REPORT OF THE
AD HOC LINE TRAP RATING PROCEDURE WORKING GROUP
OF THE
SYSTEM DESIGN TASK FORCE

June, 1990

Working Group Members:

M. T. Smith, Chairman
K. Aberg
R. E. Haskins
A. W. Scarfone

REPORT OF THE
AD HOC LINE TRAP RATING PROCEDURE WORKING GROUP
OF THE
SYSTEM DESIGN TASK FORCE

Introduction

This study compares the emergency overload current capability rating factors provided for line traps in ANSI Standard C93.3-1981 to rating factors recommended by the SDTF in Section 7 of the "Capacity Rating Procedures-Transmission Line Terminal Equipment" book. It will be determined if the current SDTF practice in rating line traps should be revised.

Recommendation

The SDTF procedure in Section 7 of the "Capacity Rating Procedures-Transmission Line Terminal Equipment" book providing recommended line trap emergency overload rating factors is acceptable based on only very infrequent operation above rated current.

Study Results

The existing emergency overload rating factors were accepted by the SDTF based on information provided by leading manufacturers (W, GE/TRENCH; Appendix I). This data assumed the line trap had been operating at rated current, reaching its full load temperature rise in a 40° C ambient, before the overload was applied. Table A below compares these factors with those provided in the ANSI Standard Appendix Table A1.

Table A

Duration of Emergency	Overload Rating Factors (40° C Ambient) SDTF	ANSI
15 minutes	1.50	1.40
4-48 hours	1.15	1.10

NOTES: 1) Assumed ANSI 4-12 hour rating factor = 4 hour rating factor.
2) Assumed SDTF 4-12 hour rating factor = GE 24-48 hour rating factor.

Plot 1, graphically shows the difference between the two rating factors extended out through a 12 hour time period.

Emergency overload rating factors for ambient temperatures below the 40° C design value can be calculated assuming the temperature rise of a current carrying part is proportional to an exponential value of the

current flowing through it. The continuous load current capability at a given ambient temperature without exceeding the hottest spot design limit is given by the formula:

$$I_a = I_o \left[(T_h - T_a)/(T_h - T_o)\right]^{.5}$$

Where:

I_a = capability at ambient T_a - amperes

I_o = nominal rating of trap, rated continuous current - amperes

T_h = maximum hottest spot design temperature, allowable hottest spot temperature rise at rated current 110° C rise (Class B insulation 110° C, Class H insulation 140° C) at a 40° C ambient - 150° C

T_a = actual ambient temperature - ° C

T_o = design ambient temperature - 40° C

Applying this formula to the design ambient temperatures of 10° C (winter) and 28° C (summer) provides the following ambient adjustment factors:

$$I_a = I_o \left(\frac{150 - 10}{150 - 40}\right)^{.5} = I_o \times \underline{1.13} \text{ at } 10^\circ \text{ C Winter}$$

$$I_a = I_o \left(\frac{150 - 28}{150 - 40}\right)^{.5} = I_o \times \underline{1.05} \text{ at } 28^\circ \text{ C Summer}$$

Table B applies the emergency overload rating factors from Table A and the normal ratings factor of 1.0 to the ambient adjustment factors above. This assumes that it is appropriate to account for lower actual ambient temperatures in this way.

Table B

	SDTF		ANSI	
Ratings	Summer	Winter	Summer	Winter
Normal	1.05	1.13	1.05	1.13
Emergency(STE)-15 minutes	1.58	1.69	1.47	1.58
Emergency(LTE)-4 hours		1.30		1.24
Emergency(LTE)-12 hours	1.21		1.16	

ANSI overload rating factors at 10°C and 28°C ambient temperatures can be derived by interpolation of the ANSI Standard Appendix Table A1. Table C compares ANSI factors derived this way to the factors derived for Table B. Note that the interpolation method yields lower overload factors.

Table C

Ratings	10°C ANSI Table B	10°C ANSI Interpolation	28°C ANSI Table B	28°C ANSI Interpolation
Emergency(STE)-15 minutes	1.58	1.475	1.47	1.43
Emergency(LTE)-4 hours	1.24	1.175		
Emergency(LTE)-12 hours			1.16	1.13

Notes: 1. Assumed ANSI LTE 4-12 hour rating = 4 hour rating factor.

The SDTF emergency overload rating factors (ambient temperature adjusted) are higher than those derived in either way from Table A1.

The following statements are extracted from the ANSI Standard Appendix containing the emergency overload rating factors:

> This Appendix is not a part of American National Standard Requirements for Power-Line Carrier Line Traps, ANSI C93.3-1981, but is included for information purposes only.
>
> Line traps are designed within temperature-rise limitations to ensure normal life expectancy. Any value of currents in excess of the rated current in this standard may cause the designed temperature rise to be exceeded and may shorten the life expectancy of the line trap.
>
> Table A1 (Appendix of ANSI Standard) shows percentages of rated continuous current that have been selected to minimize the reduction in operating life and should be applied with great care.

The SDTF recommended emergency overload rating factors are the same factors that were provided by a leading manufacturer (Appendix I; GE, Overload Ratings For Type CF Line Traps, dated 3/17/69) at the time this procedure was established. The SDTF rating factors are higher than those identified in the ANSI Standard as shown in Tables B and C.

Sig Bogdanowicz, Chairman - ANSI C93, reported (APPENDIX III) the emergency rating factors identified in Table A1 were agreed to between committee members and leading manufacturers. Manufacturers find it infeasible to determine the exact effect on life expectancy due to increased temperature if overload conditions occur frequently. Thus a conservative Table A1 was established.

The present SDTF emergency rating factors ranging from the conservative ANSI standard to a manufacturers permissible loading condition can be tolerated without major loss of life. This is based on the assumptions that emergency loadings are done only very infrequently and the line trap operates a majority of the time below rated current. The ANSI

assumption of preloading to a full load temperature rise is more conservative than preload assumptions used in the SDTF line overload capacity ratings. Hence it is not unreasonable that SDTF overload factors exceed those derived from ANSI Table A1.

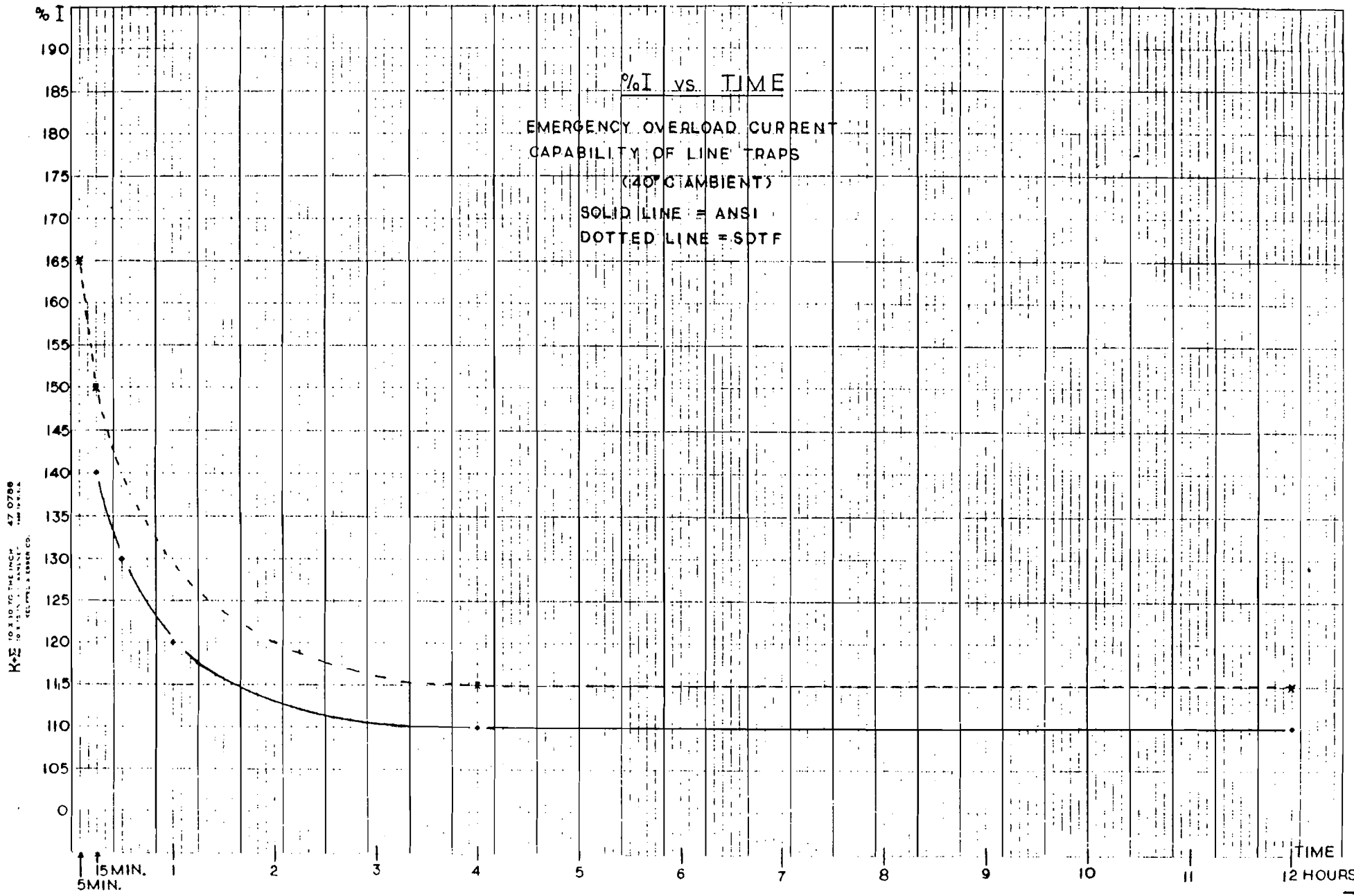
Trench Electric (APPENDIX V) line traps meet the present SDTF emergency rating guidelines. Emergency rating factors must be obtained from new suppliers or if higher loading capability is required.

The ANSI Standard Appendix Table A1 did not provide emergency overload rating factors for periods less than 15 minutes. The SDTF Drastic Action Limit (DAL) is a 5 minute overload rating. Appendix IV Figure 1 provided the SDTF a 5 minute summer and winter DAL limit of approximately 170% and 185% respectively (applied to nameplate at ambients: summer = 28° C, winter = 10° C). The calculated normal rating factors of 1.05 at 28° C and 1.13 at 10° C were removed from these percentages to give an approximate single DAL emergency overload rating factor of 1.65. The 1.65 rating factor when applied to the seasonal ambient adjusted factor provides a factor which is approximately equal to Appendix IV Figure 1.

No emergency overload rating factors were provided in the ANSI Standard Appendix Table A1 for periods less than 15 minutes. With the approximations used in deriving DAL limits from Appendix IV Figure 1 and the absence of ANSI data, no change in DAL limits is recommended.

Assuming line traps are subjected to very infrequent operation above rated current and recognizing the conservative approximations used in defining the ANSI Standard Appendix Table A1 rating factors leads to recommending no change in Normal, Long Time Emergency (LTE), Short Time Emergency (STE) or Drastic Action Limit (DAL) ratings. Therefore, Section 7 of the "Capacity Rating Procedures-Transmission Line Terminal Equipment" book is acceptable for providing emergency line trap rating factors.

AWS/sip
DEC.2.45


%I vs. TIME
EMERGENCY OVERLOAD CURRENT
CAPABILITY OF LINE TRAPS
(40°C AMBIENT)
SOLID LINE = ANSI
DOTTED LINE = SDTF
%I
190
185
180
175
170
165
160
155
150
145
140
135
130
125
120
115
110
105
0
5MIN.
15MIN.
1
2
3
4
5
6
7
8
9
10
11
12 HOURS
TIME

PLOT 1

Appendices

I Correspondence and Data from General Electric and Westinghouse Regarding Line Trap Rating Capabilities

II Requirements for Power-Line Carrier Line Traps (ANSI Standard C93.3-1981)

III Letter from ANSI C93 Chairman Regarding Origin of Information in Table A1 of the Appendix of ANSI Standard C93.3

IV Charge to the Ad Hoc Line Trap Rating Procedure Working Group, Information of Calculation of Drastic Action Limits and 1978 Issue of Section 7, Line Traps, from NEPOOL Capacity Rating Procedures.

V Correspondence with Trench Electric Regarding Line Trap Rating Capabilities

Appendix II is available from the American National Standards Association.
The other appendices are available from ISO New England upon request to the Chair of the System Design Task Force.