11. Transmission Lines. The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal.

A. **Location Map.** A location map showing proposed routes for the transmission line and showing terminal and intermediate substation locations.

B. **Miscellaneous Data:**

(1) Estimated average and peakloads to be transmitted over the transmission line, annual load factor, and power factor.

(2) Operating voltage of the line.

(3) Date that delivery of power is required.

(4) Delivery points for materials, and proportion of total material required at each point.

(5) Key map, plan and profile sheets, and special crossing drawings for the transmission line prepared in accordance with the manual of instructions for transmission line surveys.

(6) Average value of energy, in mills per kilowatt-hour, for transmission line losses.

(7) Information regarding minimum temperatures, maximum wind velocities, and icing conditions in the vicinity of the transmission line, and an expression of opinion as to whether design of the line for Standard National Electrical Safety Code loading for the area will be satisfactory. (In the State of California, loadings in accordance with General Order No. 95 of the California Public Utilities Commission will be used.

(8) Information regarding facilities to be relocated.

(9) Colored photographs. Aerial or high-angle colored photographs along the alignment showing river, highway, railroad and canal crossings, approaches at each end of the line, and any unusual or problem topographic features.

C. **Foundation Data:** The following data should reflect a recognition of the requirements for transmission line towers and foundations. The towers support and anchor electrical conductors and overhead ground wires in a variety of configurations. The towers also must withstand the wide variety of climatic conditions such as wind, snow, and ice. Foundations are required to resist uplift, horizontal, and compression loads with very little movement. Foundations for

tangent structures in good material will normally vary in depth between 6 feet and 12 feet deep, however foundations for angle and dead-end structures in poorer materials may be considerably deeper. The TSC geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.

(1) **Geologic Data:**

(a) A brief description of surficial material and bedrock that may be encountered in and immediately below footing excavations.

(b) Presence of existing or potential conditions such as snowslide, landslide, heavy rockfall, swampy, high shrink-swell clayey, permafrost or subsidence areas.

(c) Geologic logs of all subsurface exploration. The coordinate location and ground surface elevation of all existing exploratory holes should, if necessary be corrected to conform with the permanent survey control system; and all subsequent exploratory hole locations and elevations should be based on the same survey control system.

(d) A surface geology map, or series of maps, with the route marked thereon (supplemented by annotated colored aerial photos). Inserts at a larger scale must be shown when localized, complex geological conditions exist which may affect tower locations. Reaches of reasonably uniform and typical foundation conditions along the route should be indicated, based on surface inspection, foundation exploration, and general knowledge of the geology of the area. Non-Reclamation geologic investigations and reports should be referenced.

(e) Samples of foundation materials as needed for visual examination or laboratory testing.

(2) **Engineering Data:**

(a) Soils (see *Earth Manual*, latest edition):

- Foundation exploration should include penetration resistance tests in accordance with Field Penetration Test with Split-Tube Sampler, Designation E-21, *Earth Manual*, latest edition, in materials in which the test is applicable. Relative density tests should be made in soils in which the Field Penetration Test is not applicable. In-place density and plasticity tests (liquid limit and plastic index) would be applicable in suspected expansive soils. Note on all logs whether or not caving of the hole has

occurred. All holes should be carried to 25-foot depths. Where penetration resistances are less than 15 blows per foot at the 25-foot depth, holes should be advanced to 60-foot minimum depth or at least 5 feet into material having a penetration resistance of 30 or more blows per foot, whichever occurs first.

Test holes, advanced by augering and without penetration testing, or test pits may be used as required to supplement any of the above exploration, to verify similarity of materials, and to determine depths to bedrock.

Bedrock may be encountered at or near the ground surface that cannot be penetrated by penetration testing. In such cases, report whether the bedrock can definitely be expected to extend at least 20 feet below the ground surface. If it is believed that bedrock does not extend 20 feet deep, test holes must be advanced to a depth of at least 20 feet below the ground surface.

At least two test holes should be drilled in each of the uniform reaches marked on the surface geology map. Wherever possible these holes should be spotted at known angle points and at or near long span crossing tower sites. Additional holes should be drilled as are necessary for reasonable confirmation of the subsurface conditions and their boundaries, and for additional information on any special problem areas.

A test hole and penetration resistance tests are also required at each tower site for strain-type towers; sites on both sides of railroad or highway crossings; and at special structure sites (i.e., towers for other exceptional conditions).

- A description of the undisturbed state of materials encountered, and whether the material will stand in sides of the hole if augered and undercut for an auger footing.

- An estimate of the possible types of footings, for use at strain type, angle, and long span crossing towers.

- Comments on the general adequacy of surface drainage and/or possibility of dangerous erosion. These comments should take into account loss of existing sod cover due to construction activity, need and possibility of reseeding, or need and availability of material for gravel blanket or riprap protection.

- An indication of locations where pile-type footings may be required.

- Comments on probable depth, extent, and seasonal variation of depth of water table.

- Maximum flood levels of rivers or lakes and associated ice or debris-carrying or ice-shove possibilities. Any other unusual conditions that might indicate special foundation problems.

- An estimate or a determination by tests of the significant engineering properties of materials, such as density, plasticity, shear strength, and consolidation or expansion characteristics; and the effect of changes in moisture on these properties.

(b) Bedrock (see *Earth Manual*, latest edition):

- Determine the suitability of bedrock encountered for holding grouted anchor bars. (For satisfactory rocktype footings, the formation can be considerably shattered or jointed, both horizontally and vertically, as the action of the anchor bars is to "stitch together" a sufficient volume to provide safety against uplift.)

  If after nominal cleanoff of soft, weathered (severely weakened) bedrock, the material will provide a reasonably firm key for the concrete, the resulting installation is acceptable.

E. **Corrosion Survey:**

(1) In situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

(2) Performance history of materials of construction that have been used in the area.

(3) List of structures in the vicinity of (within ¼ mile) the proposed structure and appurtenant features. Determine if buried structures in the vicinity have corrosion protection and, if so, the type of corrosion protection.

(4) List location, output, and purpose of the direct-current sources in the earth situated within ¼ mile of the proposed structure and appurtenant features. If the purpose of the direct current is for cathodic protection, describe the structure protected and its location.

(5) Chemistry of geologic materials, ground water, and/or product water.

F. **Construction Materials Data.**

(1) If embankments are required, the location of and distance to suitable borrow areas for soil materials.

(2) Data on commercial concrete plants within practical hauling distance from the transmission line.

(3) Results of sampling and analysis of concrete aggregate and other materials, including previous tests conducted at the TSC.

G. **Environmental Considerations.** Design data should include, as a minimum, a brief description of the environmental commitments listed in the NEPA compliance document and the environmental resources affected by the proposed development. The emphasis should be on those areas in the range of alternatives open to the designers in developing a structural design. The following items should also be considered in preparing design data:

(1) The environmental setting.

(2) Cultural (historical, archeological, architectural, and paleontological) resources in the area of the dam and the reservoir basin.

(3) The need for blending structure with the surroundings, restoring borrow areas, and reseeding spoil banks.

(4) The need for a field conference to resolve critical environmental problems with participation of other agencies.

(5) Review of designs by other agencies.

(6) Anticipated public use around the structures.

(7) Indicate the suitability and possibility of developing Government land adjacent to our facilities for use by the public for recreation, hobbies, sports, leisure, education, health, etc.

(8) Comment on any ecological, aesthetic, bird migration corridors, or other environmental aspects peculiar to this location which would affect layout or conceptual design.

(9) Refer to the specific requirements of the Environmental Criteria for Electric Transmission Systems by the Departments of the Interior and Agriculture.

(10) Special environmental considerations for transmission lines or underground transmission systems. Emphasis should be on areas of raptor protection, threatened/endangered species habitat, high scenic or historical value, heavy public use, bird migration corridors, or fragile ecological areas.

H. **Site Security.** Many Reclamation projects may require a security risk assessment. The need for a site-specific security risk assessment should be considered for feasibility designs where an assessment may impact the field cost estimate and for specifications designs. Specific issues to consider are contained in Section 14 of Chapter 7 – Site Security and Public and Worker Safety. If assistance is required to determine specific design data needs, contact the Office of Security, Safety and Law Enforcement. Where design data and designs include site-specific security assessment, compliance with Reclamation Manual DM Part 444 – Physical Protection and Facility Security, Chapters 1 and 2 is required.