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AUDIT REPORT

POWER MARKETING ADMINISTRATIONS' INSTALLATION OF FIBER OPTICS

OCTOBER 2001

U.S. DEPARTMENT OF ENERGY
OFFICE OF INSPECTOR GENERAL
OFFICE OF AUDIT SERVICES

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MEMORANDUM FOR THE: ADMINISTRATOR, BONNEVILLE POWER ADMINISTRATION
ADMINISTRATOR, WESTERN AREA POWER ADMINISTRATION
ADMINISTRATOR, SOUTHWESTERN POWER ADMINISTRATION

FROM: Lawrence R. Ackerly, Regional Manager
Western Regional Audit Office
Office of Inspector General

SUBJECT: INFORMATION: Audit Report on "Power Marketing Administrations' Installation of Fiber Optics"

BACKGROUND

The Power Marketing Administrations (PMAs) were established to transmit and sell electrical power generated by federally owned hydroelectric projects. To accomplish these missions, three PMAs--the Bonneville Power Administration (Bonneville), the Western Area Power Administration (Western), and the Southwestern Power Administration (Southwestern)--own and operate transmission lines that cross 22 western states. Additionally, the PMAs have communication systems to ensure the reliability of the transmission lines. These communication systems perform functions such as protective relaying, system monitoring, and scheduling of electrical transmission over the transmission lines. The PMAs also use the communication systems for administrative purposes such as training and timekeeping.

To meet current and future communication needs, the three PMAs began upgrading to fiber optic communication systems. Fiber optic cable varies in transmission capacity based on the number of fiber strands that are built into the cable and the type of terminal equipment used. The PMAs were installing between 12 and 72 fibers per cable. The objective of this audit was to determine if the PMAs were installing fiber optic cable with excess fibers.

RESULTS OF AUDIT

Two of the PMAs were installing fiber optic cable with excess fibers. Bonneville was installing 36- and 72-fiber cable and Western was installing 48-fiber cable on certain routes. The third PMA, Southwestern, was installing 12-fiber cable which met its operational requirements. Bonneville and Western were installing cable with excess fiber because both PMAs considered other factors in addition to operational needs. By limiting its installation to 24-fiber cable, we estimated that Bonneville could reduce future costs between $2.7 million and $6.1 million. Additionally, if Western had continued to install all of the planned 48-fiber routes without obtaining partnering agreements, it would have

incurred $10.2 million in unnecessary costs. However, by ensuring that it either installs 24-fiber cable or has a partnering agreement in place before installing 48-fiber cable, Western will avoid these unnecessary costs. We recommended that Bonneville and Western limit the acquisition of fiber optic cable to the size needed to satisfy its operational needs.

MANAGEMENT REACTION

Management officials at Western concurred with the finding and recommendation as they pertained to Western. In fact, during the audit Western revised its plans and is now installing only 24-fiber cable. Management officials at Bonneville concurred with the recommendation but disagreed with our finding.

Management comments and OIG responses are more fully discussed in the report.

POWER MARKETING ADMINISTRATIONS' INSTALLATION OF FIBER OPTICS

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INTRODUCTION AND OBJECTIVE

The Power Marketing Administrations (PMAs) were established to transmit and sell electrical power generated by federally owned hydroelectric projects. To accomplish these tasks, three PMAs - Bonneville Power Administration (Bonneville), Western Area Power Administration (Western), and Southwestern Power Administration (Southwestern) - own and operate transmission lines that cross 22 states. Additionally, the PMAs maintain communication systems to ensure the reliability of their transmission systems. These communication systems perform vital functions such as protective relaying, system monitoring, and scheduling of electricity transmission over the transmission lines. The communication systems are also used for administrative purposes, such as training and timekeeping by the PMAs.

In the past, these communications systems were based primarily on analog microwave radios. To meet current and future demands, however, the PMAs began upgrading to fiber optic cable communication systems. Fiber optic cable varies in transmission capacity and costs based on the number of fibers built into the cable and the type of fiber optic cable used. In addition, the type of terminal equipment used to send and receive signals significantly affects the level of communications. The PMAs were installing between 12 and 72 fibers per cable. Since the number of fibers varied widely, the objective of this audit was to determine if the PMAs were installing fiber optic cable with excess fibers.

CONCLUSIONS AND OBSERVATIONS

Two of the three PMAs were installing fiber optic cable with excess fibers. Bonneville was installing cable with 36 and 72 fibers, and Western was installing cable with 48 fibers on certain routes. However, after the auditors questioned the need for 48-fiber cable, Western revised its plan to install 24-fiber cable and agreed to have partnering agreements in place before installing 48-fiber cable. Bonneville, however, continued to install cable with 36 and 72 fibers. The third PMA, Southwestern, was installing only 12-fiber cable to meet its operational requirements. The PMAs were installing cable with excess fibers for other purposes, not just to meet their own operational needs. By limiting installation costs to 24-fiber cable, however, Bonneville can avoid between $2.7 million and $6.1 million in cable acquisition costs, depending on the number and type of fibers used. Further, if Western had continued to install all of the planned 48-fiber routes without obtaining partnering agreements, it would have incurred $10.2 million in unnecessary costs.

This audit identified issues that Bonneville should consider when preparing their year-end assurance memorandums on internal controls.

_____(Signed)_____
Office of Inspector General

Installation Of Excess Fibers

Excess Fibers

Bonneville was installing fiber optic cable with excess fibers. The number of fibers in the cable that Bonneville was installing exceeded operational needs and also exceeded the operational needs of utilities with similar requirements.

Fiber Requirements

Bonneville was in the process of installing cable with 36 and 72 fibers to replace its analog radio based communications system. Bonneville claimed that cable with this number of fibers was needed to meet upcoming demands in the year 2025; however, Bonneville could not produce convincing evidence to support this claim. In a report submitted to the Congress in 2000, Bonneville stated that extra fiber was needed to meet future demands, improve reliability, provide needed redundancy, and support critical systems. Our analysis of the material prepared by Bonneville showed that its rationale for its high-fiber count cable was questionable. For instance, Bonneville wanted to have extra fibers available to:

- Meet future demands, yet it did not have support for the increased demand;
- Improve the reliability of its system, yet it already met reliability standards;
- Install cable that equaled industry standards, yet there was no industry standard size and utilities generally used between 2- and 24-fiber cable unless they planned to become commercial telecommunication service providers; and,
- Protect critical functions, a reasonable requirement.

In assessing its future needs, however, Bonneville chose not to consider one important factor. Terminal equipment currently on the market provides significant enhancements in the capacity of signals that can be sent on cable fibers. Using the highest capacity terminal equipment readily available on the market, we compared Bonneville's needs with the capability of the new equipment and found that 14-fiber cable would satisfy all of its requirements. (See Appendix 2.) Therefore, we questioned cable that exceeded 24 fibers; we used 24 rather than 14 fibers to allow for breakage and unforeseen growth.

Comparison With Other Utilities

To determine if the 36-, 48-, and 72-fiber cable being acquired and installed by Bonneville was excessive, cable purchases by similar size electric utilities were examined. Twelve utilities were contacted to determine the number of fibers being installed. Ten reported that they installed cable containing from 2 to 24 fibers to meet operational needs. The two exceptions were utilities that intended to become telecommunications service providers. To follow up on the 2 exceptions, 10 additional utilities installing cable containing more than 24 fibers were analyzed. Like the 2 cited above, the 10 utilities were installing more than 24-fiber cable in order to become telecommunications service providers. Since becoming a telecommunications service provider should not be an objective of the PMAs, we concluded that 24-fiber cable was sufficient to meet the PMAs requirements.

Acquisition Of Assets To Meet Primary Mission

The Bonneville Project Act, the Department of Energy Organization Act, and other Federal statutes give the PMAs authority to construct, purchase, or otherwise obtain any assets needed to fulfill their primary mission of selling and transmitting electrical power. Since communication systems are essential for the safe and efficient operation of the electrical transmission lines, Federal laws can be interpreted as allowing the PMAs to construct fiber optic communication systems. However, this does not give the PMAs authority to acquire assets, such as fiber optics, for purposes other than their operational needs.

Office of Management and Budget Circular No. A-76, *Performance of Commercial Activities*, and Department of Energy Order 481.1A, *Work for Others*, both address the issue of Federal Government agencies competing with private industry. Under the provisions of these two regulations, competition between Federal agencies and private industry is generally prohibited. Furthermore, in 1996 Congress specifically addressed the issue of Bonneville competing with private industry. Bonneville's 1995 Business Plan called for the development of a new "energy services" business line to market new services and increase revenues, including fiber optics. Congress directed that Bonneville refrain from any activities that would be in competition with private industry. In response, Bonneville modified its 1995 Business Plan and gave notice in the Federal Register that it would not compete with private industry.

Operational Needs

The principal reason Bonneville was installing cable with excess fibers was because other factors, such as revenue generation and local economic development, were considered instead of limiting the number of fibers to operational needs. Bonneville contended that it needed 72-fiber cable to meet its operational needs. Documents such as its 1986 Study of Fiber Optic Systems; its 1991 Fiber Optic Decision Paper; its 1995 Business Plan; and other documents, however, focused on the use of fiber optic communications as a means to increase revenues. Further, internal capital construction project reviews conducted from 1998 to 2000 showed that Bonneville considered aiding local economic development and interest by other parties in leasing fibers. Thus, it was clear that leasing played a significant part in Bonneville's decision to acquire larger capacity cable with more fibers than necessary.

Impact of Excess Fiber

By installing excess fiber and leasing it to outside parties, Bonneville is in direct competition with private companies that lease fiber. This type of competition is not permitted by Federal regulation.

Bonneville could reduce its future costs by between $2.7 million and $6.1 million if it restricted its acquisition of cable to 24 fibers, depending on the number and type of fibers used.[1] (See Appendix 3.) These cost reductions could then be used to benefit Bonneville's ratepayers.

RECOMMENDATION

We recommend that the Administrator for Bonneville Power Administration limit the acquisition of fiber optic cable to the size needed to satisfy their operational needs.

MANAGEMENT COMMENTS

Bonneville concurred with the recommendation, but not with the finding and took exception to the comparison to other utilities. Bonneville contended that the Office of Inspector General (OIG) comparison infers a one-size-fits-all conclusion. In addition, it contended that communication needs differ from utility to utility and without further information to make a comparison, the OIG analysis was not valid.

Bonneville disagreed with the analysis used by the OIG in Appendix 2 to determine future fiber needs, specifically the use of OC-192 terminal equipment. Management stated that it is less expensive to use lower capacity terminal equipment to meet operational needs and that Bonneville chose to use lower capacity terminal equipment because of system reliability requirements. Finally,

[1] The two types of fibers (Single Mode and LEAF) used by Bonneville varied significantly in costs. Documentation provided showed that Bonneville used both fibers; and in at least one case, combined the types of fibers.

management asserted that the OC-192 terminal equipment was relatively new technology and its use would be inconsistent with Bonneville's statutory obligations.

Bonneville also disagreed with the reduction of cost identified in Appendix 3. Bonneville asserted that (1) the resulting savings in installing 24-fiber cable would be offset by increased costs in terminal equipment, (2) ratepayers would bear the total cost since there would be no leasing revenue, and (3) the addition of multiplexing terminal equipment would not entirely eliminate the need for additional fibers in the future.

AUDITOR COMMENTS

Bonneville's comments, while concurring with the recommendation, were not responsive to the concern of excess fibers.

The purpose of comparing the PMAs to other utilities was not to find a one-size-fits-all solution, but rather to determine if there were any trends in the electrical utility industry. We agree with management that needs differ from one utility to another. After looking at over 20 utilities, however, we did not find any that were installing more than 24 fibers for operational needs. Those utilities that were installing more than 24 fibers were doing so to become telecommunications service providers. Based partially on this information, we concluded that Bonneville's operational needs could be met with 24-fiber cable.

Our analysis in Appendix 2 indicated that 24-fiber cable, along with improved terminal equipment, were sufficient to meet Bonneville's communication needs through 2025. The advances in fiber optic terminal equipment indicate that the capacity of information that can be sent on a single set of fibers will continue to increase dramatically in the future. Thus, with current and future developments the communication capacity of existing fibers should increase dramatically.

Bonneville’s assertion that the OC-192 equipment did not meet statutory obligations was inconsistent with information provided to us during the audit. The fiber optic consulting team used by Bonneville did not find any reliability problems with the OC-192. In fact, this team determined that single higher capacity terminal equipment was more cost-effective than using multiple lower capacity units. For example, based on manufacturer pricing information, this team determined that one OC-192 terminal costing $450,000, had the same transmission capacity as 16 OC-12s which is the terminal equipment currently used

by Bonneville at a cost of $1,184,000. This team also concluded that the use of multiple lower capacity terminal units actually decreased system reliability.

Management took exception to the reduction of costs figures based on 24-fiber cable shown in Appendix 3. The OIG's use of 24-fiber cable was based on our evaluation of the future needs of the PMA. The cost reduction range is based on the type of fiber used in the cable. Bonneville's assertion that it will only use the lower priced fiber in the future could not be substantiated. Our review of prior projects showed that, in the past, Bonneville used both types of fiber in its projects.

Appendix 1

SCOPE

We performed the audit from September 18, 2000 through June 11, 2001, at Bonneville, Western, and Southwestern. The scope of the review included existing and planned fiber optic cable projects at all three PMAs as of February 22, 2001.

METHODOLOGY

To accomplish the audit objective, we:

- Reviewed the May 24, 2000, Report to Congress submitted by the PMAs;
- Reviewed past and future fiber optic cable budgets;
- Interviewed managers, planners, and other officials from the PMAs;
- Interviewed managers, planners, and other officials from other public and private utilities;
- Reviewed applicable Federal statutes and PMA policies;
- Reviewed PMA plans for future fiber optic cable installation;
- Reviewed PMA criteria for determining the amount of fiber to install;
- Analyzed other electrical utilities to determine industry trends;
- Calculated future fiber needs;
- Contacted fiber optic equipment vendors; and,
- Observed fiber optic cable installation.

The audit was performed in accordance with generally accepted Government auditing standards for performance audits and included tests of internal controls and compliance with laws and regulations to the extent necessary to satisfy the audit objective. Internal controls related to the installation of fiber optic communication systems were reviewed. Because our review was limited, it would not necessarily have disclosed all internal control deficiencies that may have existed at the time of our audit. We assessed the significant internal controls and performance measures established under the *Government Performance and Results Act of 1993* related to the PMAs' planning, construction, and operation of fiber optic systems. There were no specific performance goals for fiber optic systems at any of the three PMAs. We did not conduct a reliability assessment of computer-processed data because only a very limited amount of such data was used during the audit.

We held an exit conference with Western officials on August 15, 2001, and with Bonneville officials on August 21, 2001.

Appendix 2

ESTIMATE OF BONNEVILLE'S FUTURE FIBER NEEDS

An estimate of Bonneville's future fiber needs was based on:

- Bonneville's estimate of communication capacity requirements for 2025;
- Communication capacity of terminal equipment currently available on the market;
- Minimum number of fibers required to meet the communication needs of each major function; and,
- Consideration of other factors such as critical functions, capacity requirements, and minimum number of fibers required per circuit.

Function	Bonneville's Estimated Communication Load for 2025 (megabits/sec)	Minimum Fiber Needs Based On Terminal Equipment Only (Note 1)	Minimum Fiber Needs Based On All Factors (Note 2)	Minimum Fiber Needs By Function According To BPA
Controls & Operational Functions	10,000	1.00	4 (Note 3)	2
Line Protection	155	0.02	2 (Note 4)	2
System Protection	622	0.06	2 (Note 4)	6
VHF	100	0.01	2 (Note 5)	2
Administrative	1,000	0.10		2
System Monitoring & Testing	1,000	0.10		2
Real Time Transmission Sensors	1,000	0.10		2
RTO/Scheduling	10,000	1.00	4 (Note 3)	6
Total	**23,877**	**2.39**	**14**	**24 (Note 6)**

1. Fiber needs were calculated by dividing Bonneville's estimated communication load for 2025 by the communication capacity of an OC-192 terminal (10,000 megabits/second).
2. Factors such as critical systems and capacity were considered to determine requirements. Additionally, each communication circuit requires a minimum of two fibers, one to send and one to receive.
3. These are critical functions with high volume traffic; thus, an additional set of fibers may be required.
4. These are critical functions and require dedicated fibers. Our analysis indicates that the future communication needs of these systems can be met with OC-192 terminal equipment.
5. These are non-critical functions forecasted to have lower communications traffic, and thus could share common fibers.
6. Bonneville planned to use the remaining fibers in the 36- and 72-fiber cable for additional redundant communication pathways, breakage, and unforeseen future growth.

The chart shows that even after dedicating extra fibers for services that may be critical or high-demand, a 14-fiber cable will satisfy Bonneville's requirements in 2025. However, the audit only questioned acquisitions above 24-fiber cable to allow spares for breakage, unanticipated future growth, and to be consistent with the report Bonneville sent to Congress.

Appendix 3

ESTIMATE OF POTENTIAL REDUCTION OF FUTURE FIBER OPTIC CABLE COSTS

An estimate of Bonneville's and Western's potential reduction of future fiber optic cable costs was based on:

- The type of fiber used and its associated cost;
- The number of miles of fiber optic cable containing greater than 24 fibers;
- An average amount of cable required to install one mile of cable;
- The cost per mile for 24-, 36-, 48-, and 72-fiber cable; and,
- The potential reduction in future cable costs.

For Bonneville, the calculated potential savings were:

	Single Mode Fiber		**LEAF Fiber**	
Fibers in Cable	36-Fiber	72-Fiber	36-Fiber	72-Fiber
Miles of Cable Route	801	175	801	175
Multiplied by Amount of Cable Per Mile (1)	1.149	1.149	1.149	1.149
Equals Miles of Cable Required	920.349	201.075	920.349	201.075
Multiplied by Cost Difference from 24-Fiber Cable (2)	$1,505	$6,753	$3,427	$14,483
Equals Amount of Potential Savings	$1,385,125	$1,357,859	$3,154,036	$2,912,169
Total Savings (3)	$2,742,984		$6,066,205	

(1) The basis for calculating one mile was the Keeler to Tillamook project. The additional cable is required to account for sag, splices, and loss from end of cable rolls.
(2) The difference in cost depends on whether Single Mode or LEAF fiber was used in the cable.
(3) Both estimates are provided since Bonneville has used both types of fibers in the past.

For Western, the calculated potential savings were:

Fibers in Cable	48-Fiber
Miles of Cable Route	1,476
Multiplied by Amount of Cable Per Mile (4)	1.044
Equals Miles of Cable Required	1,540.944
Multiplied by Cost Difference from 24-Fiber Cable	$6,600
Equals Amount of Potential Savings	$10,170,230

(4) The basis for calculating one mile amount were the Big Bend to Ft. Thompson, Ft. Thompson to Oahe, and Oahe to Pierre projects. The additional cable is required to account for sag, splices, and loss from end of cable rolls.

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