UNITED STATES
DEPARTMENT OF AGRICULTURE
RURAL DEVELOPMENT
UTILITIES PROGRAMS

ELECTRIC PROGRAMS

SUMMARY OF ITEMS OF ENGINEERING INTEREST

SEPTEMBER 2006

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TABLE OF CONTENTS

ABBREVIATIONS

Ah	Ampere hours
ANSI	American National Standards Institute
APLIC	Avian Power Line Interaction Committee
ASCE	American Society of Civil Engineers
CCA	Chromated Copper Arsenic
DC	Direct Current
DF	Douglas-fir
EES	Engineering and Environmental Staff
EPA	Environmental Protection Agency
ESD	Electric Staff Division
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
GFR	General Field Representative
GIS	Geographical Information System
GPS	Global Positioning System
GSU	Generator Step-Up
IEEE	Institute of Electrical and Electronics Engineers
kV	Kilovolt
kVA	Kilovolt-Ampere
kWh	Kilowatt hour
List of Materials	Informational Publication 202-1, “List of Materials Acceptable for Use on Systems of USDA Rural Development Electrification Borrowers”
MW	Megawatts (1,000,000 watts)
NEC	National Electrical Code
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NRECA	National Rural Electric Cooperative Association
RCRA	Resource Conservation and Recovery Act
REA	Rural Electrification Administration
RECC	Rural Electric Cooperative Corporation
RUS	Rural Utilities Service
SYP	Southern Yellow Pine
T&D	Transmission & Distribution
T&DEC	Transmission & Distribution Engineering Committee
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WE	Wind Energy
WRC	Western Red Cedar

ENGINEERING

Push Poles

The Rural Development Utility Program, Electric (RUS) does not "incorporate" push poles in any of RUS' standard specifications and drawings for line construction. Similarly, RUS does not "incorporate" many other construction assemblies and techniques. However, the RUS Regional Offices in Washington may approve the use of such assemblies, on a case-by-case, basis upon written request with adequate reasons (explanation and justification) by borrowers.

RUS does not recommend the use of push poles, and has not created a standard construction assembly unit for their use because RUS believes there are safer, less expensive, and more visibly pleasing alternatives to solve line tension problems at locations where push poles might be considered.

Obviously, push poles, without adequate and effective anti-climbing measures, provides a means for humans and animals to climb into and touch bare primary conductors which could result in injury and even death.

In lieu of the use of push poles, RUS recommends any of the following, or a combination of the following, to counteract the transverse or longitudinal loading of primary conductors.

- Use span guys to extend the conductor tension to another, adjacent pole that can be guyed.

- Use short slack span(s) where conductor tensions are guyed on the pole(s) adjacent to the designed primary deadend or angle assembly.

- Key and block the poles instead of using down guys. (Pole keys are listed in Section z-4 in the "List of Materials Acceptable for Use on Systems of USDA Rural Development Electrification Borrowers").

- Back-fill the (enlarged) pole hole with concrete or other similar solid material such as hardened foam.

- Set the pole deeper than its normal setting depth and use a larger class and longer pole.

For instance, instead of using a 45 foot, class 4 pole which might normally be selected, use a 55 foot, class 2 (or class 1) pole, cut off the top 5 feet, and set it 5 feet deeper than normal. Rake the pole away from the tension and apply an additional 5 feet of preservative at the ground line. In addition, consider blocking and keying the pole or using a solid back-fill.

For more information please contact the Distribution Branch, Rural Development Utilities Programs at (202) 720-5082.

Pole Species

The question concerning the strength of different species of poles has arisen several times. The strength of wood (fiber strength) does vary depending on the species. The fiber strength ranges from a low of 4000 pounds per square inch (psi) for northern white cedar to a high of 8400 psi for western larch. Where the confusion comes in is the difference between wood strength and load carrying capacity. All poles are classed for load carrying capacity. All poles of the same class have the same load carrying capacity. As such, a class 3 northern white cedar can carry the same load as a class 3 western larch. In order to achieve the same load carrying capacity, the lower fiber strength pole needs more fiber than the higher fiber strength pole. Thus, the 60 foot class 3 northern white cedar pole has a circumference of 53.5 inches 6 foot from the butt and the western larch has a circumference of 41 inches at the same location.

If you would like more information or have any questions, please contact Robert Lash, Transmission Branch, of the Electric Staff Division, at (202) 720-0486 or at Bob.Lash@wdc.usda.gov.

Sidewalk Guys

The Rural Development Utility Program, Electric (RUS) does not incorporate sidewalk guys in the any of RUS' standard specifications and drawings for line construction. Similarly, RUS does not "incorporate" many other construction assemblies and techniques. However, the RUS Regional Offices in Washington may approve the use of such assemblies, on a case-by-case, basis upon written request with adequate reasons (explanation and justification) by borrowers.

RUS has not created a standard construction assembly unit for sidewalk guys because historically the need for their use (in rural areas) has been, and still is, limited.

RUS does not recommend the use of sidewalk guys for the following 2 reasons.

(1) RUS recommends a minimum 1 to 1 (45-degree) guy lead. (1 to 1 implies the guy lead is equal to its attachment above ground.) When a 1 to 1 guy lead is used, the down guy has enough height over sidewalks adjacent to guyed poles that a sidewalk guy assembly is not needed.

(2) Attaching a sidewalk guy assembly to a normal down guy makes the combination pole and guy assembly into a strut. Otherwise the pole acts as a simple column. Internal tensions and compressions within the members of this new strut are greater than the tensions and compressions of the singular down guy and the singular pole. The amount of increase of these forces depends on the length and mounting height of the sidewalk guy extension arm. The design engineer needs to calculate the tension and compression force in each member of the strut to determine the required size for guy attachments, guy wires and anchors. Note that with the sidewalk guy strut arrangement, the sidewalk guy extension arm pushes on the pole and, over time, has a tendency to make the pole bow away from the arm.

For more information please contact the Distribution Branch, Rural Development Utilities Programs at (202) 720-5082.

Important Considerations when Selecting and Sizing Substation Batteries

This article will review Section 15.2 DC Auxilliary Systems in Bulletin 1724E-300 from the view point of the range of batteries available commercially and the importance of knowing as much as possible about the current demands or loads to which a battery will be subjected. The results should be that the most appropriate battery with the correct capacity will be installed with many years of useful service in the years ahead.

Battery Types and Choices

In the last 10-15 years, an alternative battery to the “lead-calcium” battery has established itself across the USA in most utiltities. This type is known as the “lead-selenium” battery, using a different grid alloy which in fact performs better at low temperatures, needing less added capacity compensation than the “lead-calcium” counterpart. It is comparable to the “lead-calcium” for low water consumption and a stable current over its life. From a maintenance viewpoint, the “selenium” is more friendly as the cell voltages are much less spread from cell to cell and variations tend to indicate the need of special attention.

A feature of the Nickel-Cadmium batteries often overlooked is that they only require voltage checks once or twice a year and in many cases, the watering intervals may be as long as 8 to 10 years.

A useful tip for monitoring purposes relates to the values of cell readings by voltage, specific gravity and nowadays, internal resistances or impedance. While each one parameter alone has limited value in assessing the battery condition, the combination of two or more of these measurements will result in relatively reliable information as to the real battery condition. The ever present issue with taking readings is that these do take time and once taken, are often not reviewed and so maintenance does suffer.

Life Cycle Costing

When considering First Cost, Years of Service, etc., it is recommended to expand this list to include Maintenance Costs as well. These should then be applied to each of the different battery types being considered. It is not always fully appreciated but the Planté battery which uses pure lead will and can last 25 and more years in the right environment. The pasted plate types, “lead-calcium” and “lead-selenium” grid types, typically provide 12-15 useful years of service. All these “Lead” batteries will however, suddenly die after their plates have been corroded by the sulfuric acid, the basis of the battery operation.

On the otherhand, the Nickel-Cadmium batteries will also last 25 and more years but will not suddenly fail. The reason is simply that the electrolyte, potassium hydroxide, is a preservative for the plates and so the plates do not suffer from the corrsion that “lead” plates suffer. Added to this fact, the Ni-Cds only require cell voltage checks once or twice annually.

Therefore, these factors for selecting batteries will have different weighting values; all batteries behave differntly from each other.

Cost of Failure

Cost of failure is recommend to be included in the life cycle costs of selecting batteries. The question that should be posed and answered is "Are there any Customers down the line for whom a failure will cost them tens of thousands of dollars per hour in lost production?" If the answer is yes, then the battery that does not suddenly fail should be adopted and the nominal added "first cost" becomes incidental and small.

Sizing Implications and Considerations

When sizing a battery, it is constructive to know as much detail as possible about the load events or current demands that will be placed on the battery and in what sequence, simultaneously or sequentially and when. The most demanding load that may be placed upon a battery is that one at the end of an eight hour period, namely, the tripping current of breakers. The second consideration is which loads occur at the same time as others. A good example is "emergency lighting", usually at the start of the outage and will therefore be functioning at the same time as the tripping, recharging of spring coils and constant loads like annuciators.

Lead batteries are rated in ampere-hours at an 8-hour rate to 1.75 volts/cell at 25^{o}C or 77^{O}F; Ni-Cd batteries are rated at the 5-hour rate to 1.00 volts/cell; their end of discharge voltages may vary from 1.05 to 1.10 volts/cell as optimized by the sizing program.

EXAMPLE 1: Battery Selection for a Lead Acid

The model duty cycle could be:

Ten 40-watt, 120-volt lamps – 3 hrs	3.5 amperes
Relays and panel indicating lamps – 8 hrs	5.0 amperes
Communications – 3 hrs	5.0 amperes
Three simultaneous Breaker Operations – 1 min.	100.0 amperes

The Load Profile may be calculated as follows:

1st period load	100 + 3.5 + 5 + 5 amperes	= 113.5A for	1 minute
2nd period load	3.5 + 5 + 5 amperes	= 13.5A	179 mins
3rd period load	5 amperes	= 5A	299 mins
4th period load	100 + 5 amperes	= 105A	1 minute

The loads of 3.5 amps (lamps) and 5 amps (comms) may or may not be simultaneous and may impact the size of a battery.

In interpreting the events in Example 1, the sizing assumed the lamp loads and communications loads were simultaneous.

The Load Profile required a "lead-calcium acid" battery of 127 ampere hours and for a "lead-selenium" battery 100 Ah. The difference is related to the plate efficiency or "amps available per positive plate". The IEEE guideline for Sizing was used.

Form 1, titled Battery Sizing Questionnaire is important to developing a reliable Load Profile.

In Example 2, the shortest period is 1 second for Nickel-Cadmium batteries, not one minute as for "lead".

EXAMPLE 2: Battery Selection for a Pocket Plate Ni-Cd

The model duty cycle could be:

Ten 40-watt, 120-volt lamps – 3 hrs	3.5 amperes
Relays and panel indicating lamps – 8 hrs	5.0 amperes
Communications – 3 hrs	5.0 amperes
Three simultaneous Breaker Operations – 1 min.	100.0 amperes

The Load Profile may be calculated as follows:

1st period load	100 + 3.5 + 5 + 5 amperes	1 second
2nd period load	3.5 + 5 + 5 amperes	179 mins 59 secs
3rd period load	5 amperes	299 mins 59 secs
4th period load	100 + 5 amperes	1 second

The loads of 3.5 amps (lamps) and 5 amps (comms) may or may not be simultaneous and may impact the size of a battery.

In the above Example 2, the load profile resulted in a battery of 70 Ah. If this were not a standard size, then the next available capacity would be selected. Note that the capacity is significantly less than a "lead-acid" battery.

Conclusions

Battery selection should include the review of the environmental circumstances of the site. An assessment of the temperature extremes to which the battery may be subjected should be taken into account, otherwise the battery may be grossly undersized. Consideration for the level of maintenance available, including how often the battery may be visited is important also. Then the choice can be soundly made. A factor all too often overlooked is the cost of failure. Are there customers for whom a power failure may result in tens of thousands of dollars of lost production per hour? If so, then the small extra initial cost of upgrading to a more reliable battery type is justifiable.

The next step is developing the load profile. Battery suppliers should be invited to assist both in guidance in sizing and an opinion of the choice of battery being selected. Sizing should be in accordance with the IEEE guidelines to ensure comparable sizing calculations. Do not be concerned if different sized batteries are selected; this will happen if both "lead-calcium" and "lead-selenium" batteries are being considered. They can differ by as much as 30 or 60% as the positive plates have different efficiencies. This subject may be discussed at greater length with your battery supplier. Form 1, on page 25, is a very useful document in clarifying the sequence of events, for if they are not fully known, then either a grossly oversized battery may result, costing too much, or it may be sadly undersized with potentially undesired results or unexpected lack of performance. Batteries deserve "life cycle" studies just as transformers do. Much depends upon them but they are not always well understood. In closing, although hydrogen is a highly explosive gas, the amounts typically generated in a normal standby mode are below the explosive limit especially if frequent air changes are designed into the room or building. Even Valve-Regulated Lead-Acid batteries should be afforded the same ventilation as their vented counterparts; see NEC Article 480.

References

IEEE 1187 "Recommended Practice for the Installation Design and Installation of Valve-Regulated Lead-Acid Storage Batteries for Stationary Applications."
IEEE 1188 "Recommended Practice for Maintenance, Testing and Replacement of Valve-Regulated Lead-Acid Batteries for Storage Applications."
IEEE 1189 "Recommended Practice for Selection of Valve-Regulated Lead-Acid Batteries for Stationary Applications.
IEEE 484 "Recommended Practice for the Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications."
IEEE 485 "Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications."
IEEE 450 "Recommended Practice for Maintenance, Testing and Replacement of Vented Lead-Acid Batteries for Stationary Applications."
IEEE 1106 "Recommended Practice for Installation, Maintenance, Testing and Replacement of Nickel-Cadmium Batteries for Stationary Applications."
IEEE 1115 "Recommended Practice for Sizing Nickel-Cadmium Batteries for Stationary Applications."
NEC Article 480 – 8 (a)

If you would like more information or have any questions, please call Mike Eskandary, Electrical Engineer, Transmission Branch, at (202) 720-9098.

Changes to the 2002 NESC, sections 24, 25, 26, & 27, for 2007

Over the past 4 years, RUS has provided information by way of the items of engineering interest concerning changes being developed and proposed for the 2007 NESC. Some of the changes to sections 24, 25, 26, & 27 in the 2007 NESC are summarized below.

Probably the most significant change that may affect transmission line design more so than distribution line design concerns the additional loading criteria to Rule 250. A new combined ice/wind map was added to the rule as Rule 250D. This new loading criteria is required for any structures over 60 feet in height. The load factors associated with these new loadings are 1.00 for grade B and .80 for Grade C. Although the ice/wind map is based a 50 year recurrence interval, the use of these load factors basically reflects a 50 year recurrence event for Grade B and a 25 recurrence event for grade C. The concurrent wind shall be applied to the projected area resulting form Rule 250D1 and Rule 250D2 multiplied by a factor of 1.00. A strength factor of .80 shall be applied. For the 2007 NESC, the ice/wind maps are from ASCE 7-2005.

The maps shown below are reproduced with permission from ASCE 7-2005, "Minimum Design Loads for Buildings and Other Structures," American Society of Civil Engineers, copyright 2006. This material may be downloaded for personal use only. Any other use requires prior permission of the American Society of Civil Engineers. This material may be found at (URL/link of abstract in Civil Engineering Database), e.g. http://www.pubs.asce.org/WWWdisplaybn.cgi?0784407223)

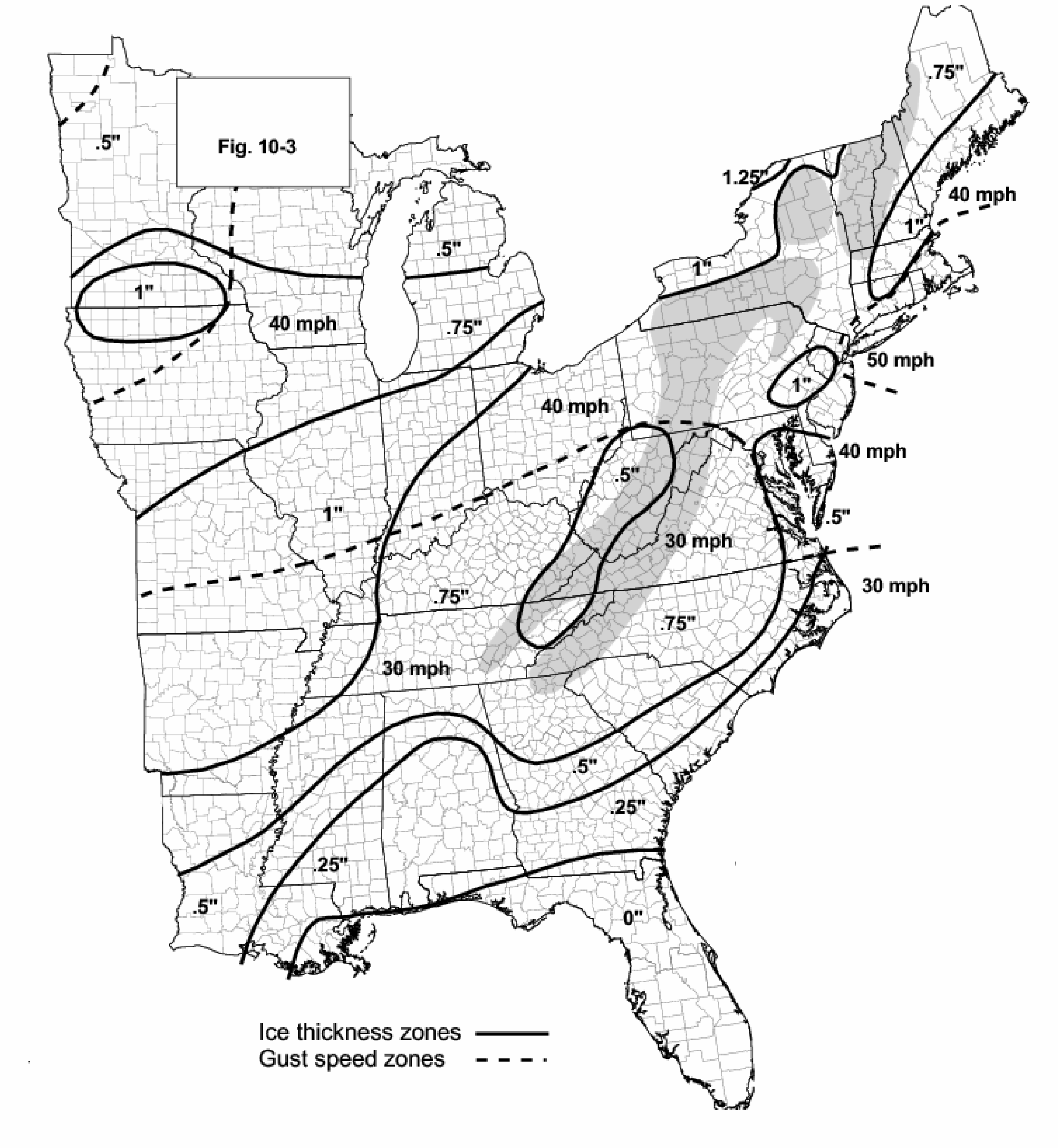
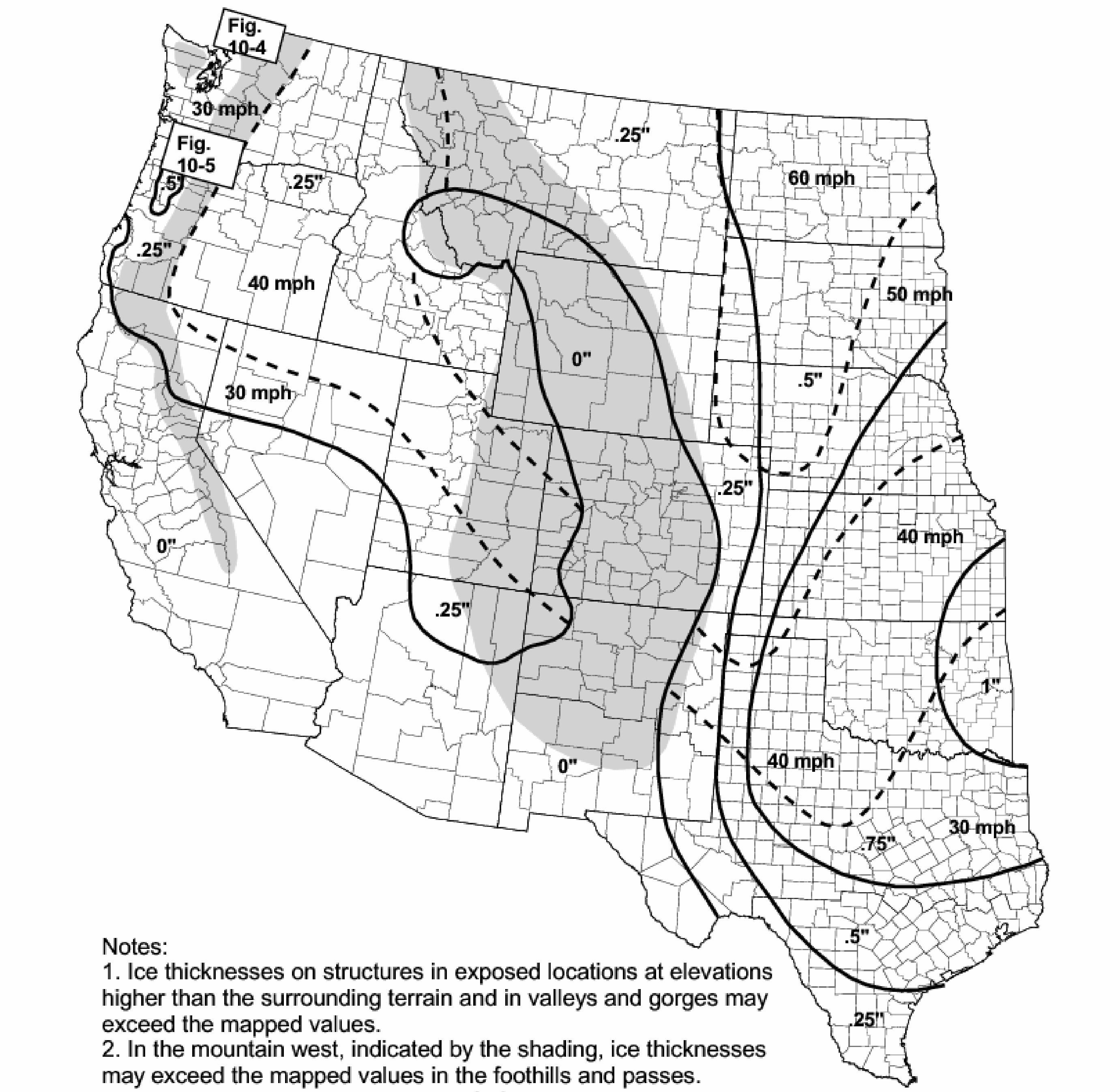


FIGURE 10-2 (continued)



Notes:
1. Ice thicknesses on structures in exposed locations at elevations higher than the surrounding terrain and in valleys and gorges may exceed the mapped values.
2. In the mountain west, indicated by the shading, ice thicknesses may exceed the mapped values in the foothills and passes. However, at elevations above 5,000 ft, freezing rain is unlikely.

FIGURE 10-3 (See Figure 10-2 for location reference)

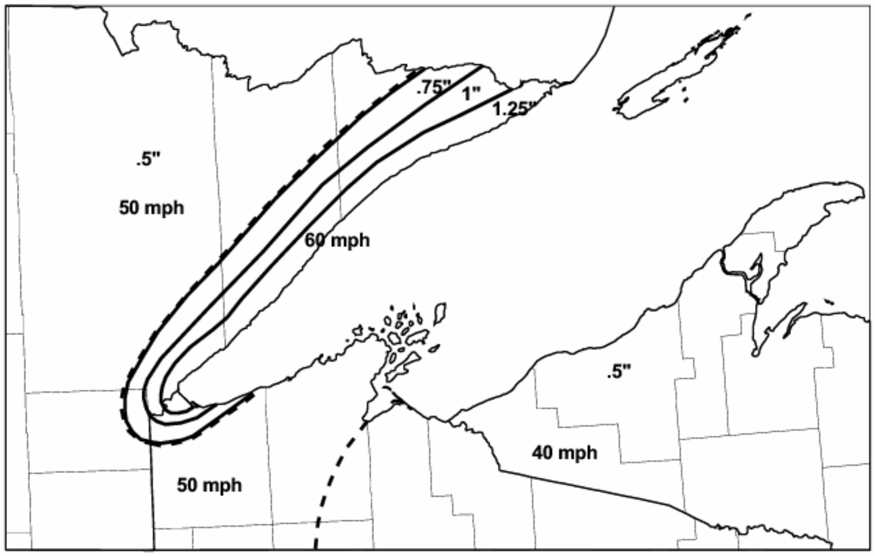


FIGURE 10-4 (See Figure 10-2 for location reference)

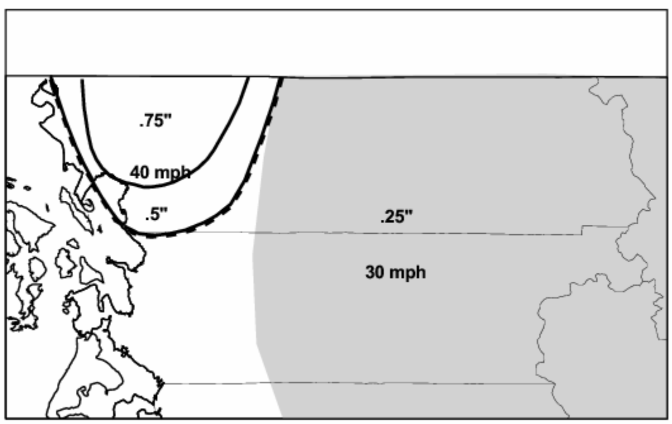
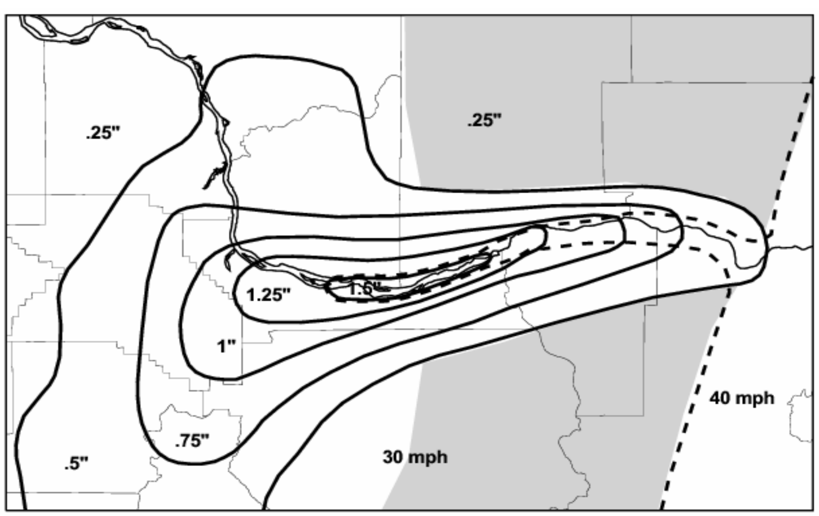


FIGURE 10-5 (See Figure 10-2 for location reference)



A footnote in several of the load factor tables (section 25) and strength factor tables (section 26) has been modified. It now reads "When structure strength deteriorates to the level of the loads multiplied by the overload factors required at replacement, the structure shall be replaced or rehabilitated. If a structure or component is replaced, it shall meet the "when installed" overload factors at replacement. Rehabilitated portions of structures shall have overload factors at the time of rehabilitation greater than of those required "at replacement."

There was a change proposal to remove the alternate method (Table 253-2) from the code. If you remember, this is the method where the transverse overload factor is 4 for Grade B and 2.67/2.0 for Grade C. In the final vote, the NESC subcommittee accepted the change proposal but modified it to indicate that the alternate method will not be used after July 31, 2010 (remember, the next revision is of the NESC is scheduled for 2012).

There was a note 2 and an exception added to Rule 261A2a. NOTE 2 and the exception reads "Maximum stress may occur above ground line. EXCEPTION 1: When installed, naturally grown wood poles, not greater than 55 ft length, installed acting as single-based structures or un-braced multiple-pole structures, shall only meet the requirements of Rule 261A2a without exceeding the permitted stress level at the ground line for un-guyed poles or at the points of attachment for guyed poles." This change will affect the design of transmission lines more so than distribution.

The three pole rule in Rule 261A2b(3) is eliminated. The three pole rule (Rule 261A2e) is restated for the reader's convenience. "Average strength of three poles - A pole (single-base structure) not individually meeting the transverse strength requirements will be permitted when reinforced by a stronger pole on each side, if all of the following are met: (1) the average strength of the three poles meets the transverse strength requirements, (2) the weak pole shall have not less than 75% of its required strength, (3) the sag and tension of the wires, conductors, and cables in the adjacent spans shall provide adequate additional support for the weak pole, and (4) the average of the spans does not exceed 45 m (150 ft).

There was a section added to Rule 261 to cover fiber reinforced structures. The rule basically says that for fiber-reinforced polymer structures, these structures shall be designed to withstand the loads in Rule 252 multiplied by the appropriate overload factors in Table 253-1 without exceeding the permitted load. The permitted load shall be the 5th percentile strength (i.e., "5% lower exclusion limit") or less, multiplied by the strength factors in Table 261-1A (where guys are used, see Rule 261C). Rule 261C3 says that when guys are used to meet the strength requirements of fiber reinforced structures, the guys shall be considered as taking the entire load in the direction in which they act, as if the structure is acting as a strut only, except for those structures considered to possess sufficient rigidity so that the guys can be considered an integral part of the structure. Rule 261D3 covers fiber-reinforced polymer crossarms and braces. "Crossarms and braces shall be designed to withstand the loads in Rule 252 multiplied by the overload factors in Table 253-1 without exceeding the permitted load. The permitted load shall be the 5th percentile strength (i.e., "5% lower exclusion limit") or less, multiplied by the strength factors in Table 261-1A."

Rule 261N is added to cover climbing and working steps to the structure. It says that "the strength required for all climbing devices (includes steps, ladders, platforms and their attachments) shall be capable of supporting 2.0 times the maximum intended load without permanent deformation. Unless otherwise quantified by the owner, the maximum intended load shall be assumed to be 300 lb, which includes the weight of the lineman, harness, tools, and equipment being supported by the lineman. NOTE: See IEEE Std 1307 TM -2004 [B46]."

In Rule 277 there were some minor adjustments made. "Rated ultimate" strength was deleted and Rule 277 now reads: "Insulators shall withstand all applicable loads specified in Rules 250, 251, and 252 except those of Rules 250C and 250D without exceeding the following percentages of their strength rating for the specified application: respective insulator type. Proper allowance should be made for the loads in Rules 250C and 250D." The strengths of the insulators have been tied to an ANSI standard. Also, non-ceramic insulators are added to the table of insulators and percentages of strength.

Other changes are discussed below:

- The term overload factor is being replaced with the words load factor.
- The load factor for extreme winds for Grade C was changed from 1.00 to .87. For grade B, the load factor remains as 1.00
- The code no longer distinguishes between urban and rural in Section 24.
- An appendix was added that gave examples for calculating the extreme wind load on structures.

If you would like more information or have any questions, please contact Donald Heald, Transmission Branch, at (202) 720-9102 or at Don.Heald@wdc.usda.gov.

OPERATIONS AND MAINTENANCE

Management of Used Treated Wood Poles

Annually, the nation's utilities remove from service untold volumes of treated wood poles. The public has a legitimate interest in the management of poles that can no longer be used for their original purpose.

Confusion sometimes exists between the chemicals (pesticides) used to preserve the pole and the actual treated wood pole itself. There is a difference. The treated wood pole falls under distinctly separate rules and regulations, which, in general acknowledge the low level of risk associated with the poles. This fact was recognized in a 1985 Environmental Protection Agency (EPA) decision that confirmed that treated wood products are not pesticides, and thus are not regulated under the Federal Insecticide, Fungicide, and Rodenticide Act.

Many poles removed from service retain enough of their original structure and characteristics to make them usable in other treated wood applications. When poles can be reused in a manner compatible with their original purpose, such as for shorter poles, fence posts, retaining walls and landscape timbers, such reuse does not constitute “disposal” and these poles are not classified as “solid waste” subject to federal or state regulation.

However, poles removed from service that have no other useful application as a product are considered solid waste. Nonetheless, these poles have not been classified as hazardous waste under the federal Resource Conservation and Recovery Act (RCRA) program. Extensive testing on Penta and creosote treated wood reveals that these poles do not test hazardous. Poles treated with CCA are exempt from hazardous waste regulation.

In summary, treated wood removed from service that is not destined for reuse is not a hazardous waste and can be disposed of as solid waste. State and local jurisdictions may have particular guidelines which the user should be aware of and follow.

If you would like more information or have any questions, please contact Robert Lash, Transmission Branch, of the Electric Staff Division, at (202) 720-0486 or at Bob.Lash@wdc.usda.gov.

ENVIRONMENTAL

IEEE Wildlife Protective Device Testing Guide

The Transmission and Distribution Committee of the IEEE Power Engineering Society has sponsored a working group to create a testing guide for wildlife protective devices. The Wildlife Protective Products Working Group is made up of various representatives from the utility industry including equipment manufacturers, utility engineers, and testing laboratories. All of which have extensive knowledge of the issues surrounding wildlife caused outages and various methods of mitigating such occurrences.

The working group has been working on a draft guide, IEEE P1656™/D6, *Draft: Guide for Testing the Electrical, Mechanical, and Durability Performance of Wildlife Protective Devices Installed on Overhead Power Distribution Systems Rated up to 38 kV*. The guide is intended to guide engineers on standard testing procedures and criteria for wildlife guards to ensure that these products do not compromise the electric systems on which they are to be installed. The guide draws on existing material testing standards which are referenced in the guide as well as the experience of those who currently manufacture and use these items.

The IEEE P1656™/D6 should make it easier for utilities to specify wildlife protective products that work well within their respective systems and foster a sense of standardization within this growing industry sector.

For more information please contact Norris W. Nicholson, Electrical Engineer, Transmission Branch, Rural Development Utilities Programs at (202) 720-1924 or e-mail at Norris.Nicholson@wdc.usda.gov.

Raptor Electrocution/Collision Prevention Information

Revised Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996. The Avian Power Line Interaction Committee (APLIC) has revised and updated Suggested Practices For Raptor Protection On Power Lines: The State of the Art in 1996. The new revised document should be available in late August or September 2006. It will be available in both hard-copy and CD format. Information on availability and how to obtain a copy will be found on http://www.aplic.org.

Several other publications/videos concerning raptor electrocution prevention, bird collision mitigation and animal caused outages are available. These publications include:

- Avian Power Line Interaction Committee (APLIC). 1994. Mitigating Bird Collisions With Power Lines: The State of the Art in 1994. Edison Electric Institute. Washington, D.C.

  (Available from the Edison Electric Institute, 701 Pennsylvania Avenue, NW, Washington, D.C. 2004-2696. Cost is $40.00 plus $6.50 handling for non-members and $32.00 plus $6.50 handling for members.) APLIC has also developed a video, which complements the above publication. The video is available through the Edison Electric Institute.

- Raptors at Risk Video

  This is a 30 minute video describing laws protecting birds and materials used to prevent electrocutions. The video is available in VHS format ($12) or as a DVD ($25). It is available from the following web site: http://www.edmlink.com/raptorvideo.htm or by contacting EDM International at (970) 204-4001.

- Wildlife Control and Protection – DSTAR Project 10-3

  This report is an update of the NRECA 1996 Animal-Caused Outages manual. Contact Lavelle Freeman at lavelle.freeman@ps.ge.com for availability.

- The Guide to Raptor Remains

  In order to address avian fatalities, many utilities now check equipment for potential areas that may pose hazards for birds. A common method is to look under power lines for dead birds. Identifying species for these fatalities is important for a number of reasons. When decomposed carcasses, bone pieces, feathers or pellets are found under electrical structures, it can be difficult to identify the species. This guide provides a resource for identifying partial remains of selected avian species. The color guide ($55) is available from the following web site: http://www.edmlink.com/guide_to_raptor_remains.htm or by contacting EDM International at (970) 204-4001.

- Bird Electrocution Mitigation Web Site

  This web site was developed by the California Energy Commission – PIER Group in partnership the Santa Cruz Predator Bird Research Group and EDM International. This site provides problem configurations and solutions. This site is unique in that it includes a product selector search engine allowing the user to review all available products used to mitigate raptor electrocutions. Here is also a utility feed back section. The web site address is: http://bems.edmlink.com/

- Avian Protection Plan Guidelines

  The guidelines are designed to help utilities to prepare an Avian Protection Plan to reduce avian mortalities with electric facilities. An Avian Protection Plan is utility-specific and is designed to reduce avian and operational risks that result from avian interactions with electric utility facilities. RUS has created a link on its website (http://www.usda.gov/rus/electric/engineering/index.htm) to either the National Rural Electric Association's website (www.nreca.coop/nreca/Policy/Regulatory/OtherEnviroissues), or the U. S. Fish and Wildlife Service's website (http://www.migratorybirds.fws.gov/). A copy of the guidelines can be obtained at these sites.

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 or E-mail: dennis.rankin@wdc.usda.gov.

RENEWABLE ENERGY

The Status of Wind Energy in the United States

Wind energy (WE) was originally used for sailing ships, grinding grain, and pumping water. Technology advanced to where WE can be used to charge batteries and whole lot of other uses that can convert kinetic energy of the wind. The first windmills were developed in Persia in 500-900 AD for pumping water and grinding grain. In 1888, Charles Brush used the first large windmill to generate electricity in Cleveland, Ohio. In 1979 new types of two-bladed turbines were rated over one Megawatt developed, tested and began operation. In 1990 more than half of worlds WE capacity was installed in California. The Federal tax credit for WE reached 25% in 1980 and rewarded businesses choosing to use renewable energy. Today, WE is mainly used to generate electricity. Wind machines generate electricity in 30 different states. The states with the most wind production are California, Texas, Iowa, Minnesota, and Wyoming.

Wind energy is the fastest growing source of energy in the past ten years and it is a large part of renewable energy arena. The growth of WE is contingent on a good wind resources and favorable legislative arrangements. Wind Farms are growing in the U.S. and Europe. Some of northwest European countries have been successful in design and construction of wind farms some of which are offshore in shallow waters. The United State ranks third in the world in WE capacity, behind Germany and Spain. Most of the WE plants are located in Europe and in the U.S. where government programs help support WE development. WE production in the U.S. is about 17 billion kWh per year. This is enough electricity to power a city the size of Chicago, but it is only a small fraction of the nation's total electricity production, about 0.4 percent. The installation capacity in the US has risen to 9,971 MW in 2006 (Reuters, July 25, 2006).

Texas officially reported overtaking California as the top WE producer in the United States (Reuters, July 25, 2006). Texas is now able to pull power from windy areas in the western half of the state to population centers using the new power lines that recently were installed. Texas total capacity of WE is now 2,370 megawatts, with California not far behind at 2,323 megawatts.

Corporations are also buying wind power. Vail Resorts in Colorado announced that it would buy enough WE to offset 100 percent of its electricity requirements. In the future the other resorts also owned by Vail Resorts will get their electricity from WE. This purchase will eliminate over million pounds of carbon dioxide emissions every year, the equivalent of taking 18,000 cars off the road. The top five purchases of WE among U.S. corporations (per megawatt hours) are: Whole Foods, Vail Resorts, Starbucks, HSBC, and Safeway. (Vail Daily News, August 1, 2006).

One of the challenges that WE is facing is how to integrate WE Plants into electric power system. This challenge stem from the natural characteristics of wind plants which differ from conventional plants. Wind plants operate when the wind blows, and their power levels very with the strength of the wind. This is one reason WE is not dispatchable in the traditional sense, which reduces the ability of system operators to control them. The lack of dispatchability also limits wind generation's ability to serve new system load.

If in the future more WE is connected to utility systems, it becomes important to understand the impact of wind generation on system operation. Progress is now being made in developing the tools and methods to minimize costs and operate reliably with high levels of wind generation. Improvement in wind forecasting will also be key to the future success of WE. Some parties use wind forecasting but are dissatisfied with high forecast errors. Technology and science of wind forecasting is continuously improving.

The Federal Energy Regulatory Commission (FERC) administers the Federal Power Act (FPA) as amended by Energy Policy Act of 1992. The core of the act ensures that transmission providers offer wholesale transmission service at rates that are just, reasonable, and not discriminatory. In many cases, wind generations do not require wholesale transmission service because the generator sells to the local utility as part of its negative load service obligation. In such instances, FERC approved transmission tariffs are not required. However, any wind generator that wishes to sell to a neighboring utility must purchase transmission service under FERC approved transmission tariff.

Wind energy offers a variable, economical alternative to conventional power plants in many areas of the country. Wind is a clean fuel; wind farms produce no air or water pollution because no fuel is burned. The most serious environmental drawbacks to wind machines may be their negative effect on wild bird populations and the visual impact on the landscape. In some locations, development of wind farms face delays because of the concern over the impact of wind turbines on military or civilian radar system. To some, large shiny bright blades of windmills on the horizon are an eyesore; to others, they are a beautiful alternative to conventional power plants.

If you would like more information or have any questions, please contact Theodore V. Pejman, Transmission Branch, at (202) 720-0999 or Ted.Pejman@wdc.usda.gov.

Introduction to Ground Source Heat Pumps

Ground source heat pumps, also called geothermal heat pumps or GeoExchange systems, are a unique heating, cooling and water heating technology. They are the most energy efficient, environmentally clean, and cost-effective space conditioning systems available, according to ENERGY STAR (a U.S. Department of Energy and Environmental Protection Agency initiative).

These systems combine the compressor and energy distribution components associated with air source heat pumps with a ground loop that extracts and stores energy in the form of BTUs in the earth. The ground loop consists of a system of buried pipes (either horizontal or vertical) in which water or other heat transfer media are circulated to collect or dissipate heat. Ground source heat pumps use the earth's renewable energy to heat and cool a home or building and they can produce hot water directly or as a by-product of their heating and cooling operation. Ground source heat pump systems are the most energy efficient, environmentally friendly, and cost-effective space conditioning systems available, according to the U.S. Environmental Protection Agency.

Ground source heat pump systems use the earth's energy storage capability to heat and cool buildings, and to provide hot water. The earth is a huge energy storage device that absorbs 47% of the sun's energy, more than 500 times more energy than mankind needs every year, in the form of clean, renewable energy. Ground source heat pump systems extract some of this heat during the heating season at an efficiency that can exceed 400% and return it during the cooling season.

Ground Source Heat Pumps are net producers of renewable thermal energy, and consequently they are a renewable energy resource. In heating mode, a ground source heat pump system will move at least three units of solar energy from the ground (measured in BTUs) for each unit of electricity energy (also measured in BTUs) used by the heat pump system. In cooling mode, a ground source heat pump transfers heat to the ground where it is stored until it is needed for heating. Currently available Ground Source Heat Pumps produce 3 to 5+ kWh of heating energy (in BTUs) for every kWh used to operate the system. The ground under the average home or building has more than enough stored energy to heat that building during a heating season. The ground source heat pump taps this energy. In summer, solar gain restores the energy extracted during the heating season.

According to a Government Accounting Office report, Ground Source Heat Pumps are the most energy-efficient means of heating and cooling buildings in most areas of the United States. Their wider use could cut energy costs, conserve fossil fuels, and reduce green house gas emissions. Ground Source Heat Pump systems are "green" in two ways, they are environmentally beneficial and they are beneficial to the economy as a whole. Ground source heat pumps can provide the United States an advantage in the world energy markets, by reducing our dependence on imported fuel oil, natural gas and propane.

Life Magazine documented a ground source heat pump installation in 1948. It is estimated that over 1,000,000 units are currently operating in the United States. Their use to date has been limited because consumers, contractors, installers, and utilities are unfamiliar with the technology and because installation costs are higher than convention fossil fuel heating systems and air conditioning. Ground source heat pumps have higher installation costs due to the investment in the ground loop, but they provide very low operating costs because of the free renewable energy extracted by the ground loop.

Benefits to Consumers

The Environmental Protection Agency, in their April 1993 publication Space Conditioning: The Next Frontier (Office of Air and Radiation, 430-R-93-004) documented a significant energy bill savings potential if consumers replaced their conventional heating and cooling systems with ground source heat pumps. The EPA reported, "Over an average 20-year lifespan, every 100,000 units of nominally sized residential GHPs will save more than 24 trillion BTUs of electrical energy, and save consumers approximately $500 million in heating and cooling costs at current prices." Today's consumers are facing higher and rapidly increasing costs for natural gas, heating oil, propane and electricity. The energy cost savings that can be obtained by the installation of ground source heat pumps are much bigger than they were in 1993.

The EPA found that, even on a source fuel basis, accounting for all losses in the fuel cycle including electricity generation at power plants, ground source heat pump systems are much more efficient than the competing fuel technologies. They are an average of 48% more efficient than the best gas furnaces on a source fuel basis, and over 75% more efficient than oil furnaces. In fact, today's best ground source heat pump systems outperform the best gas technology, gas heat pumps, by an average of 36% in heating mode and 43% in cooling mode.

The U.S. General Accounting Office estimates that if ground source heat pumps were installed nationwide, they could save several BILLION dollars annually in energy costs and substantially reduce pollution. Ground source heat pumps also strengthen U.S. energy security. Every 100,000 homes with geothermal heat pump systems reduce foreign oil consumption by 2.15 million barrels annually. Schools using ground source heat pumps are saving more than $25 million in annual energy costs, freeing up money for books, equipment and teachers. Homeowners using ground source heat pumps can save up to 70 percent on their energy bills compared to conventional heating and cooling systems. The electric bill for heating and cooling a 2,000 sq. ft. home can be as little as $1 a day using a ground source heat pump system.

The Delta-Montrose Electric Association has analyzed the consumer economics of ground source heat pumps for their members. Their energy use modeling predicts that consumers would have annual heating and cooling costs of $2,503 for propane, $2,139 with electric resistance heating, $1,540 for natural gas, and only $670 with geothermal heat pumps at today's energy prices. This forecast is based on keeping an average 2,500 square foot home at a comfortable 70 degrees in winter and 72 degrees in summer.

Surveys by utilities indicate a higher level of consumer satisfaction for Ground source heat pump systems than for conventional systems. Polls consistently show that more than 95% of all Ground source heat pump customers would recommend them to a family member or friend.

The Environmental Benefits of Ground Source Heat Pumps

According to the U.S. Dept. of Energy, "Nearly 40% of all U.S. emissions of carbon dioxide are the result of using energy to heat, cool, and provide hot water for buildings. This is about the same percentage that the transportation sector contributes. The EPA found that under most electricity generating scenarios, ground source heat pump systems have the lowest carbon dioxide emissions of all technologies analyzed, and the lowest overall environmental cost (source: "Space Conditioning: The Next Frontier"). Installing 400,000 Ground Source Heat Pump systems annually in new homes would reduce pollution by an amount equivalent to taking 500,000 cars off the road. For every 100,000 units of typically sized residential ground source heat pumps installed, more than 37.5 trillion Btu's of energy used for space conditioning and water heating can be saved, corresponding to an emissions reduction of about 2.18 million metric tons of carbon equivalents.

The current use of ground source heat pump technology has resulted in the following environmental benefits:

- Elimination of more than 5.8 million metric tons of CO_2 annually
- Annual savings of nearly 40 trillion BTUs of fossil fuels
- Taking close to 1,295,000 cars off the road
- Planting more than 385 million trees

Utility Benefits from Ground Source Heat Pumps

The potential impact of Ground Source Heat Pump systems on the nation's electric system is astounding. There are 25 million homes in the United States with electric air-conditioning but without access to natural gas. According to the Earth Science Laboratory of the University of Utah Research Institute, retrofitting these homes with Ground Source Heat Pump systems would save an amount of energy equivalent to that produced by 24 to 48 large nuclear power plants.

Due to their high efficiency, ground source heat pumps are clearly competitive with other fuel types. Ground source heat pumps allow the electric industry to compete strongly against fossil fuels on the attributes of economy, comfort, safety, reliability, and customer satisfaction. In addition to these competitive market benefits, ground source heat pumps provide electric utilities improved load factors due to their low operating demand, minimal impact on both summer and winter peaks, and long run times. When combined with load control and thermal storage, ground source heat pumps can provide long flat load curves and avoid system peaks.

The recent rapid increase in fossil fuel prices has placed electric resistance heat in a favorable economic position for consumers. The heating and cooling market is responding to this price signal through increased utilization of plug-in electric resistance heaters, central electric furnaces, and air source heat pumps with large electric resistance back up elements. These loads have historically provided poor load factors and the need to build an electric system from the generator to the service drop sized to handle the high peak demands of electric resistance heating.

An average home of 2,000 square feet requires an electric resistance heating capacity of 15 to 20 kW. In comparison, a ground source heat pump with an electric demand of 4 kW will heat and cool a home of this size. The low annual operating cost for heating and cooling provided by ground source heat pumps also enables consumers to keep their thermostats at a comfortable setting year round, eliminating the peak driving consumer practice of turning heating and cooling on and off.

The high load factor electricity sold by utilities to power ground source heat pumps generates high utility margins. Studies done by the Delta-Montrose Electric Association show that the average total margin (billed revenue less cost of power delivered) from residential members with ground source heat pump members equals $91.05 per month. Their average total margin for all members averages $56.83 per month. Ground source heat pumps provide an incremental margin of $34.22 per month, or $410.64 per year. This is revenue that would have otherwise gone to a fossil fuel provider.

Recognizing the electric utility benefits of ground source heat pumps, a consortium of 70 electric utilities serving 50% of U.S. consumers formed the Geothermal Heat Pump Consortium to deal with the barriers facing the market adoption of ground source heat pumps.

Utility Ownership of Ground Source Heat Pump Loops

A strong argument exists for utility ownership of the ground source heat pump ground loops that provide the renewable energy that generates the consumer energy savings, environmental benefits, and high margin utility load delivered by these systems. This utility investment can be recovered through a combination of a loop fee or tariff and the incremental electric revenue generated by the ground source heat pump.

The construction cost of the ground loop contributes the majority of the higher first cost associated with the installation of a ground source heat pump against a conventional heating and cooling system. Utility ownership of the loop allows the cost of this renewable energy source to be spread over the life of the loop and allows the loop to be financed at the cost of federal funds. Utilities can recover the cost of their investment over time while offering consumers a positive cash flow on their investment in the heat pump component of the system, by eliminating the operating costs associated with other forms of space heating and cooling. By taking responsibility for the ownership of the ground loop, the electric utility can capture new electric margins by competing favorably with fossil fuels.

This competitive opportunity will build new high margin load for the utility. The high margins are a function of delivering a high flow of kilowatt-hours over existing utility plant, with out stressing the system with high peak demands. Over time, system load factors will improve, as will incremental margins from a loop fee or tariff.

Given the renewable energy captured by ground source heat pumps, and the carbon savings associated with taking fossil fuels off-line, ground source heat pumps could generate significant opportunities for earning future green tag revenue. A study by the Delta-Montrose Association shows that ground source heat pumps generate twice the carbon savings of similarly priced solar photovoltaic systems. When powered with electricity produced from renewable sources, ground source heat pumps provide carbon free space heating and cooling.

The Utility Accounting Process

Utility ownership of the renewable energy generating ground loop is comparable to utility ownership of a service drop, security light, or on site energy generator. As such, the loop investments are recorded as utility plant and the associated income from a loop usage fee or tariff and the electric revenue generated by the loop are recorded as utility income. The O&M and A&G costs associated with providing the loop service are expensed as utility operating expenses.

Loan Security Measures

The utility investment in the ground loop can be protected in several ways. The first safeguard is to codify and utilize established industry design criteria for the loop. The ground source heat pump industry has a robust inventory of loop design and installation standards that have been proven by the test of time. By requiring utility design staff or contractors to follow these established design criteria, system performance and customer satisfaction can be guaranteed.

In addition to following strict design and construction criteria, the utility can also require that the design and construction staff or contractor obtain industry certification prior to engaging in these tasks. Trained utility staff can inspect the work of loop installation contractors, as is done for contract construction of electric utility plant.

Another important safeguard is the recording of a utility easement for the ground loop. Industry practice requires the on-site production of an "as built" for the ground loop. This document can be recorded as a general utility easement.

Payment by the member for use of the ground loop can be obtained either by contract or through a utility tariff and signed service agreement. The utility can use a simple mechanical means to disable the ground loop in cases of non-payment.

The high-density polyethylene pipe used in the construction of ground loops has a long life and an established performance history. The manufacturer of the polymer loop pipe provides a 50-year warranty on this material. When installers connect sections of pipe, they heat fuse the joints, which makes the connections stronger than the pipe itself. The loop pipe is inert to chemicals and salts found in soil.

References for Additional Information

Numerous on-line resources are available that provide information on ground source heat pumps. The National Rural Electric Association's Cooperative Research Network (CRN) has released a report that documents the significant peak demand savings that could be obtained in the Southern and South Eastern markets through the use of a new hybrid ground source heat pump technology. The Delta-Montrose Electric Association and its subsidiary company, InterMountain Energy One Services are also resources for utility based ground source heat pump program implementation.

Department of Energy's Energy Efficiency and Renewable Energy Network (EREN) (http://www.eren.doe.gov/RE/geo_heat_pumps.html)

The Geothermal Heat Pump Consortium (http://www.geoexchange.org/)

The International Ground Source Heat Pump Association (http://www.igshpa.okstate.edu/)

ENERGY STAR (http://www.energystar.gov)

The Delta-Montrose Electric Association (http://www.dmea.com/)

Intermountain Energy (http://www.intermountainenergy.com/)

If you would like additional information or have any questions, please contact Howard Barnes, RUS GFR, at Howard.Barnes@wdc.usda.gov.

ADMINISRATIVE AND OTHER

Guy Anchor Bonding Clamp

Rural Development Utilities Program, Electric (RUS) requires anchor bonding clamps, Item ck in the Information Publication IP 201-2, "List of Materials Acceptable for Use on Systems of USDA Rural Development Electrification Borrowers" as identified in the 15 and 25 kV overhead distribution construction specifications.

The purpose of the anchor bonding clamp is to ensure the safety of the public and line crews. A properly installed anchor bonding clamp ensures there is a solid electrical connection between the anchor rod and the guy even during occasions when the guy in the anchor assembly goes slack.

On a slack guy anchor installation that does not have an anchor bonding clamp installed, a person could come into contact with a guy wire that is solidly bonded to the neutral of the distribution system at the top of the pole and electrically is virtually disconnected from the anchor rod and anchor near where the person is standing. This could result in the person touching the guy wire and having direct contact to the electric system neutral and becoming exposed to a voltage that could be very different than the voltage of the earth the person is standing on. If the voltage difference is great enough, the person's body could become part of an electric circuit and draw an electric current that may result in anything from an unpleasant tingle to serious shock and injury.

On a slack guy anchor installation that does have an anchor bonding clamp installed, a person will be standing on earth that is essentially at the same potential as the guy/anchor assembly because of the electrical contact existing between the solidly interconnected guy wire, anchor rod, anchor and soil. With little difference in potential between the earth and the anchor guy, little if any electric current will flow in the person's body minimizing the possibility of injury.

NESC Rule 215C2 requires that guys be effectively grounded. RUS specifications provide for this grounding assurance in part by requiring the guys to be bonded to the neutral at the top of the guy. On an ordinary tight guy, the effective grounding would be completed with the tight connection of the guy wire and anchor rod eye in contact with one another. However, as mentioned, on a slack guy, this latter connection for assuring an effective bond between the anchor and guy is lost. RUS specifications require the guy anchor bonding clamp to make certain that the bond between the anchor and guy will remain effective in the event the guy becomes slack for whatever reason.

Borrowers should insure that guy anchor bonding clamps are used on all their anchor assemblies.

For more information please contact the Distribution Branch, Rural Development Utilities Programs at (202) 720-5082.

Guy Markers

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

Prior to 1997, the Rural Development Utilities Program, Electric (RUS) required guy markers to be flame retardant. To provide borrowers with greater flexibility in their choice of products and meet their needs, RUS has considered applications and listed plastic or fiberglass guy markers that are not required to be fire retardant.

In the "List of Materials Acceptable for Use on Systems of USDA Rural Development Electrification Borrowers," these guy markers are shown on a separate page and category (at-3), Guy Marker - Non-Flame Retardant.

Borrowers 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 is not active.

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

Geographical Information System

Investment into a GIS will be very expensive not only from the standpoint of software and hardware, but evenly more importantly from the standpoint of commitment to manpower to install and maintain it. The success of the GIS hinges on good GIS planning. The key to good planning is to identify information products you want to obtain from the geographical information system. This means that the GIS manager must fully understand every aspect of the electric cooperative and the potential uses for GIS.

Tomlinson in the book, Thinking About GIS, indicates ten stages to the GIS planning. These include:

- Define the strategic purpose of the organization (goals, objectives, and mandates).
- Plan for the planning.
- Conduct a technology seminar.
- Describe the information products.
- Define the scope of the GIS.
- Create a database design.
- Describe a logical data model considering data accuracy, update requirements, error tolerance, and data standards.
- Determine system requirements considering interface, communications, hardware, and software.
- Consider the best way to implement the system you designed considering benefit cost, migration and risk analysis (acquisition plan).
- Make a final report that tells you how to implement a successful GIS.

The GIS manager must be able to distinguish the difference between planning and implementing and must be willing and able to commit the resources to make the planning happen. If the manager of the GIS decides to retain a consultant to do the planning, he or she and others within the cooperative must be involved with the details during the planning stage or implementation will be doomed to failure.

Technology seminars are important to identify the informational products you want to obtain from the GIS. Not only do the technology seminars provide an opportunity to gather information but it also provides an opportunity to explain to key personnel what GIS is, its potential benefits, and the planning process you are now going through (the ten steps). By involving stakeholders at an early stage, they will more likely contribute to the planning and ultimately to the successful installation and maintenance of the GIS.

One of the most important stages in the planning stages is to identify what you want to get out of the geographical information system, i.e. “the informational products.” By talking to potential users of the GIS, you will be able to better understand their job and what informational products are required for them to do their job.

If you would like more information or have any questions, please contact Donald Heald, Transmission Branch, at (202) 720-9102 or at Don.Heald@wdc.usda.gov.

References

Tomlinson, Roger. Thinking About GIS. Redlands, CA: ESRI P, 2003.

Exhibit 1
Form 1

Information required for sizing Switchgear batteries

1. How many breakers: ______________
2. Breaker trip current: ______________
3. Breaker trip time: ______________
4. Breaker close current: ______________
5. Breaker close time: ______________
6. Breaker spring charge current: ______________
7. Breaker spring charge time: ______________
8. Is the trip operation simultaneous or sequential: ______________
9. Is the close operation simultaneous or sequential: ______________
10. Breaker sequence:
    (i.e., trip-close-spring charge) or (trip-spring charge-close) ______________
11. How many times do you require each breaker to cycle: ______________
12. At what point in the duty cycle will each breaker cycle occur: ______________
13. What are any continuous load currents such as Communications, Emergency Lighting: ______________
14. What are their respective duration time periods: ______________
15. What is the temperature range (min. & max.): ______________
16. Lead Acid or Nickel Cadmium battery: ______________
17. What is the system DC voltage, maximum:
    (Typical 48 volt = 56, Typical 120 volt = 140) ______________
18. What is the system DC voltage, minimum:
    (Typical 48 volt = 42, Typical 120 volt = 105) ______________
19. Design margin: ______________
20. Aging factor: ______________

EXHIBIT 2

Time Schedule for the Next Revision of the National Electrical Safety Code

The revision schedule for the 2012 NESC is as follows:

17 July 2008	Final date to receive change proposals from the public for revision of 2007 Edition of the NESC, preparatory to the publication of a 2012 Edition.
September-October 2008	NESC Subcommittees consider change proposals to the NESC and prepare their recommendations.
1 September 2009	Preprint of the change proposals for incorporation into the 2012 Edition of the NESC published for distribution to the NESC Committee and other interested parties. This opens the comment period, by interested parties, on the submitted change proposals and the subcommittee recommendations.
1 May 2010	The final date to submit comments on the submitted change proposal and the subcommittee recommendations. All comments and recommendations on these proposals are due to the Secretary, NESC Committee.
September-October 2010	Period for NESC Subcommittee Working Groups and NESC Subcommittees to reconsider all recommendations concerning the proposed amendments and prepare final report.
15 January 2011	Proposed revision of the NESC, Accredited Standards Committee C2, submitted to NESC Committee for letter ballot and to ANSI for concurrent public review.
15 May 2011	NESC Committee approved revisions on the NESC submitted to ANSI for recognition as an ANSI standard.
1 August 2011	Publication of the 2012 Edition of the NESC.

APPENDIX A

SELECTED METRIC CONVERSION FACTORS

TO CONVERT FROM:	TO:	MULTIPLY BY:
Inch (in)	Centimeter (cm)	2.54
Foot (ft)	Meter (m)	0.3048
Mile (mi)	Kilometer (km)	1.609
Pound (lb)	Newton (N)	4.448
Gallon (gal)	Liter (L)	3.785

APPENDIX B

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APPENDIX C

NRECA TRANSMISSION & DISTRIBUTION ENGINEERING COMMITTEE

Member	Organization	Location
Committee Chair		
Bob Occhi	Coast EPA	Bay St. Louis, MS
NRECA Staff Coordinators		
Mike Pehosh	NRECA	Arlington, VA
Bob Saint	NRECA	Arlington, VA
Overhead Distribution Lines Subcommittee		
Tom Hoffman	Agralite Electric Co-op	Benson, MN
James Byrne	Poudre Valley REA	Fort Collins, CO
Titus (Ty) Diamond	Flint Energy	Warner Robbins, GA
Allan Glidewell	Southwest Tennessee EMC	Brownsville, TN
Greg Linsly	Dixie EMC	Baton Rouge, LA
Shannon Messer	Clark Energy Co-op	Winchester, KY
Brian Nelson	Intercounty ECA	Licking, MO
Ernest Neubauer	Pioneer Electric Co-op	Piqua, OH
Terry Rosenthal, Chair	Laclede EC	Lebanon, MO
Gene Smith	SGS Witter, Inc.	Lubbock, TX
John Pavek	RUS	Washington, DC
Clive Buttrey	Middle Tennessee EMC	Murfreesboro, TN
Substation Subcommittee		
Bil Kahanek, Chair	Lower Colorado River Auth.	Austin, TX
Mike Avant	Garkane Energy Co-op	Loa, UT
Thomas Barnette	Berkeley EC	Moncks Corner, SC
Mike Eskandary	RUS	Washington, DC
Daniel Geiger	Heartland Engineering Services	Rockford, MN
Ken Malone	Middle Tennessee EMC	Murfreesboro, TN
Paul Rupard	East Kentucky Power Co-op	Winchester, KY
Jim Stine	NRECA	Arlington, VA
Kevin White	Northeast Missouri Electric Power	Palmyra, MO
Allen Xi	Burns & McDonnell	Houston, TX

System Planning Subcommittee

Robin Blanton, Chair	Piedmont EMC	Hillsborough, NC
Steve Atkinson	Northern Virginia EC	Gainesville, VA
Robert Dew	Power Tech Engineering	Norcross, GA
Joe Dorough	Jackson EMC	Jefferson, GA
Ronnie Frizzell	Arkansas EC Corp.	Little Rock, AR
David Garrison	Allgeier Martin & Associates	Okmulgee, OK
Wayne Henson	East Mississippi EPA	Meridian, MS
Donald Junta	RUS	Washington, DC
Joe Perry	Patterson & Dewar Engr.	Decatur, GA
Ryan Smoak	Mc-Call-Thomas Engineering	Orangeburg, SC
Harold Taylor	Georgia Transmission	Tucker, GA
Kenneth Winder	Moon Lake Electric	Roosevelt, UT

Power Quality Subcommittee

Ed Bevers, Chair	Rural Electric Co-op	Lindsay, OK
Chris Brewer	Blue Grass Energy Co-op	Nicholasville, KY
Robert Casey	Georgia Transmission Corp	Tucker, GA
Peter Daly	Power Systems Engineering	Madison, WI
Bhaji Dhilon	Cobb Energy	Marietta, GA
Herman Dyal	Clay Electric Co-op	Keystone Heights, FL
Doug Joens	Power System Engineering	Madison, WI
Ken Kjar	Cass County Electric Co-op	Kindred, ND
Chris Melhorn	EPRI PEAC Corporation	Knoxville, TN
Dave Mueller	Electrotek Concepts, Inc.	Knoxville, TN
Chris Perry	Nolin EMC	Elizabethtown, KY
Tim Pierce	Great River Concepts	Elk River, MN
Jeff Pogue	Wabash Valley Power Assoc	Indianapolis, IN
Lewis Shaw	Brunswick EMC	Shallotte, NC
Michael Watson	Duck River EMC	Shelbyville, TN
Jim Worley	East Kentucky Power Co-op	Winchester, KY

Transmission Lines Subcommittee

David Turner, Chair	Lower Colorado River Auth.	Austin, TX
Dominic Ballard	East Kentucky Power Co-op	Winchester, KY
Robert Beadle	North Carolina EMC	Raleigh, NC
Don Heald	RUS	Washington, DC
Chuck Lukkarila	Great River Energy	Elk River, MN
Charles McCall	Georgia Transmission Corp.	Tucker, GA
Stephen Mundorff	Tri-State G&T Association	Denver, CO
Norris Nicholson	RUS	Washington, DC
Bob Oldham	Southern Maryland EC (Retired)	FL
Aaron Shambrock	South Central Power	Lancaster, OH
Art Smith	Burns & McDonnell	Atlanta, GA
John Twitty	Alabama EC	Andalusia, AL

Underground Distribution Subcommittee

Ace Necaise, Chair	Singing River EPA	Lucedale, MS
Russ Dantzler	Mid-Carolina EC	Lexington, SC
Berl Davis	Palmetto EC	Hilton Head, SC
William Duke	Allegeier Martin & Associates	Okmulgee, OK
Steven Gwin	Middle Tennessee EMC	Murfreesboro, TN
Vince Heuser	Nolin RECC	Elizabethtown, KY
Trung Hiu	RUS	Washington, DC
Tim Mobley	Berkeley EC	Moncks Corner, SC
John Rodgers	Nodak EC, Inc.	Grand Forks, ND
Les Shankland	Mountain Parks Electric	Granby, CO
Blaine Strampe	Federated REA	Jackson, MN
Edward Thomas	Utility Elec. Consultants	Raleigh, NC
Scott Wehler	Adams Electric Co-op	Gettysburg, PA