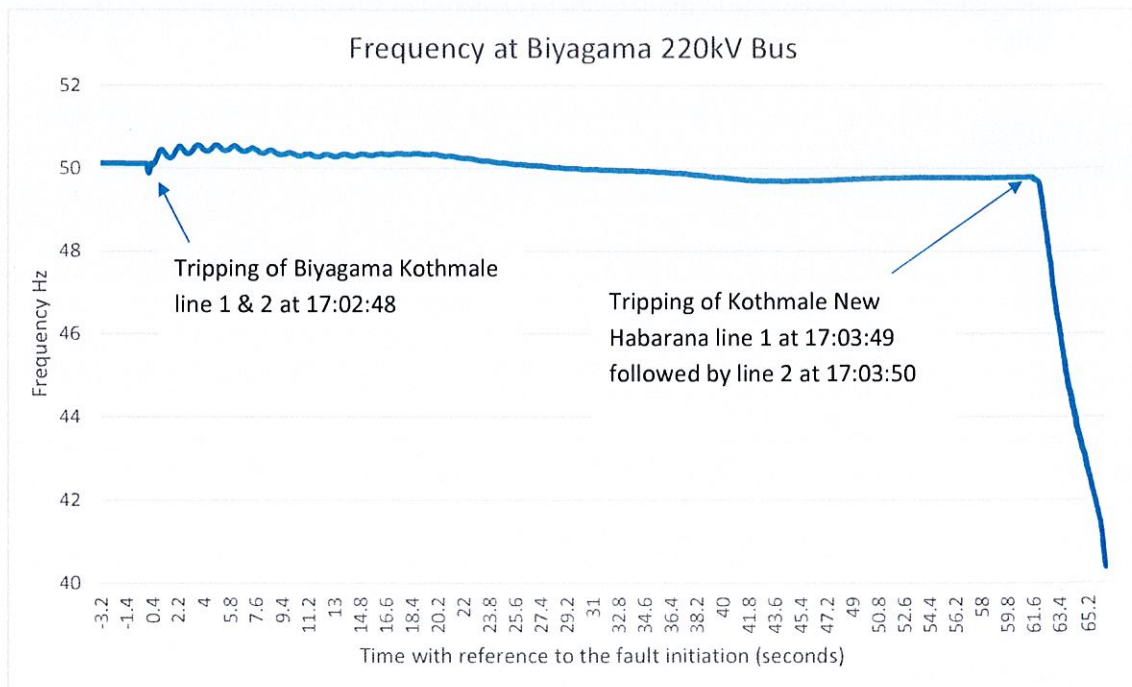


Figure 13: Frequency variation at Biyagama GSS 220kV Bus during the failure

6. SEQUENCE OF EVENTS

The sequence of incidents that took place during the system failure is summarized below.

- (1) Biyagama - Kothmale 220kV Line 01 and 02 tripped from both ends due to the operation of Line Differential Protection at 17:02:48 hrs. Multi phase (Y-B) to earth fault of magnitude in the range of 4kA has occurred in both lines resulting in the tripping of all three phases and clearing the fault within 50ms by the operation of line differential protection of both Main 1 and Main 2 protection relays. Both lines reclosed from Biyagama end after elapse of the dead time of 800ms. (Refer figure 2,3,4 & 5) Reclosing from Kothmale end was not attempted since the phase angle of the bus voltage and line voltage exceeded the synchronism check setting value of 20 degrees. (Refer figure 12)
- (2) After the tripping of Biyagama Kothmale line 01 and 02, power swing was detected in the Kothmale – New Habarana lines lasting approximately 20 seconds and subsequent stabilizing while maintaining the system frequency above 49.7Hz. (Refer figure 9,10 & 11)
- (3) After the power swing condition, the load current of New Habarana – Kothmale line 01 & 02 has reached around 850A which exceeded the overcurrent setting 800A (with tms 0.21) leading to the tripping of New Habarana – Kothmale line 01 at 17:03:49 hrs. This further overloaded New Habarana Kothmale line 2 resulting in the tripping of the line at 17:03:50 hrs. Subsequently Kothmale end frequency has increased up to 63Hz and the frequency Biyagama/Norochcholai side of the network has dropped to 40Hz resulting in the total system failure.

Chief Engineer
Protection Development Unit