

- 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 or Sites.
- (3) County and township lines.
- (4) Existing towns, highways, roads, railroads and shipping points, public utilities such as electric power and telephone lines, pipelines, etc., and stream-gauging stations.
- (5) Locations of potential construction and permanent access roads, and sites for contractor's staging areas and construction facilities.
- (6) Locations of borrow areas for natural construction materials and disposal areas for waste excavation.
- (7) 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. The locations of these features should bear the parenthetical reference to the agency most concerned; for example, Reclamation, National Park Service (NPS), or U.S. Fish and Wildlife Service (FWS).
- (8) Rights-of-way boundaries for construction, access, and staging areas.
- (9) Sources of construction power and power transmission facilities.

B. General Description of Local Conditions Covering:

- (1) The approximate distance from the nearest railroad shipping terminal to the structure site; load restrictions and physical inadequacies of existing roads and structures and an estimate of remedial improvements to accommodate construction hauling; estimate of length and major structures required for new construction access road; and possible alternative means for delivering construction materials and equipment at the structure site.
- (2) Local freight or trucking rates.
- (3) Availability or accessibility of public facilities or utilities such as: water supply; sewage disposal; telephone utility; fire protection services; and electric power for construction (give location, power supplier, voltage, number of phases, and capacity of existing transmission lines; power rate schedules; probability of interruption of supply; and requirements for additional transmission line, if needed).
- (4) Climatic conditions that will affect design or construction and operation and maintenance procedures such as: amount, rate, and distribution of rain and/or snow; ice conditions; summer and winter temperatures, with extremes; extreme wind velocities and prevailing directions; and probability of excessive dust or sand.
- (5) Names and telephone numbers of local utilities and contacts within those organizations.

C. Surface Data:

- (1) **Survey Control.** Permanent horizontal and vertical survey control should be established at the earliest possible time. A coordinate system on a true north-south grid should be established with the origin located so that all of the features (including borrow areas) at a major structure will be in one quadrant, and so that the values of the coordinates for any major structure are widely separated numerically. The coordinate system should be related to a State or national coordinate system, if available. All preceding survey work, including topography and location and ground surface elevation of subsurface exploration, should be corrected to agree with the permanent control system; and all subsequent survey work, including location and ground surface elevation of subsurface exploration, should be based on the permanent control. All line surveys should be tied to the established coordinate system at each plant site.
- (2) **Topographic Map.** A topographic map covering an area sufficient to accommodate all possible arrangements of structures including intake, tailrace, and penstocks or discharge pipes; normally this should be on a

scale of 1 inch equals 50 feet (a scale of 1 inch equals 100 feet is permitted for large area sites) and a contour interval appropriate for the relief in the project area (1 to 2 feet for flatter areas and 5 feet in areas where relief is significant). For flat or gently sloping topography contour intervals as low as 1 foot may be desirable. Show the coordinate system and existing land survey corner monuments or special control points established for the topographic survey. Show all manmade features in the included area.

- (3) **Aerial Photographs.** Aerial photographs (9-inch by 9-inch color infrared photos at 1:24,000 scale) of the sites of powerplants and major pumping plants. The purpose of the aerial views is to permit early preparation of an artist's rendition of the feature and to permit a study of the environmental impact of the structure. Later such renditions or drawings may be used for inclusion in specifications or for other purposes.

These photographs should be taken from locations that would best show the proposed structure and from an oblique angle of approximately 20° to 30° above the horizontal. Where possible, indicate known tie points to the topographic maps. These photographs should be taken between 11 a.m. and 2 p.m., so as not to show the principal area of the proposed structure in shadow. Submit the negatives or color slides.

Each region is urged to provide these photographs for smaller plants or auxiliary structures whenever it is considered that artist's conceptions would be beneficial to the project and the architectural designs would be influenced by the physical characteristics of the area.

- (4) **Photographs.** Color photographs of all existing facilities or structures in the vicinity of the proposed plant and closeup views of any features which may affect designs. Black and white photographs are acceptable for structures to be removed or demolished. Color or black and white photographs of structure sites with structure locations marked in ink.

D. Foundation Data. The following data should reflect a recognition and consideration of the type and size of the particular engineering structure and the effect on or relationship to the structure of the significant characteristics of the foundation materials and conditions at the particular site. The TSC geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.

- (1) Geologic Data:
 - (a) A description of regional geology.
 - (b) A description and interpretation of site geology including physical quality and geologic structure of the foundation strata, seasonal ground water, ground subsidence, seismic conditions, existing and

potential landslide, snowslide and rock fall areas, surface water runoff, and engineering geologic interpretations appropriate to the engineering structure involved including the conditions expected during excavation and construction.

- (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 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.
- (e) Geologic sections, with detailed soil profiles as required, showing known and interpreted subsurface conditions.
- (f) Exploratory holes should be extended into the foundation material well below the base of the structure. An effort should be made to run borehole geophysical logs when appropriate.
- (g) Color photographs of pertinent geologic and topographic features of the terrain including aerial photographs if available.
- (h) Samples of foundation strata as needed for visual examination or laboratory testing.
- (i) Determine age of faulting in vicinity, especially if suspected to be late Pleistocene or Holocene, to assist in the determination of the seismic loading by specialists in the TSC.

(2) **Engineering Data:**

- (a) Surficial soils (see *Earth Manual*, latest edition). Note geologic sections and soil profiles in (1)(e) above.
- A classification, in accordance with the Unified Classification System, of the soil in each major strata.
 - A description of the undisturbed state of the soil in each major strata.

- A delineation of the lateral extent and thickness of critical, competent, poor, or potentially unstable strata including swelling minerals, gypsum and other sulfates, caliche, etc., in foundations and excavation slopes, especially those to be permanently exposed.
 - An estimate or a determination by tests of the significant engineering properties of the strata, such as density, permeability, shear strength, and consolidation or expansion characteristics; and the effect of structure load, changes in moisture and fluctuations, or permanent rise of ground water on these properties.
 - A determination by tests of the corrosive properties and sulfate content of the soil and ground water.
- (b) Bedrock (see *Engineering Geology Field Manual*). Note geologic sections and soil profiles in (1)(e) above.
- A contour map of the top of bedrock. A description of thickness of weathered, altered, fractured, or otherwise softened zones, and other structural weaknesses and discontinuities.
 - A delineation of structurally weak, pervious, and potentially unstable zones and strata of soft rock and/or soil in foundations and excavation slopes, especially those to be permanently exposed, with attention being paid to engineering matters such as swelling minerals, presence of gypsum and other sulfates, caliche, etc.
 - An estimate or a determination by tests of the significant engineering properties of the bedrock such as density, 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 those properties.

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 Including:

- (1) Location of and distance to suitable borrow areas for permeable and impermeable soil materials for fill or embankment; and for riprap for channel or slope protection. If quantities are limited, give approximate volumes available.
- (2) An earth materials report containing complete detailed information on those potential sources of soils and rocks that have been selected for final consideration. (See *Earth Manual*.)
- (3) Information on concrete aggregates. (See “Final Investigations” in *Concrete Manual*.)
- (4) Data on commercial concrete plants within practical hauling distance from the structure site.
- (5) Information on sources and character of acceptable road surfacing materials. Consider excavated material as a possible source.
- (6) Results of sampling and analysis of materials, including previous tests conducted at the TSC.
- (7) Information including catalogues on firms within practical hauling distance from the site manufacturing precast concrete products and brick or other masonry units.

G. Hydrologic Data:

- (1) Annual periodic fluctuations of reservoir levels shown by tables or charts summarizing reservoir operation studies for the critical period. Include any annual reservoir drawdowns for operation and maintenance purposes.

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

Extent of anticipated wave action including discussion of wind fetch.

Reservoir storage allocations showing storage allocations with corresponding elevations.

Type and purpose of reservoir releases for the time of year to be made; include minimum releases for various seasons.

- (2) Information for preparation of specifications hydrographs at the TSC, including the location of gauging stations at or near the structure site and the dates for which hydrographs should be prepared. Copies of the daily discharge record should be supplied for stations with unpublished records.
- (3) 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.
- (4) Powerplant tailwater curves. Supporting data and computations should accompany the curves. Include information on any existing downstream natural barriers or river control works affecting tailwater and available data on past degradation or aggradation of stream channel and possibility of future changes.
- (5) Source of pumping plant water supply other than reservoir: maximum operating, and minimum operating water surface elevations; floodflows; average flow; and anticipated occurrence and amounts of sediment and ice (thickness). Recommend minimum trashrack or gate deck elevation. Include data on possibility of flooding due to ice jams.
- (6) Referring to subparagraphs (3) and (5) above, the water surface elevations should be determined for floods of 100-, 50-, and 10-year frequencies.
- (7) Analysis of water for chemical and physical characteristics and biological quality. Analysis should include a water quality analysis of intake water to include major ions and cations, corrosivity and parameters listed as maximum contaminant limits in the Surface Water Treatment Rule, Safe Drinking Water Act. See table 1 in the “Water Treatment Plant” section.

H. Operating Data – Powerplants:

- (1) Static head and head duration and flow duration curves to be developed (maximum, minimum, weighted average, and rated).

- (2) Proposed initial and ultimate power generation capacity.
- (3) Characteristics of powerload including: load-duration curve, load factors, typical daily load curves, summaries of power production studies, and power market demands. Value of capacity in dollars per kilowatt per year, value of energy in mills per kilowatt-hour, interest rate and plant factor for economic studies, and cost or value of alternate sources.
- (4) Destination, proposed voltage and number of outgoing transmission circuits.
- (5) Nature of operations, i.e., whether baseload, peaking or seasonal, attended, semiautomatic, fully automatic, or supervisory controlled (give estimated distances to points of control); other facilities to be controlled from this plant and, if supervisory controlled, location of master station.
- (6) Electrical system reliability criteria.
- (7) Local load requirements; and availability and capacity of reliable outside sources for alternate supply of station-service power.
- (8) Details of downstream control sections, measuring devices, gauging stations, or other operating works.

* The following data apply particularly to small hydroplants:

- (9) Need for installed maintenance and handling facilities.
- (10) Need for operation when isolated from power system, and including need for black-start capability.
- (11) Periods of shutdown (such as seasonal). Give conditions during shutdown, such as: unattended, winter maintenance, and needs for station power.
- (12) Connected power system data including:
 - (a) Voltage.
 - (b) Name and telephone numbers of electrical power utilities and contacts within those organizations.
 - (c) Location of point where connection to power utility will be made.
- (13) Need for bypass of water during generator shutdown or load rejection.

* There is no arbitrary rating limit for small hydroplants. However, ANSI C50.12 implies that small hydromachines are those below 5,000 kilovoltampere.

I. Operating Data - Pumping Plants:

- (1) Types and quantities of trash (including terrestrial and aquatic weeds, algae, etc.) anticipated at the plant intake; locations of trash-disposal areas. Recommend methods of trash handling and disposal.
- (2) Water use (municipal and industrial [M&I], irrigation) and distribution requirements: necessity for treating water and recommended method; consumption quantities by months, and locations; initial and ultimate capacities; capacity-duration curves; location of distribution and treating facilities; and special plant availability or reliability requirements. Discuss maximum static head at which maximum capacity is required, or minimum capacity which will suffice at maximum head.
- (3) Profile, alignment, and outlet conditions and requirements for discharge lines; recommended types of pipe and types of coatings and linings.
- (4) Location, capacity, hydraulic section, and water surface elevation of intake and discharge channels.
- (5) Location and direction of existing or proposed incoming powerlines terminating at plant site.
- (6) Electrical data. Data listed below will be required to initiate design. The data furnished should be sufficient to permit designers to complete the basic design (single-line diagram) for the pumping plant. After designs have progressed enough to develop details of electrical system needs, designers will prepare a list of additional data required to complete final design of electrical installation.
 - (a) Names and telephone numbers of electrical power suppliers and contacts within those organizations.
 - (b) Location of point where connection to power supply will be made.
 - (c) System voltage at which power will be supplied, number of phases, and whether service will be overhead or underground.
 - (d) Electrical system reliability criteria.
 - (e) Discuss requirements for an alternate power source. If an alternate supply is required, indicate:
 - If required by State or local authority.
 - If source should be an engine-generator.

- If a threat to life or property will result if normal power supply is lost.
 - Loads requiring service from alternate source.
- (f) Requirements for remote monitoring of conditions at the facility. Discuss location of remote station, and items required to be monitored.
 - (g) Requirements for supervisory control, including location of station from which supervisory control is exercised.
 - (h) Requirements for voice and data communications between the supervisory master station and the remote facilities.
- (7) Recommended number of pumps and pump sizes.
 - (8) Requirements for measurement of plant discharge.
 - (9) Interest rate, pumping power rate, and plant factor for economic studies.

J. Miscellaneous Data:

- (1) Existence of transmission lines of other agencies and utility companies operating in the area which might influence connection of power units; furnish voltage, capacity, type of construction, and distance of these lines from powerplant or pumping plant.
- (2) Availability of plant equipment repair shops in vicinity; provisions of central shop.
- (3) Recommendation as to inclusion of a major or minor machine shop or service area in the plant.
- (4) Requirements for enhancement and/protection and preservation of fish. Include recommendations of State fish authorities and Fish and Wildlife Service.
- (5) Recommendations on whether plant should be indoor or outdoor structure.
- (6) Housed and open operation and maintenance (O&M) storage requirements at site; offsite storage provided; existing storage space and facilities.
- (7) Recommended period for construction.
- (8) **Site Security.**

- (a) 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.
 - (b) Security requirements for protection of plant and equipment from vandalism or sabotage. Recommended specific measures to meet anticipated conditions such as 7-foot yard fence topped with barbed wire, special locks, special doors, heavy safety glass, security lighting, no windows, electronic surveillance equipment, etc.
 - (c) Description of existing project fire protection plans which will be applied to the plant, together with any specific requirements for this plant.
- (9) Expected visitor load at plant. Number of employees at plant and hours/day the plant is staffed. Recommend facilities to be provided.
 - (10) Requirements for public safety.
 - (11) Future plans for power or pumping expansion.
 - (12) State potable water standards, water quality report, and water treatment requirements.
 - (13) State requirements for wastewater treatment and disposal.
 - (14) Need for attended operation of plant during and following a nuclear attack.
 - (15) Commitments for delivery of power or water.
 - (16) Recommendations for special protection of roof or yard from falling rocks or boulders.
 - (17) Vegetation to be cleared (kinds, size, and density of growth).
 - (18) State and local building codes when applicable.
 - (19) Special exhaust, heating, ventilating, or air-conditioning requirements.

- (20) Water for construction purposes. For large rivers, this item may be unimportant. For small streams and offstream reservoirs, the item becomes critical. Determine if up to 2-ft³/s, diversion flow for construction purposes can be assured to the contractor. The Government should obtain the water rights required. If necessary to use ground water, obtain information on probable sources and yields. Furnish information on locations and yields of existing wells in the vicinity. Determine restrictions, if any, to use of ground water for this purpose. It may be necessary to obtain permits from State or other governing agencies.
- (21) Right-of-way. A marked print shall be submitted showing the following data:
 - (a) Proposed right-of-way boundaries for construction purposes.
 - (b) Proposed right-of-way boundaries for access purposes (if required).
 - (c) Designation of areas within right-of-way boundaries for the following special purposes:
 - Disposal of waste material
 - Contractor's plant, storage, and other incidental purposes
 - Borrow sources
 - Government construction facilities (if applicable)
- (22) Location of existing facilities in the construction area such as pipelines, power and telephone lines, and fences.
- (23) Office and file space requirements in plant.
- (24) Where a service area or machine shop is specified in a plant, furnish floor area requirements and the name and size of machine tools, benches required, and need for welding booths or rooms.

K. Cost Data:

- (1) Where buildings are located within the area to be cleared by the prime contractor, and if disposal will be his responsibility, designate building groups by number and furnish detailed list of buildings for each group. Details should include general description, size, materials, and general conditions. Determine if disposal will be the responsibility of prime contractor. If not, submit dates when disposition will be completed by others.

- (2) Information on local labor supply and labor problems.
- (3) Information on important construction work in progress or planned in the vicinity and the presence of interested contractors or subcontractors in the area.
- (4) Estimate of cost of right-of-way or easements. Include supporting data.
- (5) Estimates of cost for relocating railroads, highways, roads, water systems, and other public utilities. Include supporting data.

L. Environmental Considerations. Design data should include, as a minimum, the environmental commitments listed in the 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) The need for blending structures with the surroundings, including placing transmission circuits under ground.
- (3) Special environmental requirements for transmission lines or underground transmission systems.
- (4) Comment on any ecological, aesthetic, or other environmental aspects peculiar to this location which would affect layout or conceptual design.
- (5) Indicate the suitability and possibility of present or future use of land adjacent to Reclamation facilities by the public for recreation, hobbies, sports, leisure, education, health, housing, etc. Provide data on zoning regulations and subdivision proposals.
- (6) Furnish data on allowable noise limits in the vicinity of the proposed plant where fixed by law or local ordinance, or where otherwise considered necessary or advisable; measurements of existing daytime and nighttime ambient noise levels in the area; and distances to the nearest residential units.
- (7) Identify special environmental compliance requirements for ensuring that water quality standards are met, including suppression of nitrogen, adequate oxygen levels, and temperature control and control of turbidity during construction; preservation of existing growth adjacent to construction; obliteration of temporary roads and restoration to original

appearance; dust abatement, etc. Give recommendations on steps to be taken to meet these requirements.

- (8) Recommendations or commitments to maintain a specific hydrologic flow level to support biological or recreational resources.
- (9) Impact of moving construction materials on existing road facilities, including consideration of such factors as traffic congestion, effect on road condition, air pollution, etc.
- (10) Background on the need for fish facilities such as screens, fishways, and barriers.
- (11) Comment on disposal of special excavation problem materials such as lignite.
- (12) Specify seeding or replanting requirements for erosion control or aesthetics.
- (13) Furnish data on State or local restrictions on the use of soil herbicides, or local factors limiting their use.
- (14) Anticipated public use and access around the structure.
- (15) Potential Indian trust assets.
- (16) Any threatened and/or endangered habitat in or adjacent to the project.

M. Plant Up-rating:

- (1) Design data should include that listed under this section for feasibility designs, plus target date(s) for completing the uprate work and the outage periods when the unit(s) may be removed from service. In addition, the TSC should be asked for a specific list of design data required.

N. Large Synchronous Machine Armature Rewinds:

- (1) The office responsible for design should be asked for a specific list of design data required.

O. 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).