Aspects of a Well-Engineered System

By Kurt Ruchala, P.E.

A new sprinkler fire protection system, engineered and approved by the local Authority before construction is initiated, provides value for all involved parties. The owner has an understanding of the scope, size, and cost of the project. The Authority Having Jurisdiction (AHJ) is reviewing and approving a defined system, and the contractor is bidding a set scope of work. In addition, the owner can select the type and manufacturer of equipment to be installed, which will have an impact on the performance of the system over the years, and affect the life cycle cost to maintain the system.

"A well-engineered sprinkler system, prior to the start of a project, will provide for a smooth permitting and installation phase. All parties will understand their scope of work and responsibilities, and the owner will have a system that will perform as expected, be within budget, and be delivered on time."

The aspects of a well-engineered system are: An engineer competent in the design and specification of sprinkler systems; System and main components that are properly specified; Detailed drawings are provided; Hydraulic calculations are provided.

Competent Engineer

The Society of Fire Protection Engineers describes the fire protection engineer as follows: A Fire Protection Engineer (F.P.E.) by education, training, and experience: 1) is familiar with the nature and characteristics of fire, and the associated products of combustion 2) understands how fires originate, spread within and outside of buildings/structures, and controlled, and/or extinguished; 3) is able to anticipate the behavior of materials, structures, machines, apparatus, and processes as related to the protection of life and property from fire.

Many jurisdictions require a registered licensed engineer to prepare and seal fire sprinkler plans and specifications. Typically, licensing requirements include a minimum of a four-year accredited degree in engineering, four years of documented experience under a professional engineer (P.E.), and passing two examinations (a fundamentals of engineering exam, and a professional engineering exam).

A competent engineer will take responsibility for the design, and answer questions posed by the contractor for field specific issues. The above qualifications description indicates that not all engineers may be competent in fire sprinkler design.

Specifications

Equipment and materials specifications should provide a clear understanding of the products acceptable for use on a project, and the responsibilities of the contractor. Many times, the basis of these specifications is established on the requirements found in the jurisdiction's building code, and NFPA standards. However, many projects require more system performance than is typically provided in the minimum requirements of codes and standards.

The typical key sections of a specification include: 1) Quality assurance, 2) Scope of work, 3) Qualifications of the bidders, 4) Codes and standards, 5) Order of precedence, 6) Submissions, 7) General system description, 8) Delivery, storage, and handling of material, 9) General product requirements, 10) Sprinkler pipe, fittings, hangers, and supports, 11) Valves, 12) Sprinklers, 13) Alarm and supervisory devices, 14) Installation, 15) Scheduling, 16) As-built drawings, 17) Owner/operator training requirements,18) Operating and maintenance instructions, 19) Testing instructions, 20) Final acceptance test instructions, 21) Spare parts, 22) Maintenance contract, and 23) Warranty.

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The specification will provide guidance to the contractor in selecting products for their bid. The selected products then must be reviewed by the engineer to determine if they meet the
intent of the construction documents. However, it must be understood that it is the contractor's responsibility to install the system to the code, and the construction package presented by the engineer.

Typically, equipment specified includes: 1) Sprinklers, 2) Valves, 3) Flow switches, 4) Tamper switches, 5) Pipe and joining methods, 6) Hangers, 7) Seismic bracing, 8) Backflow preventers, and 9) Fire pumps.

Drawings

Construction package drawings should be detailed enough for the AHJ to approve the project, and for the contractor to bid the project. The drawings should show a system that meets the requirements of the customer, meets the code requirements, and works. Minor details such as pipe offsets going around structural elements are typically not shown, but should be accounted for in the hydraulic calculations.

Typically, sprinkler construction package drawings will show: 1) Underground pipe type and locations, 2) Water supply data and the source of the information, 3) All sprinkler locations, 4) All pipe locations, types, and sizes, 5) All valve locations, 6) Fire pump rooms, 7) Hydraulic calculation remote area(s), 8) Riser/Standpipe locations, and 9) Hose stream requirements.

Hydraulic Calculations

Hydraulic calculations are used to model the sprinkler system to determine if the pipe sizes and sprinklers specified will meet the flow and pressure requirements of the adopted code based on the fire hazard presented. Hydraulic calculations can be completed by hand, by a stand-alone calculation computer program, or by an integrated CAD program. The calculations must be based on the pipe routing, pipe type, and pipe sizes shown on the drawings. In addition, the sprinklers specified must be documented in the calculation. Buildings such as an open office plan may require only one calculation. Buildings housing offices, warehousing, and manufacturing may require multiple calculations for each unique fire hazard. Some jurisdictions may also require standpipe flow calculations for specific buildings such as high-rises.

The water supply is the basis for the calculations. The water supply information is input at the beginning of the pipe runs. The water supply can be a pump and tank, a pump and pond, an elevated tank, or in many cases, a municipal water system. The hydraulic calculations should be based on proven water supply data, which may necessitate that a water supply flow test be conducted by the water department, and witnessed by the engineer. Some jurisdictions require that the water data used for a sprinkler system design be less than 12 months old. Whichever supply is used, it should be documented on the drawings, in the specifications, or both.

Conclusion

A well-engineered sprinkler system, prior to the start of a project, will provide for a smooth permitting and installation phase. All parties will understand their scope of work and responsibilities, and the owner will have a system that will perform as expected, be within budget, and be delivered on time.

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For the past ten years, Ruchala has been involved in consulting engineering in the design and evaluation of sprinkler systems, fire alarm systems, smoke control systems, and performance-based designs.

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