UNITED STATES

DEPARTMENT OF AGRICULTURE

RURAL UTILITIES SERVICE

SUMMARY OF

ITEMS OF ENGINEERING INTEREST

AUGUST 1996

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ABBREVIATIONS

AAC	All Aluminum Conductor
AAAC	All Aluminum Alloy Conductor
ACSR	Aluminum Conductor Steel Reinforced
ACSS	Aluminum Conductor Steel Supported
ACSS/TW	Aluminum Conductor Steel Supported - Trapezoidal Wire
AMR	Automatic Meter Reading
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
BIL	Basic Impulse Level
DSM	Demand Side Management
EPA	Environmental Protection Agency
EPR	Ethylene Propylene Rubber
FCC	Federal Communications Commission
HMW	High Molecular Weight
HMWPE	High Molecular Weight Polyethylene
IEEE	Institute of Electrical and Electronics Engineers
kV	Kilovolt
RUS List of Materials	RUS Informational Publication 202-1, "List of Materials Acceptable for Use on Systems of RUS Electrification Borrowers"
MOV	Metal Oxide Varistor
NESC	National Electrical Safety Code
NRECA	National Rural Electric Cooperative Association
OCF	Overload Capacity Factor
OHGW	Overhead Ground Wire
REA	Rural Electrification Administration
RTP	Real Time Pricing
RUS	Rural Utilities Service
S&C	S&C Electric Company
SSAC	Steel Supported Aluminum Conductor
T&D	Transmission & Distribution
TOU	Time-of-Use
TR-HMW	Tree-Retardant High Molecular Weight
TR-XLPE	Tree-Retardant Cross-Linked Polyethylene
UL	Underwriters Laboratory
USFWS	United States Fish & Wildlife Service
VR	Vibration-Resistant
XLPE	Cross-Linked Polyethylene

PROCUREMENT & CONSTRUCTION

GUIDELINES FOR APPROVING THE USE OF STEEL DISTRIBUTION POLES

RUS has several areas of consideration regarding the use of steel distribution poles by borrowers. For your information and reference, we have listed below the guidelines that we are presently using when considering borrower requests for RUS approval to use steel distribution poles. We request that borrowers seeking RUS approval to use steel distribution poles on their systems adequately address each of these items:

1. Approval is only being granted on a case-by-case trial basis to gain experience.
2. Presently, approval is only being considered for site specific projects defined by the borrower.
3. The borrower should state the maximum number of steel poles to be used.
4. The borrower should furnish an analysis, using sound engineering economics, of the cost of using steel poles compared to standard RUS construction with wood poles. If the use of steel poles is more costly, other sound reasons should be furnished to justify their use.
5. All assembly units have to be built according to RUS construction standards. If nonstandard construction is proposed, the borrower must furnish sufficient dimensioned drawings and other information for our evaluation of the design.
6. The borrower needs to furnish sufficient information and data describing the proposed steel poles including the methods and materials of surface coating to be used to protect the poles and pole butts against corrosion.
7. All other material to be used has to be RUS accepted or RUS technically accepted. A compilation of accepted materials may be found in RUS Informational Publication 202-1, “List of Materials Acceptable for Use on Systems of RUS Electrification Borrowers” (RUS List of Materials). Inquiries regarding technically accepted materials should be directed to the Chairman of Technical Standards Committee “A” at (202) 720-0980. The borrower must furnish sufficient information, data and test results of all proposed nonaccepted material for our evaluation.
8. RUS strongly advocates a minimum withstand strength, (often incorrectly and simply referred to as a BIL level), of 300 kV for distribution pole top assemblies attached to steel poles. A minimum of 300 kV withstand must be maintained at deadend assemblies. The borrower should make clear what assemblies and materials are to be used and the resulting calculated withstand strength level. If the design is less than 300 kV, the borrower should state what additional measures, if any, such as the installation of surge arresters, are to be used to minimize flashovers.

   (Withstand strengths of less than 300 kV will usually facilitate flashovers of lightning strikes to or proximate to distribution lines.

A recloser operation is usually required to clear the resulting arc. Thus, a minimum of 300 kV withstand is required to maintain a reasonable quality of service. Standard RUS pole type assemblies, with wood poles, have a minimum withstand strength of 350 to 400 kV. For mathematical purposes, the total resistive type impedance of wood and capacitive type impedance of insulators should be added as perpendicular vectors.)

9. The borrowers should state what existing and additional safety measures, for line workers, will be enforced to compensate for any reduced electrical clearances between energized conductors and the proposed steel poles.
10. The borrower needs to furnish a statement regarding the anticipated impact of the steel pole design on the potential electrocution of raptors and identify any mitigation measures that will be incorporated in the design.
11. A steel pole may be used as a part of a grounding circuit if the pole meets the sufficient conductivity and low impedance requirements of the National Electrical Safety Code (NESC) and other RUS specifications. A directly embedded steel pole is not recognized in the NESC as a grounding electrode. Therefore, RUS requires that separate driven ground rods or grounding electrodes be used for all equipment, surge arresters and other required system grounds.
12. The borrower should use stainless steel or galvanized steel ground rods and soft annealed iron ground wire to mitigate the corrosive affects of buried dissimilar metals in close proximity.
13. RUS advocates using steel poles that meet the strength requirements of the NESC Grade B construction. The design of the distribution line itself only needs to meet NESC Grade C construction. Extreme ice conditions and appropriate high winds should be considered in the construction design.
14. The design of unguyed angle and deadend structures should consider pole deflection and will usually require greater embedment depths.

RUS does not judge the above items to be onerous. Each item is important for a sound and safe design. The relevant items above, plus several other design considerations, are incorporated in RUS construction drawings and specifications for wood pole distribution lines.

If you would like more information or have any questions, please call James L. Bohlk, Electrical Engineer, Distribution Branch at (202) 720-1967.

PURCHASE OF STEEL POLES

To help expedite delivery of steel poles, purchasers should provide complete design parameters and details of other features such as anchor bolts and related foundation requirements.

Normally, steel pole manufacturers prepare specific pole designs tailored to the loads and pole geometry specified. Manufacturers may also supply orders from stock of available steel poles, designed as equivalent to standard wood poles in height and classes. In selecting the type of supporting structures to be used on a line project, the design engineer should investigate which of the structure options will result in the more cost efficient approach.

Confusing pole loading tree data, drawings, or load conditions may cause misinterpretation or misapplication of the intended design requirements. Pole fabrication may be delayed if subsequent design changes for the poles are necessitated. Some of the factors to consider for the specifications on the design and fabrication of steel poles include the following:

- Length or height above the groundline, as well as the total pole length, should be shown on the drawings and in the pole data table of dimensions.
- Controlling dimension for the arm lengths should be clearly shown on the drawing. This controlling dimension should be shown in one of three ways: from the pole centerline, from the face of the pole, or from the edge of the arm's end bracket.
- Specify the shape of the arm, straight or curved. Indicate insulator swing clearances to be maintained, and arm rise dimensions. Straight arms are suggested if the arm is less than 5 feet (1.5 meters) long.
- For steel arms on suspension type poles, the elevation dimensions should reference the insulator attachment hole at the tip of the arms. For arms on deadend poles, the dimensions should refer to the centerline of the arm tip.
- When specifying loads, use one global system of x-, y-, and z-coordinates on all the pole drawings, with the appropriate sign convention, to represent combined vertical, transverse, and longitudinal forces.
- For each pole drawing, show a load tree with load force vectors at wire attachment points. For each loading case condition, specify the loads, wind pressure on pole, and overload factors, in tabular format, and how the loads are to be applied for the load case. Generally, it is clearer if the values in the load table have been resolved and combined into a set of x-, y-, and z-coordinate loads, rather than in other forms, such as showing the loads as conductor tensions or wire loads in pounds per foot (Newtons/meter), requiring additional calculations. This approach is recommended, especially if the poles include underbuild which have spans and line angles different than the transmission line.
- Pole design should include possible conditions where complex wire arrangement, underbuild, or future additions are involved. When specifying loads, the designer should consider reversing transverse wind loads, unbalanced longitudinal loads (if any), as well as various wire combinations. For complicated loadings, additional plan and elevation views may be needed to clarify the loadings and their directions.
- For an unguyed, deadended single pole steel structure designed for a range of line angles, the design loads for the minimum line angle should also be specified to

properly design the arms (the maximum line angle loads usually control the design of the pole and foundation).

- For a steel pole structure to be cambered or raked, the load condition to calculate the camber or rake should be specified.
- For guyed steel pole structures, the type, size of guy wire, maximum number of multiple guys (if any), guy anchor locations, and guy slopes should be provided.
- If using concrete drilled pier or caisson type foundations, the minimum compressive strength of the concrete should be specified so that the steel pole supplier will be able to properly design the base plate and anchor bolt cage assemblies.
- If switching equipment is to be installed on the pole, the switch manufacturer's drawings and details should be provided to the steel pole supplier.

If you would like more information or have any questions, please call Bing C. Chan or Donald G. Heald, Structural Engineers, Transmission Branch, at (202) 720-0999 or (202) 720-9102, respectively.

POLE EMBEDMENT

RUS announces the issuance of RUS Bulletin 1724E-205, “Design Guide: Embedment Depths for Concrete and Steel Poles,” dated August 22, 1995. This new bulletin provides engineering information concerning selection of embedment depths for steel and concrete transmission poles subject to large overturning moments.

Increasing use of steel and concrete poles has necessitated a more definitive method of determining pole embedment depths. The primary purpose of this bulletin is to furnish engineering information concerning selection of embedment depths for steel and concrete poles in different types of soils. The information in this bulletin may be used to approximate embedment depths for cost estimates, to make preliminary selection of embedment depths, and to verify or check selection of embedment depths based on other or more exact methods.

If you would like more information or have any questions, please call Bing C. Chan, Structural Engineer, Transmission Branch, at (202) 720-0999.

ACSS CONDUCTOR

Type ACSS conductor has been used on transmission uprating projects due to its better sag characteristic when compared to type ACSR conductor. The conductor (previously known as SSAC) is covered by ASTM designation B 856, for type ACSS, Aluminum Conductors, Coated-Steel Supported, with aluminum round wires, and ASTM B 857, for type ACSS/TW, with trapezoidal-shape aluminum wires. Both ASTM standards have been adopted by ASTM and will appear in the next ASTM Standards, Volume 02.03, Electrical Conductors.

The aluminum material in ACSS has been annealed and is "softer" than the aluminum for type ACSR conductor. ACSS has slightly better conductivity than conventional ACSR, but its principal advantage for line upgrading is its better sag-tension characteristics. Because the conductor tension is carried almost entirely by the steel strand, type ACSS conductor will sag less than ACSR under high electrical loads. It is a good conductor to consider whenever there is a considerable range between the "normal load" and the "peak load".

Due to the soft aluminum, it may be difficult to install the conductor without some local deformation. For example, at deadends, some birdcaging of the conductor at compression deadend clamps can occur during installation. To reduce birdcaging, the "come along" should be attached as far out as possible. Minor birdcaging with ACSR may also result, but the effect usually is temporary and disappears by the following day after sustained loading. With ACSS, the birdcaging may remain because the conductor wires are bent outward. A wood block may be useful in reforming the ACSS wires.

The aluminum sleeve of the compression clamp that some manufacturers furnish for ACSS may be longer than the compression clamp for a comparable size of ACSR conductor. This may actually increase the birdcaging problem.

The conductor should not be used for voltages at or above 230 kV because radio and television interference may result. This conductor is not RUS accepted (i.e., not included in the RUS List of Materials), and as such, its use for a line project is considered on a case-by-case RUS approval basis.

If you would like more information or have any questions, please call Donald G. Heald, Structural Engineer, Transmission Branch, at (202) 720-9102.

SPECIAL CONDUCTORS FOR BARE OVERHEAD LINES

Twisted-pair conductors (also known as type T-2) are used for overhead lines in areas prone to conductor motion problems caused by wind acting on conductors coated with ice. The conductor consists of two component type AAAC or ACSR conductors twisted together to form a figure-8 shape. The nonsymmetrical conductor profile presented to prevailing wind is designed to reduce or resist wind-induced motion, oscillation or vibration of the iced conductors. Conductor motion problems of conventional ACSR conductors have occurred on rural lines in the Midwest and north central areas of the U.S. and have resulted in failures of wires or strands. Key contributing factors are: location, line orientation to prevailing wind direction and wind speed, and terrain topographic features. T-2 conductor was originally developed by Kaiser Aluminum with field testing beginning in 1968. Initial line performance data and conductor observations were reported for the 1970-1980 period. Kaiser Aluminum has since sold its interest in the type T-2 conductors.

In order to obtain experience, twisted-pair conductor is conditionally accepted on page av(1), of the RUS List of Materials. Currently, four manufacturers of the special conductor are included.

The conductor sizes are limited to standard ACSR and AAAC conductors in the RUS preferred sizes (RUS does not include type AAC conductor). Component conductors must meet the applicable ASTM specifications for ACSR and AAAC wires and stranded conductors.

Additional notes on the twisted-pair conductor are:

1. Selection and design of the special conductor should be based on an engineering study or recommendation which should include such considerations as: history, performance of existing lines with similar terrain, line orientation, and wind conditions.
2. Presently, no industry-wide accepted standard exists for the special conductor. This conductor's twist lay direction and lay length may vary among the manufacturers and differences may exist if the same size of conductor is obtained from different suppliers. ASTM Committee B-1 on Electrical Conductors, is presently working on draft specifications covering material and testing requirements for twisted-pair ACSR conductors for adoption as an ASTM standard. Balloting of the proposed draft is scheduled for late 1996 or early 1997. Also planned are ASTM specifications for twisted-pair type AAAC conductors.
3. Type T-2 designation is a trademark and its name usage should be restricted to its present owner's or licensee's products. Other manufacturers have chosen various other names for their products: ACSR/Duplex, AAAC/Duplex, and type VR (Vibration-Resistant).
4. Required twisted-pair sag tension data for the ruling span and design criteria of the line project are available from the conductor manufacturers. Sag-tension characteristics should be similar to conventional, single ACSR and AAAC conductors. The specified conductor tension limits may be affected by the design recommendation on overhead groundwire (OHGW) sag (adequate midspan separation is usually assured for standard RUS structures by keeping the OHGW's initial sag at 60°F (16°C) unloaded condition, to 80 percent of the conductor's sag, under the same condition).
5. Splices for component conductors are identical to splices currently included for single ACSR and AAAC conductors. Other hardware and fittings designed or adapted for the twisted-shape conductors, such as suspension clamps, are available. Coordination of attachment design details with the hardware supplier and the conductor manufacturer will assure satisfactory performance of conductor and components.
6. Line construction of special conductor should provide specifications covering method for its handling and installation, in accordance with the conductor manufacturer's recommendations.

If you would like more information or have any questions, please call Bing C. Chan, Structural Engineer, Transmission Branch, at (202) 720-0999.

USE OF STIRRUPS

During 1995, the Overhead Distribution Lines Subcommittee of the National Rural Electric Cooperative Association's (NRECA) Transmission and Distribution (T&D) Engineering Committee conducted a survey on the use of stirrups to make connections to distribution line conductors. Five hundred and seventeen distribution cooperatives reported on their experience with using stirrups by answering questions dealing with types of stirrups used, their applications and failure rates. Several respondents provided additional comments which were very informative.

Over 50 percent of the respondents use hot line clamps on stirrups to connect transformers, cutouts, arresters, reclosers, regulators and capacitor banks to main lines. Over 60 percent use this method to connect tap lines and over 25 percent use this method to connect main lines together.

Summarized below is the approximate percentage of cooperatives that use the types of stirrups identified in the questionnaire:

- 31 % -- Bail with two attached compression connectors
- 17 % -- Bail with two separate compression connectors
- 14 % -- Loop with a single hot line clamp
- 11 % -- Loop with two hot line clamps
- 15 % -- Loop with a single compression connection

Less than 10 percent of the cooperatives reported that they had failure rates of one to five percent. Only four cooperatives reported that they had failures with more than five percent of their installed stirrups. The remaining cooperatives reported failure rates of zero to less than one percent.

Obviously, stirrups have a widespread use by distribution cooperatives. Several different types of stirrups are being used, and the reported failure rates of connections with stirrups are very low. The NRECA Overhead Distribution Lines Subcommittee and engineers at RUS analyzed the data and comments of the survey and drew several more conclusions.

There is no universal preference for stirrup types or applications. Some respondents strongly defended their preferences and denounced other types, whereas, just as many respondents made similar remarks about another type of stirrup. The same opposing views were voiced about where stirrups should and should not be used.

The primary purpose of the survey was to gather data regarding failure rates and problems with stirrups. The final data shows that there were more failures caused by the connectors than by the stirrups themselves by a ratio of approximately three to two. Some respondents blamed most failures on poor workmanship or improper tool selection when installing compression type connectors. The data and the comments also attribute the following causes for failures of stirrups and hot line clamps.

- Used in an area of vibrating conductors.
- Used where the current (load) is too high.
- Stirrup material not large enough.
- Stirrup material is aluminum.
- All purpose (aluminum) clamps used with the stirrup.

Over the last several years, RUS has not received any negative reports nor any complaints regarding connections using stirrups. In the survey, there was only one negative comment about the general use of stirrups, whereas, there were several comments advocating their widespread use. The data shows that if the proper size and material stirrups and hot line clamps are used, for the proper application, and if they are properly installed, then their failure rate is expected to be equal to or less than the other components of the distribution system.

Based on this survey's results and many discussions with its borrowers, RUS is proceeding to include the combined use of stirrups and hot line clamps in its standard drawings and specifications for primary distribution lines. **However, <u>if and until</u> RUS can properly implement this change, the use of stirrups is only authorized on those systems which have written approval by the appropriate RUS Regional Engineering Branch in Washington**. We anticipate that it will take several months to make this change.

Furthermore, the allowed use of stirrups will probably have the following conditions directed at mitigating failures. These guidelines should be followed by all distribution cooperatives presently using stirrups.

- Stirrups with two compression connectors are not to be used in areas of vibrating conductors.
- The stirrup and hot line clamp shall be sized to meet or exceed the current carrying capacity of the tap conductor or equipment jumper.
- All stirrup conductors shall be made of copper or bronze.
- All stirrup conductors shall be of #2 copper equivalent or larger.
- All-purpose or aluminum hot line clamps shall not be used with stirrups.
- Stirrups are not recommended to be used to connect reclosers, autotransformers or line regulators.
- Stirrups are not to be used to connect main lines or heavily loaded tap lines.

- All stirrups, connectors and clamps shall be installed in accordance with the manufacturer's specifications.

Stirrups and hot line clamps should not be used for sectionalizing tap and especially main lines for operational or maintenance purposes. RUS advocates permanent compression or bolted type connectors be used because of their better current carrying capabilities and proven reliability. RUS strongly recommends that line switches or fused or solid blade cutouts be used at line locations where occasional line sectionalizing may be required.

At locations where permanent connections using compression or bolted type connectors are not desired, the present RUS standards specify installing hot line clamps (over armor rods on aluminum conductors). All connections, regardless of the types of connectors, stirrups or hot line clamps to be used, need to be installed properly, carefully, and with the proper tools. All conductors needs to be thoroughly cleaned with a wire brush before installing connectors or clamps and a suitable inhibitor needs to be used before applying connectors over aluminum conductor.

RUS thanks Jim Dedman of NRECA and Chairman Jim Byrne (Poudre Valley Electric Cooperative, Ft. Collins, Colorado) and Lowell Wessel (Jackson County Rural Electric Cooperative, Browntown, Indiana) of the NRECA Overhead Distribution Lines Subcommittee for their excellent contributions in conducting and analyzing the recent stirrup survey.

If you would like more information or have any questions, please call James L. Bohlk, Electrical Engineer, Distribution Branch at (202) 720-1967.

USE OF STANDOFF BRACKETS ON FULL ROUND CABLE RISER SHIELDS

Although we have included full round cable riser shields in the RUS List of Materials, we require these shields, as well as riser conduits, to be mounted directly to the surface of the pole with no standoff brackets. This will prevent climbing by unauthorized persons. We believe the RUS required mounting method makes the installation comply with NESC Rule 217A1b and Rule 217A2 regarding "climbing" and "steps", respectively.

If you would like more information or have any questions, please call Trung Hiu, Electrical Engineer, Distribution Branch, at (202) 720-1877.

GUY ATTACHMENTS

Guy attachments which use pole eye plates or guying tees with grid gains rely on the tightness of their mounting on a wood pole to achieve full capacity. These guy attachments depend on the grid teeth (or spurs) of the pole eye plate and the grid gains for the guying tee remaining in full contact with the wood pole in order to distribute the shear loads to the pole and maintain the stability of the connection. When first installed, the guy attachments are bolted tightly to the pole.

With a tight connection, the bolts are loaded primarily in tension, the shears are distributed from the grid teeth to the wood pole, and there is little or no “pull away” at the top of the attachment. As the wood pole dries out, the connection may become less tight. If the connection loosens, the attachment will tend to “pull away” from the pole at the top bolt and “compress” the wood near the bottom bolt. Moments will be induced into both bolts. The combined tension and moment in the bolts will reduce the capacity of the guy connection.

Some borrowers may wish to make it a practice of tightening all guy attachments 2 or 3 years after a new line is constructed. Guy connections should be periodically inspected for tightness thereafter.

If you would like more information or have any questions, please call Donald G. Heald, Structural Engineer, Transmission Branch, RUS, at (202) 720-9102 or Bubba McCall, Oglethorpe Power Corporation, at (770) 270-7665.

GUY MARKERS

Guy Markers (guy guards) are used to make anchor guys conspicuous to the public in an effort to help prevent accidental collision with the guy by a pedestrian or vehicle.

Previously, the Rural Utilities Service (RUS) required guy markers to be flame retardant. In order to provide borrowers with greater flexibility in their choice of products, Technical Standards Committee “A” is now considering applications for acceptance of plastic or fiberglass guy markers that are not required to be fire retardant.

In the RUS List of Materials, these guy markers will be shown on either a separate page or in a separate category on the same page.

Borrowers will have the option of selecting either type depending on the area in which it is to be used. Non-flame retardant guy markers may be used in areas where the burning of ditches or crop burning activities are not active.

If you would like additional information or have any questions, please contact George Keel, Engineering Technician, Distribution Branch, at (202) 690-0551.

KEEP TESTING YOUR UNDERGROUND POWER CABLE

In previous Items of Engineering Interest, we have discussed testing of new underground cable. The Underground Subcommittee of the NRECA’s T&D Engineering Committee highly recommends that electric utility operators test underground cable they purchase. The Subcommittee's recommendation is founded on results of independent cable testing of cable samples conducted in 1993, 1994, and 1995. These samples were supplied by co-ops throughout the United States and represent samples of all eight major U.S. suppliers of medium voltage cable.

The Subcommittee provided its testing results as an inducement to promote the independent testing of newly purchased cable.

The Subcommittee recommends that the following tests be conducted at a minimum:

1. Dimensional analysis of all cable components;
2. Microscopic examination for voids, contaminants and protrusions; and
3. Insulation shield stripping test.

The Subcommittee also recommends that optional testing of Tree-Retardant Cross-Linked Polyethylene and Cross-Linked Polyethylene insulated cables include a Hot Oil Test. The Subcommittee does not recommend conductor shield and insulation shield resistivity tests because they consistently test well below maximum specifications.

Subcommittee recommended typical sampling rates are to test one sample, each, from the first and last reel on orders of 50,000 feet (15,240 meters) or less and one sample for each additional 50,000 feet of cable ordered.

The Subcommittee recommends that purchasers instruct manufacturers to cut samples and send them to the selected testing laboratory, or the purchaser can cut the samples upon arrival of the shipment. The Subcommittee further recommended that purchasers notify suppliers in advance that cable testing will be conducted and purchasers should establish responsibilities and procedures in case of a failure, such as: Any evidence of noncompliance with the enclosed specifications shall be justification for:

1. Further testing at manufacturer's expense (each shipping reel);
2. Rejection of the tested reel and possibly the reels preceding and following in the manufacturing process; and
3. Rejection of the entire order, depending on the severity and frequency of noncompliance.

A partial list of possible independent testing laboratories provided by the Subcommittee includes:

Cable Technology Laboratories, Inc.
P.O. Box 708
690 Jersey Ave.
New Brunswick, NJ 08903
(201) 846-3220

Forster Electrical Engineering, Inc.
550 North Burr Oak Ave.
Oregon, WI 53575
(608) 835-9009

NEETRAC
62 Lake Mirror Road, Building 3
Forest Park, GA 30050
(800) 762-6522

All of these laboratories participate in the Cable Acceptance Testing Program promoted by NRECA's T&D Underground Subcommittee. The inclusion of a laboratory in this list does not imply endorsement by RUS. The testing laboratories listed above have voluntarily agreed to collect electric cooperative test data and provide it to the NRECA Underground Subcommittee annually for information and publication. To have your data included, note on your purchase order "INCLUDE IN COOPERATIVE DATA FILE." Cooperative names will not be published and participation is voluntary.

The following table summarize results of the 1995 testing (the 1993 and 1994 testing are summarized in the 1995 Items of Engineering Interest):

1995 TEST RESULTS

CABLE TYPE	TR-XLPE*			EPR**			TOTAL
INSULATION LEVEL	15 kV	25 kV	35 kV	15 kV	25 kV	35 kV	
TOTAL TESTED	116	137	0	141	7	0	401
NUMBER FAILED CONTAMINANTS	0	0		4	0		4
NUMBER FAILED DIMENSIONAL	1	3		4	0		8
NUMBER FAILED LOW STRIP TENSION	1	2		2	0		5
NUMBER FAILED NEUTRALS TOUCH-ING, KINKED, OR CORRODED	1	0		0	0		1
NUMBER FAILED NEUTRAL INDENTATION	0	0		2	0		2
PROTRUSIONS	0	3		0	0		3
NO EXTERNAL MARKINGS	2	0		0	0		2
PERCENT FAILURES	4.3%	5.8%		8.5%	0.0%		6.2%

* Tree-Retardant Cross-Linked Polyethylene ** Ethylene Propylene Rubber

If you would like more information or have any questions, please call Trung Hiu, Electrical Engineer, Distribution Branch, at (202) 720-1877.

ANSI STANDARD FOR TESTING HARDWARE

A proposed ANSI Standard for Testing of Transmission and Distribution Line Hardware (C135.61) is in the final voting stages of IEEE. This standard will cover the requirements for mechanically testing load rated line hardware for use on transmission and distribution facilities. The standard will cover routine acceptance testing.

Hardware items which this standard specifically addresses, but is not limited to, are clevis and eye fittings, socket fittings, ball fittings, chain links, shackles, triangular and rectangular yoke plates, suspension clamps, and strain clamps.

The fact that a certain manufacturer's hardware item has been accepted by RUS is not a guarantee of production quality and that all production items will meet necessary strength tests. Many manufacturers will have their own acceptance testing procedures used on production runs. This standard defines routine acceptance tests and establishes a uniform standard which production runs are to meet.

The standard is based on a defined acceptance quality level. Given a certain lot size, there will be a minimum established sample size. Determination of acceptability will be based on the number of samples failing to pass the tests.

Once this standard is approved, borrowers should consider referring to this standard in their purchase orders of appropriate hardware. The standard requires all tests by the manufacturer to be recorded in a permanent and organized manner and maintained for a minimum of 10 years. Borrowers may want to consider asking for a copy of the test reports or for a summary report. This standard could also be used by borrowers in performing their own routine tests of hardware.

If you would like more information or have any questions, please call Donald G. Heald, Structural Engineer, Transmission Branch, at (202) 720-9102.

OPERATION

SAFETY SIGNS

In previous Items of Engineering Interest, we discussed the ANSI standards for environmental and facility safety signs. These standards are intended to promote uniform national practice, and include considerable changes from some past safety sign practices. As RUS underground construction drawings and specifications are revised, we plan to delete standards for safety signs and refer to the ANSI standards, which are:

- ANSI Z535.1 Safety Color Code
- ANSI Z535.2 Environmental and Facility Safety Signs

- ANSI Z535.3 Criteria for Safety Symbols
- ANSI Z535.4 Product Safety Signs and Labels
- ANSI Z535.5 Accident Prevention Tags (for Temporary Hazards)

These coordinated standards are intended to apply to every permanent or temporary safety sign or tag on a utility system. These standards prescribe details for colors, shapes, and panel layout for the three panels: (1) signal word panel, (2) message panel, and (3) pictorial panel. As stated in previous Items of Engineering Interest, the appropriate ANSI signs for dead-front pad-mounted equipment are a “Warning” sign on the exterior of the enclosure, and a “Danger” sign inside the enclosure. We also discussed which sign might be appropriate under the ANSI standard for substation fences. Although RUS has never stipulated which sign to use, we stated that we thought the “Danger” sign was the best choice. It now appears that many people believe the “Warning” sign better meets the ANSI criteria for substation fences, and that “Danger” signs should be installed inside substations on structures that support live parts. This belief seemed to be the prevailing opinion at the most recent NESC Technical Subcommittee meetings. We believe that in the past most borrowers have used the “Danger” sign for substation fences with no additional safety signs inside the substations. Practices under the ANSI standards are in progress but not yet finalized and, thus, it would be inappropriate to make a specific recommendation at this time. State regulatory agencies or insurance companies may have recommendations and should be contacted.

If you would like more information or have any questions, please call Trung Hiu, Electrical Engineer, Distribution Branch, at (202) 720-1877.

AUTOMATIC METER READING

Automatic meter reading (AMR) offers many advantages that electric cooperatives may want to consider. Besides providing the ability to read meters remotely to improve billing and accounting costs and accuracy of meter readings, an AMR system offers many attractive features such as signal outage notification, remote reconnect/disconnect performance, meter tampering detection, safety improvement, time-of-use (TOU) billing, new or complex rates, and load management monitoring.

Electric cooperatives just getting started in AMR should consider the specifications of available products and the performance features as well as regulatory and consumer issues. Factors to be considered include whether a prospective AMR system can be used for both single-phase and poly-phase metering and if it is compatible with both electronic and electromechanical meters, including those already on the system. It is also important to know whether the system is equally practical in both high density and low density load areas.

Industry surveys show that utilities may recover their AMR investment in about 10 years. Usually, utilities offer customers “add-on” value features such as fire alarm, power outage alert, home security, low temperature reporting, and medical alert to their customers in order to facilitate the AMR conversion revenue recovery.

Some cooperatives have already installed AMR systems on a trial basis and have experienced savings on operations costs, cash flow improvement, and otherwise found the benefits of an AMR systems very positive. It allows more timely and accurate billing and better informed reaction to customers' inquiries. AMR systems with TOU features also allow customers the ability to make more knowledgeable cost savings decisions regarding energy use. Of course, there are benefits that customers can not see directly such as system performance improvement, decrease in future rate increases, and faster response during power outages.

There are some disadvantages too. In addition to the high first cost for mass deployment, AMR users should realize that once AMR is installed, they lock themselves into a single source of supply. This could limit future choices for advanced applications such as demand side management (DSM) and real time pricing (RTP). Also meters and related electronic equipment need to be evaluated in accordance with the appropriate ANSI standards (C12 series). Communications equipment may need to conform to the requirements of the Federal Communications Commission (FCC).

If you would like more information or have any questions, please call Anh Mai, Electrical Engineer, Distribution Branch, at (202) 720-1792.

INSPECTION & MAINTENANCE

POLE INSPECTION AND MAINTENANCE

RUS announces the issuance of RUS Bulletin 1730B-121, "Pole Inspection and Maintenance," dated April 15, 1996. The purpose of this bulletin is to provide RUS borrowers with information and guidance for establishing and sustaining a continuing program of wood pole maintenance. This guide bulletin supersedes REA Bulletin 161-4, "Pole Inspection and Maintenance," published October 1974. This bulletin recommends inspection intervals for standing wood poles and contains current information on the three types of internal treatments, i.e., liquid internal preservative, fumigants, and solids. Included in this bulletin are several tables to help determine the remaining effective overload capacity factor (OCF) in poles that have experienced decay damage.

If you would like more information or have any questions, please call H. Robert Lash, Chief, Transmission Branch, at (202) 720-0486.

INSPECTION & MAINTENANCE FORM FOR PAD-MOUNTED EQUIPMENT

The NRECA T&D Underground Subcommittee has developed a sample "Inspection & Maintenance Form for Pad-Mounted Equipment." This form could prove to be quite useful and augment borrowers' operations and maintenance programs for reporting purposes. The form is included as Appendix A. Any comments or feedback would be appreciated, and should be sent to Mr. Hiu.

If you would like more information or have any questions, please call Trung Hiu, Electrical Engineer, Distribution Branch, at (202) 720-1877. The form is available in electronic format from Mr. Hiu.

SMD POWER FUSE UNIT BORE CLOSEDOWN

S&C Electric Company's SMD power fuses include a solid material liner consisting of compressed boric acid cakes which generate deionizing gases to effect circuit interruption. The solid material liner is susceptible to damage from gross water entry, moderate amounts of water entry combined with corona, and, in some fuse unit vintages, high temperatures. Analysis has shown that such damage may involve deterioration of the boric acid cakes, followed by the constriction of the fuse unit bore, i.e., fuse unit bore closedown. The extent and rate of bore closedown depends on the amount of water that has entered the fuse unit. In the most severe cases, the constriction may actually immobilize the fuse unit arcing rod and prevent proper operation of the fuse.

Over the years, a number of fuse units returned to S&C for inspection have been found to exhibit fuse unit bore closedown. Most such returned fuse units were severely damaged by the gross entry of water. This can be prevented by following minimal storage and handling precautions, i.e., to store fuse units in a dry place and to avoid leaving fuse units hanging open in the mountings. In a smaller number of cases, bore closedown occurred with relatively small amounts of water inadvertently introduced into a fuse unit, such as might occur when a fuse unit is temporarily left hanging open in a mounting during a rainstorm.

<u>Design and Process Improvements</u>

To minimize the susceptibility of fuse units to bore closedown, improved techniques were adopted in the early 1970's for the assembly of boric acid cakes. In 1985, numerous additional refinements were implemented, including a new rain cap design for all SMD fuse units rated 69 kV and below, as well as for SMD-1A fuse units rated 115/138 kV.

The electrical mechanism for fuse unit bore closedown, as mentioned earlier, can involve corona discharge within the fuse unit in the presence of excessive moisture. SMD-1A and SMD-2B Fuse Units rated 115 kV and 138 kV were modified in the early 1960's to include a semiconductive coating on the inside (bore) surface of the solid material liner. This proved so effective that it has also been applied to all 69 kV fuse units since 1985. Subsequently, as a precautionary measure, 34.5 kV and 46 kV fuse units have also been bore coated since 1992.

Inspection Procedures

S&C SMD-1A, SMD-2B, and SMD-2C fuse units can be tested in the field for bore closedown using a technique called airflow testing. SMD-50 fuse units may be tested by means of X-ray analysis and SMD-3 Fuse Units require complete fuse unit disassembly at S&C to inspect for bore closedown. All three techniques are nondestructive to the fuse unit.

S&C recommends periodic airflow testing to values furnished with the S&C Airflow Test Instrument which reflect the minimum bore diameter that is within tolerance.

Fuse units that may have experienced questionable storage in the past should have the condition of the bore verified by airflow testing, X-ray analysis, or disassembly inspection at S&C. The person to be contacted at S&C for any questions or problems concerning fuse bore closedown is Roger Knopf, at (312) 338-1000, extension 2748.

If you would like more information or have any questions, please call Harvey L. Bowles, Chief, Distribution Branch, at (202) 720-5082.

SIMPLIFIED REPLACEMENT GUIDE FOR MEDIUM VOLTAGE CABLE

As an ongoing effort to improve quality of service, the NRECA T&D Underground Subcommittee has developed a "Simplified Replacement Guide for Medium Voltage Cable."

This simplified guide is intended for electric utilities that do not have formal cable replacement programs. There are many philosophies for cable replacement ranging from a points system for rating cable and failures to a simplified approach of replacing cable after a certain number of failures. There are two primary reasons for replacing medium voltage cable: (1) failure of the cable insulation system and (2) severe damage to the concentric neutral wires via corrosion. Mechanical failures resulting from installations and dig-ins should be handled on a case-by-case basis and are not addressed in this guide.

The guide promotes maintaining an accurate system for reporting and tracking of primary cable failures. A good tracking system will help in identifying problem cables by manufacturer, by year of manufacture and of installation, by type, by location, etc. A sample reporting form is included as Appendix B.

This replacement guide addresses three criteria to consider:

1) Neutral Corrosion. Neutral deterioration can occur anywhere in a span or run of cable compromising the continuity of the neutral and may affect system operation and safety.

Presence of stray voltages may be an indication of corrosion problems, but the only positive way to determine the extent of corrosion is to dig up sections of cable for inspection or have a corrosion survey performed. Spot cable replacement for corroded neutral cable is usually not a practical solution due to the sporadic nature of deterioration. The best solution is to replace extremely deteriorated cable on a per span basis and schedule replacement of moderately deteriorated spans for a later time. Whenever a primary cable is exposed because of a failure or a dig-in, the neutral should be inspected. If there is extreme corrosion, the cable should be repaired to restore power and the entire run scheduled for immediate replacement. The reporting form in Appendix B includes a guide for estimating the condition of the concentric neutral.

2) <u>Single-Phase Loop Feed Cable and Cable Feeding Noncritical Loads.</u> This cable should be replaced after two or three unexplained insulation failures. If there are other spans of the same vintage (type, manufacturer and date) cable in the same loop that have failed, they should be scheduled to be replaced also.

3) <u>Three-Phase Cable, Radial Single-Phase and Critical Loads.</u> When there is an unexplained insulation failure of this cable, a sample of the cable should be sent to a laboratory for failure analysis. A two foot (0.6 m) sample is preferred, but a smaller sample can be accommodated by most labs. A longer sample will give a better indication of the cable's condition. The recommended tests to be performed on this failed cable are wafer analysis for analysis of voids, contaminants, protrusions, and trees and a hot oil test of XLPE or HMWPE. Volume resistivity tests are expensive and are not usually needed on failed cable. Cable strip tension tests are also not usually needed unless there is an obvious lack of bonding between the insulation and the shield. If there are trees larger than one half of the insulation thickness, the cable should be replaced as soon as possible. If there are large numbers of smaller trees, the utility has to make a decision on when the cable should be replaced. If there are large contaminants, many contaminants, large protrusions or large voids in the insulation, the cable should be replaced as soon as possible. Some cable labs will try to determine the remaining life of the cable, but that is an inexact science at best.

The following labs participate in NRECA's cable acceptance program:

Cable Technology Laboratories, Inc.
P.O. Box 708
690 Jersey Ave.
New Brunswick, NJ 08903
(201) 846-3220

Forster Electrical Engineering, Inc.
550 North Burr Oak Ave.
Oregon, WI 53575
(608) 835-9009

NEETRAC
62 Lake Mirror Road, Building 3
Forest Park, GA 30050
(404) 608-5104

All of these laboratories participate in the Cable Acceptance Testing Program promoted by NRECA's T&D Underground Subcommittee. The inclusion of a laboratory in this list does not imply endorsement by RUS.

This guide was prepared by the NRECA T&D Underground Subcommittee. Any comments or feedback would be appreciated, and should be sent to Mr. Hiu.

If you would like more information or have any questions, please call Trung Hiu, Electrical Engineer, Distribution Branch, at (202) 720-1877. The guide is available in electronic format from Mr. Hiu.

ENVIRONMENTAL MATTERS

RAPTOR ELECTROCUTIONS ON ELECTRIC UTILITY DISTRIBUTION OVERHEAD STRUCTURES

A review of utility raptor electrocution forms filed with RUS since 1985 was presented at the 1996 Rural Electric Power Conference in Fort Worth, Texas. The paper presented by Richard Harness of Electrical Systems Consultants, titled "RAPTOR ELECTROCUTIONS ON ELECTRIC UTILITY DISTRIBUTION OVERHEAD STRUCTURES" indicates that overhead distribution powerline poles configured with transformers and bare jumpers are associated with the most raptor electrocutions. The paper indicates that although many utilities today are employing larger crossarms in their new construction to provide increased phase-to-phase and phase-to-ground separation to reduce the potential for electrocutions, uninsulated jumper wires may pose a greater threat to raptors.

The paper reviews the type and frequency of overhead electric distribution pole-top units associated with raptor electrocutions. Bird-of-Prey fatality data was collected from 51 electric utilities located in Montana, Nebraska, New Mexico and Texas. Records were obtained from 41 RUS borrowers and 10 other municipal or investor-owned utilities, spanning the years 1986 through 1995. Most of the information base was obtained from a generic raptor electrocution reporting form created and distributed by RUS in 1985. Additional records were obtained from the United States Fish & Wildlife Service (USFWS) and through ads placed in wildlife and utility trade journals.

A number of different raptor species were represented in the data. The birds covered a wide size range, from small American kestrels (wingspan, 50 cm) to large bald eagles (wingspan, 2 m). Listed in Table 1 is a breakdown of the number and type of species electrocuted.

TABLE 1

RAPTOR SPECIES TABULATION

SPECIES	NUMBER
Hawk	78
Red-tailed hawk	21
Swainson's hawk	3
Ferruginous hawk	2
Harris hawk	2
Rough-legged hawk	1
Goshawk	1
Harrier	1
Kestrel	4
Gyrfalcon	1
Prairie falcon	1
HAWK	**115**

SPECIES	NUMBER
Golden eagle	63
Bald eagle	9
Eagle	6
EAGLE	**78**
Owl	44
Great horned owl	32
Short-eared owl	1
Western screech owl	3
Great Gray owl	2
OWL	**82**
TURKEY VULTURE	**15**
OSPREY	**11**

Because electric cooperatives use construction unit standards developed and published by RUS, each electrocution record was assigned a specific standardized distribution pole-top construction unit. Table 2 illustrates the association of raptor mortality by species group as it relates to RUS distribution pole-top construction units.

TABLE 2

DISTRIBUTION LINE DATA - CONFIRMED AND SUSPECTED ELECTROCUTIONS

	Unknown	Transformers		Tangent	Deadend & Tap	Switch	Recloser	Riser	Capacitor	Ground	Total No. Raptors
		1-Phase	3-Phase								
Eagles	5	11	27	21	7	0	1	2	2	2	78
Hawks	3	35	40	12	8	2	2	3	1	9	115
Owls	4	24	25	6	5	1	6	4	1	6	82
Vultures	1	5	5	0	0	0	1	0	1	2	15
Osprey	0	0	4	2	4	0	0	1	0	0	11
Total	13	75	101	41	24	3	10	10	5	19	**301**

Total Transformers 176 58.47% of all confirmed and suspected electrocutions were associated with transformers

Table 2 shows a strong correlation between both single and three-phase transformers and raptor mortality. Transformers accounted for 58 percent of all confirmed and suspected electrocutions.

Although tangent structures proportionally killed more eagles than other raptor species, they still only accounted for 27 percent of all eagle electrocutions. Transformers still killed the greatest number of eagles, accounting for 49 percent of all reported and confirmed eagle electrocutions. The correlation between both single and three-phase transformers and raptor mortality is important not only because transformers account for the greatest percentage of electrocutions, but because the percentage of poles on rural electric systems with transformers is relatively low (between 13 and 24 percent of all pole structures).

Further review of transformer caused electrocutions reveals that three-phase transformers account for 57 percent of all transformer deaths. This is significant because three-phase transformer banks are showing higher mortality rates than single-phase transformers even though the number of three-phase banks in rural areas would typically be much lower. The paper estimates that less than 21 percent of all rural electric systems require three-phase transformer banks. Since transformers should only comprise between 13 and 24 percent of all pole structures and less than 21 percent of these should be three-phase units, multi-phase transformer banks are particularly lethal to raptors since they are still associated with 57 percent of all transformer electrocutions.

Three-phase transformer banks are potentially lethal to raptors because of minimal phase-to-phase and phase-to-ground separation between bare energized jumper wires connecting transformers, protective cutouts and surge arresters. Rural multi-phase transformer banks often serve remote irrigation or oil pumps and may be particularly harmful because they are situated near open agricultural fields likely to support numerous raptors. Additional factors such as habitat type, prey availability, raptor behavior, species, sex, age, and size may also contribute to the frequency of rural three-phase transformer electrocutions.

Fortunately, transformer units can be raptor-proofed without making structural changes. The amount of exposed energized hardware can be dramatically reduced on new transformer installations by using 600 volt insulated jumper wire and installing insulated bushing covers. Existing transformer units can be retrofitted by either replacing bare wire with 600 volt insulated jumpers or by sliding insulating material over bare jumpers. Several utility manufacturers produce insulating material constructed with an open seam, allowing it to be easily slipped over existing bare conductors. Because the insulating material and bushing covers are relatively inexpensive and easy to install, this option is also economically attractive compared to increasing separation between conductors.

Although it may be appropriate to utilize increased phase separation in remote areas with high golden eagle populations, the mortality data presented in this paper indicates that an emphasis on providing insulated jumpers on all electrical equipment and at tap and deadend locations should provide more protection for all raptor species, including eagles, at less cost to the utility.

If you would like more information or have any questions, please call Dennis Rankin, Environmental Protection Specialist, Engineering and Environmental Staff, RUS, at (202) 720-1953, or Richard Harness, Electrical Systems Consultants, Inc., at (970) 224-9100.

INSULATED DISTRIBUTION TRANSFORMER COVERS

Raptor electrocution continues to be one of the major concerns of the U.S. Fish and Wildlife Service and state wildlife agencies. Based on electrocution data collected by RUS, transformer poles appear to be associated with the majority of raptor electrocutions.

Some reputable transformer manufacturers have informed the Electric Staff Division that they sell pole-type distribution transformers with a protective insulated cover rated at 15 kV dielectric strength. The additional cost for this feature ranges from $5 to $8.

Since RUS has not received any testing criteria nor test results, we cannot attest to the accuracy nor durability of the cover insulation. The quoted insulation values may deteriorate over time due to exposure to ultraviolet light, contamination, and other aging factors. However, insulated covers on pole-type distribution transformers will help to mitigate the electrocution of raptors and small animals on the top of transformers. If your system is experiencing problems due to raptor or small animal electrocutions, you might consider purchasing pole-type distribution transformers with insulated covers. You do not need any special approval from RUS to buy transformers with this feature if the basic transformer is RUS accepted (i.e., included in the RUS List of Materials.)

If you have any experience with transformers with insulated covers or if you would like more information or have any questions, please call Dennis Rankin, Environmental Protection Specialist, Engineering and Environmental Staff, at (202) 720-1953.

CONTROL OF SULFUR HEXAFLUORIDE (SF_6) EMISSIONS

Sulfur hexafluoride (SF_6) serves as a common dielectric in circuit breakers and as an insulator in many other types of electrical power equipment. According to Ko et al. (1993), the major use of SF_6 worldwide is in electrical transmission and distribution systems. SF_6 has been identified by the Intergovernmental Panel on Climate Change as a potent greenhouse gas (1995). The atmospheric lifetime for SF_6 is estimated to be 3,200 years with a global warming potential for a 100-year time horizon of 24,900. Studies report the atmospheric concentration of SF_6 to be low but estimate its rate of increase to be approximately 7 to 8 percent per year (Rinsland, 1991; Maiss, 1994). Due to the extreme length of time required to remove the gas from the atmosphere, emissions will likely accumulate. Thus, there is good reason to control the release of SF_6.

To reduce emissions of SF_6 from electrical transmission and distribution systems, the United States Environmental Protection Agency (EPA) is developing a voluntary partnership with the industry. Such a program presents a new and innovative way to achieve environmental protection. For electrical power systems, opportunities exist to reduce emissions. EPA encourages better maintenance of equipment, capture and recycling of the gas, consideration of opportunities for substituting environmentally benign chemicals for SF_6, and perhaps replacement of older, leaking equipment.

Voluntary partnerships will be sought with individual utilities. EPA is interested in working with interested parties in the industry to develop the format of the voluntary program. EPA invites utilities to join in investigating options for reduction of emissions of the greenhouse gas SF_6.

If you would like more information or have any questions, please call Harvey L. Bowles, Chief, Distribution Branch at (202) 720-5082, or Elizabeth Dutrow, U.S. Environmental Protection Agency, (202) 233-9061.

Intergovernmental Panel on Climate Change. Climate Change 1994, Radiative Forcing of Climate Change. The Press Syndicate of the University of Cambridge. New York, New York. 1995.

Ko, Malcolm, et al. "Atmospheric Sulfur Hexafluoride: Sources, Sinks and Greenhouse Warming". Journal of Geophysical Research. Volume 98. Number D6. pp. 10,499-10,507. June 20, 1993.

Maiss, M. and I. Levin. "Global Increase of SF_6 Observed in the Atmosphere." Geophysical Research Letters. Volume 21. Number 7. pp. 569-572. April 1, 1994.

Rinsland, C. P., et al. "ATMOS/ATLAS 1 Measurements of Sulfur Hexafluoride (SF_6) in the Lower Stratosphere and Upper Troposphere." Journal of Geophysical Research. Volume 98. Number D11. pp. 20,491-20,494. November 20, 1993.

ADMINISTRATIVE

RECENT RUS ENGINEERING PUBLICATIONS

RUS has published several items recently of interest to the RUS electric engineering community. These publications include:

- Bulletin 1726-601, "Electric System Construction Policies and Procedures -- Interpretations" (5/10/96). This bulletin, mostly in a question and answer format, provides clarifications and interpretations concerning some of the policies and procedures in 7 CFR 1726 relevant to RUS electric borrowers when purchasing materials and equipment, and when constructing facilities by contract or force account.

- Bulletin 1730B-121, "Pole Inspection and Maintenance" (4/15/96). This bulletin provides information and guidance to RUS electric borrowers in establishing or sustaining a continuing program of effective, ongoing pole maintenance.

If you need any of these publications, please contact RUS' Program Support and Regulatory Analysis Staff at (202) 720-8674.

TRANSMISSION AND DISTRIBUTION ENGINEERING COMMITTEE

In 1991, NRECA established its Transmission and Distribution Engineering Committee to work with REA (now RUS) in the development and maintenance of electric transmission and distribution standards and specifications, and the exchange of engineering information of mutual interest to rural electric utilities. The Committee is composed of some of the most dedicated and talented individuals from NRECA and from electric cooperatives all across the United States. These individuals routinely donate several weekends and considerable amounts of other personal time each year to fulfill their commitments to the Committee.

We want to use this opportunity to thank these individuals and the organizations that sponsor their participation.

The following list includes Committee members as of August 1996:

NRECA TRANSMISSION & DISTRIBUTION ENGINEERING COMMITTEE

MEMBER	ORGANIZATION	LOCATION
Committee Chairman **Jim Baker**	Middle Tennessee EMC	Murfreesboro, TN
NRECA Staff Coordinator **Jim Dedman**	NRECA	Arlington, Virginia
Craig Anderson	Dairyland Power Co-op	LaCrosse, WI
Dominic Ballard	East Kentucky Power Co-op	Winchester, KY
David Beam	North Carolina EMC	Raleigh, NC
Alan Blackmon	Blue Ridge EC	Pickens, SC
Gregory Broussard	Jackson EMC	Jefferson, GA
James Byrne	Poudre Valley REA	Fort Collins, CO
Jim Carter	NRECA - WQC	Spartanburg, SC
James Crouch	Fairfield EC	Winnsboro, SC
Russ Dantzier	Mid-Carolina EC	Lexington, SC
Berl Davis	Palmetto EC	Hilton Head, SC
Bruce Dreyer	Middle Tennessee EMC	Murfreesboro, TN
Carl Garner	Middle Tennessee EMC	Murfreesboro, TN
David Garrison	East Central Oklahoma EC	Okmulgee, OK
David Gebhardt	LaPlata EA	Durango, CO
Ron Gunnell	Randolph EMC	Asheboro, NC
Jack Heflin	Western Farmers EC	Anadarko, OK
Wayne Henson	East Mississippi EPA	Meridian, MS

MEMBER	ORGANIZATION	LOCATION
Vince Heuser	Nolin RECC	Elizabethtown, KY
Robert Johnson	Arkansas EC Corp.	Little Rock, AR
Joseph Joplin	Rutherford EMC	Forest City, NC
Kendrick Kirschenmann	Rushmore EPC	Rapid City, SD
Russell Lea	Clay EC	Keystone Heights, FL
Gregory Lindsly	Dixie EMC	Baton Rouge, LA
Troy Little	Four County EPA	Columbus, MS
Charles Lukkarila	United Power Assn.	Elk River, MN
Charles (Bubba) McCall	Oglethorpe Power Corp.	Tucker, GA
David Moore	Johnson County EC	Cleburn, TX
William Murray	Berkeley EC	Moncks Corner, SC
Jim Newberg	Missoula EC, Inc.	Missoula, MT
David Obenshain	Piedmont EMC	Hillsborough, NC
Bob Oldham	Southern Maryland EC	Hughesville, MD
Mike Opitz	Western Farmers EC	Anadarko, OK
Michael Pehosh	Ozarks EC	Fayetteville, AR
Chris Perry	Nolin RECC	Elizabethtown, KY
Peter Platz	Coast Electric Power	Bay St. Louis, MS
John Rodgers	Nodak EC, Inc.	Grand Forks, ND
Paul Rupard	East Kentucky Power Co-op	Winchester, KY
Brad Schmidt	Cass County EC	Fargo, ND
Stephen Shirey	Allegheny EC	Harrisburg, PA
Robert Siekas	Cherryland EC	Grawn, MI
Gordon Sloan	Sulphur Springs Valley EC	Willcox, AZ
Thomas Slusher	Union EMC	Monroe, NC
Michael Smith	Singing River Electric Co-op	Lucedale, MS
Paul Spears	Tri-County Electric Co-op	Azle, TX
Gary Stein	Wabash Valley Power Assn.	Indianapolis, IN
Blaine Strampe	Federated REA	Jackson, MN
Tom Suggs	Natchez Trace EPA	Houston, MS
John Twitty	Alabama EC	Andalusia, AL
Scott Wehler	Adams EC	Gettysburg, PA
Lowell Wessel	Jackson County REC	Browntown, IN
Kenneth Winder	Moon Lake Electric	Roosevelt, UT

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APPENDIX A

INSPECTION & MAINTENANCE FORM FOR PAD-MOUNTED EQUIPMENT

LOCATION:____ MANUFACTURER.....__________________________________

MAP ID........____ SERIAL NO.................__________________________________

TYPE OF EQUIPMENT [ ] TRANSFORMER............................KVA .... _____________ PHASES 1 3____
[ ] JUNCTION CABINET...................[ ] 3 PHASE................[ ] V PHASE...............[ ] 1 PHASE
[ ] SWITCHGEAR...............................MODEL 3 4 5 6 9 10 11 13 OTHER______
[ ] OTHER-SPECIFY____________________

EXTERIOR MARKING "WARNING" DECAL....[ ] NEED TO REPLACE OR ADD..[ ] REPLACED OR ADDED..[ ] OK
LOCATION NUMBER..[ ] NEED TO REPLACE OR ADD..[ ] REPLACED OR ADDED..[ ] OK
OTHER-SPECIFY____________________ [ ] NEED TO REPLACE OR ADD..[ ] REPLACED OR ADDED..[ ] OK

FOUNDATION: TYPE...[ ] BOX PAD..........[ ] FLAT POLY PAD........[ ] CONCRETE PAD
CONDITION.....[ ] NEED TO REPAIR OR REPLACE..............[ ] REPAIRED...........[ ] REPLACED..........[ ] OK
GRADE.....[ ] NEED TO RAISE OR LEVEL......................[ ] RAISED................[ ] LEVELED.............[ ] OK

EXTERIOR FINISH........[ ] FADING -NO CORROSION.................[ ] NEEDS PAINTING..........[ ] PAINTED..........[ ] OK
[ ] CORRODING...[ ] NEEDS REPAIR...............[ ] REPAIRED
[ ] CORRODING-BEYOND REPAIR......[ ] NEEDS REPLACING......[ ] REPLACED

OIL FILLED EQUIPMENT.......[ ] MINOR LEAK.....[ ] NEEDS REPAIR.....[ ] REPAIRED.....[ ] REPLACED.....[ ] OK
[ ] MAJOR LEAK - MUST BE REPAIRED OR REPLACED IMMEDIATELY

EQUIPMENT SECURITY: ITEMS NOT CHECKED AS "YES", MUST BE REPAIRED OR REPLACED IMMEDIATELY
SECURED TO FOUNDATION...[ ] REPAIRED.........................[ ] REPLACED.........................[ ] YES
PENTAHEAD BOLT PRESENT AND SECURED........[ ] REPAIRED.........................[ ] REPLACED.........................[ ] YES
HASP AND PAD OR OTHER LOCK INSTALLED.... .[ ] REPAIRED.........................[ ] REPLACED.........................[ ] YES

INTERIOR MARKING... "DANGER" DECAL...[ ] NEED TO REPLACE OR ADD...[ ] REPLACED OR ADDED...[ ] OK
CABLE LABELS....[ ] NEED TO REPLACE OR ADD...[ ] REPLACED OR ADDED...[ ] OK

INTERIOR FINISH.........[ ] FADING - NO CORROSION................[ ] NEEDS PAINTING..........[ ] PAINTED..........[ ] OK
[ ] CORRODING..[ ] NEEDS REPAIR...............[ ] REPAIRED
[ ] CORRODING-BEYOND REPAIR......[ ] NEEDS REPLACING......[ ] REPLACED

TERMINATIONS............ELBOWS.............__________ NEEDS REPLACING__________ REPLACED__________ OK_____
(ENTER POTHEADS.......__________ NEEDS REPLACING__________ REPLACED__________ OK_____
QUANTITIES) SECONDARY....__________ NEEDS REPLACING__________ REPLACED__________ OK_____

GROUNDS..........ROD-MEASURED OHMS_____[ ] NEED TO REPLACE OR ADD..[ ] REPLACED OR ADDED..[ ] OK
CONNECTIONS:..........................[ ] NEED REPAIR.............................[ ] REPAIRED..........................[ ] OK

SURGE ARRESTERS....EXISTING.........................[ ] NEED TO REPLACE OR ADD..[ ] REPLACED OR ADDED..[ ] OK
CONNECTIONS:............[ ] NEED REPAIR..............................[ ] REPAIRED..........................[ ] OK

FAULT INDICATORS.....[ ] TESTED..................[ ] NEED TO REPLACE OR ADD...[ ] REPLACED OR ADDED..[ ] OK

INSECT NESTS....[ ] NEEDS TREATING...[ ] TREATED/REMOVED-DO NOT REMOVE FIREANT NESTS...[ ] NONE

LIST ANY OBSTRUCTIONS: ____
(FENCES; TREES; SHRUBS; BUILDINGS; ETC.)

PLEASE NOTE ANY OTHER PROBLEMS, ACTION TAKEN OR NEEDED: _______________________________________

____
(USE OTHER SIDE IF ADDITIONAL SPACE IS NEEDED)

INSPECTED BY:____DATE:____

ANY HAZARDOUS SITUATIONS, SAFETY VIOLATIONS OR MAJOR OIL LEAKS
MUST BE REPORTED AND REPAIRED IMMEDIATELY!

APPENDIX B

UNDERGROUND CABLE FAILURE REPORT

Cooperative:____________________________ **Date**___________ **Truck/Crew:**_______________
Location______________________________________ **Underground Outage #** ______________

*** **Circle Appropriate Answer** ***

Conductor	**Type**	**Metal**	**Manufacturer**	**Insulation**	**Size**	**Oper. Volts**
#2	Solid	Copper	Alcoa	HMW	175	5kV
1/0	Strand	Aluminum	Cablec	TR-HMW	220	15kV
4/0	Filled Strand		CPI	XLPE	260	25kV
250			Essex	TR-XLPE	320	35kV
350			GE	EPR	345	
500			Hendrix	_______	______	
750			Kaiser			
_____			Kerite			
			Okonite			
			Pirelli			
			Reynolds			
			Rome			
			Southwire			
			General			
			Phelps-Dodge			
			___________			

Jacket	**Neutral**	**Condition**	
None	Tinned Cu.	Like new	25% gone
Semi-con	Bare Cu.	Green	50% gone
Insulated	Flat Strap	Red	75% gone
	Ridgelock	Red & pitting	100% gone
	# of wires___	Red & deep pitting	
		Severed strands	

Year Manufactured________________
Year Installed_____________________
Direct buried or duct (type_________)
Plowed or trenched
Main Line or Service Tap
Number of phases: 1 2 3
Phase designation: A B C
Are Anodes Installed? Yes No
Year Anodes Installed ______________
Are Fault Indicators Installed? Yes No
Did they work properly? Yes No
Are MOV's installed? Yes No
What is the cable depth?__________in.

Comments:____
____

APPENDIX C

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