

PROBLEM STATEMENT

The Ceylon Electricity Board (CEB) is the main utility of electricity supply in Sri Lanka. The medium voltage distribution network consists of 33 kV and 11 kV lines and majority of them are of overhead bare ACSR conductors. A few MV lines are ELM conductors and All Aluminum Alloy conductors (AAAC). The main problem that the CEB faces in maintaining reliability of the medium voltage lines is insulator flashover due to salt pollution in coastal belt, lightning, switching and vegetation.

It is obvious that this situation is more obvious and well known to Area Engineers and Maintenance Engineers who have involved in attending frequent breakdowns due to insulator flashover in coastal regions over the years especially during monsoon period. This phenomenon is more aggravated in areas where less rainfall, high wind and high lightning conditions prevail.

Ratmalana Grid Substation (GSS) is one of the important GSSs in Western Province South and it consists of 3×31.5 MVA, 132/33 kV substations and nine 33 kV outgoing feeders. These 33 kV feeders feed power to important areas like Ratmalana industrial zone, Ratmalana Airport, CGR workshop, Maliban factory, Ratmalan Primary substation (PSS), Katubedda PSS, Moratuwa PSS (PSS) and Angulana PSS.

This specific problem is related to one of the 33 kV lines namely RF - 9 of WPS - 1, which feeds power from Ratmalana GSS to Moratuwa 2×5 MVA PSS and Angulana 3×5 MVA PSS. It is very important to provide a reliable power supply to those areas as they are highly industrialized, commercialized and densely populated. Furthermore those commercial, industrial and residential consumers contribute to a substantial portion of revenue at higher tariff rate to the CEB and they are more concerned about the reliability of electricity supply.

The total length of the line RF – 9 is about 6.4 km. Out of the total length about 3.4 km is going along the coastal area. The single line diagram of the RF - 9 is shown in Figure 2.1 for further reference.

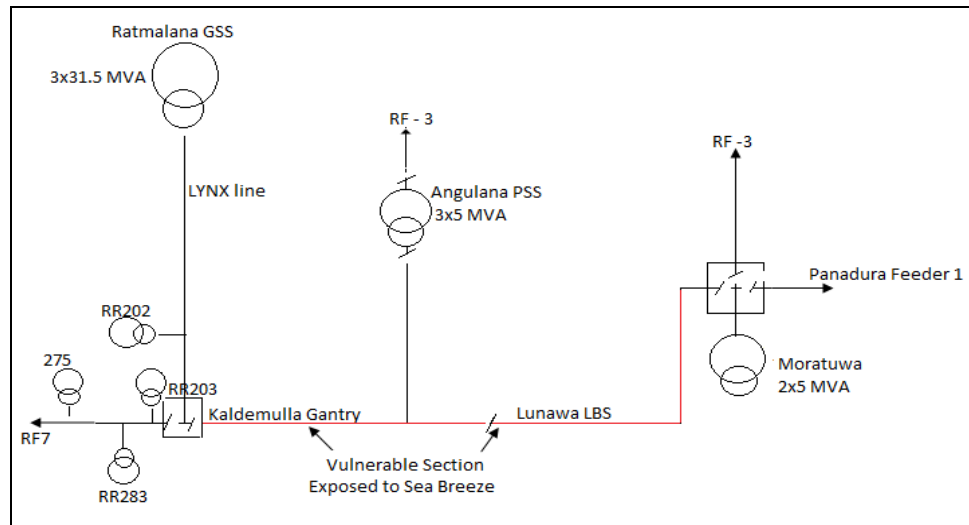


Figure 2.1 The single line diagram for feeding arrangement of the RF – 9

When analyzing the outage details of RF - 9, it has been noted that in most instances of tripping in the feeder were caused by the insulator flashover due to lightning and saline pollution. During the monsoon period, the tripping rate is very high. Most of the flashovers on the insulators have been reported on the 33 kV line running closer to the sea. The outage details except load shedding of RF - 9 are given in Table 2.1.



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Table 2.1 Outage Details of RF - 9

Year	Fault Time T < 5min		Fault Time T > 5min		Total Failure Time Duration (min)
	No of Faults	Duration (min)	No of Faults	Duration (min)	
2008	26	74	28	2,089	2,163
2009	27	78	21	1,752	1,830
2010	48	123	23	2,397	2,520
2011	35	81	20	1,896	1,977
2012	29	90	25	2,128	2,239

The other major reason for tripping is vegetation surrounding RF - 9. During two rainy seasons, the branches of fast growing trees and coconut plantations are responsible for many faults especially on windy days.

Normally when a permanent fault occurs in a MV line, the time for fault identification and clearing of wayleaves or replacing of insulators etc. is higher. In RF - 9, when permanent fault occurred, the time is not much higher because the line length is shorter and the breakdown service of Ratmalana CSC is situated closer to RF - 9. Therefore in RF - 9, the restoration time takes more than one hour is considered as a permanent fault. If the fault identification takes more time, it has to make alternative feeding arrangements. Some photographs of RF - 9 are shown in Figure 2.2 and 2.3.



Figure 2.2 Photograph of Ratmalana Feeder - 9



Figure 2.3 Photograph of Ratmalana Feeder - 9

Some photographs of insulators which are flashed over and replaced from the RF - 9 are shown in Figure 2.4 and 2.5.



Figure 2.4 The Flashover 33kV Pin Insulator



Figure 2.5 The Flashover 33kV Shackle Insulators

If a permanent fault occurs in RF - 9, the load of Angulana PSS is temporarily transferred to Ratmalana Feeder - 3 and Moratuwa PSS is transferred to Panadura Feeder - 1 (PF - 1). This is to be done after de-loading some 11 kV feeders from relevant PSSs to adjacent PSSs. Ratmalana Feeder - 3 (RF - 3) is not a healthy line because length of the line is very long and it experiences frequent faults occur due to vegetation. The transferring of the load to PF - 1 is more difficult task and it could be done only after de-loading because this feeder is overloaded at present. Once the fault is rectified in RF - 9, power supply has to be normalized by energizing RF - 9. This takes a considerable time.

Presently under the routine maintenance, this feeder is washed once a year. During the preventive maintenance programmes all the insulators are visually inspected and those with poor glazed surface are replaced