C.8.1.5.

Real time ampacity estimation system for 345 kV transmission cable installed on tunnel

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In summer, the peak load is mainly due to the non-industrial reasons such as air-conditioners and other cooling equipments. To cover the concentrated peak load in stable, the power transmission lines should be efficiently operated. To meet that purpose, real time ampacity estimation technique has been used for estimating & up-rating the cable ampacity within required short periods.

In this paper, the results of real time ampacity evaluation test for 345 kV OF cables during summer peak load period are described. Its evaluation test was performed for double circuits of 345 kV 2000mm^2 oil filled cable system installed in tunnel. Each of circuits has the static power capacity of 652.6[MVA] and is installed at a 16.7km long tunnel with fire barriers.

The system was configured with distribution temperature sensor for detecting hot spots of cables and a number of resistive type temperature sensors around hot spots for estimating thermal parameters of tunnel and fire barriers. The sheath circulating current (for each cross bonding areas) was estimated, also. By means of digital communication system, all of the input data were gathered within 10 minutes cycle time.

The acquired current and temperatures in tunnel and cables are shown in figure 1. The calculated temperature of each cable layers is shown as figure 2. The conductor temperature has a similar pattern as the surface temperature of cable.

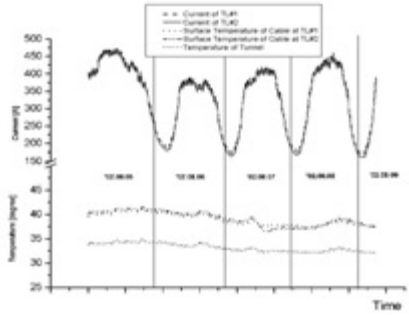

Fig. 1. Temperature of tunnel & Cables.

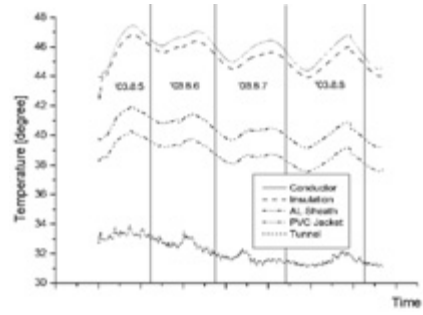

Fig. 2. Calculated temperatures on each layer of cable.

As a experimental results, The position of hot spot was detected at a shallow urban area and is moved around 60 m as figure 3, daily.

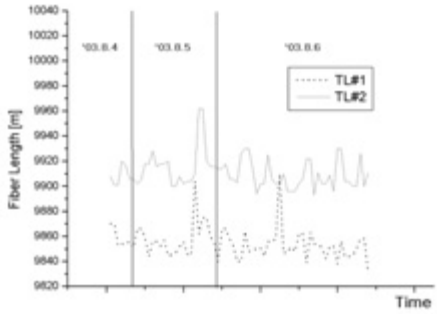

Figure 3. Detected hot spots

Real time ampacity was estimated as Table 1. It is shown that the rainfall and temperature of tunnel has a close relationship. The temperature of tunnel directly effects on the temperature of cable surface and is finally determining the temperature of cable conductor. Because both circuits have a function of redundancy for emergency, the effects of conductor current was too small to be mainly considered.

		Tunnel temp.	Cable surface Temp.	Conductor Temp.	2 hour Rating	4 hour Rating	12 hour Rating	24 hour Rating	100 hour Rating	Weather
'03.8.5	11:30	33.72	40.13	44.029	1810.982	1579.562	1282.058	1197.620	1143.212	• Temperature [℃] -Average : 26.7 -Highest : 28.3 -Lowest : 23.2 • Rainfall : 22 [mm]
	13:30	33.97	40.56	43.965	1765.838	1559.291	1281.019	1199.517	1144.558	
	15:00	33.97	40.65	44.783	1704.042	1512.046	1260.627	1188.384	1135.912	
	22:00	34.88	41.48	47.404	1677.213	1500.991	1257.871	1185.442	1129.413	
'03.8.6	11:00	33.48	39.86	46.396	1685.574	1513.200	1272.788	1200.551	1144.276	•Temperature [℃] -Average : 22.4 -Highest : 26.1 -Lowest : 19.5 • Rainfall : 151.5 [mm]
	13:30	33.51	40.01	46.667	1676.690	1507.922	1271.165	1199.773	1143.827	
	15:00	33.63	40.16	46.648	1682.779	1511.314	1271.415	1199.293	1143.036	
	22:00	33.45	39.98	47.002	1678.021	1511.657	1275.292	1203.336	1145.984	
'03.8.7	11:00	33.05	39.13	45.33	1710.862	1528.021	1277.853	1203.736	1147.429	•Temperature [℃] -Average : 21.2 -Highest : 22 -Lowest : 19.9 • Rainfall : 178[mm]
	13:30	32.93	38.7	45.744	1690.523	1517.622	1277.208	1205.146	1149.431	
	15:00	32.50	37.48	46.026	1669.858	1507.089	1277.153	1207.510	1152.890	
	22:00	32.62	37.23	46.357	1685.497	1519.724	1283.454	1211.415	1154.058	
'03.8.8	11:00	32.14	37.11	44.781	1702.861	1527.405	1284.748	1212.309	1156.964	•Temperature [℃] -Average : 25.1 -Highest : 30.1 -Lowest : 21.2 • Rainfall : 0.5[mm]
	13:30	32.41	37.81	45.322	1681.792	1512.938	1277.964	1207.598	1153.572	
	15:00	32.41	38.24	45.651	1668.602	1504.825	1275.348	1206.304	1152.899	
	22:00	32.93	39.13	46.809	1661.724	1502.230	1274.541	1205.060	1149.669	

Table 1. Summary of real time ampacity ratings

By this study, the real time estimation technique for thermal condition of cables successfully evaluated and is broadly promoting to be adopted in Korea, near future.