Cable Lore

ANACONDA

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HOT CONDUCTOR COSTS MONEY!

One of the primary goals in the development of rubber or plastic compounds for cable insulations and jackets is to obtain physical and electrical characteristics that are stable at elevated temperatures in either wet or dry environments. From an engineering and design viewpoint high temperature resistance is highly desirable and increases the safety factor during periods of emergency. Network cable applications and the AIEE Limiter tests are an example of judiciously applying laboratory data to actual cable application. The keynote here is, insulation stability during an emergency. One factor that should constantly be kept in mind is a footnote that appears in IPCEA Standards covering emergency overload ratings - "Operation at these emergency overload temperatures shall not exceed 100 hrs. per year. Such 100-hr. overload periods shall not exceed five."

It is most regrettable that the research performed to develop materials with excellent thermal stability appears to have been turned slightly out of focus and some questionable conclusions reached because of this distortion.

Because of commercial expediency, temperature ratings have become a natural "gimmick" with considerable appeal to consumers and, in a sense, turned the cable business into a temperature race.

One sound method for placing operating temperature back into proper perspective is to bring into sharp focus a very fundamental fact of electrical engineering - "Hot conductor costs money!" As the current load increases on a given conductor size, the following phenomena occurs:

1. The conductor resistance increases.
2. The conductor increases in temperature; becomes an electric furnace.
3. Voltage drop increases and makes the conductor less efficient.
4. The degradation of insulations and coverings is accelerated.

The following tables illustrate dramatically the degree of both power losses and dollars lost if current ratings are used indiscriminately. A heavy premium is paid when advantage is taken of the maximum current rating placed on an insulated conductor.

TABLE 1

1000 FOOT CIRCUIT SUPPLYING 440 VOLTS, THREE-PHASE TO 100% PF LOAD
3-1/C, 4/0 cu. 600-Volt Cables in Metallic Conduit. 40°C Free Air Ambient

tc	Amps.	0 - 0 Volt. Drop	Sending End Voltage 0 - 0	Kw Loss in Cables/Hr.	Cable Losses 2080 Hrs/Yrs.* @ 1.5¢/KWH
60	184	19	459	5.952	$185.70
65	204	22	462	7.578	236.43
70	222	24	464	9.270	289.22
75	238	27	467	10.824	337.71
80	252	28	468	12.345	385.16
85	265	30	470	13.863	432.53
90	278	33	473	15.510	483.91
100	296	36	476	18.189	567.50
110	308	39	479	20.376	635.73
120	315	41	481	21.984	685.90

TABLE 2

tc	Cable Losses 2080 Hrs/Yr.* @ 1.5¢/KWH	Losses/Yr. For Operating in Excess of 60°C	At 5% per Annum for 10 Yrs. Power Loss Would Amortize
60	$185.70	-	-
65	236.43	$ 50.73	$ 638.08
70	289.22	103.52	1302.06
75	337.71	152.01	1911.97
80	385.16	199.46	2508.79
85	432.53	246.83	3104.60
90	483.91	298.21	3750.85
100	567.50	381.80	4802.24
110	635.73	450.03	5660.43
120	685.90	500.20	6291.46

* 2080 Hrs. = 8 hrs. per day, 5 days per week, 5 weeks per year.

It becomes apparent, then, that in any particular application, the premium for hot conductor must be weighed most carefully to gain maximum efficiency at minimum cost.

For most applications, the savings realized from an efficiently designed power system will more than pay for the conductor required to place this system in effect. The increased safety factor gives added value in greater system reliability.