

UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Utilities Service

Bulletin 1730-1

SUBJECT: Electric System Operation and Maintenance (O&M)

To: RUS Electric Borrowers and RUS Electric Staff

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Office of Primary Interest: Electric Staff Division

Filing Instructions: This Bulletin supersedes REA Bulletin 161-5, Electric System Review and Evaluation, dated October, 1978. File this bulletin with 7 CFR 1730.

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.

/s/

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January 1/26/98

Date

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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
GFR	General Field Representative
IFT	Interfacial Tension
kVA	Kilovolt-Ampere
kW	Kilowatt
kWh	kilowatt-hour
NESC	National Electrical Safety Code
O&M	Operations 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' review and evaluation thereof.

2. Borrower Guidelines

2.1 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:

- (a) Service interruption reports and summaries of experience (including power supply outages.)
- (b) Overhead and underground line inspection and maintenance records, including pole inspection and line patrol records.
- (c) Substation inspection and maintenance records.
- (d) Recloser and sectionalizer records.
- (e) Line Voltage regulator records.
- (f) Distribution transformer records.
- (g) Watt-hour and demand meter records.
- (h) Right-of-way maintenance records.
- (i) Line Voltage and current records.
- (j) Up-to-date system maps.

- (k) System losses.
- (l) Idle services.
- (m) External system impacts (including EMF questions, stray voltage, radio and television interference, etc.)--records of inquiries and resulting actions.

2.2 Emergency Restoration Plan: Each borrower should have a written plan detailing how to restore its system in the event of a system wide outage resulting from a major natural disaster or other causes. This plan should include how to contact emergency agencies, borrower management and other key personnel, contractors and equipment suppliers, other utilities, and any others that might need to be reached 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 under any and all circumstances.

2.3 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 2 or 3 years as indicated on the form.

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

3.1. RUS will conduct a periodic review and evaluation of each borrower's operation and maintenance 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.

3.2. Distribution Borrowers: The General Field Representative (GFR) is responsible, within the GFR's assigned territory, for initiating and conducting a periodic review and evaluation of each distribution borrower's operation and maintenance programs, practices, and records. This review and evaluation is to be done at least once every 3 years.

3.2.1 The GFR may inspect facilities as well as records, and may also observe construction and maintenance work in the field. Key borrower personnel responsible for the facilities being inspected should accompany the GFR during such inspections.

3.2.2 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.

3.2.3 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.

3.2.4 Upon completion of the O&M review and evaluation, the GFR will communicate his/her findings to the borrower.

3.3 Power Supply Borrowers: The Power Supply Division (PSD) is responsible for initiating and conducting a periodic review and evaluation of each power supply borrower's operation and maintenance programs, practices, and records . PSD will consult with the borrower and arrange a scheduled time for the review and evaluation. PSD will determine the frequency of this review and evaluation.

3.3.1 The GFR will, upon request by PSD, assist in the review and evaluation, particularly with respect to transmission, subtransmission, and substation facilities.

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 violations of RUS or NESC requirements including clearance or separations in any substation. All substations accessible by authorized personnel only. Operating manual available for each substation.
- b. Physical Condition: Structure, Major Equipment, Appearance: Rare instances of rust, weeds, dangerous insects, and bird nesting. No leaks, no temporary bus being used on an ongoing basis, only minor material associated with maintenance of the substation equipment stored in yard. No debris, no openings under fence greater than 3 inches (76 mm), no broken insulators, parallel power transformers properly fault protected. Circuit, phases & airbreak switch handles are properly identified.
- c. Inspection Records Each Substation: Written monthly inspection reports completed and reviewed by responsible personnel for all substations. Infrared inspection of all connectors at least every five years. Dielectric, dissolved gas, and interfacial tension (IFT) tests of oil filled equipment performed at least every five years or within one year of exposure to a through fault which causes the transformer protective devices to de-energize the transformer. Annual power factor test of all equipment rated 230 kV or above. Relays are functionally tested annually and cleaned, calibrated, and tested every three years.
- d. Oil Spill Prevention: Oil spill prevention and mitigation plans prepared and available for all substations.

CONDITIONS NORMALLY NEEDED TO JUSTIFY A RATING OF 3

2. Transmission Lines

- a. Right-of-Way - Clearing, Erosion, Appearance, Intrusions: No uncontrolled erosion. Gates or gaps at all fence crossings. Structures and lines not impacted by untrimmed right of way. Structures generally accessible by service vehicles.
- b. Physical Condition - Structure, Conductor, Guying: All structures vertical and guys taut. No broken insulators or crossarms, and no unauthorized attachments. Essentially all structures numbered. Structures and attachments conform to NESC requirements.
- c. Inspection Program and Records: Walking, riding, or aerial line patrol of all lines (including those on private right-of-way) performed at least annually. Records maintained for pole inspection and line patrol and deficiencies corrected on a timely basis. Above and below ground pole inspection performed on cycle based upon decay zone using experienced inspectors.

3. Distribution Lines - Overhead

- a. Inspection and Maintenance - Program and Records: Above and below ground pole inspection performed on cycle based upon decay zone using experienced inspectors. Records of all poles inspected, treated, rejected and changed out readily available in summary form. All overhead lines (including those on private right-of-way) patrolled annually (walking, riding, or aerial); more frequently if experience dictates. Records maintained for pole inspection and line patrol with deficiencies corrected in a timely manner. Pole and equipment changeout program in place to keep rejected poles and failed equipment to a minimum.
- b. Compliance with Safety Codes - Clearances: All facilities staked prior to construction by personnel familiar with NESC requirements. Line patrols identify changed conditions requiring greater clearances.

CONDITIONS NORMALLY NEEDED TO JUSTIFY A RATING OF 3

Compliance with Safety Codes - Foreign Structures: Utility has policy and practice of immediately remedying foreign structures which 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. Unauthorized attachments and violations of the NESC promptly remedied.

- c. Observed Physical Condition from Field Checking - Right-of-way: Structures and lines not impacted by untrimmed right-of-way. Right-of-way re-trimming cycles to be dictated by local conditions.

Observed Physical Condition from Field Checking - Other: Rare instances of leaning poles, slack guys, broken grounds, loose hardware and superfluous material on structures. No broken crossarms or insulators, and no pole steps on wood poles. Installation of miscellaneous distribution equipment meets NESC requirements. Neutral properly identified when located on crossarm.

4. Distribution - Underground Cable

- a. Grounding and Corrosion Control: Ground rods located at each transformer plus at least four per mile (1.6 km), not including grounds at individual services, in accordance with the NESC. Record system kept of visible cable condition when excavated. Periodic testing at selected locations of underground cable and grounding points for evidence of corrosion. Appropriate and timely actions taken to correct any unsatisfactory conditions.
- b. Surface Grading, Appearance: Rare instances of earth settling which could create hazards to the general public and timely action taken to correct any deficiency.

CONDITIONS NORMALLY NEEDED TO JUSTIFY A RATING OF 3

- c. Riser Poles: Hazards, Guying, Condition: Cut-outs mounted per RUS requirements. Riser cable covered with conduit to within 4 feet (1.2m) of the bottom of the potheads. Adequate surge protection installed.

5. Distribution Line Equipment: Conditions and Records

- a. Voltage Regulators: Voltage regulators inspected and maintained in accordance with the manufacturer's recommended timetable. Regulators checked for proper operation at least semi-annually. 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 performed every five years or within one year of exposure to a through fault which causes the protective devices to de-energize the regulator.
- b. Sectionalizing Equipment: Oil circuit reclosers (OCR's) and breakers inspected and maintained in accordance with the manufacturer's recommended timetable. Records reflect inspection results, maintenance performed, and date.
- c. Distribution Transformers: Complete records 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 performed periodically as needed.
- d. Pad Mounted Equipment - Safety - Locking, Dead Front, Barriers: All padmount enclosures meet RUS dead-front requirements (secondary barriers, recessed penta-head nut, and separate pad-lock.) Grounding in accordance with RUS and NESC requirements. "Danger" signs inside all enclosures and "Warning" signs on the exterior in accordance with ANSI Z535.

Pad Mounted Equipment - Appearance - Settlement, Condition: Rare instances of leaning or undermined enclosures. Prompt action taken to correct deficiencies.

CONDITIONS NORMALLY NEEDED TO JUSTIFY A RATING OF 3

- e. Watt-hour and Demand Meter Reading and Testing: All meters tested in accordance with state regulations (where applicable) or ANSI C12.1. PT, CT and demand meters are generally tested on at least a 3 year cycle. Complete records kept as to size, location, and date installed.

PART II - OPERATION AND MAINTENANCE

6. Line Maintenance and Work Order Procedures

- a. Work Planning and Scheduling: All lines staked prior to construction by personnel familiar with NESC requirements. Work order inspections performed in accordance with 7 CFR 1724, Electric Engineering, Architectural Services and Design Policies and Procedures (i.e., within 6 months of completion of construction.) Utility promptly provides inspector with written notice that clean-up work has been completed. Construction Work Plan projects completed in time to meet load level requirements. New service connections completed in reasonable time frames.

Work Backlogs - Right-of-way Maintenance: Adequate resources being provided to address re-clearing on timely basis. Right-of-way re-trimming cycles to be dictated by local conditions.

Work Backlogs - Poles: All reject poles replaced within 6 months of inspection. "Danger" and "Hazard" poles replaced as soon as possible.

Work Backlogs - Idle Services - Retirement of: Policy and procedures in place to address retirement of idle services so that ratio of idle services to total is less than 10% unless specific local conditions dictate otherwise.

CONDITIONS NORMALLY NEEDED TO JUSTIFY A RATING OF 3

Work Backlogs - Other: Job orders from line inspection completed in reasonable time frames.

7. Service Interruptions

- a. Average Annual Hours/Consumer by Cause: Rating to consider the effect of all types of outages, including planned. Evidence of concern would be when total outages exceed 5 hours or power supply outages exceed 1 hour per consumer per year. Outages accounted for in accordance with RUS Bulletin 161-1.
- b. Emergency Restoration Plan: Emergency restoration plan 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 with respect to television and radio interference, voltage flicker, neutral-to-earth voltage, harmonics, and EMF. Complaints generally resolved quickly and effectively. Summary of complaints maintained and analyzed periodically.

9. Loading and Load Balance

- a. Distribution Transformer Loading: Loading ratio (kVA to peak kW) may range from 2 to 4, depending upon levels of load management, seasonal customers, as well as other factors.
- b. Load Control Apparatus: Have records of individual controllers showing location, type of load being controlled, and any maintenance. Load control results summarized.

CONDITIONS NORMALLY NEEDED TO JUSTIFY A RATING OF 3

- c. Substation and Feeder Loading: All feeders balanced at each substation to within 20% during peak loads.

10. Maps and Plant Records

- a. Operating Maps - Accurate and Up-to-Date: Consumers can be identified 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 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 map (generally 2 years old or less) depicting a multiple line layout of distribution facilities of the utility. The location and sizes of substations, 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 are located and identified as to voltage and ownership.
- d. Staking Sheets: Staking sheets are prepared for projects prior to construction. The sketch and construction units are consistent. North arrow and grid reference are present. Spans lengths are correctly listed and all line angles and guy lead lengths are stated. Final staking sheets are consistent with the "as-built" conditions.

PART III - ENGINEERING

11. System Load Conditions and Losses

- a. Annual System Losses: System losses are appropriate for the conditions encountered. Reasonable efforts made to reduce system losses.

CONDITIONS NORMALLY NEEDED TO JUSTIFY A RATING OF 3

- b. Annual Load Factor: Load factor is appropriate for the conditions encountered, generally at least 45%. Reasonable efforts made to improve load factor, where possible.
- c. Power Factor at Monthly Peak: Each distribution substation maintains a power factor between 0.95 lagging and 0.95 leading at time of power supply coincident peak demand.

12. Voltage Conditions

- a. Voltage Surveys: Sufficient number of recording and/or indicating voltmeters are available and utilized to monitor specific locations where voltage conditions warrant special attention. Annual graphs or statistical analyses are kept for each meter for the most recent 5 year period.
- b. 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 by computer analysis. Regulated substation output voltage and line regulators are maintained so that Range A service voltage per RUS Bulletin 169-4 is provided to all consumers.

13. Load Studies and Planning

- a. Long Range Engineering Plan: System planning study is current, 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.
- c. Sectionalizing Study: System sectionalizing is reviewed and updated as needed concurrently with each Construction Work Plan and with significant change in fault current conditions.

CONDITIONS NORMALLY NEEDED TO JUSTIFY A RATING OF 3

- d. Load Data for Engineering Studies: A completely integrated data base automatically assigns consumers, and their load (kWh or kW) to specific geographical locations that are associated with specific distribution line sections. Data is sufficiently accurate that the difference between the calculated and measured substation kW is less than 5%.
- e. Power Requirements Data: Power requirements study is current and completed in compliance with the requirements stated in 7 CFR 1710.

PART IV - OPERATION AND MAINTENANCE BUDGETS

14. Budgeting

Adequacy of Budgets For Needed Work: Utility prepares an annual 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 timing during the year when the proposed work is to be performed.