2. Powerplants and Pumping Plants. 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. The following is a list of possible data required for design of powerplants and pumping plants and additions, modifications, or rehabilitations to existing powerplant and pumping plants. The size and complexity of the structure should govern the amount and detail of the design data required. Where both pumping and generating functions are to be provided in the same plant, furnish design data for both.

For existing non- Reclamation powerplants and pumping plants (i.e., Bureau of Indian Affairs), single-line diagrams and switching diagrams which include equipment ratings will be necessary for a proper evaluation of existing equipment within the scope of any proposed changes.

A. **General Map Showing:**

(1) A key map locating the general map area within the State.

(2) The structure site.

(3) Existing towns, highways, roads, railroads, public utilities, transmission lines, substations, stream-gauging stations, townships, range, and section line.

(4) Locations of construction access road and permanent roads; and sites for required construction facilities.

(5) Sources of natural construction materials and disposal areas for waste material, including the extent of mitigation required.

(6) Existing or potential areas or features having a bearing on the design, construction, operation, or management of the project feature such as: recreation areas; fish and wildlife areas; building areas; areas of cultural sensitivity; and areas of archeological, historical, and mining or paleontological interest.

B. **General Description of Local Conditions Covering:**

(1) The capabilities of and constraints imposed by local shipping and transportation facilities.

(2) Availability of housing and other facilities in nearest towns, requirements for a construction camp, and need for permanent buildings for operating personnel.

(3) Availability or accessibility of public facilities or utilities such as: water supply; sewage disposal; telephone and electric power for construction and for operation and maintenance.

(4) Climatic conditions that will affect design or construction procedures such as: amount, rate, and distribution of rain and/or snow; ice conditions; summer and winter temperatures, with extremes; and extreme wind velocities and prevailing directions; relative humidity including any variations due to monsoon seasons. (Extensive tabulations are not necessary.)

(5) Air pollution sources.

(6) Names and telephone numbers of local utilities and contacts within those organizations.

C. **Survey Control.** Minimal field surveys should be done to obtain horizontal and vertical control. Use of any existing coordinate system or vertical control system is acceptable, but tying to the State plane coordinate system is recommended .

D. **Topographic Map.** A topographic map covering an area sufficient to include all practical arrangements of the structure including intake, tailrace, penstocks and discharge lines, switchyard or substation, service area, and visitor facilities. Show all manmade features in the included area on the map. A scale of 1 inch equals 50 feet with a 2-foot contour interval is suitable in most cases. For long discharge lines or penstocks, strip topography at a scale of 1 inch equals 400 feet and a 2-foot contour interval may be used. The scale contour interval and detail should be based on the conditions and need at each particular site. Photographs of the sites are desirable, in color if available with proposed structures marked in ink.

E. **Foundation Data.** The amount and detail of foundation data required for a feasibility design will vary greatly because of the wide range of size and complexity encountered in powerplants and pumping plants. The guiding criteria should be to provide sufficient data to allow the designer to determine the type of foundation required for the structure and to identify major foundation problems. Adequate foundation data may be obtained for small structures from an inspection of surface conditions and one or two exploratory holes or test pits to determine type of overburden and foundation conditions some distance below the base of the structure. These data, and any other data in the following paragraph that are relevant, along with a brief description of geologic conditions of the site, can be included in the design data.

For larger and more complex structures, a more comprehensive geologic program will be required, including a geologic report. For structures of this magnitude, a field conference should be held, including an inspection of the site to determine

the geologic investigations program. In developing the geologic program and in preparing the geologic report, the following should be considered:

(1) A resume of regional geology.

(2) A description and interpretation of site geology including physical quality, excavation characteristics and geologic structure of the foundation strata, ground water and seismic conditions, existing and potential slide areas, and engineering geologic interpretations as appropriate.

(3) Geologic logs of all subsurface exploration. All exploratory hole locations and elevations should be based on the same survey control system.

(4) A geologic map, plotted on the topographic map of the site, showing surface geology and the location of geologic sections, soil profiles, and all subsurface exploration.

(5) Geologic sections, with soil profiles as required, showing known and interpreted subsurface conditions.

(a) A classification, in accordance with the Unified Classification System, of the soil in each major stratum.

(b) A description of the undisturbed state of the soil in each major stratum.

(c) A delineation of the lateral extent and thickness of critical, competent, poor, or potentially unstable strata in foundations and excavation slopes, especially those to be permanently exposed.

(d) An estimate or a determination by limited tests of the significant engineering properties of the strata, such as excavation characteristics, density, permeability, shear strength, and consolidation or expansive characteristics; and the effect of structure load, changes in moisture, and fluctuations of permanent rise of ground water on these properties.

(6) Samples of foundation strata as needed for visual examination or laboratory testing.

(7) A determination of natural ground water conditions at the site.

(8) Bedrock. Note geologic sections and soil profiles in (5) above.

(a) A description of the contour of bedrock surface, thickness of weathered, altered, or otherwise softened zones, and other structural weaknesses and discontinuities.

(b) A delineation of structurally weak, pervious, and potentially unstable zones and strata of soft rock and/or soil in foundation or excavation slopes, especially those to be permanently exposed.

(c) A determination by limited tests of the significant engineering properties of the bedrock such as density, excavation characteristics, absorption, permeability, shear strength, and strain characteristics; and the effect of structure load, changes in moisture, and fluctuations or permanent rise of ground water on these properties.

(9) **Seismotectonic Data.** Provide background information on the seismic loadings in the area and recommendations for coordination of data collection.

F. **Construction Materials Including:**

(1) Inventory of available impervious and pervious embankment materials and rock for riprap and rockfill.

(2) Information on concrete aggregates.

(3) Data on commercial concrete plants within hauling distances from the site.

(4) Information on sources and character of acceptable road surfacing materials, if required.

(5) References to results of previous tests of materials including service history and photographs of sources.

(6) Report alkali conditions in soil and water which might affect the choice of sulfate resisting cement.

(7) Requirements concerning stockpiles and suggested permanent stockpile locations.

(8) Environmental impacts associated with removing or obtaining construction material.

G. **Hydrologic Data:**

(1) Annual periodic fluctuations of reservoir levels shown by tables or charts summarizing reservoir operation studies for normal and critical periods. Extent of anticipated wave action, including discussion of wave fetch.

Anticipated occurrence and amounts of silt, sediments, ice (thickness) and drift (trash), and possible effect on reservoir outlets to powerplants or inlets to pumping plants.

(2) Where unwatering of a plant site adjacent to a stream or lake is required, give maximum water levels expected during the construction period and the possibility of controlling water levels by operation of upstream or downstream facilities.

(3) Powerplant tailwater curves.

(4) Source of pumping plant water supply other than reservoir: maximum operating, and minimum operating water surface elevations; flood flows; average flow; and anticipated occurrence and amounts of sediments and ice (thickness). Recommend minimum trashrack or gate deck elevation.

(5) Analysis of water for chemical and physical characteristics and biological quality.

H. **Operating Data – Powerplants:**

(1) Static head and head duration and flow duration curves to be developed (maximum, minimum, weighted average, and rated). (For determination of rated head see chapter 1.3B of Design Standards No. 6, Turbines and Pumps.)

(2) Proposed initial and ultimate capacity.

(3) Characteristics of power load including: load-duration curve, load factors, typical daily load curves, summaries of power production studies, and power market demands.

(4) Destination, proposed voltage, and number of outgoing transmission circuits. Name of agency or utility with whom interface will be made.

Requirements for minimum and maximum system impedance, and any operating limitations to be imposed by agency or utility supplying power.

(5) Nature of operations, i.e., whether base load, peaking or seasonal, attended, semiautomatic, fully automatic or supervisory controlled; other facilities to be controlled from this plant and, if supervisory controlled; location of master station.

(6) Available source and the kilovolt capacity of standby station-service power.

I. **Operating Data - Pumping Plants:**

(1) Types and quantities of trash anticipated at the plant intake.

(2) Water use (municipal and industrial [M&I], irrigation) and distribution requirements: necessity for treating water and recommended method; consumption quantities by months; initial and ultimate capacities; capacity-duration curve.

(3) Profile, alignment, and outlet conditions and requirements for discharge lines.

(4) Location, capacity, hydraulic section, and water surface elevation of intake and discharge channels.

(5) Location and direction of existing or proposed incoming power lines terminating at plant site.

(6) Source and voltage of pumping power. Name of agency or utility supplying power, limitations on starting voltage dips and, number of starts, power factor limitations, and distance to source. Requirements for minimum and maximum system impedance, and any operating limitations to be imposed by agency or utility supplying power.

(7) Nature of operations, i.e., whether attended, semiautomatic, fully automatic, or supervisory controlled. If supervisory controlled, give location of master station.

(8) Recommended pump sizes and numbers.

(9) Requirements for measurement of plant discharge.

(10) Number of operators and support personnel.

(11) Requirement for year-round operation.

J. **Miscellaneous Data:**

(1) Recommendation as to inclusion of a major or minor machine shop or service area in the plant.

(2) Recommendations on whether plant should be indoor or outdoor structure.

(3) Requirements for public safety and visitor facilities.

(4) Future plans for power or pumping expansion.

(5) Water temperature including seasonal variations.

K. **Environmental Considerations.** Design data should include, as a minimum, the environmental commitments listed in the National Environmental Policy Act (NEPA) compliance document that would affect dam design and a brief description of the environmental resources that could be affected by the proposed development. The emphasis should be on those areas within 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) Cultural (historical, archeological, architectural, and paleontological) resources in the area of the plant.

(2) Recommendations for ensuring water quality standards are met including: suppression of nitrogen, adequate oxygen levels, and temperature control and control of turbidity during construction; also requirements for multilevel intakes.

(3) Recommendations or commitments to maintain a specific hydrologic flow level to support biological or recreational resources.

(4) Background on the need for fish facilities such as screens, fishways, and barriers. Requirements for enhancement and/or protection and preservation of fish. Include recommendations of State fish authorities and Fish and Wildlife Service.

(5) Impact of moving construction materials on existing road facilities, including consideration of such factors as traffic congestion, effect on road condition, air pollution, etc.

(6) Amount of power required for operation of pumping plants.

(7) Erosion and sediment control.

(8) The need for blending structures with the surroundings, including placing transmission circuits under ground.

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

(10) Review of designs by other agencies including the findings of the Fish and Wildlife Coordination Act Report (if available).

(11) Anticipated public use around the structure.

(12) Location of closest residences (other than that of the operator) that might be affected by the noise of plant operation.

(13) Potential Indian trust assets.

(14) Potential environmental justice issues.

(15) Any threatened and/or endangered critical habitat in/or adjacent to the project.

L. **Powerplant Uprating.** Design data should include, as a minimum, a description of the hydrologic and hydraulic conditions and anticipated increase in power capacity and/or energy. The data should also include recommendations regarding the expected means (machine addition or machine rebuilding) of achieving the uprate. The following items should be considered in preparing data:

(1) Need or replacement of any existing major power equipment due to age or deterioration.

(2) Changes in operation of the plant, such as from base load to peaking load operation, changes in upstream or downstream storage, and changes in irrigation demands.

(3) Environmental and recreational impacts resulting from changes in water release through the plant. Identify proposed mitigation measures if appropriate.

(4) Need or desirability to replace an existing rotating exciter with a static exciter.

(5) Recommendation as to replacing an existing voltage regulator with a static type.

(6) Identify and describe any changes required to bring the plant or equipment into compliance with electrical, safety, or fire codes.

(7) Identify any equipment that is being replaced and having any historical value.

M. **Mechanical Systems and Equipment:**

(1) Heating, ventilating, and air-conditioning system requirements. Preference for evaporative cooling or refrigeration cooling for the main plant/building area. Preference for electric or gas heat utilizing propane/natural gas.

(2) Is natural gas available at the site?

(3) Noise restrictions at the site.

(4) Requirements for emergency engine generator set for the plant/building. Systems to be connected to the standby emergency engine generator set.

(5) Anticipated engine generator usage for sizing the fuel storage tank.

(6) Preferred fuel (diesel/propane/natural gas) for the engine generator set.

(7) Required water quality analysis to determine the materials of construction for the plant piping systems. Types of materials of construction for existing piping systems conveying water. Have there been any corrosion problems with existing systems?

(8) Types of water supplies available at the site for plant/building fire suppression and other water usage requirements.

(9) Preferences concerning the method of joining the piping components for the various plant/building auxiliary mechanical systems. Are victaulic type grooved coupling connections acceptable?

(10) Types of hazardous materials on the existing piping systems (i.e., lead based paint, asbestos).

N. **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.