CHAPTER III

GENERAL FACILITIES CONSIDERATIONS

A. GENERAL DESIGN GUIDELINES AND STANDARDS

Design guidelines and standards are presented below for the general considerations associated with PWSS facilities. Design criteria for the various other, more specific aspects of a PWSS (i.e., source development, treatment, storage, pumping, distribution, and chemical storage, handling and application) are included in the remaining chapters.

1. ALTERNATIVE SOLUTIONS AND REGIONALIZATION – Feasible alternatives should be considered for a PWSS design, e.g., KSA 19-3545 to 19-3556 provide for cooperative water supplies via the Public Wholesale Water Supply District Act. This act allows water supply entities to take advantage of the benefits associated with regionalization of water systems. It requires significant prior planning before these benefits can be realized. Also, interconnections between systems are encouraged.

2. SERVICE NEEDS – An appraisal of future requirements for service must include all potential users including residential, commercial, institutional, and industrial. Historical water use and population data should be used to project minimum, average, and maximum daily needs. The KWO compiles water use data for many Kansas municipalities that can be used to estimate the needs for similar cities (KWO, 2006). The possibility of fire flows or other heavy demands should also be considered along with water losses. Water savings from implemented water conservation programs should be recognized. The water source(s) and treatment facilities shall be designed for the maximum day demand at the end of the design period.

3. DESIGN PERIODS – The planned installation of any PWSS component requires an estimate of its needed capacity and the expected life of its major materials of construction. A 20 to 30 year design period is typical of most installations (e.g., intake structures, pump stations, and treatment works), but a 50-year design period is not uncommon for major impoundments, intakes, and long raw water transmission lines. Shorter design periods of 10 to 20 years are appropriate for scattered wells and other less costly structures.

   Phased construction of "as needed" facilities is permitted but supporting facilities not built economically and conveniently in stages should be constructed with capacities for future use. Examples of "as needed" facilities include pumps, tanks, and additional treatment trains.

4. CONSERVATION – The design should conserve water, chemicals and power. Every activity demanding significant energy should be evaluated and considered in comparing design alternatives. Emphasis should be placed on water conservation. This includes the recycling of water in the treatment sequence (consistent with the Filter Backwash Recycling Rule), reduction of leakage and unnecessary use in the distribution system, and the utilization of water saving devices and methods. KWO has published guidelines and reviewed measures for water conservation (KWO, 1990 and 2007). DWR and KWO require conservation programs for PWSSs requesting new appropriations or purchasing water from federal reservoirs. DWR may require existing PWSSs to initiate a conservation program if their water use is determined to be excessive.

5. NEW PROCESSES, METHODS, CHEMICALS, AND EQUIPMENT – Designs or designs containing processes, methods, chemicals and/or equipment viewed as being innovative or "non-standard" will be considered for approval if they can be demonstrated to be both effective and economical over the anticipated range of water quality, flow, time, weather, and climate. Also, operator skills and equipment support for the innovative design must be demonstrated. The design engineer must submit to KDHE a detailed plan of testing for the proposed innovation, and after its approval, must document the test conclusions showing why an exception should be granted to the minimum design standards. Furthermore, the following conditions will apply:

   a. The PWSS must obtain from the equipment supplier or contractor performance guarantees for the innovative equipment, process, or design. Copies of the performance guarantees are to be provided to KDHE upon request.

   b. The PWSS, by official document action, must certify that it is aware of the potential risks of the "non-standard" equipment, process, or design; that it has the funds to refinance and construct a conventional process to replace the failed system; and that it will ensure that adequate treatment will be provided until the failed system is replaced.

   c. Conditional approvals of designs, processes or equipment considered to be innovative or "non-standard" are to be interpreted as one-time site specific approvals only; thus, such an approval does not guarantee subsequent approval at that same site or at any other site. Each proposed application will be considered on a case-by-case basis and shall be discussed with the Chief of the Public Water Supply Section of the Bureau of Water prior to approval.

6. WASTE HANDLING AND DISPOSAL – Important considerations in evaluating alternative treatment processes are the quantities and characteristics of waste streams generated by the treatment sequence. The quantities and characteristics of the individual waste streams depend on source water quality, the processes utilized and

the chemicals applied in those treatment processes. Some treatment processes may not be viable because of the cost of, or regulatory restrictions on, the handling and disposal of the waste streams generated.

In the design of water treatment facilities, provisions must be made for proper disposal of all water treatment plant waste streams in accordance with local, state and federal regulations. KDHE strongly recommends that the review of handling and disposal of waste streams with regard to the requirements of the National Pollutant Discharge Elimination System (NPDES) permitting program for the state of Kansas be initiated early on in the design process.

7. COSTS AND FINANCING – Cost estimates shall be made for all alternative designs and shall include their capital and O&M costs. Sources and methods of financing the recommended design shall be identified. USEPA has published a resource guide for financial assistance programs for small water supply systems (USEPA, 1989).

8. SECURITY – Water system facilities shall be designed to include measures to provide protection against vandalism, terrorist acts, access by non-authorized personnel or any other types of unauthorized activities. Such measures shall include locked security doors; windows with security locks, or sized or barred to prevent human entrance; surveillance systems; lighting; controlled points of access; and security fencing around drinking water systems (e.g., wellheads, manholes, pump houses, treatment buildings and storage facilities).

B. PLANT SITING CONSIDERATIONS

1. EVALUATION OF ALTERNATIVE SITES – In general, the selection of the plant site should include a comparison of the following features for each site alternative and for present and future needs:

   a. Source water quality;

   b. Availability and cost of land, including taxes;

   c. Site preparation requirements for cleaning, grading, and landscaping;

   d. Identification of easements and acquisition of right-of-ways;

   e. Site drainage, flood protection, and impacts of construction on drainage and flooding;

   f. Soil, foundation, and groundwater conditions;

   g. Adaptability to plant layout needs;

h. Adjacent and surrounding developments;

i. Public attitude toward proposed facilities;

j. Availability of needed utility services (with two independent power sources being preferred, to minimize standby needs, but with auxiliary on-site generation being an acceptable substitute for key equipment and facilities);

k. Convenience to roads, highways, and railroads;

l. Emergency, civil defense, and natural hazards;

m. Environmental restrictions and regulations;

n. Accommodation of future expansions; and

o. Securability of facilities.

2. PLANT SITING RESTRICTIONS – KAR 28-15-17 states that a new or expanded facility shall not be initiated or constructed at a site which the department determines:

a. Is subject to a significant risk from earthquakes, floods, fires, or other disasters which could cause a breakdown of the PWSS or a portion of it;

b. Except for intake structures is within the floodplain of a 100 year flood, or is lower than the recorded high water level where appropriate records exist; or

c. Is adjacent to a major source of pollution that KDHE determines has a potentially adverse influence on the water supply.

3. PWSSs AND POLLUTION SOURCES – The capabilities of the existing and proposed water works must be evaluated considering possible effects of adjacent pollution sources. Such effects could include actual or potential impairment of raw or finished water quality.

4. SITE SURVEY – A site survey should be conducted for each new water treatment facility. A site survey is an organized effort that in part collects and assimilates pollution information for a given area. It includes an evaluation of watershed, stream, and storage characteristics in terms of their natural and developed states. Of paramount importance are temporal and spatial water quality variations. Existing and future pollution sources and pollution control facilities should be evaluated. A risk analysis should be done to evaluate pollution problems caused by transportation failure, ruptured oil tanks, or other potential sources of pollution.

5. SOURCE WATER ASSESSMENT – The 1996 Amendments to the Safe Drinking Water Act required each state to develop a SWAP to, in part, facilitate a SWA for each public water supply system that treats and/or distributes raw source water. A SWA includes the following: delineation of the source water assessment area; inventory of potential contaminant sources; and a susceptibility analysis. KDHE recommends that the system of interest be reviewed to determine if a SWA is required or if its SWA must be updated to reflect or support the proposed design changes. Information regarding SWAP and SWA can be found at KDHE's web address: http://www.kdheks.gov/pws/.

C. PLANT LAYOUT AND OTHER CONSIDERATIONS

1. PLANT AND BUILDING LAYOUT – Design of a PWSS site and facilities involves structural, functional, aesthetic, and cost considerations for the proposed and future additions. Applicable state and local building, electrical, fire, and plumbing codes more stringent than KDHE requirements must be met. Also, applicable ASTM, AWWA, and NSF International's ANSI/NSF standards must be satisfied. Design considerations include:

   a. Centralized operation with accessibility to facilities;

   b. Available utility service connections and adequate ventilation, lighting, heating, sewers, and drainage;

   c. Elimination of operating inconveniences and hazardous conditions;

   d. Enclosure, separation, and distribution of facilities;

   e. Space for offices, meeting rooms, lunch room, laboratory, O&M areas, processes, and storage (with process areas also including room for equipment disassembly for maintenance);

   f. Provision of access ways for water and waste streams, utilities, chemicals, drainage, flooding, O&M personnel, visitors, equipment, and vehicles;

   g. Architecture, landscaping, buffer zones and neighbors;

   h. Future expansion; and

   i. Security provisions to prevent unauthorized access and protect from unauthorized activities that would otherwise adversely impact the system and/or disrupt the production of drinking of water.

2. MATERIALS OF CONSTRUCTION – The potential effects of weathering, corrosion, leaching of contaminants and scale formation should be evaluated for all

components of a PWSS. Materials, coatings, chemicals and lubricants that will contact or potentially contact source, partially treated or finished waters shall be appropriate for use in the production of drinking water in order to protect public health and the environment, and comply with NSF International's ANSI/NSF Standards 60 and 61, applicable AWWA standards, or equivalent. Also, the impact of corrosion products and control methods on water quality shall be considered. Contact between dissimilar metals should be avoided to minimize galvanic action.

A proposal that includes the use of mercury-containing lamps must include safeguards to minimize the possibility of on-line lamp breakage, a plan for the proper recycling (preferably) or disposal of used lamps, and a lamp break response plan (USEPA, 2006a). The response plan must include sampling and cleanup procedures, procedures for protecting the safety of both the consumers and the operators, and procedures for maintaining compliance with the SDWA, OSHA health and safety standards, the Clean Water Act, and RCRA.

3. VENTILATION AND DEHUMIDIFICATION – Designs shall consider the buildup of chemicals and/or moisture due to leakage and poor air circulation in confined spaces. These potential areas (such as pump stations, filter pipe galleries, chemical feed areas, and basements) should be properly cleaned, ventilated and/or dehumidified to prevent accidents and corrosion.

4. OPERATION AND MAINTENANCE – Considerations shall be given to the O&M requirements of proposed facilities in terms of anticipated manpower and equipment needs. Manpower needs include certified operators and maintenance personnel with the skills required to service the new system. Equipment needs should also include handling units for the removal of equipment. O&M manuals shall be provided and shall include parts lists and order forms for all equipment.

5. AUTOMATION – The servicing and operator training requirements for automatic equipment must be provided. Manual override is required for all automatic controls.

6. MONITORING, SAMPLING, AND LABORATORY REQUIREMENTS – Process instrumentation and analytical measurement devices shall be installed where necessary to satisfy operational and regulatory reporting requirements. Sampling taps shall be available to permit the collection of samples to satisfy KDHE's reporting and procedural requirements for various water quality analyses.

   Analytical methods employed as part of satisfying monitoring and reporting requirements must be performed by KDHE laboratories or a KDHE certified laboratory. Analytical methods employed as part of controlling plant operations can be made without certification but every effort should be made to conform to the procedures described in the latest edition of *Standard Methods for the Examination of Water and Wastewater* (APHA *et al.*, 2005) or those methods and procedures as otherwise required by the drinking water regulations.

7. EMERGENCY PLAN – Potential disasters must be anticipated and plans formulated to abate their effect upon the provision of a safe and adequate water supply. Disasters that must be considered include: tornado, drought, flood, storms, fire, explosion, sabotage, vandalism, civil disorder, nuclear attack and fall-out, and power, equipment and operator failures. KAR 28-15-18(c) requires each community water supply system to prepare an emergency operations plan to safeguard the water supply for the protection of the public if natural or man-made disasters occur. KDHE has prepared a guidance document to assist water utilities in the preparation and implementation of emergency plans (KDHE, 2005).

8. SAFETY – Accident prevention and emergency service equipment shall be provided to minimize operational hazards. This will include proper ventilation, approved electrical fixtures, handrails, guards, grating, warning signs, and protective clothing and equipment. Applicable OSHA and NIOSH standards must be satisfied.

9. CONTAMINATION OF SOURCE, PARTIALLY TREATED OR FINISHED WATERS – Under no circumstances shall a cross connection between a non-potable source and either a source water, a partially treated water or a completely treated water (e.g., finished water) be allowed. Facilities shall be designed to preclude contamination by plants, animals, insects or hazardous materials.

10. DISINFECTION – All wells, pipes, tanks, and equipment that can convey or store potable water shall be disinfected in accordance with current AWWA Standards. KAR 28-15-18(d) specifically requires that newly constructed or repaired water distribution mains and finished water storage facilities be flushed and disinfected before use. The plans and specifications shall outline the procedure and include the disinfection dosage, contact time, method of testing and the results of the procedure, and the appropriate de-chlorination and disposal of highly chlorinated disinfection solutions.

11. HYDRAULICS – A hydraulic profile of the PWSS must be determined for the proposed design. Also, consideration should be given to the required flow regimes for the system components.

    Hydraulic profiles should be drawn for average, maximum and peak hydraulic conditions in order to set adequate freeboard in basins and channels, and thereby allow establishment of critical elevations for process units and support facilities. It is important to satisfy the hydraulic needs of the processes as well as acknowledge the topography of the site.

12. PIPING AND CHANNELS – All flow conveyance systems shall be designed to handle the maximum expected flow with due consideration to solids deposition problems. Operational flexibility should be provided by appropriate use of interconnections and bypasses to and around the system components. Extra wall castings should be provided for future pipe passages through concrete structures.

Chemical storage facilities should be kept close to unloading areas and points of chemical addition to reduce the length of chemical feed lines.

Table III-1 presents a recommended color scheme for identifying various PWSS pipes. It is required for new facilities. It is further recommended that the name of the liquid or gas be painted on the pipe with arrows indicating the direction of flow. When there is insufficient contrast between two colors, a 6 inch (15.2 cm) band of a color that does adequately contrast may then be painted on one pipe at intervals of approximately 30 inches (76 cm) in order to aid in distinguishing between the pipes.

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TABLE III-1

COLOR CODE FOR PWSS PIPING

Water Lines	Raw	Olive Green
	Settled	Aqua
	Finished or Potable	Dark Blue
Chemical Lines	Alum or Primary Coagulant	Orange
	Ammonia	White
	Carbon Dioxide	Dark Green with Red Band
	Carbon Slurry	Black
	Caustic	Yellow with Green Band
	Chlorine Gas	Yellow (under vacuum) Yellow with Red Band (under pressure)
	Chlorine Solution	Yellow with White Band
	Chlorine Dioxide	Yellow with Blue Band
	Fluoride	Light Blue with Red Band
	Lime Slurry	Light Green
	Ozone	Yellow with Orange Band
	Phosphate Compounds	Light Green with Red Band
	Polymers or Coagulant Aids	Orange with Green Band
	Potassium Permanganate	Violet
	Soda Ash	Light Green with White Band
	Sulfur Dioxide	Light Green with Yellow Band
	Sulfuric Acid	Red with Yellow Band
Waste Lines	Backwash Waste	Light Brown
	Process Waste	Dark Brown
	Sewer (Sanitary or other)	Dark Gray
Other	Compressed Air	Dark Green
	Gas	Red
	Other lines	Light Gray

Source: Adapted from *Recommended Standards for Water Works* (Recommended Standards, 2003).

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