

I. Executive Summary

Project Finance Advisors, LLC (PFA), of Bethesda, MD USA is conducting a multi-disciplinary study (the “Study”) examining the overall feasibility of Empresa Nacional de Energía Eléctrica (ENEE) providing telecommunication services or transmission capacity to telecom/media operators and other customers in Honduras. The study is funded under a cost share arrangement with the U.S. Trade and Development Agency (USTDA). ENEE is responsible for almost all of Honduras’ electric-power activities including planning, generation, transmission, distribution and system administration, with the Energy Commission holding responsibility for regulating the sector.

This section of the report relates to PFA’s assessment of the viability of installing fiber optic infrastructure along ENEE’s Rights of Way (ROW). This report is delivered in preliminary format as part of PFA’s “first milestone” in its contract with ENEE. Other deliverable reports for this milestone include a Market Assessment and Preliminary Pricing Scenario for recommended services as well as a regulatory and legal analysis of how ENEE may be allowed to offer, or restricted from offering, such services.

PFA’s Market Assessment (Task 1) makes the recommendation that ENEE not offer “retail” voice, data or ISP services at this point. Rather, PFA recommends that ENEE provide “Bandwidth Services” to other telecom/media operators such as voice, data and media operators and Internet Service Providers (ISPs). Large Enterprises will also be targeted by ENEE’s Bandwidth Services offering. More specifically, it is recommended that the network be designed to offer dedicated point-to-point links operating at 2, 45 and 155 megabits per second (Mbps), and at rates higher than 155 Mbps, should a market demand materialize. It is further recommended that the network not offer “dark” (unlit) fiber. Extensive evidence indicates that dark fiber does not generally represent a viable and profitable business for electric power companies.

PFA has reviewed internal data on ENEE’s assessment of the communications facilities it needs to service its own internal needs, but information on the prospects for commercialization that is independent of the present Study is quite limited. PFA has reviewed limited technical information contained in an ENEE internal study conducted in January 2002: *Proyecto de fibra óptica Tegucigalpa—Puerto Cortés utilizando las torres de la ENEE*. PFA performed an in-country field survey (“walk-down”) of a portion of ENEE’s transmission towers in early March 2004 to determine the types of suitable fiber-optic cable and to identify technical challenges to construction of a commercial network.

As specified in the Terms of Reference of PFA’s agreements with both ENEE and USTDA, this report examines the following areas:

1. Recommendations regarding the particular transmission lines (existing and proposed) to be equipped with fiber optic cable and equipment;
2. A field survey (“walk-down”) of selected ENEE routes and tower structures, together with an assessment of any impediments along the ENEE’s ROW for installation of this

fiber. This assessment includes the need for so-called “make-ready” costs to reinforce, repair or replace particular towers. One aim of the survey was to estimate the capital costs associated with installing various types of fiber-optic cable, including OPGW and ADSS.

3. Recommendations regarding the specific types of fiber strands, and their number, especially in consideration of possible network topologies (e.g., the extent to which either physical or virtual fiber “rings” can be feasibly constructed).
4. An assessment of various technologies and components for fiber-optic backbones to determine those that are most efficient and effective for ENEE.

PFA’s key conclusions regarding the technical assessment are as follows:

- Fiber optics is clearly the technology of choice for the long-haul portion of the network. It is also the technology of choice for the metropolitan-area portions of the network in Tegucigalpa and San Pedro Sula. Cost estimates for construction of the fiber optic segments are discussed in greater detail in the Financial Assessment of the Study.
- PFA recommends the use of OPGW fiber-optic cable for both the long-haul portions and the metropolitan rings envisioned for the network.
- Furthermore, ENEE should install OPGW fiber-optic cable that contains a total of 48 fiber optic strands, consisting of 24 single mode fibers and 24 non-zero dispersion shifted (NZDS) fiber compliant with ITU-T standards G.652 and G.655 respectively. For the optional network extensions, PFA believes that 24 count G.655 compliant fiber is sufficient.
- For commercial use, the associated transmission and multiplexing equipment will be based on Synchronous Digital Hierarchy (SDH) technology and STM-1 and STM-4 multiplexing for commercial traffic.
- PFA envisions installation of OPGW fiber along the 138 kV transmission lines from Tegucigalpa to San Pedro Sula, despite the fact that a 230 kV transmission line parallels much of this route. Due to its accessibility and proximity to expected customer concentrations, the 138 kV transmission system is recommended for fiber optic installation. This “backbone” network will extend further, via additional 138 kV lines, to Puerto Cortés, where both the Arcos-1 and Maya-1 submarine cables make landfall in Honduras. From Tegucigalpa southward, the backbone” will employ existing or planned 230-kV transmission lines.
- Additionally, OPGW fiber will be installed on above-ground 138-kV transmission facilities in the Tegucigalpa and San Pedro Sula metropolitan areas, so as to create metropolitan fiber “rings.”

- Several optional extensions of the network are possible and are discussed more fully in the Market Assessment. The principal extensions would be based upon installation of fiber on the 138 kV and 69 kV lines already in place. Although these lines were not systematically inspected, tower types used along these lines were identified and any issues with necessary clearance are analyzed for those tower types.
- PFA estimates that 720.6 kilometers of fiber will be required for the backbone fiber optic route. Optional extensions to East and West, chiefly employing 69-kV lines, could account for an additional 541.7 kilometers of fiber. The cost-benefit of installing fiber on these routes is discussed in the Financial Assessment.
- PFA's field inspection of the 138 kV route between Tegucigalpa and Puerto Cortés, including urban substations in the Tegucigalpa and San Pedro Sula areas as well as intermediate points such as Comayagua and Siguatepeque, indicated few significant obstacles to installing fiber-optic cable along ENEE's ROW. The major "make-ready" issues involve the severe tower corrosion witnessed at the Puerto Cortés substation and pollution effects in the urban areas of San Pedro Sula and Tegucigalpa. In general, rural towers were in much better condition than those in Tegucigalpa, San Pedro Sula, and Puerto Cortés, but did show signs of age, which manifested itself predominantly as galvanization loss.
- As currently configured communication equipment costs for a commercial network along all the potential extension of ENEE's grid would cost \$6.3 million including management and installation.
- Costs for communication equipment for ENEE's internal use only approximate \$1.74 million inclusive of management and installation charges.
- Total costs for the network if OPGW 48 strand and OPGW 24 strand cable is used is \$24.6 million. This cost includes a number of ancillary costs such as make ready costs on the all towers and commercial scale equipment at 30 substations.
- Of all the costs considered fiber costs are the largest element accounting for almost 60% of all costs. Equipment costs are the second driving factor accounting for 27% of all costs. Clearly the ability to scale these costs back in a cost-efficient manner will help in implementation financing.
- If fiber is installed only along the backbone, metropolitan rings and two of the extensions, total costs are lowered to \$18.7 million a decline of 24%. The timing and costs of installing fiber and equipment along the optional extensions are discussed more fully in the Financial Assessment.