TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401

5N 157B Lookout Place

October 7, 1986

Director of Nuclear Reactor Regulation
Attn: Mr. B. J. Youngblood, Project Director
PWR Project Directorate No. 4
Division of Pressurized Water Reactors
(PWR) Licensing-A
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Youngblood:

In the Matter of the	)	Docket Nos. 50-327
Tennessee Valley Authority	)	50-328
		50-390
		50-391

Enclosed is TVA's response to your letter to S. A. White dated August 4, 1986. This response addresses your 15 Watts Bar Nuclear Plant (WBN) specific cable pulling questions from an engineering/design perspective. Similar cable pulling questions at the Sequoyah Nuclear Plant (SQN) will be addressed in detail in TVA's response to your August 29, 1986 letter.

Also as requested in your letter, we have enclosed a list of related WBN employee concerns. As you will note, there are a number of concerns which question the adequacy of the cable pulling program. These concerns are being evaluated by the TVA Employee Concerns Special Program (ECSP). If concern evaluations identify problems with either the specified requirements or the implementation of these requirements, corrective actions may be required which affect the program requirements as identified in the enclosed response. The ECSP reports will be provided to you for your information when completed.

Based upon preliminary concerns expressed by your reviewers on September 10, 1986 at WBN, enclosed are two memorandums (From W. S. Raughley to Those listed dated September 2, 1986, "All Nuclear Plants - Electrical Issues - Class 1E Cable Bend Radius," and dated July 16, 1986, "All Nuclear Plants - Electrical Issues - Support of Cables in Vertical Conduits") which should resolve some of these additional concerns. Supplemental documentation to our response is provided as deemed appropriate. We hope this additional information will allow you to complete your review.

Please note that the requested sidewall bearing pressure test report will be submitted to you upon completion of a third-party review. Submittal of the report after a third-party review was discussed with your reviewers in a meeting on July 17, 1986 in Knoxville.

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1/1

Director of Nuclear Reactor Regulation October 7, 1986

The enclosures in this letter are:

Enclosure 1	Response to questions transmitted with your letter to S. A. White dated August 4, 1986
Enclosure 2	Summary of how General Construction Specification Number G-38 requirements are communicated to working level as requested in the July 17, 1986 meeting in Knoxville
Enclosure 3	Listing of employee concerns which are related to your cable pulling concerns listed in your August 4, 1896 letter
Enclosure 4	TVA memorandums dated September 2, 1986 and July 16, 1986 which address some additional cable pulling concerns expressed at the September 10, 1986 meeting at WBN

The extension on the response date requested in your August 4, 1986 letter has been coordinated with your staff.

If you have any questions regarding this matter, please get in touch with M. K. Brandon at FTS 858-8076.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

R Gridley

R. L. Gridley, Manager
Nuclear Safety & Licensing

Enclosures
cc (Enclosures):
U.S. Nuclear Regulatory Commission
Region II
Attn: Dr. J. Nelson Grace, Regional Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30339

Mr. Gary Zech, Director
TVA Projects
U.S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

Mr. Tom Kenyon
Watts Bar Project Manager
U.S. Nuclear Regulatory Commission
7920 Norfolk Avenue
Bethesda, Maryland 20814

ENCLOSURE 1

ENCLOSURE 1

Responses to NRC questions contained in the August 4, 1986, NRC letter from B. J. Youngblood to S. A. White.

ITEMS 1 & 2

1. Describe the types of lubricants used, and the method of application during cable pulling. To the extent possible, describe the periods during plant construction in which different types of lubricants were used and the types of cable with which they were used.

2. Is there a record indicating that lubricants were used during cable pulls?

RESPONSE

Warehouse inventory records indicate four types of cable pulling lubricants purchased and issued for use since July 1974. While there is no record indicating specifically where lubricants were used, our records do indicate the volume of lubricant used. The quantity purchased and issued of each type is listed below:[1]

1. Polywater type G & J
   - Quantity bought = 6,000 gallons — Started purchasing 10-5-83
   - Quantity issued = 3,134 gallons — Still using
2. Soapstone Powder (in 50# bags) — Started purchasing 2-22-77
   - quantity bought = 145 bags — Still using
   - quantity issued = 90 bags
3. Hi-green cable pulling lubricant — Started purchasing 9-1-78
   - Quantity bought = 2,800 gallons — Stopped using 8-2-79
   - Quantity issued = 2,800 gallons
4. Yellow No. 77 cable pulling lubricant — Started purchasing 9-1-78
   - Quantity bought = 6,069 gallons — Stopped using after 02-11-83
   - Quantity issued - 3,967 gallons

The cable lubricants listed were to be applied by hand. Of the above lubricants, only the soapstone power was approved for use on braid-covered cables. All of the above were approved for use on rubber- or plastic-covered cables. Ends of cables do not indicate any abuse and residues in conduit ends and the above volumes indicate that sufficient quantities of lubricant were used.

[1]The attached stores ledgers show the type of lubricant issued and the date of issuance.

STORES LEDGER

DATE OF RECEIPT OR ISSUE	PURCHASE ORDER OR S T NO.	PURCHASED FROM / ISSUE REQUISITION NO.	MATERIAL RECEIVED COST	MATERIAL RECEIVED QUANTITY	QUANTITY ISSUED	BALANCE ON HAND QUANTITY	BALANCE ON HAND UNIT COST	BALANCE ON HAND AMOUNT
9/18/85		Brought Forward		6000	2730	3270	6.00	
9/[illegible]/85		8714			15	3255		19,530.00
9/26/85		8922			25	3330		19,380.00
						SEP 30 1985		
[illegible]/85		0066			20	3210		
10/31/85		(11-26-85 0424			25	3185		
11/29/85		write off 265 [illegible]) 0555			10	3175		19,050.00
						DEC 25 1985		
						MAR 25 1986.		
4/30/86		3244			10	3165		
		3245			50	3115		
5/13/86		3376			20	3095		
5/19/86		3432			55	3040		
6/2/86		3607			50	2990		
6/[illegible]	R-Deschler	G-195316 86-45			50	2940		17,640.00
						JUN 25 1986		
7-1-86		3750			50	2890		
7/24/86		4006			24	2866		

LUBRICANT CABLE PULLING [illegible] WATER

P59XAKG

MAX.	SIZE	ARTICLE	UNIT	MATERIAL-BIN NO
#64-620	5 gallon	~~P59XAKG~~ min 500 [illegible]	[illegible]	[illegible]

TVA 244 (FD-8-49)

STORES LEDGER

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

DATE OF RECEIPT OR ISSUE	PURCHASE ORDER OR S.T. NO.	PURCHASED FROM	ISSUE REQUISITION NO.	MATERIAL RECEIVED COST	MATERIAL RECEIVED QUANTITY	QUANTITY ISSUED	BALANCE ON HAND QUANTITY	UNIT COST	AMOUNT
1/9/85		Brought Forward			2,800	2030	770	6.00	
1/30/85			3012			25	745		
2/6/85			3165			50	695		4170.00
2/18/85	706188	85-1267	85-65	1200.00	200		895	6.00	5370.00
[illegible]			3347			20	875		
[illegible]			3349			25	850		
[illegible]			3502			20	830		4980.00
[illegible]	706197	85-1405	85-72	9000.00	1500		2330	6.00	13,980.00
[illegible]			3841			50	2280		
[illegible]			4066			20	2260		
[illegible]			4211			25	2235		13410.00
[illegible]			4419			35	2200		13,200.00
[illegible]	729065	85-2090	85-90	9000.00	1500		3700	6.00	22200.00
							MAR 25 1985		
3/27/85			4524			125	3575		
[illegible]			4526			20	3555		
[illegible]			5004			20	3535		
[illegible]			5005			20	3515		
[illegible]			5054			30	3485		
[illegible]			5055			40	3445		
[illegible]			6351			30	3415		20,490.00
							JUN 25 1985		
[illegible]			6723			20	3395		
[illegible]			6958			40	3355		
[illegible]			6790			30	3325		
[illegible]							3325		
[illegible]			8354			25	3300		
[illegible]			8584			30	3270		

MAX. 26-640

MIN.

SIZE: 5 gallon pails

ARTICLE: Lubricant Cable Pulling [illegible]

P59XARG 6.00 500 m 2130

UNIT: Gal.

MATERIAL BIN NO. [illegible]

TVA 244 (FD-8-49)

TVA 244 (FD-8-49)

STORES LEDGER

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

DATE OF REC'D OR ISSUE	PURCHASE ORDER OR S T NO	PURCHASED FROM / ISSUE REQUISITION NO.		MATERIAL RECEIVED COST	MATERIAL RECEIVED QUANTITY	QUANTITY ISSUED	BALANCE ON HAND QUANTITY	BALANCE ON HAND UNIT COST	BALANCE ON HAND AMOUNT
[illegible]		Brought Forward			2000	1280	720	5.811	
[illegible]/13/84			10569			10	710		
[illegible]/13/84			105[illegible]			25	685		
9/[illegible]/84			10651			60	625		
"			10645			30	595		
9/30/84			10779			50	545		3167.00
							SEP 30 1984		
[illegible]			014			60	485		
[illegible]			015			25	460		
[illegible]			018			10	450		
10-22-84			436			15	435		
[illegible]/25/84			0772			40	395		
[illegible]			0873			40	355		
[illegible]			0876			50	305		
[illegible]			0965			30	275		
[illegible]			0898			30	245		
11/[illegible]/84			1211			50	195		
11/7/84			1279			20	175		
[illegible]			1346			25	150		
[illegible]/26/84			1535			20	130		
[illegible]/28/84			1625			25	105		
[illegible]			1713			65	40		
[illegible]			2132			30	10		58.11
							DEC 25 1984		
1/3/85			2244			10	~~0~~		—
[illegible]	706188	85-0884	85-49	4800.00	800		800	6.00	4800.00
[illegible]/8/85			2395			30	770		

MAX. [illegible] MIN.	SIZE 5 gallon pails	ARTICLE [illegible] Cable pulling [illegible]	P59XAKG 3800 MIN 400 1030	UNIT Gal.	MATERIAL-BIN NO. [illegible]

STORES LEDGER

Date of Receipt or Issue	Purchase Order or S T No	Purchased From / Issue Requisition No.	Material Received: Cost	Material Received: Quantity	Quantity Issued	Balance on Hand: Quantity	Balance on Hand: Unit Cost	Balance on Hand: Amount
[illegible]		Brought Forward		1000	735	265	5.100	1351.50
[illegible]	CT8060	84-3[illegible] SH-140	6000.00	1000		1265	5.811	7351.50
[illegible]		[illegible]			25	1240		
[illegible]		6932			15	1225		
[illegible]		6994			20	1205		
[illegible]		7150			10	1195		
[illegible]		7217			30	1165		
[illegible]		7214			25	1140		
[illegible]		[illegible]			30	1110		
[illegible]		7249			15	1095		
[illegible]		[illegible]			5	1090		
[illegible]		[illegible]			25	1065		
[illegible]		7350			25	1040		6043.44
						JUN 25 1984		
[illegible]		8306			30	1010		
[illegible]		8707			30	980		
[illegible]		8801			20	960		
[illegible]		9234			25	935		
[illegible]		9238			15	920		
[illegible]		9291			20	900		
[illegible]		9438			5	895		
[illegible]		9701			10	885		
[illegible]		[illegible]			10	875		
[illegible]		10157			30	845		
[illegible]		10248			25	820		
[illegible]		10429			20	800		
9-12-84	1073	84-26			80	720		
				9160	1280	720		

MAX [illegible] MIN

SIZE 5 gallon pails

ARTICLE [illegible] Min-500 [illegible]

UNIT [illegible]

MATERIAL BIN NO

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STORES LEDGER

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Date of Receipt or Issue	Purchase Order Cost No	Purchased From	Issue Requisition No.	Material Received Cost	Material Received Quantity	Quantity Issued	Balance on Hand Quantity	Balance on Hand Unit Cost	Balance on Hand Amount
10/3/83	677349	84-0050	84-11	5100.00	1,000		1,000	5.100	5100.00
11/1/83			483			40	960		
11/1/83			984			50	910		
11/7/83			1124			30	880		
11/9/83			1182			25	855		
11/8/83			1298			15	840		4284.00
							DEC 25 1983		
1/3/84			2814			25	815		
1/4/84			3779			20	795		
1/5/84			3850			20	775		
1/12/84			3083			20	755		
1/14/84			3111			80	675		
1/15/84			3141			30	645		
1/16/84			3113			10	635		
1/19/84			3927			25	610		
1/23/84			3429			40	570		
2/1/84			3934			25	545		
2/1/84			3735			40	505		
2/2/84			3777			40	465		
2/7/84			3929			25	440		
2/7/84			3930			25	415		
3/9/84			4192			30	385		
3/21/84			5152			30	355		1810.50
							MAR 25 1984		
4/3/84			5260			25	330		
4/9/84			5677			20	310		
4/11/84			5730			20	290		
4/13/84			5857			25	265		

MAX CL-640 | MIN | SIZE 5 gallon pails | ARTICLE Lubricant Cable Pulling Polywater | 1000 | 725 | UNIT can | MATERIAL BIN NO [illegible]

TVA 244 (FD-8-49)

STORES LEDGER

TVA 244 (FD-8-49)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Date of Receipt or Issue	Purchase Order or S T No	Purchased From / Issue Requisition No	Material Received: Cost	Material Received: Quantity	Quantity Issued	Balance on Hand: Quantity	Balance on Hand: Unit Cost	Balance on Hand: Amount
9-24-82		Amt. fwd		60	32	28	14.817	
9-28-82		8873			1	27		
9-29-82		8900			6	21		311 30
						SEP 30 1982		
11-1-82		913			2	19		
"		914			1	18		266 74
						DEC 25 1982		
						MAR 25 1983		
5-16-83		5961			2	16		
6-15-83		6953			2	14		
6-22-83		7121			1	13		192 65
						JUN 25 1983		
8/8/83	677308	83-4565 83-194	574 35	35		48	15.979	767 00
8/24/83		10372			1	47		
8-30-83	1073	83-26			2	45		719 06
		INVENTORY 08 30 83				45		
						SEP 30 1983		
						DEC 25 1983		
1-24-84		3473			2	43		687 10
						MAR 25 1984		
						JUN 25 1984		
						43		
9/11/84		10568			2	41		
9/14/84		10646			5	36		
9/24/84		10935			2	34		543 29
				95	61			
						SEP 30 1984		

MAX	SIZE	ARTICLE	UNIT	MATERIAL BIN NO
#79	50# bags	Soapstone Powder #3192K14 Min - 15 9/84	bags	W10 B4 21.22
MIN.				

STORES LEDGER

Date	Purchase Order Received From / Issue Requisition No.	Material Received Cost	Material Received Quantity	Quantity Issued	Balance on Hand Quantity	Unit Cost	Amount
3-3-80	Ant. fuel		60	8	52	14.819	
3-1-80	5769			5	47		
3-18-80	6339			1	46		681 67
					MAR 25 1980		
4-30-80	7630			1	45		666 86
					JUN 25 1980		
6 27 80	9268			1	44		
8-19-80	10454			1	43		637 22
	INVENTORY 828 80				43		
9-26-80	11315			1	42		622 40
					SEP 30 1980		
					DEC 26 1980		
2-25-81	3141			2	40		592 76
	INVENTORY 04 10 81				MAR 25 1981		
					40		
					JUN 25 1981		
8-24-81	7045			4	36		533 48
					SEP 30 1981		
					DEC 25 1981		
3-12-82	3808			4	32		474 21
					MAR 25 1982		
					JUN 25 1982		
8-12-82	7467			1	31		
	INVENTORY 08 16 82				31		
8-19-82	7657			1	30		
9-15-82	8396			1	29		
9-27-82	8829			1	28		

Max	Size	Article	Unit	Material Sym No.
#79	50# bags	Soapstone Powder #3192K14	bags	Wat 10 8-3
Min				

TVA 244 (FD-8-49)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Date	Purchase Order or R.T. No.	Purchased From	Issue Requisition No.	Material Received Cost	Material Received Quantity	Quantity Issued	Balance on Hand Quantity	Balance on Hand Unit Cost	Balance on Hand Amount
2-22-77	545317 ✓	77-5030	77-158	160 00	20		20	8.00	160.00
								MAR 25 1977	
3-28-77	1732	DSS 77-109		44 60			20	10.23	204 60
								JUN 25 1977	
							SEP 30 1977		
							DEC 25 1977		
							MAR 25 1978		204 60
							JUN 25 1978		
		INVENTORY JUL 17 1978					20		
							SEP 30 1978		
							DEC 25 1978		
3-9-79			9191			1	19		194 37
							MAR 25 1979		
4-5-79	577830	79-2809	79-125	340 00	20		39	13.702	534 37
5-1-79	"	79-3094	79-142	340 00	20		59	14.819	874 37
6-2-79			14270			50	9		133 37
							JUN 25 1979		
7-19-79			16269			1	8		
7-21-79			16309			2	6		
7-25-79			14270-A			49	55		
		INVENTORY 7 31 79					55		
8-3-79			16896			1	54		
8-6-79			17033			1	53		
8-22-79			17709			1	52		770 59
							SEP 28 1979		
							DEC 25 1979		

Max.	Size	Article	Unit	Material Dis. No.
IV 79	50# bags	Soapstone Powder #3192K14	bag	MAT 10 [illegible]
Min.				Ban [illegible]

STORES LEDGER

TVA 2H (FD-8-49)

STORES LEDGER

Date		Order No.	Material Received Cost	Material Received Quantity	Quantity Issued	Balance on Hand Quantity	Unit Cost	Amount
	Amt. fwd.			2800	2649	151	4.478	
6-4-79		14382			4	147		
5-22-79		14504			4	143		
6-7-79		14567			100	43		
6-18-79		15038			4	39		174 64
6-19-79		15081			4	35		156 73
						JUN 25 1979		
6-27-79		15343			8	27		
7-10-79		15875			8	19		
"		15876			8	11		
7-24-79		16558			8	3		
	INVENTORY 7 31 79					3		
8-2-79		16936			3	-0-		-0-

SEP 28 1979
DEC 25 1979
MAR 25 1980
JUN 25 1980
SEP 30 1980
DEC 26 1980
MAR 25 1981
JUN 25 1981
SEP 30 1981
DEC 25 1981
MAR 25 1982
JUN 25 1982
SEP 30 1982

TVA 214 (FD-8-49)

MAX	SIZE	ARTICLE	UNIT	MATERIAL CODE NO
15-231 + 15-232	1 gallon			
MIN: K-Green	5 gallon	Lubricant, wire pulling	Gal.	

STORES LEDGER

[illegible]	Purchase Order Purchased From / Issue Requisition No.	Material Received: Cost	Material Received: Quantity	Quantity Issued	Balance on Hand: Quantity	Balance on Hand: Unit Cost	Balance on Hand: Amount
	Amt fwd		2800	1563	1237	4.478	
3-21-79	10024			4	1233		5521.37
					MAR 25 1979		
3-28-79	10145			16	1217		
"	10146			100	1117		
3-30-79	10147			25	1092		
3-26-79	10148			12	1080		
3-27-79	10149			5	1075		
4-2-79	10710			48	1027		
4-3-79	10807			3	1024		
4-4-79	10935			25	999		
4-8-79	11200			20	979		
4-9-79	11379			150	829		
4-10-79	11544			100	729		
4-11-79	11545			4	725		
4-12-79	11612			8	717		
4-18-79	11753			4	713		
4-24-79	12167			150	563		
4-27-79	12462			100	463		
5-3-79	12637			4	459		
5-3-79	12638			8	451		
5-3-79	12639			150	301		
5-11-79	13296			10	291		
5-15-79	13360			12	279		
5-22-79	13743			12	267		
5-29-79	13951			100	167		
6-3-79	14331			4	163		
"	14315			12	151		

Max / Min	Size	Article	Unit	Material Bin No.
15-231 + 15-232 / Hi-Green	1 Gallon / 5 Gallon	Lubricant, wire pulling	Gal.	[illegible]

TVA 244 (FD-8-49)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Date of Issue	Purchase Order Ors & No	Purchased From	Issue Requisition No	Material Received Cost	Material Received Quantity	Quantity Issued	Balance on Hand Quantity	Balance on Hand Unit Cost	Balance on Hand Amount
9-1-78	556343 ✓	78-6217	78-231	12,537.00	2800		2800	4.478	12,537.00
							SEP 30 1978		
10-7-78			410			125	2675		
10-18-78			1118			125	2550		
10-26-78			1552			80	2470		
12-4-78			3398			100	2370		
12-19-78			4244			100	2270		10,165.06
							DEC 25 1978		
1-6-79			5046			100	2170		
1-25-79			5925			125	2045		
2-6-79			6924			4	2041		
2-14-79			7362			100	1941		
2-15-79			7432			10	1931		
"			7433			4	1927		
2-21-79			7897			20	1907		
"			7940			10	1897		
2-23-79			8069			25	1872		
2-26-79			8264			15	1857		
2-23-79			8265			5	1852		
3-2-79			8590			150	1702		
3-1-79			8589			95	1607		
3-7-79			8942			10	1597		
"			8943			10	1587		
3-13-79			9310			50	1537		
3-15-79			9367			100	1437		
3-15-79			9487			100	1337		
3-20-79			9914			100	1237		

Max / Min	Size	Article	Unit	Material Bin No
#15231 + 15-232 / Hi-Green	1 Gallon / 5 Gallon	Lubricant, wire pulling	Gal.	[illegible]

STORES LEDGER

TVA 244 (FD-8-49)

STORES LEDGER

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Date	Purchase Order or S.I. No.	Purchased From / Issue Requisition No.		Material Received Cost	Material Received Quantity	Quantity Issued	Balance on Hand Quantity	Balance on Hand Unit Cost	Balance on Hand Amount
9-16-82		Amt. fwd			6069	3946	2123	4.073	
9-15-82			8395			8	2115		
							2115		
9-22-82			8735			8	2107		
9-28-82			8874			5	2112		8602.18
							SEP 30 1982		
							DEC 25 1982		
2-11-83	Fed Ind Equip	11-239162	83-15			2112	-0-		-0-
							MAR 25 1983		
							JUN 25 1983		
							SEP 30 1983		
							DEC 25 1983		
							MAR 25 1984		

Max	Size	Article	Unit	Material Bin No.
EXR-X51	5 gal.	Lubricant, wire pulling, [illegible]	gal.	[illegible]
Min #77	1 gal.			I-6

TVA 244 (FD-5-49)

STORES LEDGER

TVA 214 (FD-8-13)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Date	Purchase Order or S. T. No.	Purchased From / Issue Requisition No.	Material Received Cost	Material Received Quantity	Quantity Issued	Balance on Hand Quantity	Balance on Hand Unit Cost	Balance on Hand Amount
3/17/82		Beacon Chemical		6069	3612	2457	4.073	
3-26-82		3871			12	2445		9958.49
						MAR 2 5 1982		
4-5-82		4219			43	2402		
4-6-82		4267			20	2382		
4-7-82		4324			5	2377		
4-15-82		4458			8	2369		
4-15-82		4471			20	2349		
4-20-82		4584			5	2344		
4-21-82		4597			2	2342		
5-14-82		5101			12	2330		
5-18-82		5183			1	2329		
5/28/82		5322			20	2309		
6/3/82		5511			12	2297		
6/16/82		6039			10	2287		
6/23/82		6221			24	2263		4217.20
						JUN 2 5 1982		
7/15/82		6688			12	2251		
7-21-82		6813			20	2231		
7-27-82		6967			16	2215		
7-28-82		6928			8	2207		
8-4-82		7286			8	2199		
"		7287			20	2179		
8-10-82		7409			8	2171		
8-17-82		7592			20	2151		
8-27-82		7819			12	2139		
9-2-82		8044			8	2131		
9-15-82		8594			8	2123		

2000 ea. 1 gal.
1000 ea. 5 gal.
(211 @ 5 gal.)

MAS / MIN	SIZE	ARTICLE	UNIT	MATERIAL BIN NO.
EXR-X51 / #77	5 gallon / 1 gallon	#31-351 #31-355 6069 3846 Lubricant wire pulling [illegible]	[illegible]	[illegible] 3-6

STORES LEDGER

TVA 244 (FD-8-49)

Date of Receipt or Issue	Purchase Order or S.T. No.	Purchased From / Issue Requisition No.	Material Received: Cost	Material Received: Quantity	Quantity Issued	Balance on Hand: Quantity	Balance on Hand: Unit Cost	Balance on Hand: Amount
7/31/81		Brought Forward		6069	3264	2805	4.073	
7/20/81		6176			25	2780		
8-12-81		6680			20	2760		
8-27-81		7043			8	2752		
9-1-81		7167			20	2732		
9-2-81		7165			4	2728		
9-15-81		7500			20	2708		
9-18-81		7578			15	2693		
9-23-81		7707			8	2685		10,936 01
						SEP 30	1981	
10-9-81		9			8	2677		
10-1-81		44			6	2671		
10-27-81		666			15	2656		
12-1-81		1386			20	2636		
12-4-81		1552			8	2628		
12-10-81		1666			8	2620		
12-15-81		1802			8	2612		
12-22-81		1954			8	2604		10,606 09
						DEC 25	1981	
1-7-82		2052			20	2584		
1-8-82		2054			15	2569		
1-20-82		2414			8	2561		
1-25-82		2547			16	2545		
1-21-82		2667			20	2525		
2-10-82		3006			8	2517		
2-11-82		3008			20	2497		
2-24-82		3424			20	2477		
3-12-82		3508			20	2457		

2000 ea. 1 gal.
1660 ea. 5 gal.
(2000 5 gal.)

Max / Min	Size	Article		Unit	Material Bin No.
Max: EYR-X51 Min: #77	5 gallon 1 gallon	Lubricant series sulfur yellow	#31-351 6069 3612 #31-355	Gal.	[illegible]

STORES LEDGER

Date	Purchase Order / Cost No.	Purchased From	Issue Requisition No.	Material Received Cost	Material Received Quantity	Quantity Issued	Balance on Hand Quantity	Balance on Hand Unit Cost	Balance on Hand Amount
10-6-79		Amt. fwd			3069	2985	84	5.45	
10-1-79			8			8	76		
"			9			12	64		
"			10			8	56		
10-3-79			18			8	48		
"			24			10	38		
10-4-79			25			5	33		
"			34			33	-0-		-0-
							DEC 25 1979		
							MAR 25 1980		
							JUN 25 1980		
							SEP 30 1980		
							DEC 26 1980		
							MAR 25 1981		
2-27-81	R-623538	81-1354	81-99	12,218 00	3000		3000	4.073	12,218 00
3-2-81			3760			20	2980		
4-8-81			4065			20	2960		
4-21-81			4305			4	2956		
4-27-81			4384			4	2952		
		INVENTORY 04 10 81					2952		
5-13-81			4746			30	2922		
5-20-81			4887			8	2914		
6-5-81			5250			24	2890		
6-15-81			5387			20	2890		11,659 51
							JUN 25 1981		
6-29-81			5680			25	2845		
7-8-81			5990			40	2805		

Max / Min	Size	Article	Unit	Material Bin No.
Max: EXR-X51	5 gallon	#31-351 #31-355 6069 3264		Ret 15
Min: #77	1 gallon	Lubricant, wire pulling, yellow	Gal.	Row [illegible]

2000 ea. - 1 gal.
1000 ea. - 5 gal.
(200 @ 5 gal)

TVA 244 (FD-8-49)

STORES LEDGER

Date of Receipt or Issue	Purchase Order or S.T. No.	Purchased From / Issue Requisition No.	Material Received Cost	Material Received Quantity	Quantity Issued	Balance on Hand Quantity	Unit Cost	Amount
		Amt forwarded		2925	2659	266	3.938	
4-14-78		17283			120	146		574 95
						SEP 30 1978		
10-7-78		410			100	46		
10-9-78		606			4	42		
10-12-78		827			8	34		
"		828			10	24		
10-27-78		1549			2	22		
11-7-78		1878			4	18		
12-15-78		3963			5	13		51 19
						DEC 25 1978		
1-5-79		4436			5	8		
1-11-79		5400			5	3		
3-1-79		8589			3	0		0
						MAR 2 1979		
						JUN 25 1979		
8-16-79	FPO# 546488	– 79-212	610 40	112		112	5.45	610 40
8-14-79	FPO# 546401	– 79-212	174 40	32		144	5.45	784 80
8-29-79		18172			8	136		
8-3-79		18264			4	132		
8-31-79		18319			8	124		
9-4-79		18369			8	116		
9-8-79		18524			4	112		
"		18525			12	100		
9-18-79		19030			4	96		
9-19-79		19031			4	92		
"		19032			8	84		457 80

Max	Size	Article		Material Bin No
EXR-XSI	5 Gallon	3069 2925	SEP 28 1979	
Min #77	1 Gallon	Lubricant, wire pulling yellow	Gal.	

TVA 244 (FD-8-49)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Date of Receipt or Issue	Purchase Order or S.T. No	Purchased From	Issue Requisition No.	Material Received Cost	Material Received Quantity	Quantity Issued	Balance on Hand Quantity	Balance on Hand Unit Cost	Balance on Hand Amount
[illegible]		[illegible]			1425	650	775	4.419	3424.73
3-31-78			5122			4	771		
4-10-78			9088			12	759		
4-25-78			[illegible]55			4	755		
5-3-78			10669			48	707		
5-8-78			10483			48	659		
5-9-78			10684			150	509		
5-12-78			10801			150	359		
5-16-78			10932			359	-0-		-0-
							JUN [illegible] 1978		
[illegible]-78	556328	78-4936	78-182	5892 30	1495		1495	3.941	5892 30
6-24-78			12426			6	1489		
6-15-78			13051			99	1390		
6-10-78			13183			150	1240		
6-15-78			13184			30	1210		
[illegible]			[illegible]			396	814		
7-26-78			14309			80	734		
7-29-78			14646			4	730		
7-31-78			14698			4	726		
8-3-78			15103			4	722		2845.40
8-3-78	556328	78-5647	78-210	17 70	5		727	3.938	2863 10
8-10-78			15312						
,			15313			12	715		
8-17-78			15607			200	515		
8-21-78			15933			160	355		
8-25-78			16447			4	351		
8-30-78			16411			5	346		
						80	266		

INVENTORY JUL [illegible] 1978

MAX / MIN	SIZE	ARTICLE	UNIT	MATERIAL BIN NO
EXR-XS1 / # 77	5 Gallon / 1 Gallon	Lubricant, Wire Pulling. Yellow	Gal.	[illegible]

STORES LEDGER

TVA 244 (FD-8-49)

STORES LEDGER

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Date of Receipt or Issue	Purchase Order or S.T. No.	Purchased From	Issue Requisition No.	Material Received Cost	Material Received Quantity	Quantity Issued	Balance on Hand Quantity	Balance on Hand Unit Cost	Balance on Hand Amount
[illegible]		Amt last [illegible]			875	430	445	4.977	
			714			8	437		
10-21-77			922			2	435		
10-31-77			1439			12	423		
11-4-77			1526			2	421		
"			1676			16	405		
11-5-77			1697			4	401		
11-11-77			1975			25	376		
			2106			12	364		
11-17-77			2235			40	324		
11-18-77			2441			4	320		
11-25-77			2817			3	317		
11-31-77			2822			12	305		
11-30-77			2938			4	301		
12-30-77			3952			5	296	4.979	1473.78
							DEC 2 5 1977		
12-20-77	547741	78-1590	78-60	2264.90	550		846	4.419	3738.62
1-5-78			4563			8	838		
1-9-78			4735			4	834		
1-14-78			4922			10	824		
"			5115			2	822		
1-[illegible]-78			5114			[illegible]	810		
1-24-78			5556			4	806		
2-14-78			6215			12	794		
3-9-78			7405			4	790		
3-15-78			7496			14	776		
3-22-78			8028			1	775		3424.73
							MAR 15 1978		

MAX	SIZE	ARTICLE			UNIT	MATERIAL BIN NO.
1XR-XB1	5 gallon		~~2200~~ 1825	650		
MIN [illegible]	1 gallon	[illegible]			[illegible]	

TVA 211 (FD-8-49)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Date	Purchase Order or Req. No.	Purchased From / Issue Requisition No.		Material Received Cost	Material Received Quantity	Quantity Issued	Balance on Hand Quantity	Unit Cost	Amount
		cont. art. fwd			325	265	60	4.244	
5-2-77			10827			12	48		
5-[illegible]-77			10936			1	47		
5-12-77			11242			8	39		165 52
4-20-77	549622	77-6270	77-214	217 00	50		89	4.298	382 52
5-6-77	"	77-6607	77-214	2550 00	500		589	4.779	2932 52
5-16-77			10057			4	585		
5-20-77			11409			16	569		
5-23-77			11673			5	564		
5-23-77			11733			4	560		
5-27-77			11822			10	550		
6-11-77			12333			2	548		
"			12335			6	542		
6-14-77			12474			2	540		2688 06
									JUN 25 1977
6-28-77			13070			4	536		
6-29-77			13071			1	535		
7-12-77			13541			5	530		
7-15-77			13719			10	520		
[illegible]			14104			15	505		
8-4-77			14577			5	500		
8-16-77			14999			5	495		
8-30-77			15442			4	491		
"			15443			12	479		
9-19-77			16195			25	454		2260 47
							SEP 30 1977		
10-4-77			143			5	449		
			144			4	445		

MAX EXR-XS1 #77 | SIZE 5 gallon / 1 Gallon | ARTICLE Lubricant Yellow 77 | UNIT Gal. | MATERIAL BIN NO. [illegible]

STORES LEDGER

TVA 211 (FD-8-49)

STORES LEDGER

Date of Receipt or Issue	Purchase Order or S.T. No.	Purchased From	Issue Requisition No.	Material Received Cost	Material Received Quantity	Quantity Issued	Balance on Hand Quantity	Balance on Hand Unit Cost	Balance on Hand Amount
			Amt brt forward		125	96	29	4.661	
7-13-76			2401			10	19		
9-17-76			2741			2	17		
9-28-76			3154			12	5		20.31
								SEP 30 1976	
10-6-76			3587			2	3		
11-1-76		1673 #	77-2			10	13		
		INVENTORY NOV 1 1976							
11-5-76			4466			1	12		
[illegible]-76			4546			5	7		28.73
11-[illegible]-76	545.34	77-2734	7785	852.00	200		207	4.[illegible]44	875.43
11-12-76			4876			6	201		
11-19-76			5127			2	199		
12-3-76			5509			5	194		
12-[illegible]-76			5717			8	186		
12-6-76			5721			10	176		
12-8-76			5725			8	168		
								DEC 31 1976	[illegible]
1-10-77			6931			5	163		
1-19-77			7255			8	155		
1-28-77			7506			5	150		
	Sequoyah	#94667	7725			50	100		
2-18-77			8368			10	90		
3-16-77			9220			12	78		331.03
								MAR 25 1977	
3-26-77			9702			6	72		
4-25-77			10573			4	68		
4-29-77			10790			8	60		

Max / Min	Size	Article			Unit	Material Bin No
MAX EYR-XS1 MIN #77	1 gallon	Lubricant, Wire Pulling	325	265	Can	R[illegible]

TVA 244 (FD-8-49)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

STORES LEDGER

Date of Receipt or Issue	Purchase Order or S T No.	Purchased From	Issue Requisition No.	Material Received Cost		Material Received Quantity	Quantity Issued	Balance on Hand Quantity	Unit Cost	Amount	
7-30-74	P/O 454068	Thomas Bryant Electric	75-17	93	75	25		25	3.75	93	.75
8-1-74			115				6	19		71	25
8-21-74	55113	75-1136	75-35	412	00	100		119	4.061	453	25
9-10-74			234				4	115			
"			235				5	110		446	71
		INVENTORY	OCT 10 1974					[illegible]	SEP	25 1974	
11-19-74			454				1	109			
12-4-74			507				2	107		434	53
									DEC	25 1974	
									[illegible]	1975	
									JUN	30 1975	
										434	53
									SEP	25 1975	
11-17-75			1244				2	105			
		INVENTORY	DEC 2 1975								
										426	40
									DEC	25 1975	
									MAR	25 1976	
4-7-76			4502				2	103			
5-13-76			5806				1	102			
6-14-76			6561				10	92			
6-18-76			6718				6	86		349	25
									JUN	30 1976	
7-2-76			41				2	84			
7-6-76			42				15	69			
7-22-76			522				10	59			
7-27-76			712				12	47			
9-21-76			1430				8	39			
EXR XS1			2240				10	29			

Max	Size	Article	Unit	Material-Bin No
77	1 Gallon	Lubricant Wire Pulling Ideal Yellow #77	CAN	R13-5 38-5
Min				

TVA 244 (FD-8-49)

ITEM 3

Describe in detail the process of elimination used in determining the worst-case conduits with regard to cable pulling. Include such information as the lengths of conduit considered to be too short to be of concern, the assumptions used in scoping the worst-case conditions, and the methods used to determine the 12 worst-case conduits.

RESPONSE

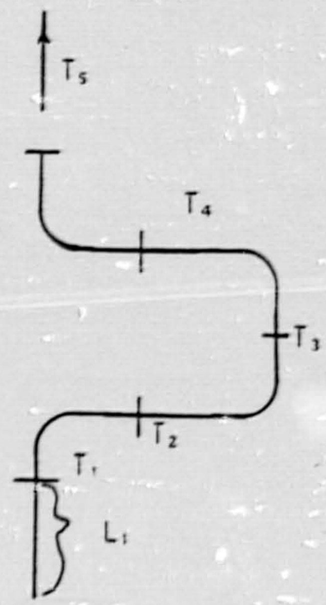
The purpose of the calculations was to determine acceptability of sidewall bearing pressures (SWP) exerted on Class 1E cables in existing conduits. All Class 1E (approximately 10,400) conduits were evaluated through preliminary screening, field inspection, and detailed calculations.

A. PRELIMINARY SCREENING

The screening analysis was performed as follows:

(1) Developed a list of assumed worst-case configurations based on vertical conduit with four 90° bends in pulling end of conduit. The cable pull was assumed to be upward. See figure:

3" Conduit
3 Cables
W_c = 1.4
K = 0.42
R = 0.955 ft.
a = 90° (1.57 rad)
Sidewall bearing pressure (SWP) = 300 lbs/ft (Conservatively assumed)
W = Cable weight per foot



(2) Calculated maximum pulling tension allowable to avoid exceeding sidewall bearing pressure limits (300 lbs/ft for power and control; 100 lbs./ft. for instrumentation).

EXAMPLE: $T = \frac{3(SWP)R}{(3W_c-2)}$

T = 391 lbs for above figure

(3) Calculated length of conduit in terms of W that would correspond with allowable sidewall bearing pressure limits. This was done for all the conduit sizes and number of cables in each conduit.

EXAMPLE: $T_1 = WL_1$

$$T_2 \approx T_1 e^{\kappa a} = T_1 \quad (1.93)$$
$$T_3 \approx T_2 e^{\kappa a} = T_1 \quad (3.72)$$
$$T_4 \approx T_3 e^{\kappa a} = T_1 \quad (7.18)$$
$$T_5 \approx T_4 e^{\kappa a} = T_1 \quad (13.86) = WL_1 \ (13.86)$$

$$L_1 = \frac{T_5}{(13.86)(W)} = \frac{391}{(13.86)W} = \frac{28.21}{W}$$

(4) Screened the conduit schedule for lengths exceeding the calculated lengths by using nominal weights of cables. A large number of extremely short cables were eliminated from further analysis because they were shorter than the length of four 90° bends.

The original number of 10,400 conduits was reduced during the preliminary screening process to a list of 1,914 conduits requiring further evaluation.

Conservatism was used in the screening method because:

(a) sidewall bearing pressure criteria used in the screening was 300 lb/ft. Test results of 600-1500 lb/ft were later obtained in tests performed by TVA to determine SWP capabilities of various cables,
(b) four conduit bends were assumed back to back. Using a more typical conduit with bends distributed throughout the conduit could result in pulling tensions 1/2 to 1/4 of those in screening, and
(c) initial conduit section assumed to be vertical. This assumption doubled the resultant tension as compared to pulling through a horizontal section (which is far more typical).

B. FIELD INSPECTION

Obtained a sample size of 81 worst-case conduits for detailed calculations (approximately 20 conduits per voltage level). The worst-case conduits were selected by visual inspection of 778 of the 1,914 conduits using the criteria of multiple bends (>360°), long lengths, elevation changes, and conduit fill ($\geq$30%) (EEB Engineering Procedure 22.29).

C. DETAILED CALCULATIONS

The detailed calculations of the 81 worst-case conduits showed 12 conduits exceeding the sidewall bearing pressure limits of 300 lbs/ft or 100 lbs/ft as applicable. These values are based on the assumption that the cables were pulled in the direction that would cause sidewall bearing pressures to be greater.

ITEM 4

Discuss the extent to which the following were considered in determination of the worst-case cable pulling situations:

a. Pull-by in which new cable was pulled past cable already in a conduit.
b. Differences in cable construction, jacket materials, and diameters when one type of cable was pulled by another in a conduit.
c. Differences in cable construction, jacket materials, and diameters when mixes of cable types were included in a multiple pull.

RESPONSE

Differences in cable construction, jacket materials, and diameters were not specifically considered in TVA's evaluation of the worst-case cable pulling situations. The concern of cable "pull-bys" was considered on a generic basis by TVA when preparing its sidewall pressure evaluation program. As it is normal practice to route only one circuit in power level conduits, pull-bys occur generally in instrumentation and control level conduits only. Typical conductor sizes routed in such conduits are No. 8 through No. 16 AWG. The results of the cable sidewall bearing pressure tests indicate that for such conductor sizes, the limiting parameter for installation is not sidewall pressure, but rather conductor strength.

An NRC review team conducted an interview on September 9, 1986 with TVA construction employees knowledgable of cable pulling practices at WBN. As indicated then, the construction employees knew their business well, good construction practices were used, ample amounts of cable lubricant were used, and the work was done in the presence of quality control inspectors. Work was stopped if a problem developed during a pull and a construction engineer was called to evaluate the situation before continuing. The above practices were followed to avoid cable damage during pulls.

In addition, the calculations performed included specific conservatism in regard to cable pull-bys. The conduit configuration utilized assumed an entirely vertical conduit run with all conduit bends at the top of the run (the cable was assumed to have been pulled upwards). Therefore, the tension assumed going into the bends was equal to the full weight per foot of the cable multipled by its length. If the pull were assumed to be horizontal, as the great majority of conduit runs are, the weight of the cable would be offset by the effective coefficient of friction, thereby, more than halving the resulting tension into the bends. In addition, by assuming all cables were pulled together, TVA has calculated a tension and corresponding sidewall pressure based on the total weight of all cables. If only a portion of the cables were pulled at one time the resulting tension and, therefore, sidewall pressure would be proportionately reduced.

ITEM 5

Describe the extent to which different classes of cables that may be intermixed within a conduit (e.g., V5 with V4, etc.).

RESPONSE

The design maintains separation of the cables by voltage classification.

Design Input Memorandum DIM-WB-DC-30-5-3 to Watts Bar Design Criteria WB-DC-30-5, "Power Control, and Signal Cables for use in Category I Structures," which was issued March 13, 1986 states that cables routed in conduit shall be separated by voltage levels with two exceptions.

1. Cables of different voltage levels may be routed together when a piece of equipment has only one conduit opening. These cables should be separated with respect to voltage levels as soon as possible. Generally these are very short lengths (less than three feet).

2. When the circuit protective device in a radial feeder is capable of interrupting both power and control circuits for a piece of equipment, the associated power and control cables may be routed together in the same conduit.

This DIM was issued to formally document the requirements for separation of voltage levels in conduits which had been explicitly stated for cable trays. However, the design reflects that the same voltage level separation has been maintained in conduits as in cable trays. The 81 worst-case conduits in the SWP study did not have mixed voltage levels in them.

ITEM 6

Describe the types of repairs that may be performed on cables or their jackets.

RESPONSE

When an insulated cable becomes damaged (i.e., conductor strands are nicked or insulation cut) it is either spliced, replaced, or repaired depending on the extent of damage. TVA General Construction Specification G-38, "Installing Insulated Cables Rated Up To 15,000 Volts," has the following criteria for Class 1E cable repair.

A. For low-voltage (600V or less) cables, repair to the jacket, shield (where applicable), and insulation may be made with the following restrictions:

a) If the conductor or insulation has been damaged, the cable shall be spliced or replaced.

b) Where damage involves other cable components (i.e., jacket and/or shield) each component shall be repaired individually.

c) Damaged Class 1E coaxial and triaxial cables shall be replaced.

Raychem Type N materials are required to be used for splicing Class 1E cables that are required to function in harsh environments.

B. For medium-voltage (5kV-15kV) power cables, repair may be made to the jacket only. (If damage extends beyond the jacket, the cable shall be spliced or replaced.)

Repairs to both Class 1E low-voltage (except as noted in 6.A.c) and medium-voltage cable jacket damage require the use of Raychem Type N heat-shrinkable sleeving or Raychem NJRS wraparound cable jacket repair sleeves.

ITEM 7

Describe the extent to which repaired or spliced cable is allowed to be pulled into a conduit.

RESPONSE

TVA General Construction Specification G-38 and drawings require Class 1E cables to be spliced in boxes or enclosures in seismic Category I structures, in electrical manholes, handholes, and cable trenches.

Splices for Class 1E cables are typically made where the circuit length exceeds the full standard cable reel length, the cable insulation or conductor has been damaged, or the point of termination must be extended because of a design change.

General Construction Specification G-38 does not prohibit repaired Class 1E cable from being pulled in conduit. However, repairs to cable jacket generally are made after the cable has been pulled. Cable jacket damage to Class 1E cables requires use of either Raychem Type N (Nuclear grade) sleeving or NJRS repair sleeve, except Class 1E coaxial and triaxial cables which are not allowed to be repaired but must be replaced.

ITEM 8

Are the conduits that could have been abused during pulling located in harsh environment areas such that they may be subjected to such conditions as high moisture, flooding, steam, or high temperature conditions during normal or accident periods?

RESPONSE

As noted in the following table, some of the worst-case conduits are located in a harsh environment areas.

CONDUIT	ENVIRONMENT
1-4J-292-1054-G	Mild
0-3MC-290-409-A	Mild
0-3MC-290-409-A	Mild
1-2PM-293-5664-E	Harsh
1-2PM-293-5677-D	Harsh
0-3RM-290-609-B	Mild
1-2PLC-299-62-E	Harsh
1-2PLC-299-82-B	Mild
1-4PLC-292-282-B	Harsh
1-4PLC-292-2810-B	Harsh
1-4PLC-292-2940-A	Mild
1-4PLC-292-2801-A	Harsh
1-4PLC-292-279-B	Harsh

Table Continued (Item 8)

CONDUIT	ENVIRONMENT
1-2PLC-299-61-D	Harsh
1-4PLC-292-2814-B	Harsh
1-2PLC-299-63-G	Harsh
1-2PM-292-7274-A	Harsh
1-2PM-293-5678-D	Harsh
1-2PS-292-704-E	Harsh
1-5PP-292-2189-B	Harsh
1-5PP-292-2656-A	Mild
1-5PP-292-2183-A	Harsh
1-5PP-292-2182-B	Harsh
0-4B-292-1090-G	Mild
1-4B-292-1044-D	Mild
0-3MC-292-629-A	Harsh
1-3M-292-3380-A	Mild
1-3VC-292-580-A	Harsh
1-3PV-290-961-D	Mild
1-3VC-292-582-A	Harsh
1-4VC-292-1082-B	Harsh
1-3VC-292-1077-A	Harsh
1-3G-290-1525-B	Mild
1-3G-290-1524-A	Mild
2-2NM-290-3256-E	Mild
2-4PLC-292-2300-A	Mild
2-4PLC-292-2519-A	Mild
2-4PLC-292-852-A	Mild
2-4PLC-293-1136-A	Harsh

Table Continued (Item 8)

2-3PLC-292-1184-A	Harsh
2-3PLC-292-1185-B	Harsh
2-3M-292-4338-B	Harsh
2-3M-292-3360-A	Mild
2-2PM-293-7869-D	Harsh
2-2PM-292-6444-E	Harsh
2-3PLC-292-2303-A	Mild
2-2PM-292-7400-B	Harsh
2-2PM-293-7872-F	Harsh
2-2PS-292-704-E	Harsh
2-2RM-293-438-A	Harsh
2-2PV-290-825-E	Mild
2-3PLC-292-1928-B	Harsh
2-4PLC-292-1280-B	Harsh
2-4PLC-292-2882-A	Mild
2-4PLC-292-2922-B	Mild
2-3VC-293-2577-A	Harsh
2-2PM-292-7401-A	Harsh
2-2PM-293-6426-D	Harsh
2-4PLC-292-2763-A	Harsh
2-3PLC-290-215-B	Mild
2-4PLC-292-631-B	Harsh
2-4PLC-292-853-B	Mild
2-3M-290-2987-B	Mild
2-3VC-293-2035-B	Harsh
2-3VC-293-2069-B	Harsh

Table Continued (Item 8)

CONDUIT	ENVIRONMENT
2-5PP-292-2183-A	Harsh
2-5PP-292-2296-B	Mild
2-5PP-292-2297-B	Mild
2-5PP-292-2291-A	Mild
2-5PP-292-2292-A	Mild
2-5PP-292-2190-B	Harsh
2-5PP-292-2656-A	Mild
2-5PP-292-2191-A	Harsh
2-3VC-293-1259-B	Harsh
2-4PLC-292-860-A	Mild
0-5PP-296-2488-B	Mild
0-5PP-296-2481-A	Mild
1-5PP-292-2190-B	Harsh
1-5PP-292-2280-A	Harsh
1-5PP-292-2188-A	Harsh
0-5PP-296-2483-A	Mild

ITEM 9

What in-situ testing has been done to the cables on a routine basis or subsequent to the generation of the concerns related to cable abuse?

RESPONSE

After a cable is pulled, a continuity check is performed as part of the termination process. Megger and/or high potential testing is conducted on medium-voltage (6900-V) motor circuits and 100HP and greater low-voltage (480V) motor circuits. As specified in maintenance instructions, periodic testing is performed for medium-voltage motor circuits and 100HP and greater low-voltage motor circuits.

ITEM 10

Describe any testing or monitoring programs that TVA will implement relating to the cables suspected of having been abused?

RESPONSE

Testing is planned as described in item 9. In addition, TVA will implement an extensive trend analysis program to track, consolidate, and categorize identified conditions adverse to quality. This program will be implemented by November 1986. The trend analysis program will readily identify any adverse trends associated with cabling at any TVA nuclear plant. It should be noted that neither TVA nor the industry has identified any adverse trend with cable failures. If negative trends develop, either from within TVA or the industry, TVA would implement actions necessary to ensure safety is maintained.

ITEM 11

Prior to pulls were the conduits known to be clean and obstruction free?

RESPONSE

Since 1968 TVA General Construction Specifications G-40, "Installing Electrical Conduit Systems and Conduit Boxes," require that after a conduit is installed, it shall be inspected and cleaned out, and compressed air shall be used in blowing out any accumulation of trapped liquids.

The nuclear plant site procedures, such as Division of Nuclear Construction's Quality Control Procedure and Quality Control Instruction, and Office of Nuclear Power's Modifications and Additions Instruction (M&AI), include the requirements. WBN procedures, with the exception of WBN M&AI procedures, were previously provided by letter from R. L. Gridley to B. J. Youngblood dated July 25, 1986. The current revisions of applicable WBN M&AI procedures are attached.

WATTS BAR NUCLEAR PLANT

MODIFICATIONS AND ADDITIONS INSTRUCTION

MAI-3

INSTALLATION AND INSPECTION OF INSULATED CONTROL, SIGNAL, AND POWER CABLES

UNITS 1 AND 2

CURRENT REVISION LEVEL: 6

Responsible Section: Modifications

Prepared By: James E. Hoffert

Revised By: James E. Hoffert

Submitted By: [signature]
Supervisor

PORC Review Date: 1/15/86

Approved By: [signature]
for Plant Manager

Date Approved: 1/15/86

Last page of this instruction: 38

1C	Doc Control Unit, LP4S 160D-C
	NRC
1C	NSRS, 249 A HBB-K
1C	Plant Master File
	Plant Manager
	Supt (O&E)
	Supt (Maint)
	Plant Adm Svs Supv
	ASE Duty Station
	Building Services Supv
	Chem Lab
	Chem Engg Unit Supv
	Chief, Nuclear Safety Staff
	Chief, Nuclear Training Branch
	Chief, Quality Audits Br, 1350 CUBB-C
	Compliance Unit
	Component Engg & Svs Group
	DPSO-WBN
1U	Dwg & Vendor Manual Supv
1C	Elect Maint Supv
	Engg Section Supv
	Health Physics Supv
	Health Physics Lab
	Industrial Safety Supv
	Instr Maint Supv
	Instr Shop
	Materials Unit Supv
2C	Mech Maint Supv
	Mech Engg Unit Supv
1C	Modifications Manager
	Operating Instruction Coordinator
	Operations Supv
	Operations Training Sect Supv
	Operator Training Classroom
2C+1U	P&S Supv
2C	Plant QA Supv
	Plant Training Officer
	Power Stores Unit Supv
	Preop Test Supv
	Public Safety
	Reactor Engg Unit Supv
	Shift Engr's Office
	Staff Reference Copy
	Support Svs Supv
	Tech Support Center
	Unit 1 Control Rm
	Unit 2 Control Rm
1C	John Raulston, NEB, W10A63 C-K
	Site Director
	Watts Bar Tech Svs
	Design Svs Manager
1TC	DCU-A-QC
2C	Modif. Elect. Foreman James Hunt

OS/6 331

HISTORY OF REVISION/REVIEW

REV. NO.	DATE	REVISED PAGES	REASON FOR CURRENT REVISION (INCLUDE ALL TEMPORARY CHANGE NUMBERS)
2	82/10/26	All	General revision
3	84/02/14	All	General revision. Move portions of this procedure to MAI-4 and MAI-9.
4	3/04/85	All	Change FSGL to MGL. Incorporate instruction; change TC-85-188. General revision.
5	12/5/85	All	Incorporate Const Spec G-38, revision 6 and SRN-G-38-6.
6	1-15-86	5, 12, 24, 29, 30, 37	Incorporate OC Spec Revision Notice SRN-G-38-7.

1.0 PURPOSE

The purpose of this instruction is to outline the general installation criteria and inspection requirements for the installation of CSSC control, signal, and power cables.

2.0 SCOPE

** This instruction applies to all CSSC and non-CSSC electrical cables routed by OE to be used in control, signal, and power circuits. For non-CSSC cables, QC inspections shall be performed by the craft foreman or cognizant engineer. For non-CSSC cables designated as associated cables, QC inspection of the route only is required. Applicable portions of this instruction should be used for repair of damaged cables or cable repulls under a Maintenance Request.

3.0 REFERENCES

3.1 Source Documents

3.1.1 General Construction Specification G-38, "Installing Insulated Cables Rated up to 15,000 Volts Inclusive"

3.2 Other Documents

3.2.1 MAI-4, "Installation and Inspection of Cable Terminations"

3.2.2 MAI-13, "Installation, Inspection, and Documentation of Exposed Rigid and Flexible Conduit"

3.2.3 MAI-14, "Installation and Inspection of Electrical Penetration Pressure Seals, Fire-Stop Barriers, and Flame Retardant Cable Coating"

3.2.4 MI-57.14 (15), "Splicing of Low (Medium) Voltage Cables"

4.0 GENERAL CRITERIA

4.1 Cable Lubricants

* When pulling cables in conduits, lubricants should be used to minimize the potential for cable jacket and/or insulation damage. When available, manufacturer's instructions shall be followed in applying the lubricant. Other lubricants may be acceptable provided they are approved for use by the vendor of the cable on which the lubricant is to be applied. Recommended cable lubricants are listed below:

4.1.1 For rubber or plastic covered cables use:

(1) Dust with mica or soapstone

(2) Water

(3) Talc

(4) Bishop No. 45 Cable Pulling Lubricant (Bishop Electric, Division of Sola Basic Industries)

(5) Y-er Eas (Electro Compound Company)

(6) Soapstone and water

(7) Soap (low alkali such as Ivory Flakes) and water

(8) Polywater lubricants "A", "G", and "J" (American Polywater Corporation). Use of lubricant "A" should be restricted to pulling applications involving long, vertical runs.

(9) Slip-X 300 (American Colloid Company)

* (10) CRC wire pulling lubricant with Teflon (CRC Chemicals, Inc.)

4.1.2 For braid-covered cables use:

(1) Soapstone

(2) Talc

(3) Soapstone and water thick paste (use very little water and smear the paste lightly on the cable)

4.2 Cable Ties

4.2.1 Cable ties shall be of the self-locking type. Cable ties for general plant use may be of nylon as manufactured by Thomas and Betts Company, AMP Special Industries, Panduit Corporation, All-State, Dennison (South Eastern Associates, Inc.) or equivalent. Stainless steel or Tefzel cable ties may also be used in general plant areas.

4.2.2 Cable ties for use within the primary containment shall be either stainless steel as manufactured by AMP Special Industries or equivalent, or ETFE fluoropolymer (such as Tefzel from Thomas and Betts Company) with a locking device or equivalent. **

4.2.3 The use of cable ties in cable trays is to be kept to a minimum to reduce the quantities of combustible materials in the unlikely event of a fire.

4.2.4 Cable ties in cable trays are color coded corresponding to the color code of the division of cable separation (Attachment 1).

4.3 Cable Identification

4.3.1 Cables routed in cable trays designated for Class IE (train or channel) circuits shall be identified for the division of separation at intermediate points. As a minimum, the identifications (which may be accomplished by means of marking, tagging, or taping) shall occur near tray intersections and along the cable tray system at 5-foot intervals to provide visual verification that the cable installation conforms with the separation criteria (section 4.4.2). The intermediate cable markings shall conform with the color code for the division of cable separation (attachment 1). These cable markings should be applied prior to or during installation. Nondivisional cables are not required to be marked at intermediate points.

4.4 Minimum Bending Radius

4.4.1 The minimum bending radius of an insulated cable consists of two parts:

(1) the minimum pulling radius
(2) the minimum training radius

4.4.2 The minimum pulling radius is the smallest radius to which a cable maybe bent during pulling. This radius is measured on the inner curature of the bend. The minimum cable pull radius shall be six times the outside diameter of unshielded power and control cable and twelve times the O.D. of all shielded cables.

4.4.3 The minimum training radius is the smallest radius to which a cable may be bent after all pulling operations have been completed. Unless relaxed values are approved by OE prior to implementation, the minimum cable training radius for a single conductor cable is the appropriate installation factor from attachment 6 times the O.D. of the cable. For multiconductor cables having an overall shield, the minimum training radius is determined in the same manner as for a single conductor cable. For multiconductor cables not having an overall shield, the minimum training radius is equal to the appropriate installation factor from attachment 6 times the O.D. of the largest conductor in the multiconductor. The training radius for coaxial cable may be relaxed to a value equal to the O.D. of the cable multiplied by a factor of 4; triaxial may likewise be relaxed, except by a factor of 8. For shielded medium voltage cables, the value listed on attachment 7 may be used.

4.5 Maximum Allowable Pulling Force (F_m)

4.5.1 The amount of pulling force used for initial installations, pullbys (a cable pull into a conduit containing cables installed by a previous pull), or pullbacks (the process of removing previously installed cables from raceways) shall be limited to avoid damaging the cable. It is primarily to avoid elongation of the conductor. The pulling force for a cable pull through a specific conduit configuration may be less when sidewall pressure requirements are applied.

*

4.5.2 The maximum allowable pulling force for a single cable pull will be recorded on data sheet 2 by the cognizant engineer. The value supplied by the cable vendor must be used when supplied. If this value is not supplied by the cable vendor, then the cognizant engineer will calculate the force using MGL-E1 and documented on data sheets 2 or 3. This value will be used when connecting a pull rope device to the conductor. When using a basket weave grip (mare's tail), the maximum allowable pulling force shall be limited to:

(1) Unshielded jacket cables--the lesser of 2000 pounds or the value recorded on data sheet 2.

(2) Shield jacket cables--the less of 1000 pounds or the value recorded on data sheet 2.

4.5.3 The maximum allowable pulling force for a group cable pull shall be 80 percent of the sum of the individual maximum allowable pulling forces for power and control cables, or 60 percent of the sum of the individual maximum allowable pulling forces for instrumentation cables. These requirements apply for pulls in conduits or cable trays when a pull rope is required.

4.6 Expected Pulling Force and Sidewall Pressure (SWP)

4.6.1 The sidewall pressure is the radial force exerted on the insulation and cable jacket at a bend point of a raceway when the cable is under tension. The cognizant engineer using MGL-E1 shall calculate the expected SWP in the direction of the pull for cables routed in conduits designated for Class 1E cables prior to making the actual pull.

4.6.2 SWP calculations are not required in the following:

(1) If the monitoring of the pulling force is not required, (see section 4.7.7.2).

(2) If the conduit run is straight between pull points (no bends).

(3) If adherence to F_m requirements prevents violation of the SWP requirements. The F_m is likely to be more restrictive than SWP requirements for instrumentation and small control cables.

(4) If the conduit bend has a large radius. A conduit bend with a radius of 15 feet or greater shall be treated as a straight length in calculating the expected pull forces.

Calculation of the expected SWP requires calculation of the expected pulling force. If the total expected pulling force is less than F_m and the expected SWP is less than the maximum allowable value supplied by the cable vendor (300 lb/ft for power and control cables and 100 lb/ft for instrumentation cables shall be used, in lieu of vendor information) the cables may be pulled; if not, a second calculation shall be made, assuming the pull is in the opposite direction from that assumed in the initial calculation. If still too high, additional pull points must be installed or the raceway routing otherwise changed to bring the expected pulling force and/or expected SWP within acceptable limits. If the expected SWP does not exceed allowable maximum limits at the bend where the greatest expected pulling force occurs, calculation of the expected SWP at other bends is not necessary.

(5) If for initial cable pulls in horizontal conduit, the cable length within the conduit is no greater than that calculated by the cognizant engineer using section 6.4 of MGL-E1 and the tables on attachment G of MGL-E1. The cables show maximum lengths between pull points with equivalent degree bends shown. The cognizant engineer shall document these calculations on Data Sheet 4.

4.7 Cable Installation

4.7.1 The Cable Installation Sheet (Data Sheet 1) specifies the route a cable is required to take between points of termination. Measures shall be taken to ensure that this route is followed in installing the cable. If instances occur where cables cannot be installed exactly as indicated on the Cable Installation Sheet, the cognizant engineer shall be notified for disposition.

4.7.2 Cables shall be installed in conduits and trays that bear the same color-coded separation level except for associated cables. Associated cables are non-CSSC cables routed in trained cable trays and/or conduits; however, they shall not cross from one train to another.

4.7.3 The guidelines outlined below shall be followed when installing cables on cable trays:

4.7.3.1 Cables shall be placed on low-level signal trays, medium-level signal trays, control trays, and 480-volt trays in a neat, orderly fashion. Temporary bridges shall be used at intersections to allow cables to be pulled without excessive interlacing.

4.7.3.2 All medium voltage power cables (5-15-kV) larger than number 2/0 AWG shall be placed on trays in grouped, three-phase circuits. Medium voltage power cables which are No. 2/0 AWG shall be either grouped as above or laid side-by-side with no space between individual conductors. Except as noted in 4.7.3.3 below, the nominal spacing between adjacent 3-phase circuit bundles or between a 3-phase circuit bundle and ungrouped No. 2/0 AWG cables shall be determined as outlined on attachment 2.

4.7.3.3 The nominal spacing defined on attachment 2 may be less at points where cables enter or exit a tray and at tray fittings where necessary to prevent exceeding the minimum cable bending radius as specified on the Cable Installation Sheet. However, nominal spacing should be restored as soon as practical.

4.7.3.4 Cable ties (see section 4.2) may be used where required to maintain a neat orderly arrangement of cables or to maintain the required nominal spacing between medium voltage circuits.

4.7.3.5 In vertical cable trays, cable ties shall be used to support cables at the top of the raceway or as close to the top as practical, plus a support for each additional interval of spacing as specified in the table below. (In vertical solid bottom trays, cable supports as defined on OE drawings shall be provided.) If the total vertical tray riser is less than 25 percent of the spacing specified in the table below, no cable support shall be required.

SPACING FOR CABLE SUPPORTS
IN VERTICAL RACEWAYS

CABLE SIZE	SUPPORT SPAN
18 AWG to 1/0 AWG	Not greater than 100 ft
2/00 AWG to 4/0 AWG	Not greater than 80 ft
250 MCM to 350 MCM	Not greater than 60 ft
400 MCM to 500 MCM	Not greater than 50 ft
750 MCM	Not greater than 40 ft

4.7.3.6 In horizontal cable trays, cable ties are installed at intervals not to exceed 15 feet to confine cables to the contour of the trays (for both changes in direction and elevation) and/or maintain an orderly arrangement.

4.7.4 Supports for cables in vertical conduits shall be provided at the top of the raceway or as close to the top as practical; plus a support for each additional interval of spacing as specified in the table in section 4.7.3.5. If the total vertical riser is less than 25 percent of the spacing specified, then no cable supports shall be required. Commercially available cable support devices, such as Kellems support grips by Harvey Hubbell, Incorporated, may be used. As an alternative, cable support may be provided by use of Dow Corning Sylgard-170 or 3M Company Scotchcast No. 9 (XR-5240) sealants in a condulet or a similar type conduit body such as an "EYS" fitting. Following manufacturer's instructions, the sealant shall be applied around the cable inside the conduit body. Another method of supporting cable in conduit bodies is to use a Raychem NJRS nuclear jacket repair wraparound sleeve; a length of sleeve shall be cut half the length of the conduit body opening and wrapped around the cable(s) following manufacturer's instructions for the sleeving. (This method is intended only to be used on existing conduit. Future conduit installations should have a pullbox installed that would allow a commerical cable support device.)

* 4.7.5 Unless otherwise noted on design drawings, the following guidelines apply to cable installation at cable sleeves or cable slots at electrical penetration fire stop/pressure seals:

* 4.7.5.1 Cables, as practical, should be laid straight and should not cross each other within the penetration.

* 4.7.5.2 When anchoring to the cable tray, slack is to be left in cables by not anchoring to the cable tray for a distance of approximtely 5 feet on each side of the penetration to facilitate fire stop/pressure seal installation. The slack shall not be excessive to the point that cables cannot be neatly arranged within the tray.

* 4.7.5.3 Cables are to be cleaned by wiping with clean cloths to remove any cable pulling lubricant that was applied during the installation process. Only those portions of cables within the penetration where the sealant material is to be installed need to be cleaned.

* 4.7.5.4 Nonmetallic spacers may be temporarily placed between each row of cables outside each penetration where the sealant material is to be installed. After installation of sealant material, the spacers are to be removed. See MAI-14 for details of electrical penetration fire stops.

* 4.7.6 The cable shall be prepared and pulled into raceways by one or a combination of the following methods to the extent practical, smaller size cables should be located nearer the center of the bundle when making group cable pulls.

* 4.7.6.1 Manually. Certain types of raceways have open tops or removable covers, such as cable trays and cable trenches. When pulling in raceways of this type, the most expedient way to pull cable may be to:

(1) Position personnel at corners having sharp edges and periodically along the raceway as required to "hand feed" the cable, or

(2) Pull the cable along the side of the raceway and then lay it into the raceway.

As long as the cable remains in these type raceways and one of the methods described above is used to install the cable, no preparation of the cable for pulling is necessary. However, if the cable must exit and enter another type of raceway (such as a conduit) requiring the use of a pull rope, the end of the cable shall be prepared for pulling that portion of the run in accordance with section 4.7.6.2, 4.7.6.3, or 4.7.6.4.

*

* 4.7.6.2 Cables may be prepared for pulling by forming a loop on the end of the conductor (see Figure 4.7.6.2). To use this method, remove jacket, insulation, and filler materials as needed to fold the conductor back on itself. The cable shall be pulled by connecting to this loop; do not connect to the jacket or insulation. For a multiconductor cable or for a group cable pull, a loop shall be formed on the end of each conductor. Provided the shield and/or drain wire of shielded cables remains under the insulation or jacket, it does not have to be treated as a conductor.

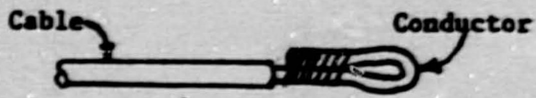


Figure 4.7.6.2: Typical cable pulling arrangement using a loop on the end of the conductor.

4.7.6.3 Crip-on-the-Conductor Pulling Eye. A pulling eye which attaches directly to the conductor (such as a crimp-on-the-conductor pulling eye available from Cyprus Cable Support Systems Company) may be used to pull a cable; see figure 4.7.6.3. To use this method, remove enough jacket, insulation, and filler materials to allow the bare conductor to be inserted into the barrel of the pulling eye. The pulling eye shall then be attached to the conductor according to manufacturer's instructions. When this method is to be used to pull multiconductor cables or for a group cable pull, all of the individual conductors shall be crimped in the barrel of the pulling eye.

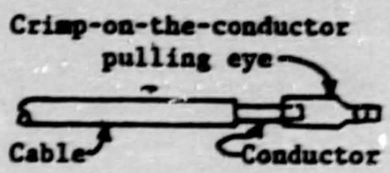


Figure 4.7.6.3: Typical cable pulling arrangement using a crimp-on-the-conductor pulling eye

4.7.6.4 Basket Weave Grips. A fourth acceptable method of preparing the cable for pulling is by use of a basket weave grip (such as a Kellems Pulling Grip available from the Kellems Division of Hubbell) installed according to manufacturer's instructions. See figure 4.7.6.4. Split grips (such as Kellems Universal Slack Pulling Grips or Cable Luffing Grips) are especially useful in cable pullbacks. (An equivalent to the split grip is the field applied "mare's tail" which is a type of basket weave grip constructed by unraveling a rope and reweaving it around the cable.)

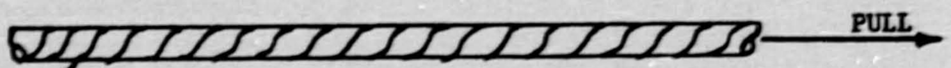
Figure 4.7.6.4: Typical cable pulling arrangement using basket weave grip

4.7.6.5 The sharp points and edges of the hardware used to attach the cable to the pull rope shall be taped or covered with heat shrinkable sleeves to protect the inside of the conduit and any previously installed cables. The pull rope may be manila rope, synthetic fiber rope, or hemp rope.

4.7.6.6 On mechanically assisted pulls, appropriate measures should be taken to protect personnel should breakage of the pull rope occur. A swivel (such as a Pengo-miller available from Hubbell) should be used between the pulling eye and the pull rope on all mechanically assisted pull. (On more difficult hand pulls, a swivel may also be advantageous.) The swivel allows for spin out of the pulling torque relieving the twisting strain on the cable and thereby reducing the difficulty of the pull. Do not run swivels over cable sheaves while under tension and do not exceed the pulling capability of the mechanical pulling device.

4.7.7 Pull Force Monitoring

Except as noted below, the pull force shall be monitored for initial installations as well as reworks to ensure the maximum pull tension specified on the data sheet 1 is not exceeded. Break ropes selected from attachment 3 or a calibrated dynamometer shall be used to limit the pull force. See figure 4.7.7-1.

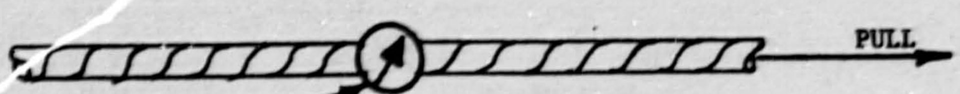


Pull rope having a break strength which does not exceed the maximum pull tension.

or

Break link having a break strength which does not exceed the maximum pull tension.

or



Dynamometer to measure the actual pull force to ensure the maximum pull tension is not exceeded.

or

*

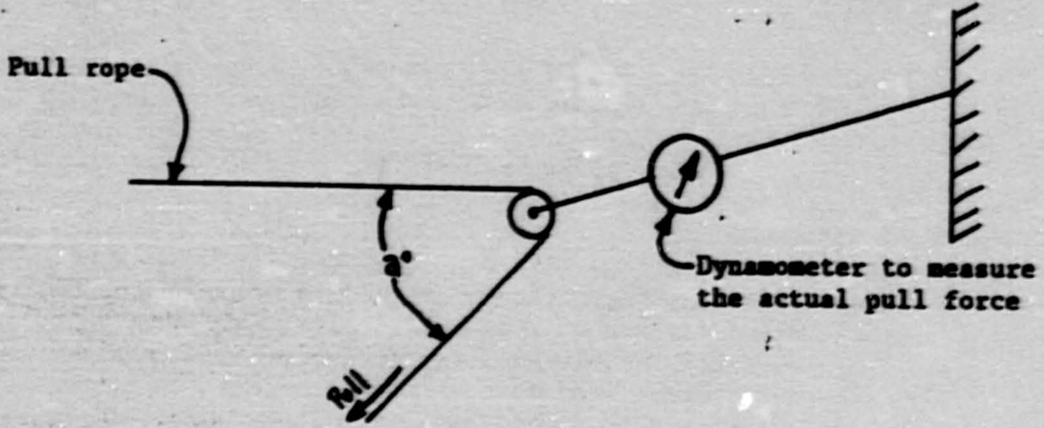


Figure 4.7.7-1: Pull force monitoring

4.7.7.1 When a dynamometer is used and not placed in direct line with the cable pull, the reading on the dynamometer must be multiplied by the appropriate multiplying factor from table 4.7.7.1 to obtain the true pulling force on the cable. The multiplying factor is determined as follows:

$$\text{Multiplying Factor} = 1/[2 \cos (a/2)]$$

When the angle falls between two tabulated values of Angle (a^{o}) in table 4.7.7.1, the multiplying factor may be calculated using the above equation or shall be assumed to be the value for the higher angle.

Angle, a^{o}	Multiplying Factor
0	.5
30	0.518
45	0.541
60	0.578
90	0.709
100	0.781
110	0.869
120	1.0
130	1.181
140	1.46
150	1.931
160	2.882
170	5.747

Table 4.7.7.1 - Multiplying factors for use with dynamometer readings

4.7.7.2 In the following applications, monitoring the pull force is not required:

a. When the initial installation or a pullback is accomplished by the techniques described in section 4.7.6.1, monitoring is not required since the pulling force is adequately controlled by the installation technique.

b. During initial installation, pullbys, or pullbacks monitoring is not required where cables can be pushed through the conduit. Immediately subsequent to pushing the cable through, the remaining length of required cable may be pulled by one person, by hand, from the other end of the conduit or out of the nearest pull point without having to monitor the pull force.

c. When the cognizant engineer can determine by the method described in MGL-E1 that the pulling tension value will be zero, monitoring is not required if:

(1) A cable is being installed in an empty conduit (no previously installed cables),

(2) A cable is being reworked, and it is the only cable in the conduit, or

(3) A conduit installation is being reworked, and all cables in the conduit are being removed.

d. When the ends of cables being pulled through a conduit enter a pull point or exit the end of the conduit, additional footage may be pulled as needed without monitoring provided,

(1) The pull force has been monitored until the cables entered the pull point or exited the end of the conduit, and

(2) Application of cable pulling lubricant continues if it was used during the monitored portion of the pull.

(3) Pulling is stopped if it becomes significantly more difficult to pull than when the pull force was being monitored. The problem shall be determined and corrected before pulling is continued.

e. For cables which are to be reused after being pulled back out of a conduit, one person may pull up to 3 feet of slack from the nearest pull point without monitoring to allow attachment of a basket weave type grip (see section 4.7.6.4). After this slack has been obtained, the pullback force shall then be monitored (unless section 4.7.7.2.b or 4.7.7.2.c above applies) to ensure the maximum pull force for single cable pulls; 0.8 of the maximum pull force for group power and control cable pulls; or 0.6 of the maximum pull force for group instrumentation cable pulls is not exceeded.

*

e. Measures shall be taken to minimize excessive amounts of cable lubricants from entering equipment at termination points.

f. Cables shall not be pulled when the temperature is below 15°F unless approved by OE.

g. Where mechanical assistance is needed, pulling equipment (such as a winch) which will provide a steady continuous pull on the cable should be used.

h. "Reverse bends" (bends opposite to the direction the cable has been wound on the cable reel) should be avoided where possible.

5.7 To the extent practical, a cable pull through a conduit should be delayed until all cables to be routed through that conduit have been identified. However, "pullbys" (cable pulls in conduits with existing cables) are acceptable but may require that extra precautions (as determined by cognizant engineer) be taken to avoid damaging the existing cables. It may be necessary to pullback existing cables before installation of a new cable rather than using a pullby in order to eliminate possible sidewall pressure problems. Due to conditions occurring inside the conduit, such as less available cross sectional area and configuration of the existing cables, the following requirements apply to installations involving pullbys:

(a) All requirements pertaining to cable pulls in empty conduits, such as the maximum allowable pulling force and sidewall pressure limitations, are also applicable to pullbys/pullbacks. A coefficient of friction of 0.5 shall be used in the sidewall pressure calculations for pullbys/pullbacks.

(b) A method which will minimize the potential for damage to existing cables shall be selected to install the cable pull rope.

(c) Pullbys may require the use of larger amounts of cable pulling lubricants.

(d) After starting, the pullby shall be immediately terminated if the cables suddenly become more difficult to pull. The problem shall be identified and corrected before attempting to restart the pullby.

5.8 When a cable is required to be pulled back from its existing route, the cognizant engineer will initiate and authorize it on data sheet 5. Since the same requirements apply as a cable installation, data sheets 2, 3, or 4 (as required) will be calculated prior to pulling back the cable. If the cable is to be reused, then the repull shall be documented on data sheet 6.

5.9 When a cable tray cover is removed, the tray voltage level and mode numbers identifying the location of the tray cover shall be recorded by the craftsman on data sheet 7. The craft foreman shall verify the removal and reinstallation of the tray covers.

5.10 After pulling each run of cable the cable should be temporarily identified. For cables pulled by using a loop on the end of the conductor or using a crimp-on-the-conductor pulling eye, a sufficient length of cable shall be removed from the pulling end to ensure that an adequate length of undamaged cable is available for termination. For cables pulled by a metallic weave basket grip, a minimum of 5 feet shall be removed behind the grip. The ends of cables located outdoors or in other wet locations shall be sealed by taping, or by use of a heat shrinkable end cap or other suitable means if subject to being wetted. To minimize the possibility of damaging electrical terminals or contacts, remove cable lubricants, as applicable, from the termination compartment and from the cables inside the termination compartment by wiping with a clean cloth after the pull is completed.

6.0 INSPECTIONS AND ACCEPTANCE CRITERIA

6.1 The installation of cable is an in-process inspection requiring the presence of a QC inspector throughout the installation. The inspector shall perform the inspections indicated below, and verify that the acceptance criteria is met by signing the Cable Installation Sheet.

6.1.2 Material--Verify that the proper size, ~~and type~~ Type, and Contract Number of cable is used as shown on the Cable Installation Sheet. Also, verify by visual examination that the material is free of defects and cuts both before and after installation.

6.1.3 Lubricant--Verify that only the recommended lubricants as listed in section 4.1 are used.

6.1.4 Routing--Verify that the cable is installed according to the route specified on the Cable Installation Sheet. In cases where equipment not being installed has prevented the flex conduit installation, the cable pull will be considered complete if enough cable is left to complete the installation later; however, it shall be noted in the remarks section of the Cable Installation Sheet by the inspector. Installation of the cable when the flex conduit is installed will not be required to be inspected. When a cable leaves the cable tray into a conduit, the routing will be correct if the conduit is routed to either side of the node number in the cable routing where it is suppose to leave the tray. If there is at least one node number in between the conduit and the required node number, then the cable routing shall be changed by the cognizant engineer. For example, a cable is routed through cable tray node numbers 315, 316, 317, and 318; and the conduit is supposed to be located at node 318, then then the conduit could physically be located anywhere in between nodes 317 and 318 or 318 and 319 to be correctly routed.

6.1.5 Bending Radius--Verify that the minimum pulling radius (see section 4.4 and section 5.6.b) as specified on the Cable Installation Sheet is not violated during cable pulling. After the cable has been pulled, verify the tiedown of the cable to the minimum training radius is not violated.

5.10 After pulling each run of cable the cable should be temporarily identified. For cables pulled by using a loop on the end of the conductor or using a crimp-on-the-conductor pulling eye, a sufficient length of cable shall be removed from the pulling end to ensure that an adequate length of undamaged cable is available for termination. For cables pulled by a metallic weave basket grip, a minimum of 5 feet shall be removed behind the grip. The ends of cables located outdoors or in other wet locations shall be sealed by taping, or by use of a heat shrinkable end cap or other suitable means if subject to being wetted. To minimize the possibility of damaging electrical terminals or contacts, remove cable lubricants, as applicable, from the termination compartment and from the cables inside the termination compartment by wiping with a clean cloth after the pull is completed.

6.0 INSPECTIONS AND ACCEPTANCE CRITERIA

6.1 The installation of cable is an in-process inspection requiring the presence of a QC inspector throughout the installation. The inspector shall perform the inspections indicated below, and verify that the acceptance criteria is met by signing the Cable Installation Sheet.

6.1.2 Material--Verify that the proper size and type of cable is used as shown on the Cable Installation Sheet. Also, verify by visual examination that the material is free of defects and cuts both before and after installation.

6.1.3 Lubricant--Verify that only the recommended lubricants as listed in section 4.1 are used.

6.1.4 Routing--Verify that the cable is installed according to the route specified on the Cable Installation Sheet. In cases where equipment not being installed has prevented the flex conduit installation, the cable pull will be considered complete if enough cable is left to complete the installation later; however, it shall be noted in the remarks section of the Cable Installation Sheet by the inspector. Installation of the cable when the flex conduit is installed will not be required to be inspected. When a cable leaves the cable tray into a conduit, the routing will be correct if the conduit is routed to either side of the node number in the cable routing where it is suppose to leave the tray. If there is at least one node number in between the conduit and the required node number, then the cable routing shall be changed by the cognizant engineer. For example, a cable is routed through cable tray node numbers 315, 316, 317, and 318; and the conduit is supposed to be located at node 318, then then the conduit could physically be located anywhere in between nodes 317 and 318 or 318 and 319 to be correctly routed.

6.1.5 Bending Radius--Verify that the minimum pulling radius (see section 4.4 and section 5.6.b) as specified on the Cable Installation Sheet is not violated during cable pulling. After the cable has been pulled, verify the tiedown of the cable to the minimum training radius is not violated.

At pullpoints such as boxes and conduit bodies (e.g., condulets), the tension on the cable in the area of bending is negligible. Therefore, only the requirements for a training radius shall be assumed to apply at pullpoints.

6.1.6 Pull Force--Verify that the maximum allowable pull force (see section 4.5) specified on data sheet 2 or 3 (as applicable) is not exceeded.

6.1.7 Separation Criteria--Verify that cable installation does not violate the separation criteria as specified in section 4.7.2.

6.1.8 Cable Distribution and Cable Support--Verify that cables are distributed and supported as specified in section 4.7.3.

6.1.9 Penetrations--Verify that cables are installed in penetrations as specified in section 4.7.4.

6.1.10 Identification--Verify that cables are identified per sections 4.3 and 5.10.