HOW TO ORGANIZE YOUR NEW POWER PLANT—1

313 Items to Follow Up in Designing a New Plant

First installment of a practical series on selecting, designing, constructing, starting, operating and maintaining modern electric-generating stations to give most economical service

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► THE DESIGN of each power plant grows out of a series of compromises. Adjustments must be made according to the location, climate, usable space, fuel, equipment availability and price. Ideas of both designer and owner influence plant arrangement, equipment selected and the building. These compromises frequently produce features undesirable from an operating, maintenance or testing standpoint.

The person responsible for starting and testing the new plant should, if possible, have the opportunity to review the plans as they progress. He may save considerable time and expense by (1) suggesting changes to make operation simpler, safer or more economical, and (2) checking to see that test points and instruments are properly located and available.

Even more important, those who are to supervise operation and maintenance should review and criticize the plans as they become available, and are revised. This should keep everyone satisfied and happy with the setup in years to come.

Local conditions and practices, or likes and dislikes, may indicate the desirability of altering plant design in greater or lesser degree from usual arrangements. A list of special features desired should be prepared. After checking on the costs involved, and discussion and approval by all interested parties, these additions should be incorporated in the design.

Check list on pp 79-81 has shown by long experience to include desirable features of plant design. As the design progresses a periodic review of the plans, using the check list and a list of special features as guides, will show whether items are being satisfactorily taken care of. Those that are not should be studied to arrive at the best possible compromise.

This list will not replace capable design knowledge and experience, but it can help considerably in insuring that items are not overlooked. Incorporation of these items into the design at the earliest possible point saves considerable time and expense in getting the plant into operation. Representatives from the owner's engineering or operating organization should be designated to follow design closely. They should carefully scrutinize purchase orders and design prints to check on the various features before actual construction goes too far to allow changes.

Models built prior to construction are often used to assure satisfactory appearance and adequate operating and maintenance clearances. While the cost of model construction may seem rather large, it usually runs much less than one percent of total plant cost. Without first checking in model form, more than this amount may be spent in redesigning and making field changes to correct unforeseen conflicts of piping, ducts, and building steel.

Even with a model, closest cooperation between structural, mechanical, and electrical design engineers is needed to prevent interferences of equipment in the field. As prints reach the plant under construction, they are often checked for interference by the men who will be responsible for running the plant. Last-minute field changes cause delay and expense, and at times other unforeseen complications.

Specification preparation is one of many important services rendered by designers and consultants. Specifications for equipment and building may be quite complex, requiring considerable experience to prepare satisfactory ones. Preliminary specifications are usually revised to describe more exactly the unit to be eventually purchased. The revised form usually is included as part of the purchase contract, giving information on details of equipment design and performance. A complete set of purchase orders and specifications should be available to the testing crews and operators for their information.

Purchase orders should specify that the manufacturer furnish an adequate number of instruction books and construction prints. These should be made available to operators and repairmen responsible for the machines. Where the manufacturer is to supply special service or instruction, the details and cost should be included in the order.

The form and legal provisions for payment, delivery, guarantees, etc. must be carefully worded, and should be prepared by an experienced purchas-

...ral Design Considerations

- ...dequate site area for present and future expansion.
- ...dequate water supply for present and future needs.
- ...lant above flood level or protected against high water.
- ...lant oriented for best railroad, transmission-line approach.
- ...lan for future expansion considered in plant general design.
- ...uture fuel changes considered in plant design.
- ...uel cost and availability, load-factor variation, makeup-water needs, operating personnel, prevailing conditions considered in choosing equipment and steam conditions.
- ...oiler, turbine, electrical operating levels on same floor.
- ...onvenient passageway between main operating areas.
- ...dequate room for operation, maintenance around equipment.
- ...oadways accommodate large trailer trucks in reaching turbine-room crane.
- ...quipment numbering system agreed on and used in design.
- ...perating, maintenance instructions, parts lists made available to operating personnel before plant starts.
- ...dequate quiet space for office and meeting areas.
- ...dequate locker rooms with plan for future needs worked out.
- ...afe supply of drinking water throughout plant.
- ...dequate, convenient space for shop and maintenance needs.
- ...hop and shelving layout built before plant starts.
- ...ll equipment spare parts to be delivered before plant starts.

...l Handling, Storage and Preparation

- ...ips on low points of gas lines.
- ...p gas lines run level in solid ground, or are carefully graded and drained to avoid pockets cutting off gas flow.
- ...ain gas-line shutoff valve on outside of boilerhouse.
- ...age line for incoming gas-pressure run to control room.
- ...eans for recording gas flow, temperature, specific gravity.
- ...n provided by gas supplier or in plant design.
- ...mall-capacity regulator for gas supply at light loads.
- ...eans to beat regulators if pressure drop is more than 5:1.
- ...eeder line for gas regulator runs downstream to give steady pressure at most essential point.
- ...ypass valve around gas-control valve.
- ...as-control valve and main bypass operable from control board.
- ...mall bypass valve around gas-control valve operable from burners for lighting off.
- ...urner header of ample size to reduce velocity effects.
- ...oth ends of burner supply header vented.
- ...st pressure taps at header inlet, both ends of header and inlet to individual burners.
- ...il-tank heaters of ample size with unrestricted flow areas, thermostatically controlled.
- ...racer heating lines for oil lines in cold climates.
- ...eans for gaging storage and oil tanks.
- ...acilities for unloading daily full-load fuel in 8 hours.
- ...ethods for moving oil and coal cars.
- ...oal-car trackage reduces interference from unloaded cars.
- ...conomical arrangements for moving fuel to or from storage.
- ...dequate area for present and future coal storage.
- ...oal preparation and handling arranged for minimum dust.
- ...oal supply, handling, milling equipment interlocked for safety.
- ...oal bunker and chutes arranged for free flow of wet coal.
- ...der and pulverizer capacity to handle maximum wet, hard coal.
- ...ulverized fuel piping for good distribution and minimum settling out.
- ...pace and layout for fuel sampling, preparation, testing.

...ter and Water Treatment

- ...eep wells far apart, minimizing water table drawdown.
- ...ater-depth gage lines for wells.
- ...upports for discharge lines near pumps.
- ...ettling-basin level control for at least one pump.
- ...evel gages in settling basin.
- ...umps for draining and cleaning settling basin.
- ...ump outlet from settling basin set few inches above bottom.
- 8 Elevated-tank level indicator visible from plant.
- 9 High- and low-level alarms for elevated tank.
- 10 Altitude valve for elevated tank.
- 11 Elevated-tank overflow piped so tank may be overflowed continuously during winter.
- 12 Service-water pump head at full load only slightly above elevated-tank static head.
- 13 Water meters ahead of zeolite softeners.
- 14 Check valve to prevent hot water reaching zeolite material.
- 15 Representative samples of water obtained at earliest date.
- 16 Minimum water-treatment equipment installed initially with provision for later amplification if needed.
- 17 Minimum chlorination equipment.
- 18 Water-testing apparatus, chemicals ordered for early delivery.
- 19 Ample space for water apparatus storage and use.
- 20 Provide for convenient truck, railroad delivery of chemicals.
- 21 Ample space for dry storage of chemicals.
- 22 Platforms or hoists for easy chemical handling.
- 23 Hose connection, floor sumps to clean chemical use areas.
- 24 Zeolite material suitable for incoming water condition.
- 25 Chemical feed tank, pumps to supply chemicals to boiler or boiler feedwater.
- 26 Phosphate feed direct to boiler drums.
- 27 Safe handling, good distribution by acid feed system.
- 28 Gage boards or scales to show condensate storage-tank contents in thousands of pounds.
- 29 Cooling coils and layout for steam and hot-water samples.

Circulating-Water System

- 1 Log boom at intake to keep floating trash away.
- 2 Intake equipment of corrosion-resistant materials or finish.
- 3 Traveling screens and auxiliaries installed where needed.
- 4 Ample screen area, screens in series for dirty water.
- 5 Means for safely cleaning and washing screens.
- 6 Necessary equipment for screen hoisting.
- 7 Stop logs or other method for complete rapid unwatering of circulating-water tunnels.
- 8 Intake screens and racks removable for repair and inspection.
- 9 Screen chamber and circulating-water tunnels avoid sudden turns to minimize eddies.
- 10 Pump suction pipes carried fairly close to tunnel bottom.
- 11 Circulating pump-suction piping arranged to avoid air pockets, spins or uneven distribution to pump inlet.
- 12 Circulating pumps to be self-priming where feasible.
- 13 Motor-operated or butterfly valves for pump, condenser piping.
- 14 Rubber expansion joints for pipe and condenser expansion.
- 15 Check valve or other means to prevent pump reversal with cooling tower or parallel pump installation.
- 16 Cooling tower separated to minimize recirculation.
- 17 Tower location minimizes traffic, plant hazards from fog, spray.
- 18 Towers have best aspect to warm-weather winds.
- 19 Tower approach and water capacity sized with condenser for best over-all economy.
- 20 Tower makeup inlet where cool incoming water does most good.
- 21 Tower blowdown easily observed, measured by weir.
- 22 Tower overflow adequate in size and non-siphoning.
- 23 Convenient method for regulating water to tower sections.
- 24 Tower basin volume equals 8 to 12 hr normal evaporation.
- 25 Tower basin sloped to drain to clean-out sump for easy drainage and cleaning.
- 26 Tower basin constructed to be essentially leakproof.

Condenser and Auxiliaries

- 1 Most economical condenser design for water supply available.
- 2 Condenser tubes arranged to avoid subcooling of condensate.
- 3 Divided waterbox or backwashing method if needed.
- 4 Room for condenser tube removal.
- 5 Means for handling waterbox covers.
- 6 Waterboxes without air pockets or turbulence-producing corners.
- 7 Waterbox drain valves adequate in size.

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