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UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Utilities Service

Bulletin 1730-1
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SUBJECT: Electric System Operation and Maintenance (O&M)

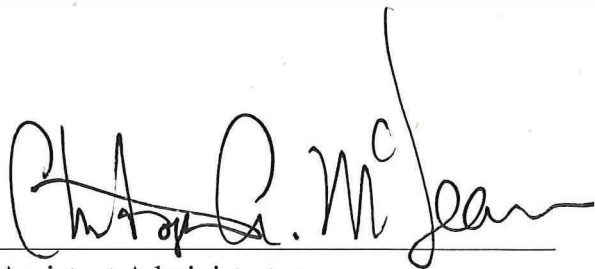
To: RUS Electric Borrowers and RUS Electric Staff

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Purpose: This bulletin contains guidelines related to electric borrowers' operation and maintenance (O&M) and outlines the Rural Utilities Service's (RUS) standard practices with respect to review and evaluation of O&M practices.



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9/23/16
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ABBREVIATIONS

ANSI	American National Standards Institute
CAP	Corrective Action Plan
CFR	Code of Federal Regulations
CT	Current Transformer
EMF	Electric and Magnetic Fields
EPA	Environmental Protection Agency
ERP	Emergency Response Plan
FERC	Federal Energy Regulatory Commission
GFR	General Field Representative
IFT	Interfacial Tension
kVA	Kilovolt-Ampere
kW	Kilowatt
kWh	Kilowatt-hour
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
O&M	Operation and Maintenance
OCR	Oil Circuit Recloser
PCB	Polychlorinated Biphenyl
PSD	Power Supply Division
PT	Potential Transformer
REA	Rural Electrification Administration
RUS	Rural Utilities Service

1. Purpose

This bulletin contains guidelines related to electric borrowers' operation and maintenance (O&M) and outlines the Rural Utilities Service's (RUS) standard practices with respect to review and evaluation of O&M practices. 7 CFR 1730 contains the policies and procedures of RUS related to electric borrowers' O&M practices and RUS's review and evaluation thereof. The express and exclusive purpose of this bulletin is to protect RUS by protecting and preserving its loan collateral. This bulletin does not supersede or replace any practices or procedures as they relate to safety, including, but not limited to those practices or procedures referenced herein, and does not address any safety aspects in regard to the electric borrowers' electric infrastructure or safety practices or procedures.

Borrowers that are required to be registered on the NERC Compliance Registry are responsible for meeting all of the applicable standards as required by the borrowers' specific functional registrations. It is not the intent of this bulletin to encompass, supersede or replace the reliability requirements enforced by NERC and its associated regional reliability organizations. Borrowers may choose to research, implement or incorporate some or all of the NERC standards into their operational procedures.

2. Borrower Guidelines

- a. Records: Each borrower is responsible for maintaining records of the physical and electrical condition of its electric system. Any or all of these records may be reviewed by RUS during its review and evaluation. Such records include, but are not limited to:
 - (1) Service interruption and power supply outage reports.
 - (2) Overhead and underground line patrol, inspection and maintenance records, including pole inspection.
 - (3) Substation inspection and maintenance records.
 - (4) Overcurrent (non-fuse) apparatus records (recloser, sectionalizing, relay-protected)
 - (5) Line voltage regulator records.
 - (6) Distribution transformer records.
 - (7) Oil handling and storage records

- (8) Meter records.
 - (9) Right-of-way maintenance records.
 - (10) Line voltage and amperage records.
 - (11) Avian protection/contact records
 - (12) System maps.
 - (13) System loss records.
 - (14) Idle services records.
 - (15) Power quality investigation records.
 - (16) Other records as required by local, state or other governmental entities
- b. Emergency Restoration Plan (ERP): Each borrower should have a written plan detailing how to restore its system in the event of large area or system-wide outage resulting from a major natural disaster or other cause. This plan should include how to contact emergency agencies, borrower management and other key personnel, material suppliers, contractors and equipment suppliers, other utilities, and any others who might need to be contacted in an emergency. It should also include recovery from loss of power to the headquarters, key offices, and/or operation center facilities. It should be readily accessible at all times by appropriate personnel, and under any and all circumstances. RUS Guide 1730B-2 contains the procedures for developing an ERP.
- c. System Ratings: RUS Form 300, Review Rating Summary, includes a numerical rating system as follows:
- 0: Unsatisfactory – no records
 - 1: Unsatisfactory – corrective action needed
 - 2: Acceptable, but could be improved – see attached recommendations
 - 3: Satisfactory – no additional action required at this time
- N/A: Not Applicable

Exhibit A provides a guide for the conditions normally needed to justify a rating of 3 for each of the items on RUS Form 300. The explanatory notes section of RUS Form 300

should include a list of all items rated as unsatisfactory (ratings 0 or 1) along with comments indicating the action or implementation that is proposed. This is in addition to the Corrective Action Plan (CAP) required by 7 CFR 1730. Additional expenditures required for deferred maintenance should be indicated in the O&M Budgets, Part IV of RUS Form 300. These may be distributed over a period of two or three years as indicated on the form.

3. Review and Evaluation of O&M Practices by RUS

- a. RUS will conduct a periodic review and evaluation of each borrower's O&M programs and practices. The purpose of this review is to assess loan security and to determine borrower compliance with RUS policy as outlined in Part 7 CFR 1730.
- b. The General Field Representative (GFR) is responsible, within the GFR's assigned territory, for initiating and conducting a periodic review and evaluation of each borrower's O&M programs, practices, and records. This review and evaluation is normally done at least once every three years.
- c. The GFR may review and evaluate facilities as well as records, and may also observe construction and maintenance work in the field. Key borrower personnel responsible for these facilities should accompany the GFR during such reviews.
- d. If adequate information is available, the GFR will complete the review and evaluation and consult with the borrower regarding its programs and records for operation, maintenance, and system improvements. The GFR's signature on the Form 300 signifies concurrence with the borrower's analysis, ratings, and explanatory notes unless indicated otherwise.
- e. If adequate information is not available, the GFR's review and evaluation will be deferred until the borrower has remedied the deficiencies identified by the GFR.
- f. Upon completion of the O&M review and evaluation, the GFR will communicate his/her findings to the borrower verbally (exit interview), and in writing.

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EXHIBIT A
RUS FORM 300 RATING GUIDE
CONDITIONS NORMALLY NEEDED TO JUSTIFY A RATING OF 3

PART I - TRANSMISSION and DISTRIBUTION FACILITIES

1. Substations (Transmission and Distribution)

- a. Safety, Clearance Code Compliance: No known violations of RUS, or NESC requirements are present in any substation, including clearances, grounding, and separations. All substations are accessible by authorized personnel only. Operating manual and one-line diagram are available for each substation. Appropriate safety equipment and operational tools are serviceable and available on site.

- b. Physical Condition – Structure, Major Equipment, and Appearance: Utility is able to present records that reflect rare instances of rust, weeds, dangerous insects, and bird nesting exist; only minor material associated with maintenance of the substation equipment are stored in yard; no leaks, no temporary bus or grounding being used on an ongoing basis; no debris inside or around the substation; no openings under fence greater than three inches (76 mm); and no broken insulators exist. Power transformers are properly fault-protected. Circuits, phases, and airbreak switch handles are properly identified.

- c. Inspection Records of Each Substation: Written monthly inspection reports are completed and reviewed by responsible personnel.
 1. Infrared inspection of all connectors, arrestors and other applicable apparatus as recommended by manufacturer;
 2. Dielectric, dissolved gas, and interfacial tension (IFT) tests of oil-filled equipment performed as recommended by manufacturer;

CONDITIONS NORMALLY NEEDED TO JUSTIFY A RATING OF 3

3. Annual Power factor tests of all applicable equipment;
 4. Protective relays are functionally tested annually. Additional tests may be required per regulatory and/or manufactures recommendations and acceptable industry practice.
- d. Oil Spill Prevention: Oil spill prevention and mitigation plans are prepared and available for all substations. On-site oil containment systems are inspected and serviceable.

2. Transmission Lines

- a. Vegetation and Line Maintenance: Borrower is responsible for having a documented Vegetation and Line Maintenance program compliant with RUS and industry standards. Documented inspections should be completed and reviewed by qualified personnel for all transmission lines at intervals consistent with accepted industry and local practices.
- b. Right-of-Way (ROW) – Clearing, Erosion, Appearance, and Intrusions: A process is in place to identify and address uncontrolled erosion. Gates or gaps exist at all fence crossings as necessary for proper access. Structures and lines are not impacted by untrimmed ROW. Structures are generally accessible by service vehicles.
 1. Floor Maintenance: All transmission ROW floors should be maintained either mechanically or by herbicide to allow for access and prevention of grow-ins.
 2. Danger Trees: All transmission ROWs should be patrolled to identify trees that may cause an outage. A process should be in place to document such trees' locations and provide for their immediate removal.
 3. Side Trimming: All transmission line ROW should be trimmed as needed. Appropriate techniques should be used based on terrain and type of vegetation.

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- c. Physical Condition – Structure, Conductor, and Guying: All structures are plumb and all guys taut. Conductors are serviceable with infrequent damage, few splices, and are properly sagged. A process is in place to identify and repair broken insulators, crossarms, and overvoltage-protection devices, as well as unauthorized attachments and encroachments. Essentially all structures are numbered. Poles, structures and hardware have minimal structural defects and corrosion. Structures and attachments conform to NESC requirements. Wood poles should be inspected at regular intervals to prevent decay and are replaced when less than 67% of the original required strength is remaining.

- d. Line Patrol Program and Records: All overhead lines (including those on private ROW) are patrolled at intervals of at least once per year. Records of line patrol activity showing dates and locations where line patrol has been performed and any apparent deficiencies are readily available in summary form. Line patrol is defined as simple visual inspection, of applicable electrical equipment and structures, which is designed to identify obvious structural problems and potential hazards. Records are maintained and line patrol deficiencies are corrected in a timely manner.

- e. Pole Inspection Program and Records: Above and below ground pole inspections are performed on a cycle based upon decay zone, or as experience as shown to be necessary, using experienced inspectors and accepted industry practices. Records of all poles inspected, treated, rejected and changed out readily available in summary form.

CONDITIONS NORMALLY NEEDED TO JUSTIFY A RATING OF 3

3. Distribution Lines - Overhead

- a. Pole Inspection - Program and Records: Above and below ground pole inspections are performed on a cycle based upon decay zone, or as experience as shown to be necessary, using experienced inspectors. Records of all poles inspected, treated, rejected and changed out readily available in summary form.
- b. Line Patrol Program and Records - All overhead lines are patrolled at intervals of three years. Records of line patrol activity showing dates and locations where line patrol has been performed and any apparent deficiencies are readily available in summary form. Line patrol is defined as a simple visual inspection, of applicable electrical equipment, clearances, structures, and joint attachments so as to identify obvious problems and potential hazards. Records are maintained for deficiencies which are to be corrected in a timely manner.
- c. Compliance with Safety Codes – Clearances: All facilities staked prior to construction are done by personnel familiar with NESC requirements. Conditions requiring greater clearances identified in line patrols are addressed as soon as practical.

Compliance with Safety Codes – Foreign Structures: Utility has policy and practice of promptly remedying foreign structures that conflict with primary lines upon observation.

Compliance with Safety Codes – Attachments: All overhead attachments meet NESC separation and clearance requirements. Up-to-date joint-use and pole rental agreements are in effect. Utility has policy and practice of periodic attachment inspection. Unauthorized attachments and violations of the NESC are promptly remedied.

- d. Observed Physical Condition from Field Checking – Right-of-Way: Structures and lines are not impacted by ROW vegetation and structures. ROW vegetation trimming cycles to be dictated by local conditions. Clearance issues with structures are remediated as soon as possible.

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Observed Physical Condition from Field Checking – Other: Rare instances of leaning poles, slack guys, broken grounds, damaged or corroded conductors, excessive splices, loose hardware, and/or superfluous material on structures exist. No broken crossarms or insulators exist, and no pole steps are on wood poles. Installation of miscellaneous distribution equipment meets NESC requirements. Neutral conductor is properly identified when located on crossarm. Dated pole inspection tags are installed on all inspected wood poles. These dated pole inspection tags can either be physical or electronic.

4. Distribution - Underground Cable

- a. Grounding and Corrosion Control: Ground rods are properly installed at each transformer, in addition to a minimum of four per mile (1.6 km), not including grounds at individual services, in accordance with the NESC. Appropriate and timely actions are taken to correct any unsatisfactory conditions.
- b. Surface Grading, Appearance: Rare instances of earth settling, which could create hazards to the general public, exist, and timely action is taken to correct any deficiency.
- c. Riser Poles – Hazards, Guying, Condition: Cut-outs are mounted per RUS requirements. Riser cable is covered with conduit to within four feet (1.2m) of the bottom of the potheads. Damaged conduits are promptly replaced or repaired. Adequate overvoltage protection is installed.

5. Distribution Line Equipment: Conditions and Records

- a. Voltage Regulators: Voltage regulators are inspected and maintained in accordance with the manufacturer's recommendations, accepted industry practices and experience, and as local conditions dictate. Knowledge of and compliance with EPA requirements with respect to PCB-contaminated oil and equipment. Dielectric, dissolved gas, and IFT tests of oil-filled equipment are performed every five years or at intervals consistent with

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accepted industry practices, vendor recommendations, borrower experience, and local conditions or events such as storms, faults, and related equipment failure.

- b. Sectionalizing Equipment: Oil circuit reclosers (OCRs) and breakers are inspected and maintained in accordance with the manufacturer's recommended timetable. Records reflect inspection results, maintenance performed, and date. Protective relaying controls are tested at periodic times as considered good industry practice or every three years.
- c. Distribution Transformers: Complete records are kept as to size, location, and date installed. Knowledge of and compliance with EPA requirements with respect to PCB-contaminated oil and equipment. Transformer loading analysis is performed periodically as needed.
- d. Pad-Mounted Equipment – Safety – Locking, Dead Front, Barriers: All pad-mount enclosures meet RUS dead-front requirements (secondary barriers, recessed penta-head nut, and separate pad-lock). Grounding is ensured in accordance with RUS and NESC requirements. "Danger" signs are installed inside all enclosures and "Warning" signs are installed on the exterior in accordance with ANSI Z535.
- e. Pad-Mounted Equipment – Appearance – Settlement, Condition: Rare instances of leaning or undermined enclosures exist. Prompt action is taken to correct deficiencies. Equipment exterior and interior surfaces are relatively free of rust and corrosion and are still intact (i.e., no holes).
- f. Watt-hour and Demand Meter Reading and Testing: All meters are tested in accordance with state regulations (where applicable) or ANSI C12.1. PT, CT, and demand meters are generally tested on at least a three-year cycle. Complete records are kept as to size, location, and date installed.

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PART II - OPERATION AND MAINTENANCE

6. Line Maintenance and Work Order Procedures

- a. Work Planning and Scheduling: All lines are staked prior to construction by personnel familiar with NESC requirements. Work order inspections are performed in accordance with 7 CFR 1724, Electric Engineering, Architectural Services and Design Policies and Procedures (i.e., within six months of completion of construction). Utility shall document that all remedial work has been completed and provide notice to any contracted work order inspection entities of the same. Construction Work Plan projects are completed in time to meet load-level requirements. New service connections are completed in reasonable timeframes.
- b. Work Backlogs – Right-of-Way Maintenance: Adequate resources are provided to address re-clearing on timely basis. ROW re-trimming cycles to be dictated by local conditions.
- c. Work Backlogs – Poles: All reject poles are replaced within six months of inspection. "Danger" and "Hazard" poles are replaced as soon as possible.
- d. Work Backlogs – Idle Services - Retirement of: Policy and procedures are in place to address retirement of idle services so ratio of idle services to total is less than 10% unless specific local conditions dictate otherwise.
- e. Work Backlogs – Other: Job orders from line inspections are completed in reasonable timeframes.

7. Service Interruptions

- a. System Average Interruption Duration Index (SAIDI): Service continuity objectives are described in Section 5 of RUS Bulletin 1730A-119. For Form 300, Part II, 7(a), the "All

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Other SAIDI” classification will be the primary category for evaluation. The current guideline is an “All Other SAIDI” of 200 minutes or less for a “Satisfactory” rating of 3.

- b. Emergency Restoration Plan: Emergency restoration plan is readily available and covers multiple scenarios, including loss of power to the headquarters, key offices, and/or operations centers.

8. Power Quality

General Freedom from Complaints: Minimal complaints are received with respect to television and radio interference, voltage flicker, neutral-to-earth voltage, harmonics, and EMF. Complaints are generally resolved quickly and effectively. Summary of complaints is maintained and analyzed periodically.

9. Loading and Load Balance

- a. Coop shall provide evidence of transformer load studies that identify underutilized capacity or overloaded transformers. Transformers consistently loaded to 50% or less of nameplate capacity, or over 140% of nameplate capacity, should be considered for replacement.
- b. Load Control Apparatus: Have records of individual controllers showing location, type of load being controlled, and any maintenance. Load control results are summarized.
- c. Substation and Feeder Loading: All feeders are balanced among phases to within 20% during peak loads.

10. Maps and Plant Records

- a. Operating Maps – Accurate and Up-to-Date: Consumers are identifiable by location with a set of maps carried by all service personnel. Maps depict roads, grid lines, waterways, railroads, and other landmarks necessary to locate consumers. Maps are of a functional

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size and permit location of consumers irrespective of date of service. Detail maps are current and up-to-date, generally 1 year old or less.

- b. Circuit Diagrams: Current and up-to-date maps depicting a multiple line layout of distribution facilities of the utility are kept at the utility's office. The locations and sizes of substations, distribution lines, line regulators, reclosers, capacitors, and substation boundaries are clearly shown. Primary voltage drops are indicated at the ends of primary feeder lines. All transmission lines within the service territory are depicted and identified as to voltage and ownership.
- c. Staking Sheets: Staking sheets are prepared for projects prior to construction. The sketch and construction units are consistent and sheets shall provide sufficient engineering detail to note all aspects of construction and unit specification, including but not limited to orientation, geographic location, operating voltage, ruling span, and special notes. Final staking sheets are consistent with the "as-built" conditions.
- d. Electronic Maps: Operational electronic maps or other field force automation applications may contain the required aforementioned information in user accessible attribute form.

11. Oil Storage & Handling

Records of oil testing, storage, spills, and spill prevention are present and maintained in accordance with federal requirements. Where applicable, a current spill prevention containment and control (SPCC) plan shall be in place and followed.

12. Avian Protection and Response Plan

Records of system improvements for purposes of avian protection and responses to avian contacts with utility plant are present and maintained in accordance with federal requirements.

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PART III - ENGINEERING

13. System Load Conditions and Losses

- a. Annual System Losses: System losses are appropriate for the conditions encountered. Reasonable efforts are made to reduce system losses.
- b. Annual Load Factor: Load factor is appropriate for the conditions encountered. Reasonable efforts made to improve load factor, where possible.
- c. Power Factor at Monthly Peak: Each distribution substation maintains a power factor as required by the wholesale power supplier.

14. Voltage Conditions

Substation Transformer Output Voltage Spread: All substations include automatic voltage regulators or voltage regulating transformers. Each substation has continuous voltage recording, which is monitored monthly. Regulated substation output voltage and line regulators are maintained so Range A service voltage per RUS Bulletin 1724D-113 is provided to all consumers.

15. Load Studies and Planning

- a. Long Range Engineering Plan: System planning study is valid and meets the requirements of 7 CFR 1710, can be used as a guide for preparing the next Construction Work Plan, and is prepared in accordance with RUS Bulletin 1724D-101A.
- b. Construction Work Plan: Work Plan is up-to-date, meets the requirements of 7 CFR 1710, and is prepared in accordance with RUS Bulletin 1724D-101B.

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- c. Sectionalizing Study: System sectionalizing is reviewed and updated as needed concurrently with each Construction Work Plan and when significant changes occur in fault current conditions in accordance with RUS Bulletin 1724E-102.
- d. Load Data for Engineering Studies: An integrated database automatically assigns consumers and their load to specific geographical locations that are associated with specific distribution line sections. Data is sufficiently accurate so the difference between the calculated and measured substation kW is less than 5%.
- e. Power Requirements Study: Power Requirements Study is current and completed in compliance with the requirements stated in 7 CFR 1710.

PART IV - OPERATION AND MAINTENANCE BUDGETS

16. Budgeting

Adequacy of Budgets For Needed Work: Utility prepares an annual O&M budget with specific item quantities and dollars prior to the beginning of each year for each department. The O&M budget is broken down to show each program, the quantities of work to be accomplished and the time during the year when the proposed work is to be performed.

17. Date discussed with Board of Directors

Date that budget was discussed with the Board of Directors.