

Preliminary Report on Total System Failures

Date : 8/17/2020
Time of failure : 12:30 Hrs
Weather Condition : Dry

Description

Failure initiated with operation of 220kV BB protection at Kera GSS, followed by operation of BB DEF protection from LVPS GIS . System collapsed leading for a blackout at 12:30hrs. System restoration started from Kothmale PS, New Laxapana and Samanalawewa PS simultaneously. Restoration from Mahaweli system was synchronized to Southern system at Polpitiya PS.All GSSs were restored by 20:20 hrs.

Pre Fault Conditions

Generation data at 12:30 hrs.

	Load (MW)	Mvar	
Laxapana Complex	302	60	
Mahaweli Complex	438	134	
Samanala Complex	41	23	
LVPS	806	73	
Thermal Complex	156	68	
IPP	177	41	
Small Hydro(CEB)	Time	0	
Mini Hydro (IPP)	21	0	
Wind	14	0	
Solar	28	3	
Shunt reactive power	-	305	
Total Load	1983	707	
Spinning Reserve	194	9.8	%

Frequency Control : Victoria Unit No.01 and Victoria unit 02

Transmission System

Opening points of 132kV and 220kV system Ring connections.

- 1 Dehi - Havelock 132 kV cable from Dehi end
- 2 Kolon - Panni 132 kV both ccts from Kolon end
- 3 N/Galle 132kV B/C
- 4 Ukuwela 132kV B/C
- 5 Badulla 132kV B/C
- 6 Katu-Kotu both ccts from Katu end
- 7 New Polpitiya-Padukka both ccts from both ends
- 8 Col F-Col N interconnection from Col N
- 9 Kolonnawa-Col E cable from Col E end
- 10 Pannipitiya 220kV B/C , 132kV B/C

Failure Sequence Summary (Initiating incident and Initial moments in summary)

Equipment/Line	Failed Time	Load reading at 12:30hrs.	Indication/Reason			
1 Kera -WCP cct 02	12:30	397A	O/C, E/F			
2 Kera-Kotu cct 02	12:30	38A	Distance Protection , O/C ,E/F			
3 Kera-Kotu cct 01	12:30	38A	Distance Protection , O/C ,E/F			
4 Kera-Kotu cct 01	12:30	38A	Distance Protection , O/C ,E/F			
5 Kera-Col L	12:30	351A	DEF protection			
6 LVPS Coupler CB 20352	12:30		Not Available			
7 LVPS unit 03	12:30	272MW	Not Available			
8 LVPS unit 02	12:30	268MW	Not Available			
9 LVPS Coupler CB 20852	12:30		Not Available			
10 LVPS Coupler CB 21252	12:30		Not Available			
11 LVPS-N'Chilaw cct 01	12:30	813A	Distance Protection			
12 LVPS unit 01	12:30	266MW	Not Available			
13 New Chilaw-LVPS cct 01	12:30	813A	Distance Protection			
14 LVPS-N'Anu cct 02	12:30	201A	Distance Protection			
15 New Chilaw-LVPS cct 01	12:30	813A	Distance Protection			

Restoration Summary

Restored Duration	GSS/PSS
1 Restored within half an hour (0 - 1/2 hr)	
2 Restored within the next half an hour (1/2hr-1hr)	
3 Restored within the next half an hour (1hr-1 1/2 hr)	
4 Restored within the next half an hour (1 1/2hr-2hr)	
5 Restored within the next half an hour (2hr-2 1/2 hr)	
6 More than 2 1/2 hr	98

Successful Restoration	GSS	Time
First Energized	Biyagma	16:11
Last Energized	Mannar	20:20

Unrestored or delayed equipment

Equipment	Reason/Comment
Kerawalapitiya 220kV B/B 02	Due to operation of BB protection
LVPS 220kV B/B 02 and B/B 03	Due to operation of BB protection
Kotu-Veyangoda cct 01	
Rantambe 132kV switchyard	Due to fire at CVT

Comments of the SCE

Six consecutive attempts for restoration failed with Generation from Mahaweli and three attempts failed with generation from S'wewa. Successive restoration initiated from Mahaweli at 16:10Hrs and S'wewa generation at 13:35hrs with both systems synchronisation at Pol PS at 18:42hrs. Kukule PS was started for islanding operation 16:13Hrs and was synchronised with S'wewa system from Ambalangoda GSS at 18:21Hrs. Rantambe 132kV switchyard restoration was delayed due to a fire broke out in a CVT. Therefore, energizing of Ampara, Vaunathiv, Mahiyangana and Monaragala GSSs were delayed. Energizing all 33kV feeders were delayed due to inadequate generation.

SCE

Comments of the CE(SO)

System collapsed due to sudden loss of 47% generation from the system which is not possible to recover at any means such as UFLS. First three attempts of restoration from Kotmale and Victoria failed as generators were tripped without any proper reason while they were in low loads around 30-40 MW. Similar situation happened in the New Laxapana and Samanalawewa as well. It has been taken around 3 hrs for the first three unsuccessful attempts. It was followed by severe system frequency oscillation between Kotmale unit 02 and 01 during the fourth attempt which failed again. However, similar oscillation has been observed in fifth attempt as well and it was arrested by making Kothmale unit 02 governor manual. Colombo restoration delayed as there were no generators with adequate capacity with frequency control capability connected to Colombo city network. It is not possible to energize the Colombo city cable network initially from the Mahaweli system due to voltage issues. Hence, it is highly recommended to have Gas turbines having adequate capacity (100MW) with frequency control option in Colombo network in order to expedite the total failure restoration under present network and loading conditions. Further, It is highly recommended to develop a suitable mechanism to have an auxiliary supply to LAKVIJAYA power station following a Total system failure as it takes considerable time to make available the supply to Norechhole GIS due to voltage issues.

Eranga Kudahewa
CE(SO) -SYC

Attachment 1	Generator failure and restoration summary
Attachment 2	Transmission line failure and restoration summary
Attachment 3	GSS and Colombo PSS failure and restoration summary
Attachment 4	Problems Encountered during the restoration of the failure
Attachment 5	Operation of Under frequency load shedding
Attachment 6	Frequency Plot

Generator Failure and Successful Restoration summary

POWER STATION	UNIT	MW	TRIPPED AT	Unit Generation(MW) at 12.30hrs	Mvar	RELAY INDICATION / REASONS FOR TRIPPING / REMARKS	Restored at
LAXAPANA COMPLEX							
O/LAXAPANA	1	10	12:30	10	2	Under Frequency tripped	17:37
	2	10	12:30	10	1	Under Frequency tripped	17:26
	3	10	12:30	10	1	Under Frequency tripped	19:53
	4	12.5	12:30	10	2	Under Frequency tripped	19:09
	5	12.5	12:30	12	2	Under Frequency tripped	19:13
N/LAXAPANA	1	57	12:30	56	22	Under Frequency tripped to SNL	18:12
	2	50	12:30	50	20	Under Frequency tripped to SNL	18:35
WIMALASURENDRA	1	25		0	0		
	2	25	12:30	25	3	Under Frequency tripped	17:47
CANYON	1	30		0	0		
	2	30	12:30	30	1	Over Speed , Over Active Power (Incoming line tripped from N'Lax)	21:23
POLPITIYA	1	45	12:30	45	6	Mech &External tripped	18:15
	2	45	12:30	44	2	Under frequency. Mech &External tripped	17:57
MAHAWELI COMPLEX							
KOTMALE	1	67	12:30	63	15	Generator Protection operated	16:12
	2	67	12:30	67	14	Under Frequency	17:04
	3	67	12:30	64	14	Under Frequency	18:01
UPPER KOTMALE	1	75	12:30	55	18	Generator Protection A,B	18:10
	2	75	12:30	55	17	Generator Protection A,B	18:46
VICTORIA	1	70	12:30	25	21	Circuit Breaker Open	17:56
	2	70	12:30	44	13	Circuit Breaker Open	17:29
	3	70		0	0		
RANDENIGALA	1	60		0	0		
	2	60		0	0		
RANTAMBE	1	25	Time	0	0		
	2	25		0	0		
UKUWELA	1	20	12:30	19	10	Under Frequency tripped	19:28
	2	20	12:30	17	5	Under Frequency tripped	18:25
BOWATENNA		40	12:30	29	6	Under Frequency tripped	18:18
OHER HYDRO							
SAMANALAWEWA	1	60	12:30	3	15	Gen. Under/Over frequency/ Emergency tripped	15:35
	2	60		0	0		
KUKULE	1	40		0	0		
	2	40	12:30	38	9	Under Frequency	17:37
UDAWALAWA							
INGINIYAGALA							
THERMAL COMPLEX							
KPS - GT	1	16		0	0		
	2	16		0	0		
	3	18		0	0		
	4	16		0	0		
	5	16		0	0		
NEW G.T. - KPS	7	115		0	0		
KCCP-GT		108		0	0		
KCCP-STEAM		55		0	0		
LAKVIJAYA	1	270	12:30	266	22	Drum level high	Yet to resume
	2	270	12:30	268	22	Drum level high	Yet to resume
	3	270	12:30	272	29	Drum level high	Yet to resume
SAPU - DIESEL	1	18	12:30	17	8	AVR Fault	00:49 (18/08/20)
	2	18		0	0		
	3	18	12:30	18	11	AVR Fault	01:08 (18/08/20)
	4	18		0	0		
NEW DIESEL	5	10	12:30	8	5	Over frequency /Under Frequency	19:30
	6	10		0	0		
	7	10	12:30	9	5	Over frequency /Under Frequency	19:31
	8	10		0	0		
	9	10	12:30	7	5	Over frequency /Under Frequency	19:37
	10	10		0	0		
	11	10	12:30	8	2	Over frequency /Under Frequency	19:45
	12	10	12:30	7	4	Over frequency /Under Frequency	19:45
UTHURU JANANI	1	24	12:30	22	0	Under Frquency tripped / Over Current	19:20
POWER BARGE		60	12:30	60	26	Under Frequency	18:12
PRIVATE POWER.							
SOJITZ		165		0	0		
ACE EMB		92	12:30	37	3	Under Frequency - Incoming line also tripped	19:00

ASIA POWER		48		0	0		
WCP		270	12:30	140	37	Line CB tripped from Kera GIS	21:36
<i>Wind Power</i>		125	12:30	15	0		
<i>MINI HYDRO</i>			12:30	21	0		
<i>SOLAR</i>			12:30	28	3		
<i>CAPACITORS</i>					305		
TOTAL GENERATION AT		12:30	hrs	1984 MW	706 MVar		

GSS/PS failure and restoration summary

GSS/SY/PS	Failed at	Load(MW)	Energized at	Remarks
Col Sub J	12:30		16:45	
Col. Sub B	12:30		19:35	
Col. Sub C	12:30	15.7	19:23	
Col. Sub D	12:30		19:35	
Col. Sub E	12:30	39	19:19	
Col. Sub F	12:30	36	19:47	
Col. Sub G	12:30		19:35	
Col. Sub H	12:30		16:45	
Col. Sub L	12:30	9	19:02	
Col. Sub M	12:30	0	19:11	
Col. Sub N	12:30	0	19:47	
Havelock Town (A)	12:30	40.5	18:55	
Maradana	12:30	38.3	18:56	
Ambalangoda	12:30	28.62	18:08	
Ampara	12:30	49.2	19:59	
Anu New	12:30	24.7	18:31	
Anu Old	12:30	17.2	18:33	
Athurugiriya	12:30	39.6	17:26	
Aniyakanda	12:30	31.5	16:35	
Badulla	12:30	26	18:53	
Balangoda	12:30	15.9	16:25	
Beliatta	12:30	16	15:50	
Biyagama	12:30	69.4	16:11	
Bolawatta	12:30	60	16:43	
Bowetenna PS	12:30		18:14	
Canyon PS	12:30		Time	
Chunnakam	12:30	14.9	19:09	
Dehiwala	12:30	34	19:10	
Deniyaya	12:30	8.6	16:30	
Embilipitiya	12:30	13.3	15:37	
Habarana	12:30	38.4	19:20	
Hambanthota	12:30	24	18:21	
Horana	12:30	42.6	18:15	
Inginiyagala	12:30		21:08	
Katunayaka	12:30	30.9	16:39	
Kelanithissa 132kV	12:30		18:45	
Kelanithissa 220kV	12:30		16:50	
Kelanithissa 33kV	12:30	29.4	16:45	
Kelaniya	12:30	34.1	16:23	
Kerawalapitiya GSS	12:30	24.4	19:30	
Kilinochchi	12:30	15	19:04	
Kiribathkumbura	12:30	35.1	17:50	
Kolonnawa Old	12:30	7.7	19:45	
Kolonnawa GIS	12:30	58.2	16:46	
Kosgama	12:30	43.4	17:26	
Kotmale PS	12:30		16:10	
Kotugoda 132kV	12:30		16:25	
Kotugoda 220kV	12:30	86	16:25	
Kurunegala	12:30	50.6	18:05	
Kukule PS	12:30		16:13	
Lax New PS	12:30		17:23	
Lax Old PS	12:30		17:26	
Matara	12:30	34.3	16:05	
Matugama	12:30	34.7	16:20	
Mahiyanganaya	12:30	6.4	20:05	
Nuwara Eliya	12:30	1.2	18:58	
Norechchole GIS	12:30		20:38	
Naula	12:30	10	19:22	

Oruwala	12:30	5	20:15
Panadura	12:30	64.2	18:57

Pannipitiya	12:30	45.8	19:03
Pannala	12:30	50.5	16:55
LVPS	12:30		19:34
Polpitiya PS	12:30		18:15
Puttlam	12:30	28	17:41
Randenigala PS	12:30		17:46
Rantambe PS	12:30		17:52
Rathnapura	12:30	11.8	18:13
Ratmalana	12:30	47.4	19:18
Samanalawewa PS	12:30		15:35
Sapu Gss	12:30	52.5	3:36
Sapu. Diesel PS	12:30		18:21
Seethawake	12:30	23.1	18:47
Sri Jaya Pura	12:30	49.6	17:52
Thulhiriya	12:30	39	17:53
Trinco	12:30	19	19:02
Ukuwela GSS	12:30	28.3	18:11
Ukuwela PS	12:30		18:11
Upper Kothmale PS	12:30		18:04
Maho	12:30	18	17:52
Polon	12:30	22.8	19:25
New Galle	12:30	52.7	16:07
Vauniya	12:30	6.3	18:58
Veyangoda	12:30	31.6	18:20
Victoria PS	12:30		17:46
Kerawalapitiya PS	12:30		19:39
WPS PS	12:30		17:40
WPS GSS	12:30	0.2	17:40
Vaunativu	12:30	18	20:12
Monaragala	12:30	84	17:30
New Valachchena	12:30	7.5	19:24
N/Chilaw 132kV	12:30	0	17:30
Chilaw	12:30	29.4	17:30
Maliboda	12:30	0.3	18:55
Kegalle	12:30	19.9	17:58
Pallekele	12:30	19.5	18:51
Mannar	12:30	5	20:20
Uturu Jannani PS	12:30		19:10

GSS/PS failure and Successful Restoration Sequence

GSS/SY/PS	Failed at	Load(MW)	Energized at	Remarks
Samanalawewa PS	12:30		15:35	
Embilipitiya	12:30	13.3	15:37	
Beliatta	12:30	16	15:50	
Matara	12:30	34.3	16:05	
New Galle	12:30	52.7	16:07	
Kotmale PS	12:30		16:10	
Biyagama	12:30	69.4	16:11	
Kukule PS	12:30		16:13	
Sapu Gss	12:30	52.5	16:15	
Matugama	12:30	34.7	16:20	
Kelaniya	12:30	34.1	16:23	
Balangoda	12:30	15.9	16:25	
Kotugoda 132kV	12:30		16:25	
Kotugoda 220kV	12:30	86	16:25	
Deniyaya	12:30	8.6	16:30	
Aniyakanda	12:30	31.5	16:35	
Katunayaka	12:30	30.9	16:39	
Bolawatta	12:30	60	16:43	
Col Sub J	12:30		16:45	
Col. Sub H	12:30		16:45	
Kelanithissa 33kV	12:30	29.4	16:45	
Kolonnawa GIS	12:30	58.2	16:46	
Kelanithissa 220kV	12:30		16:50	
Pannala	12:30	50.5	16:55	
Lax New PS	12:30		17:23	
Athurugiriya	12:30	39.6	Time	
Kosgama	12:30	43.4		
Lax Old PS	12:30		17:26	
Monaragala	12:30	84	17:30	
N/Chilaw 132kV	12:30	0	17:30	
Chilaw	12:30	29.4	17:30	
WPS PS	12:30		17:40	
WPS GSS	12:30	0.2	17:40	
Puttlam	12:30	28	17:41	
Randenigala PS	12:30		17:46	
Victoria PS	12:30		17:46	
Kiribathkumbura	12:30	35.1	17:50	
Rantambe PS	12:30		17:52	
Sri Jaya Pura	12:30	49.6	17:52	
Maho	12:30	18	17:52	
Thulhiriya	12:30	39	17:53	
Kegalle	12:30	19.9	17:58	
Upper Kothmale PS	12:30		18:04	
Kurunegala	12:30	50.6	18:05	
Ambalangoda	12:30	28.62	18:08	
Ukuwela GSS	12:30	28.3	18:11	
Ukuwela PS	12:30		18:11	
Rathnapura	12:30	11.8	18:13	
Bowetenna PS	12:30		18:14	
Horana	12:30	42.6	18:15	
Polpitiya PS	12:30		18:15	
Veyangoda	12:30	31.6	18:20	
Hambanthota	12:30	24	18:21	
Sapu. Diesel PS	12:30		18:21	
Anu New	12:30	24.7	18:31	
Anu Old	12:30	17.2	18:33	
Kelanithissa 132kV	12:30		18:45	
Seethawake	12:30	23.1	18:47	
Pallekele	12:30	19.5	18:51	
Badulla	12:30	26	18:53	
Havelock Town (A)	12:30	40.5	18:55	

Maliboda	12:30	0.3	18:55
Maradana	12:30	38.3	18:56
Panadura	12:30	64.2	18:57
Nuwara Eliya	12:30	1.2	18:58
Vauniya	12:30	6.3	18:58
Col. Sub L	12:30	9	19:02
Trinco	12:30	19	19:02
Pannipitiya	12:30	45.8	19:03
Kilinochchi	12:30	15	19:04
Chunnakam	12:30	14.9	19:09
Dehiwala	12:30	34	19:10
Uturu Jannani PS	12:30		19:10
Col. Sub M	12:30	0	19:11
Ratmalana	12:30	47.4	19:18
Col. Sub E	12:30	39	19:19
Habarana	12:30	38.4	19:20
Naula	12:30	10	19:22
Col. Sub C	12:30	15.7	19:23
New Valachchena	12:30	7.5	19:24
Polonnaruwa	12:30	22.8	19:25
Kerawalapitiya GSS	12:30	24.4	19:30
LVPS	12:30		19:34
Col. Sub B	12:30		19:35
Col. Sub D	12:30		19:35
Col. Sub G	12:30		19:35
Kerawalapitiya PS	12:30		19:39
Kolonnawa Old	12:30	7.7	19:45
Col. Sub F	12:30	36	19:47
Col. Sub N	12:30	0	19:47
Ampara	12:30	49.2	19:59
Mahiyanganaya	12:30	6.4	20:05
Vaunativu	12:30	18	20:12
Oruwala	12:30	5	20:15
Mannar	12:30	5	20:20
Inginiyagala	12:30		21:08
Canyon PS	12:30		21:10
Norechchole GIS	12:30		20:38

Sequence of Unsuccessful Restoration Summary

01st Attempt

No	Location	Equipment	Time
1	Vic	Gen 02	12:57
2	Vic	Koth PS 01	12:57
3	Koth	PS	13:00
4	Koth	Biya 01	13:02
5	Biya	GSS	13:04
6	Vic	Gen 02 / tripped	13:10
7			
8			
9			

02nd Attempt

No	Location	Equipment	Time
1	Victoria	Gen 01	13:21
2	Vic	Koth PS 01	13:21
3	Koth	PS	13:24
4	Koth	Biya 01	13:24
5	Biya	GSS	13:24
6	Vic	Gen 01 / tripped	13:27
7			
8			
9			

03rd Attempt

No	Location	Equipment	Time
1	Victoria	Gen 01	13:33
2	Vic	Koth PS 01	13:33
3	Koth	PS	13:34
4	Koth	Biya 01	13:34
5	Biya	GSS	13:36
6	Vic	Gen 01 / tripped	13:36
7			
8			
9			

04th Attempt

No	Location	Equipment	Time
1	Koth	Gen 03	13:36
2	Koth	Biya 01	13:36
3	Biya	GSS	13:40
4	Biya	Kotu 01	13:41
5	Kotu	GSS	13:47
6	Kotu	Aniya	13:59
7	Aniya	GSS	13:59
8	Biya	Sapu 01	14:04
9	Sapu	GSS	14:06

05th Attempt

No	Location	Equipment	Time
1	Kothmale	Gen 01	14:19
2	Kothmale	Biya 01	14:19
3	Biya	GSS	14:20
4	Biya	Kotu 01	14:21
5	Kotu	GSS	14:24
6	Kotu	Aniya	14:29
7	Aniya	GSS	14:30
8	Kelaniya	Aniya	14:41
9	Kelaniya	GSS	14:42

06th Attempt

No	Location	Equipment	Time
1	Koth	Gen 03	15:42
2	Koth	Biya 01	15:42
3	Biya	GSS	15:42
4	Biya	Sapu GSS 01	15:44
5	Sapu	GSS	15:44
6	Biya	Kotu 02	15:52
7	Kotu	GSS	15:52
8	Koth	Gen 01 / tripped	
9			

Report on Operation of Under Frequency Load Shedding

Date : 17/08/2020
 Time : 12:30 AM hrs.
 Reason : WCP 130 MW +Lakvijaya 807MW tripping

Rejected Generation : MW NOTE:

Total generation (recorded) prior to tripping: 1,984 MW

GSS	Feeder No	Stage	OFF TIME	ON TIME	LOAD / (A)	OFF TIME	ON TIME	LOAD / (A)
Athurugiriya	3	I	12:30		160			
	6	I	12:30		90			
	8	I	12:30		172			
Rathnapura	1	I	12:30		64			
Mathugama	1	I	12:30		45			
	3	I	12:30		80			
	5	II						
	10	II						
	6	III						
Kotugoda	9	III						
	13	I						
	11	I						
	3	II	12:30		190			
Sapugaskanda	9	IV	12:30		291			
	12	V or df/dt	12:30		270			
	9	I	12:30		25			
	11	I	12:30		72			
Sapugaskanda	2	II						
	4	II						
	7	II	Time		110			
	6	III	12:30		39			
	3	IV						
	8	IV	12:30		107			
	Kosgama	1	I	12:30		210		
8		I	12:30		200			
2		II	12:30		145			
3		IV	12:30		70			
Ukuwela	10	I	12:30		165			
	3	II	12:30		39			
	12	df/dt	12:30		69			
	1	II	12:30		78			
Habarana	3	I						
	1	II						
	6	II						
	7	II						
	2	df/dt						
	4	df/dt						
New Galle	3	I	12:30		76			
	11	I	12:30		23			
	1	df/dt						
	6	df/dt						
	4	df/dt						
Thulhiriya	5	I	12:30		138			
	6	I	12:30		17			
	4	III	12:30		84			
	1	III	12:30		139			
	2	IV	12:30		80			
Matara								
	6	I	12:30		84			
	4	III	12:30		180			

GSS	Feeder No	Stage	OFF TIME	ON TIME	LOAD / (A)	OFF TIME	ON TIME	LOAD / (A)
	8	III	12:30		112			
	2	df/dt	12:30		140			
	7	df/dt						
	3		12:30		25			
	5		12:30		to be received			
	1	df/dt	12:30		43			
Badulla	6	I	12:30		17			
	3	III	12:30		29			
	5	III	12:30		48			
	1	IV	12:30		31			

GSS	Feeder No	Stage	OFF TIME	ON TIME	LOAD / (A)	OFF TIME	ON TIME	LOAD / (A)
Biyagama	1	I	12:30		10			
	3	III	12:30		135			
	5	III	12:30		195			
	6	III	12:30		230			
	4	IV	12:30		200			
	7	V or df/dt	12:30		0			
Kelaniya	8	V or df/dt	12:30		240			
	3	I						
	2	I						
Belliatra	1	df/dt						
	4	II	12:30		44			
	5	II	12:30		0			
Ambalangoda	6	II	12:30		41			
	2	II	12:30		65			
	3	II	12:30		120			
	4	II	12:30		60			
Kiribathkumbura	6	II	12:30		137			
	13	II						
	7	III						
	2	III						
	3	III						
Dehiwala	4	IV						
	7	II	12:30		133			
	6	III	12:30		113			
	8	III	12:30		142			
	1	IV	12:30		13			
Rathmalana	3	IV	12:30		248			
	F7	II	12:30		15			
	F9	II	12:30		278			
	F6	IV	12:30		240			
	F2	df/dt	12:30		0			
Veyangoda	F3	df/dt	12:30		172			
	7	II						
	3	III						
	4	IV						
	6	IV						
Panadura	8	V						
	3	II	12:30		96			
	2	V or df/dt	12:30		200			
N/Anu	4	V or df/dt						
	5	V or df/dt	12:30		122			
	Trinco 1 & 2	III						
Kilinochchi	2	III						
	4	III						
Aniyakanda	3	III						
	7	III						
	1	IV						
	5	df/dt						
Pannipitiya	3	III	12:30		10			
	6	III						
	9	III	12:30		178			
	10	III	12:30		0			
	2	IV	12:30		159			
	4	IV	12:30		286			
	7	IV	12:30		0			
	8	IV						

GSS	Feeder No	Stage	OFF TIME	ON TIME	LOAD / (A)	OFF TIME	ON TIME	LOAD / (A)
	5	V	12:30		72			
Madampe	4	III						
	7	III	12:30		80			
	1	V or df/dt	12:30		90			
	2	V or df/dt						
	3	V or df/dt	12:30		60			
	5		12:30		100			
	6		12:30		10			

GSS	Feeder No	Stage	OFF TIME	ON TIME	LOAD / (A)	OFF TIME	ON TIME	LOAD / (A)
Ampara	3	IV						
	5	IV						
Sub C		IV						
Sub A	1137	IV	12:30					
	14	IV	12:30					
	525	IV	12:30					
	1011	IV	12:30					
Sub F	571	IV	12:30					
	116	IV						
	54	IV						
	624	IV						
	43	IV						
Sub I	9	IV						
	18	IV	12:30					
	45	IV						
	1240	IV						
	1130	IV						
Sub E	602	IV	12:30					
	981	IV						
	10	IV						
	609	IV						
Kolonnawa GIS	335	IV						
	B1	IV	12:30		107			
	C1	IV	12:30		88			
	C2	IV	12:30		177			
Horana	G2	IV						
	5	IV						
	2	df/dt	12:30		95			
	3	df/dt	12:30		230			
Pannala	4	df/dt	12:30		132			
	3	V						
	5	V						
	7	V						
	2	df/dt						
	4	df/dt						
Kurunegala	6	df/dt						
	6	V						
	5	V or df/dt						
	2	df/dt						
	3	df/dt						
S'Japura	4	df/dt						
	1	df/dt	12:30		74			
	2	df/dt	12:30		147			
	4	df/dt	12:30		107			
	5	df/dt	12:30		82			
	6	df/dt						
Bolawatta	8	df/dt						
	2	df/dt						
	3	df/dt	12:30		208			
	4	df/dt	12:30		152			
	5	df/dt	12:30		108			
	8	df/dt	12:30		274			
	10		12:30		215			

GSS	Feeder No	Stage	OFF TIME	ON TIME	LOAD / (A)	OFF TIME	ON TIME	LOAD / (A)
Katunayaka	1	df/dt	12:30		120			
	2	df/dt	12:30		148			
	7	df/dt	12:30		0			
	8	df/dt	12:30		161			
Deniyaya	1	df/dt						
	2	df/dt						
Mahiyangane	2	df/dt						
	5	df/dt						

10876 A

UFLS Stage	Shedded load in [A]	Shedded load in [MW]	Shedded load as a %
Stage I	1648.0	93.3	4.7%
Stage II	1551.0	87.8	4.4%
Stage III	1714.0	97.0	4.9%
Stage IV	2097.0	118.7	6.0%
Stage V	72.0	4.1	0.2%
Stage V or df/dt	982.0	55.6	2.8%
df/dt	2462.0	139.3	7.0%
Total	10526.0	595.6	30.0%

Total Rejected Generation MW 0 0.0%

Total Shedded 33kV Load in [A] 10876 -

Total Shedded 33kV Load in MW 615 31.0%

Total generation (recorded) prior to tripping: **1984**

power factor : **0.99**

Problems Encountered during the restoration of the failure

STATION	EQUIPMENT	PROBLEM / COMMENT	Whether a delay is caused (Y/N)	Recommandation
All UFLS stations	UFLS Scheme	Feeders having under frequency trip setting specially at stage 1 leads to system collapse during initial stage of restoration.	Yes	There should be way to disable to UFLS scheme at once in every station and It should be clearly identified to CROs as well. Better to incorporate this in the Specification for new GSS
Biyagama, Kotugoda, Sapugaskanda, Kosgama, Athurugiriya, Seethawaka, Kelaniya, Aniyakanda	33kV feeders	It was very hard to find low load 33kV feeders during the initial loading of generators. This leads to difficulties in maintaining the stability of the generators at low loads while energizing the 33kV feeders.	Yes	Some mechanism should be developed to isolate the already identified feeders to reduce the feeder loads to less than 5 MW in GSS where going to be energized initial stage of the restoration process.
Biyagama, Kotugoda, Sapugaskanda	33kV feeders	It has been noted that Kothmale generators are tripped due to over frequency during the restoration process. It means load fluctuation has been occurred within the feeders.	Yes	Hence, it is recommend to revisit the 33kV loading and quality of the feeder load which is going to be used for first energization'
Kolonnawa	S'Japura line 01 and 02	Couldn't switch on via syncho check relay	Yes	
Colombo Gss		Restoration delayed due to unavailability of fast acting generators with adequate capacity at Colombo city network.	Yes	Gas turbines having adequate capacity (100MW) with frequency control option in Colombo network in order to expedite the total failure restoration under present network and loading conditions.
New Laxapana	Gen 01 & 02	Unstable at low load conditions	Yes	
Lakvijaya PS	Auxiliary supply	It takes more than two hours to energize the Norechchole GIS following a total failure which will delay the auxiliary supply to Lakvijaya generators.	Yes	It is highly recommend to develop a suitable mechanism to have an auxiliary supply to LAKVIJAYA power station following a Total system failure

Time

Frequency Vs Voltage

