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UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Utilities Service

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SUBJECT: System Planning Guide, Construction Work Plans

TO: RUS Electric Borrowers and RUS Electric Staff

EFFECTIVE DATE: Date of Approval

OFFICE OF PRIMARY INTEREST: Engineering Standards Branch, Office of Customer Service and Technical Assistance

INSTRUCTIONS: This Bulletin is a revision of RUS Bulletin 1724D-101B, "System Planning Guide, Construction Work Plans," dated December 18, 2012.

AVAILABILITY: This Bulletin, and any other RUS bulletin mentioned herein, is available on the RUS electric webpage at www.rd.usda.gov/publications/regulations-guidelines/bulletins/electric.

PURPOSE: The purpose of this bulletin is to provide guidance to borrowers and engineers in the preparation of construction work plans (CWPs) for electric systems. A CWP is the documented results of an engineering study which has determined all of the new construction required to provide adequate and reliable electric service during the planning period. A CWP is used as an engineering support document for a loan application, as a component of ongoing integrated system planning, and as means for specifying and documenting plant requirements for the next four years.

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by CHRISTOPHER
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Date: 2019.09.17
09:28:23 -04'00'

Christopher A. McLean
Assistant Administrator
Electric Program

_____ Date

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Exhibit A - Typical Construction Work Plan Table of Contents

INDEX:

- System Planning Guide
- Long-Range System Plan
- Construction Work Plans

ABBREVIATIONS

AMR	Automatic Meter Reading
AMI	Automated Metering Infrastructure
CFR	Code of Federal Regulations
CWP	Construction Work Plan
ER	Environmental Report
G&T	Generation and Transmission Cooperative
GFR	General Field Representative
kW	Kilowatt
LRP	Long-Range Plan
O&M	Operations and Maintenance
OCR	Oil Circuit Recloser
RUS	Rural Utilities Service
SCADA	Supervisory Control and Data Acquisition

1. USE OF CONSTRUCTION WORK PLAN (CWP)

The CWP process is used to determine and document a borrower's four year construction needs that are the most feasible, environmentally acceptable, and economical. New construction is periodically required in order to provide and maintain adequate and reliable electric service to all of a system's new and existing members. The CWP should include all recommended electric plant facilities regardless of the financing source (general funds, RUS, or all other lenders).

A CWP is a valuable reference for the preparation of annual construction budgets and schedules. The CWP report is also used as an engineering support document for a loan application to finance a proposed construction program. As such, the CWP is used as a means to inform RUS and receive RUS's approval of proposed new construction items.

2. PREPARATION

The first step in the CWP preparation or development process usually involves a meeting among the system's management, the system's staff or consulting engineer, the RUS General Field Representative (GFR), and perhaps the borrower's power supplier. An agreement should be reached at this meeting on the new CWP's planning period, projected maximum loads and number of consumers, and other technical items as presented in this section. At this time, an agreement should also be reached on dates and type of data to be furnished to the engineer, the target completion date of the CWP and future dates of any coordination, and CWP draft review meetings.

- a. To Be Reviewed. The following data and studies need to be reviewed, analyzed, and updated by the planning engineer.
 - (1) Historical system data such as energy purchases and sales, losses, peak kW demands, and number of consumers need to be tabulated. This information is generally included in the CWP as reference information but is also used in the CWP analysis.
 - (2) System design criteria has to be established. These criteria identify the standards within which the system must perform. The design criteria become the basis for defining and identifying problems on the system and for justifying necessary improvements. The design criteria should address all aspects of the system that are to be analyzed. All design criteria should be documented and included in the CWP. The system management, engineer, and GFR should agree upon the design criteria before development of the CWP study begins.
 - (3) The following values should be used in the design criteria.
 - (a) The maximum voltage drop on primary distribution lines should not exceed the allowances set forth in ANSI C84.1.

- (b) Design considerations shall include the thermal loading limits as recommend by the manufacturer. The use of best engineering practices will be utilized on the system under case by case basis when necessary.
- (c) Review of primary conductor loading to ensure that best engineering practices are followed, and they follow the recommended manufacturer's limits based on design.
- (d) Conductors be replaced if found to contain an average of over two splices per phase per span in a one- mile (1.6-kilometer) section.
- (e) System shall be designed to achieve a maximum of 200 consumer outage minutes, per consumer, per year, excluding outages caused by a major event or the power supplier, for the last five consecutive years.

Note: The above values are guidelines and should be reviewed by engineering personnel familiar with the system to arrive at specific values for individual utilities.

- (4) The list in Section 2a(3) in this bulletin is not inclusive of all criteria that can or should be used. Design criteria should address deficient system components such as deteriorated poles and equipment, inadequate clearances, safety and code violations, and define the type of construction to be used as the system standard. The types of problems documented, and the numerical quantities addressed will be somewhat different for each electric system.
- (5) Design criteria should also consider the addition of programs such as Conservation Voltage Reduction, Distributed Automation, Demand Response, and other technologies that will impact system reliability. These projects may require more stringent design parameters than usually recommended.
- (6) The system's currently approved Load Forecast (formerly referred to as a Power Requirements Study) needs to be reviewed. The projected system peak kW loads and number of consumers for the CWP planning period should be derived directly from this load forecast. The Load Forecast is generally used to project a system coincident peak from energy related factors, whereas a CWP is designed at a distribution circuit level which generally peaks at higher levels at the substation and distribution system levels. For the purposes of the CWP analysis, historical substation loading should be used for forecast load levels when designing for distribution improvements. Diversity and coincidence factors should be considered

when correlating with the Load Forecast load levels, as well as transmission and substation transformer loading. Any loads and numbers of consumers used that are not consistent with the Load Forecast projections need to be explained in the CWP.

- (7) The system's Long Range Plan (LRP) needs to be analyzed to ascertain that its basis (load projections, economic factors, etc.) are still valid for the CWP planning period and also that its construction recommendations are still required, feasible, and economically sound. It is appropriate to include a thorough, yet concise, written review of the LRP in the CWP, including a comparison of historical projected versus actual peak loads. A written summary of the overall recommendations of the LRP helps the reader understand how new recommended construction items conform to the projected development of the system.

Note: As of March 12, 2013, RUS no longer reviews or accepts the LRP from borrowers; however, RUS does require borrowers to continue to maintain a board approved, up-to-date LRP and keep the LRP on file.

- (8) Previous CWP and CWP amendments need to be reviewed to determine which projects have been or will be completed and which construction items need to be carried over into the current CWP. Carryover items may need new cost estimates and occasionally may need additional justification. The status of the construction items of the previous CWP can be explained succinctly with a table.
- (9) The engineer should use the system's most recent Operations and Maintenance (O&M) survey with its associated "Review Rating Summary" (RUS Form 300) to determine the condition of system components such as poles and conductors, outages, and tree trimming. This summary may also be used to justify the need of new construction items and programs to correct those areas where the system does not meet the design criteria. The O&M survey should be appropriately updated and analyzed to assure that it describes the system's present conditions. A new O&M survey should be performed before beginning the CWP if the present survey is more than 4 years old. A concise written analysis of the O&M survey and results, and any recommendations contained in the survey, should be included in the CWP. This analysis should contain enough details to explain deficiencies found on the system and the work required to correct them.
- (10) All other relevant studies recently performed on the system, such as sectionalizing, system aging, and power factor correction, should be reviewed in detail and compared to the requirements of the design criteria. All present and projected deficiencies on the system should be documented in the CWP to explain the problems found and the

construction required to resolve them. Narratives and tables may be used to explain and justify recommended construction.

Periodic system data and reports, such as substation maintenance reports and min-max voltmeter readings or equivalent AMI data if available, should be tabulated, analyzed, and compared in detail to the design criteria. All data that is included in the CWP report should be summarized in a concisely written narrative or table. Only include data used to define problems or explain and justify proposed construction items.

- (11) The system's service interruption record for the previous five years should be analyzed and summarized in a table and included in the CWP. The CWP narrative should address findings of the interruption analysis and any category with 200 or more consumer outage minutes, per consumer, per year should be explained in adequate detail.
- (12) The following maps, data, and information need to be gathered, updated, analyzed, tabulated, and documented as appropriate:
 - Various system, key, circuit, and area maps
 - Results of circuit analysis and economic analysis of the system
 - Installed costs of existing lines and equipment
 - Historic and projected numbers, distances, and costs associated with installing new overhead and underground lines, services, transformers, and meters
 - Historic and projected numbers, distances, and costs associated with replacing overhead and underground services, transformers, and meters.

This information is also useful as exhibits in the CWP to explain recommended construction items or projects.

- (13) It is suggested that the engineer interview line crews, warehouse personnel, and others who have firsthand knowledge of deficiencies on the system or problems with equipment. All reported deficiencies should be corroborated before recommending construction items in the CWP.

3. DETERMINING CONSTRUCTION REQUIREMENTS

- a. New Consumers. The projected number of new consumers is interpolated from the system's load forecast. The number of new consumers, line distances, equipment, and cost data from the past several years is used to project needed construction and its cost to provide service to new consumers to be added during the time period covered by the CWP. The cost to add anticipated new large power usage members to the system during the CWP coverage period should also be added to these totals.

- b. Historical Data. Use historical data averages to determine the number and associated costs for any non-site specific construction needs in order to maintain adequate service to existing members.
- c. System Peak Demand. Projected total system peak demands are also interpolated from the load forecast. The totals may be modified, with explanation, to include recently attained new load data. The engineer should apply appropriate growth and diversity factors to individual circuits and substations so that the total loads are in agreement with the load forecast projections. Loading tables, which show equipment capacities, projected circuit and substation transformer loads, new load additions, load transfers, and new construction projects should be included in the CWP. These loading tables are used to determine and show substation equipment which is anticipated to be loaded above the design criteria.
- d. Anticipated Loads. Each of the system's distribution circuits, updated to include anticipated new loads and circuit changes, should be analyzed at its projected peak load for the entire CWP planning period. The primary voltage drop at each circuit node, the thermal loading of all circuits' conductors and equipment, circuit power factors, and circuit load balances should be compared to the design criteria.
- e. Voltage Drops. Primary voltage drops calculated by computer programs should be corroborated with actual field measurements which have been adjusted to load levels equal to the computer runs. These field measurements can be obtained from periodic readings of the system's installed voltmeters, historic voltage readings from AMI meters, or from voltage and current investigations performed on the system. Calculated readings that are different from the actual adjusted measured readings, need to be reconciled using good engineering judgment to justify new construction items. Costly construction projects should not be based solely on computer calculations that may be prone to input errors or based on assumptions not pertinent to the line being analyzed.
- f. Recommendations. The CWP should include recommendations for correcting each item found that does not comply with the design criteria. This includes all problems found during the substation and circuit loading analyses, problems found in the engineer's review of the system's planning and O&M studies and operating reports, and problems found in studying the power supply system if applicable to the borrower.
- g. Alternative Solutions. The engineer usually has several options available to resolve existing and anticipated problems. Most solutions require new construction or equipment replacement. The engineer is expected to investigate all feasible alternative solutions and make recommendations that are in compliance with the LRP. Solutions recommended are also expected to be the most economical, considering the needs of both the distribution and the power supply system together as one system. The present worth cost of alternative plans can easily be determined and compared by downloading and using the

computerized workbook attached to RUS Bulletin 1724D-104, "An Engineering Economics Computer Workbook Procedure."

- h. Power Supply and Delivery Points. New power supply and delivery point construction items and projects, which are to be provided by a utility other than the borrower, need to be discussed with and concurred by the power supplier before the recommendation is included in the CWP. Agreement, in writing, needs to be reached on the location and amount of new capacity or delivery and the in-service date.

4. THE CONSTRUCTION WORK PLAN REPORT

The purpose of the CWP report, which is a documentation of the CWP study and recommendations, is to describe, justify, and summarize the items which have been determined necessary for construction during the work plan period. Written justification usually explains the need for a system improvement to meet the design criteria pertaining to voltage, thermal loading, service reliability, or losses, and also explains economic benefits compared to other feasible alternatives. The contents of the report should contain sufficient facts and details, including maps, graphs, and tables, to accomplish the above purposes. Narratives should be concise, factual, and relevant. It is suggested that any information or data which does not contribute to the stated purpose of the report be omitted. A table of contents for a typical CWP is illustrated in Exhibit A. RUS recommends that all of the components listed in Exhibit A, plus all other pertinent subjects, be incorporated in CWPs submitted to RUS for approval.

- a. Executive Summary. An "Executive Summary" section should be included at the beginning of the CWP report. This summary should be short enough to be read within a few minutes and fully understood without referring to other sections of the report. The purpose of the summary is to briefly describe the system, the basis of the engineering study, and summarize the proposed construction program. This summary should also include expected results and the estimated costs. The following items should also be included in the Executive Summary.
 - (1) A brief description of the borrower, the electric system, and the power supplier. Small maps may help clarify these descriptions.
 - (2) A complete summary listing of all of the proposed construction items detailing the total cost of the proposed construction program or a table in the format of RUS Form 740C, "Cost Estimates and Loan Budget for Electric Borrowers." These construction items should be numerically coded according to the latest RUS guidelines.
 - (3) A loading table showing the results of the proposed construction items, projected circuit and transformer loading, new load additions and load transfers. The table should show that all anticipated equipment and circuit loading problems will be resolved during the planning period.

- b. Historical and Projected Data. A section of the CWP report should document historical and projected system data, the design criteria, unit cost estimates and their derivation, and a written analysis of the various system studies and data that the engineer reviewed, prepared and used in performing the systems analysis. In general, this information is used to determine the portions of the system and equipment which do not meet the design criteria. The information is also used to formulate a basis for the acceptability and cost estimates of alternative plans to resolve the existing and anticipated problems.
- c. Documentation. Another complete section of the CWP report should be used to document the entire construction program proposed. It is suggested that the items in this section be arranged in the same order as found on RUS Form 740C. All significant proposed new construction items, groups of items, and system modifications should be adequately and concisely described and justified. Justification usually includes the reason for and expected results of the construction, and also shows favorable economics when compared to other feasible alternatives.
- (1) Transmission line, substation, and other power supply items can be explained using form and contents similar to distribution items.
 - (2) A concise written summary analysis of other relevant independent system studies, such as O&M, sectionalizing, Supervisory Control Data Acquisition (SCADA), load management, Automatic Meter Reading (AMR) feasibility, and system aging studies should be included in the report. This analysis should explain the study, its results, and the need for new construction. A copy of each study need not be included in or appended to the CWP report. A listing or table of the construction items and their associated costs proposed as a result of each of the above studies should be placed in the CWP report with the other required construction items.
- d. Calculations. Samples of calculations performed by the engineer, and sample printouts of the computer programs used by the engineer, such as engineering economic analysis and distribution circuit analysis, should be included in the Appendix of the CWP report. It is desirable to include only one or two typical samples of calculations or printouts. However, the engineer should retain all pertinent calculations, data, and notes for future references.
- e. Appendix. The Appendix of the CWP should also include maps of the system which show, as a minimum, the following information:
- The borrower's service area and each substation area;
 - The power supply system facilities such as generating stations, transmission lines, and substations;
 - Distribution lines and components such as line regulators, capacitors, protection devices, etc.;

- Representative primary voltage drops resulting from projected loads throughout the system and at the end of each circuit;
- Planned and/or anticipated new loads, lines, equipment, etc.;
- Recommended new and carryover construction items; and
- Any additional data or information that may be required to describe the system or describe and justify proposed new construction items.

f. Maps

- (1) The first map should show the existing system, with anticipated loads (existing customer growth and additions), anticipated and planned circuit changes, and projected resulting primary voltages at the end of the planning period. The purpose of this map is to clearly describe the system and show anticipated problems at the end of the planning period without proposed new construction items.
- (2) The second map should contain all of the pertinent information included on the first map plus the proposed construction items and the resulting voltage and other system improvements. The purpose of this map is to show that the proposed new construction and changes will improve primary voltages or otherwise are beneficial to the system.
- (3) The above-mentioned maps should be drawn neatly, as close to scale as possible, and utilize accepted standard symbols. A key of the symbols should be included on the maps.

5. ENVIRONMENTAL REPORTS (CWP and CWP AMMENDMENTS)

Refer to Title 7 of the Code of Federal Regulations, Part 1970, Environmental Policies and Procedures, for requirements regarding environmental reviews. The environmental review process is concluded when the RUS approves the applicability of a Categorical Exclusion (CE), issues a Finding of No Significant Impact (FONSI), or issues a Record of Decision (ROD) and must be completed prior to the start of construction.

6. CONSTRUCTION WORK PLAN AMENDMENTS

A CWP amendment is required to add facilities to a previously, RUS approved CWP or to make significant physical changes in the facilities already included in a RUS approved CWP unless the project meets the qualifications of a minor project.

7. APPROVAL OF CONSTRUCTION WORK PLANS

- a. Approval. Where practical, a draft of the CWP report should be presented to the RUS GFR prior to completing the final version.

- b. Approval Authority. RUS CWP approval authority is delegated to the GFR for all distribution, headquarters, and transmission facilities. Approval for any generation or acquisition of facilities contained in the CWP is delegated to the appropriate RUS office in Washington, D.C. RUS will determine the appropriate approval authority for all other types of facilities on a case by case basis. Electronic copies of all documentation shall be submitted to RUS. RUS approval of the CWP constitutes general approval of the need for the construction of facilities in the CWP. Borrowers seeking financing from RUS for the construction of these projects should consult the appropriate regulation regarding the need for design approval, contract approval, or environmental approval.

EXHIBIT A
TYPICAL CONSTRUCTION WORK PLAN TABLE OF CONTENTS

- i. Title Page; Engineer's Certification
- ii. Table of Contents

- I. EXECUTIVE SUMMARY
 - A. Purpose, Results, and General Basis of Study
 - B. Service Area, Distribution System, and Power Supply
 - C. Summary of Construction Program and Costs
 - D. Loading Table with Changes

- II. BASIS OF STUDY AND PROPOSED CONSTRUCTION
 - A. Design Criteria
 - B. Distribution Line and Equipment Costs
 - C. Status of Previous CWP Items
 - D. Analysis of Current System Studies
 - 1. Current Long-Range Plan
 - 2. Current O&M Survey (RUS Form 300)
 - 3. Sectionalizing Studies
 - E. Historical and Projected System Data
 - 1. Annual Energy, Load, and Consumer Data
 - 2. Substation Load Data
 - 3. Transformer and Circuit Loads
 - 4. Load Current Measurements
 - 5. Voltage Measurements
 - 6. System Outages and Reliability

- III. REQUIRED CONSTRUCTION ITEMS [See Note Below]
 - A. Service to New Customers
 - B. Service Changes to Existing Customers
 - C. Distribution Lines – Additions and Changes
 - D. Substations (Metering Points) – Additions and Changes
 - E. Sectionalizing Equipment – Additions and Changes
 - F. Line Regulators – Additions and Changes
 - G. Capacitors – Additions and Changes
 - H. Ordinary Replacements
 - I. Other Distribution Items

Note: This list of required construction items may not be complete for all systems. Other categories—such as transmission lines, SCADA facilities, and headquarters facilities—should be included in each CWP as appropriate.

IV. APPENDIX

- A. Samples of Computerized Analyses Used
 - 1. Economic Analysis of Alternative Plans
 - 2. Distribution Circuit Analysis Printout
 - 3. Economical Conductor Sizes
- B. Letter of Concurrence from Power Supplier
- C. Systems Maps with Projected Load Levels
 - 1. Map of Projected System Without Changes
 - 2. Map with Proposed New Construction Items