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**Fire Sprinkler Systems, Backflow Prevention,
and Public Health and Safety:
Working toward Consensus**

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ABSTRACT

The goal of this paper is to summarize, from the perspective of a neutral "third party" observer, what happened during the Fire & Water 1997 conference: what differences and disagreements between the water works and fire protection communities became apparent; what similarities and areas of agreement emerged; what was accomplished; and what plans were made for the future.

Several important differences between the two communities were identified, ranging from attitudes toward the scope of the problem of backflow prevention and the role of public opinion to how to respond to extremely low-probability risks and whether risk trade-offs are acceptable. At the same time, several similarities between the two communities were evident, including a mutual interest in protecting the public from risk, a focus on risk prevention, and a recognition of the need for compromise on backflow-related issues. An explanation based on the differential success in reducing risk over time between the fire protection and water works communities is offered to explain the conflict between the two groups.

Finally, the achievements of the conference are described, including near unanimous agreement on backflow prevention recommendations for 11 different situations that varied by AWWA M-14/NFPA sprinkler class type and the type of piping employed. Suggestions for future directions for cooperative work between the fire protection and water works communities are also discussed.

Introduction

The goal of the Fire & Water 1997 Conference was to bring together two professions which have been in conflict -- the fire protection and water works communities -- to exchange information and to begin a process of working toward consensus on policy issues related to fire sprinkler systems, backflow prevention, and public health and safety. Toward this end, four representatives from each community gave invited talks covering the history, current issues, future, and potential solutions of the conflict from the perspective of their own profession. Each side presented compelling arguments for its point of view. Representatives of the water works community focused on the need for backflow prevention devices to protect the public water supply and to reduce the risk of waterborne illness, claiming that the introduction of fire sprinkler systems creates a risk to water quality that must be minimized. In contrast, representatives of the fire protection community focused on the need for increased adoption of fire sprinkler systems to reduce the number of fire-related deaths and injuries and suggested that backflow prevention devices may interfere with this mission by reducing the effectiveness and rate of adoption of sprinkler systems.

In addition to these invited presentations, several moderated discussion sessions were held where the speakers interacted with the audience, which included engineers, researchers, industry representatives, government personnel, professionals, and consultants from both communities. This format allowed for a diverse array of viewpoints and ideas to be presented, considered, and debated and provided participants an opportunity to learn about each other and to search for mutually agreeable ways to resolve their differences. The paper summarizes what happened during these sessions: what differences and disagreements between the two groups became apparent; what similarities and areas of agreement emerged; what was accomplished; and what plans were made for the future.

Before beginning this summary, it is important to note its origin. The Conference Steering Committee felt that, given the history of conflict between the two groups, it was important to engage the services of a neutral "third party," someone with no history or

background in fire protection or water quality and no stake in the outcome of the conference, to observe, organize, and summarize the comments of the participants at the end of each day. I was asked by the Steering Committee to fill this role, and this paper is based on the material I presented during summary sessions held at the end of each day of the conference, although it has since been substantially reorganized and revised. It is important to note that the opinions put forth in this paper are mine alone and do not necessarily represent the opinions of the Conference Steering Committee or the conference attendees.

To provide some context in which to interpret this paper, it is also important to describe the background and limitations of its author. I am a social psychologist who studies judgment and decision making and risk perception and communication. I have no background in water quality or fire protection engineering and can claim no expertise in risk analysis. I had no prior history with the topics of fire sprinkler systems and backflow prevention prior to the conference, and most of what I know about them now I learned during the conference. Thus, whatever degree of objectivity and impartiality I have been able to bring to the task of summarizing the events of the conference has come at a cost: lack of technical sophistication. As a result, the summary comments presented below are written at a very general level of abstraction and many important details have been omitted.

The Importance of Working toward Consensus

The opportunity to participate in this conference has afforded me an all-too-rare glimpse into the formative stages of public health and safety policy. It has been gratifying to see and hear so many representatives from so many different organizations who are dedicated to protecting the life and health of the general public. However, at the same time it has been somewhat disconcerting to find out the extent to which these experts disagree on what is in the public's best interest. Of course, some level of disagreement is inevitable and unavoidable when analyzing risks, and in some cases (e.g., when relevant data are ambiguous, incomplete, or contradictory) a high level of disagreement can be appropriate. However, above and beyond the hazards of fire and water, when the scientific, technical, and policy experts disagree about what the risks are

and what should be done about them, the very existence of the disagreement, beyond what is appropriate and necessary, can have a negative impact on public health and safety (Slovic et al., 1979).

As people's lives have become increasingly busy and complicated, they have more often than ever been forced to rely on expert opinion and judgment to determine when to worry about risks and when protective action is desirable. In many cases people lack the requisite time or background knowledge to even find out in detail what the experts think. When this happens, people tend to rely on more easily identifiable characteristics of expert opinion, for example, the extent to which different experts appear to agree or disagree. When expert agreement is high, the majority of the public will typically accept the experts' opinions and try (although not always successfully) to follow their advice. However, when expert agreement is low, the majority of the public will tend to use the existence of disagreement as an excuse for waiting and doing nothing and may end up accepting higher levels of risk than they would had the experts agreed.

In this climate of increasing public reliance on expert opinion, it has therefore become more critical than ever for health and safety experts to work toward building a consensus on matters of risk analysis and policy. From this perspective the willingness of the participants of the Fire and Water 1997 Conference to begin the process of resolving their differences is itself an important step in the process of protecting the public against risk.

Differences

An important part of any conflict resolution process is to make sure that differences and disagreements between the conflicting parties are brought out into the open so that they are available for inspection, review, and debate. Little progress can be made until the parties at least agree on what their disagreements are. At this conference it soon became apparent that there are good reasons why the fire protection and water works communities are at odds over the issue of backflow prevention: there are multiple basic and important issues on which the two sides differ or disagree. The following list of differences and disagreements that I perceived as emerging during the conference is

offered, not to suggest that one side is right and the other wrong, but simply to further the goal of making areas of disagreement explicit.

1. Scope of the problem of backflow prevention. The fire protection community is interested in backflow prevention as it relates to the operation of fire sprinkler systems. However, to the water works community, these systems are just a subset of the water systems (including plumbing/heating systems, irrigation systems, and a multitude of industrial water use applications) for which backflow is a concern. In other words, the water works community views backflow prevention in a much larger context than the fire protection community. This difference in perceived scope of the problem might in and of itself result in some degree of intergroup conflict, since fire-protection-related systems will naturally take up a larger part of the agenda for one group over the other.

2. How to respond to risks that are unknown or unknowable. Forming policies about backflow prevention requires the policymaker to make assumptions when estimating the impact of low-probability risks that are not yet (and may never be) known with certainty. The two communities tend to differ in how they arrive at these judgments: the water works community often bases its estimates on "worst-case scenarios," whereas the fire protection community more often assumes a "typical" or "average" scenario. Given this difference in approach, it is not surprising that the two communities tend to arrive at different conclusions.

3. How to respond to extremely low-probability risks. The two communities also differ in how they react when risk analyses conclude that a risk is very small. The fire protection community is likely to express the opinion that there are some risks that are so small that they can be ignored. In contrast, the water works community is likely to want to keep taking steps to reduce the risk even further or to "eliminate the possibility of risk."

4. The role of the public's preferences. The attitude of the two communities toward public opinion and how it should enter into their decision making is quite different. The

water works community, for example, often justifies its actions by claiming that they are simply giving the public what they want and what they are willing to pay a premium for - clean and safe drinking water. In contrast, the fire protection community believes that people greatly underestimate the risks of fire-related death or injury and thus do not necessarily know what is in their own best interest. Thus, the fire protection community is more willing than the water works community to rely on expert judgment rather than public opinion when forming policy.

5. The effect of costly backflow prevention requirements. The two sides differ in the extent to which they are concerned about the costs associated with backflow prevention. The fire protection community argues that costs should be minimized or eliminated because fewer people will buy fire sprinkler systems if backflow prevention requirements make the systems more expensive. The water works community sees the costs of backflow prevention as less relevant because the public has indicated a willingness to pay a lot of money to maintain water quality.

6. Attitudes toward existing regulations. There is a noticeable difference in the willingness of the two communities to question the wisdom of applying existing general water quality regulations to fire protection systems. The water works community, for example, often explains its actions as necessary to comply with existing legal standards for water quality and sees no reason to treat fire protection systems differently than other water delivery systems. The fire protection community, on the other hand, is much more likely to call for changes in existing regulations and to view fire sprinkler systems as a special case that should be regulated differently than other systems.

7. Appropriate goals for water quality. When the topic of water quality is discussed, the two sides have a tendency to ask different questions. The fire protection community prefers to ask, Does the water cause illness or death? In contrast, the water works community prefers to ask, Is the quality of the water degraded? This tendency to apply different standards to the question of water quality likely makes intergroup

communication more difficult and consequently interferes with the search for reliable answers to both questions.

8. Willingness to make risk trade-offs. The risks associated with stagnant water in fire sprinkler systems are not yet fully known. However, even if these risks were quantified and found to be substantial, the fire protection community would still be likely to argue for increased installation of fire sprinkler systems. This is because they perceive the reduction in fire risk gained by installing sprinkler systems to be much larger than any increased water risk that goes along with it. The fire protection community is therefore willing to accept an increase in the risks associated with stagnant water because they believe the public's overall risk from fire and water combined will be reduced. The water works community, however, has expressed very little interest in making such a trade-off between fire and water risks, finds it unacceptable to take any action that might increase the likelihood of illnesses and deaths caused by contaminated water, and wants to keep the two issues separate. This difference in attitudes toward risk trade-offs has resulted in the two groups pursuing somewhat different solution strategies with different timetables: the fire protection community is pressing for immediate action that reduces overall risk, whereas the water works community prefers to wait until a solution becomes available that will reduce fire risk without creating any increased water risk.

The differences in opinion between the water works and fire protection communities are numerous and the opinions of each side are often strongly held. This makes the job of working toward consensus a difficult one -- but not as difficult as it would be if the differences could not be identified and described in detail.

Similarities

Although the fire protection and water works communities disagree on many issues, they do not disagree about everything. It is important to recognize that the two groups have many similarities as well. One of the major purposes of an event like the Fire & Water 1997 Conference is to give people from each side of a conflict a chance to

meet, interact with, and learn about each other in both professional and informal social settings. If people take advantage of such an opportunity, they often find that they have a lot in common with the people they are at odds with. Certainly from the vantage point of this observer, the fire protection and water works communities as represented at this conference are much more similar than they are different.

Many of the similarities among the two groups are so basic that they are not often openly expressed. The following similarities were not necessarily made explicit during the conference, but they were evident from the participants' attitudes and actions.

1. Both groups are trying to do what is in the best interests of the public, as they perceive it.
2. Both groups recognize the value and importance of the work done by the other group. Everyone agrees that protecting the public water supply is very important, just as everyone agrees that fire protection is very important.
3. The members of both groups are skeptically minded, and require that potential solutions be tested and evaluated scientifically before accepting them.
4. The two professions have adopted a very similar strategy for protecting the life and health of the public: preventing people from being exposed to the risk in the first place. Just as the water works community has labored to prevent people from being exposed to contaminated water, the fire protection community is now working to promote widespread adoption of sprinkler systems that will put out fires before they progress to the point of endangering lives.
5. The majority of the members of both communities acknowledge that the question of appropriate backflow prevention policy has no simple or obvious answer but involves many complex issues that can be argued either way. Thus, most people perceive that compromise on backflow prevention policy is necessary.

These similarities, although basic, are important to identify and make explicit in order for the two groups to learn to trust each other and to build a sense that cooperation and compromise is possible. And their existence bodes well for the chances of the two groups settling on mutually agreeable policies -- few groups that are in conflict can claim to have so much in common.

Sources of Conflict

Given that the water works and fire protection communities have similar goals and approaches, why do they so often disagree? One simple answer to this question is that the problem the two groups are trying to solve is a difficult one. The issue of backflow prevention policy raises several complex technical questions, the answers to which often, through complicated chains of cause and effect, raise even more difficult and more complex questions. It also involves several complex social and economic questions, such as does the public know what is in their best interest on complicated technical matters and how will people respond if the cost of fire sprinkler systems is significantly increased? Learning and decision making in such complex situations is notoriously difficult (see Sterman, 1994). In addition, in many cases the data necessary to answer the relevant questions are not yet available or are incomplete. And, the people working to resolve these issues are operating under a lot of constraints, such as the necessity of complying with existing regulations that are not uniform and of responding to pressures from the insurance industry and other organizations. Given these characteristics of the problems faced by the two groups, some degree of confusion and conflict is probably inevitable.

However, these difficulties are not insurmountable and in and of themselves cannot explain the difficulty the two groups have had in achieving consensus. One way of explaining the controversy might be to impugn the motives or question the reasoning of one side or the other, but to this observer such an explanation is unproductive and unnecessary. Both sides have noble motives and have expressed opinions and attitudes that have some validity. And, it is entirely possible for two groups with pure motives and valid reasoning to disagree.

In my opinion one of the most important sources of conflict between the fire protection and water works communities is that the history of the two fields and their differential success in reducing risk in their respective domains has led them to apply very different perspectives to the current controversy. Figure 1 presents a general and simplified graph of the reversed S-shaped pattern that many risks follow as efforts are made to reduce their magnitude over time. Initially, when a risk to life or health is first acknowledged, efforts to reduce the risk are often ineffective due to lack of knowledge or inability to generate public concern, and the magnitude of the risk drops only very slowly. Eventually, as knowledge and concern increases, effective methods that can greatly reduce the magnitude of the risk are developed and applied, and the curve steepens as the risk falls dramatically in a relatively short period of time. Finally, once the risk is reduced to a comparatively low magnitude, physical, economic, and other barriers make it difficult to take any further actions that can reduce the risk by a substantial amount, and the curve flattens out again.

Now, if one were to place current magnitudes of risks to life and health in the U. S. posed by unsafe drinking water and by fire on this graph, as shown in Figure 1, it would become apparent that the water works and fire protection communities are at very different stages in their histories. The water works community has, over the course of time, managed to reduce the risks of illness and death to levels so low that they are difficult to measure. In contrast, the fire protection community is still somewhere on the steep part of the curve: substantial progress has been made, but the risk is still high and thousands of people still die from fire-related causes every year.

The fact that the two communities are at different stages in the historical process of risk reduction naturally leads them to adopt different attitudes. The fire protection community is focused on making their way down the steep part of this curve: they have a technology available, fire sprinkler systems, that could dramatically reduce the risk of fire-related injury or death if it were widely applied. From this perspective, it makes sense to conclude that nothing could be more important than taking the actions necessary to achieve this large reduction in risk, and if some other

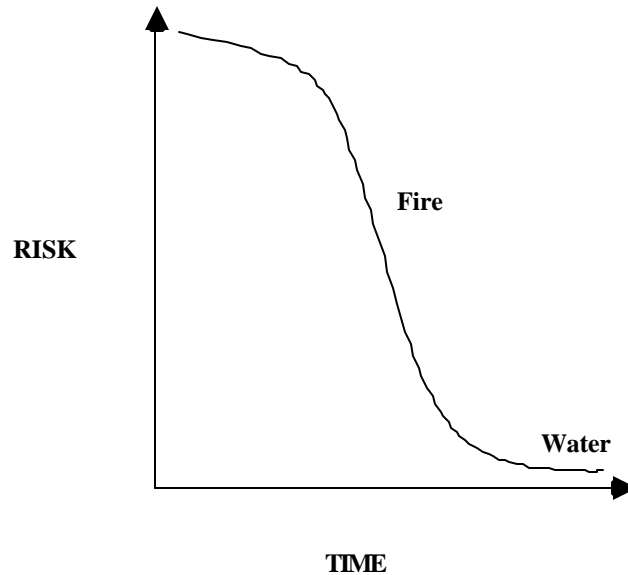


Figure 1 Prototypical pattern of risk reduction over time

risks must be increased in the process, so be it. The water works community, however, has already been through this process. They have long-since experienced the difficult and frustrating times when dramatic reductions in risk were possible but were hard to implement due to the lack of public concern or to the costs involved or to the existence of other priorities and now oversee what is perhaps the safest drinking water supply system in the world. From this perspective, it makes sense to conclude that nothing could be more important than protecting this hard-won victory, and that taking a step back in time to an increased level of risk would be a mistake.

For two parties in conflict to reach consensus, identifying and making their differences explicit is necessary but not sufficient -- the sources of conflict must be acknowledged and understood. The historical framework above -- in which the fire protection community in many ways represents the water works community's past, and the water works community represents the fire protection community's future -- is offered as one way of thinking about the two communities that might further this goal.

Achievements

Given the history of conflict between the two parties, the different perspectives they brought to the conference, and the complexity of the problems they were faced with, the achievements of the Fire & Water 1997 conference can only be described as remarkable. In between the first and second day of the conference a small group of people from both the water works and fire protection communities, on their own initiative, agreed to participate in an extra session to attempt to come up with a compromise solution that both sides could live with. After much discussion and give and take on both sides, the group ended up with a table providing backflow prevention recommendations for 11 different situations that varied by AWWA M-14/NFPA sprinkler class type and the type of piping employed. These recommendations, with the caveat that they constituted a temporary compromise and not a long-term solution, subsequently received the near unanimous endorsement of the full conference.

This compromise solution is noteworthy in several respects:

1. The conference attendees agreed that some situations require the highest available level of protection (RPZs).
2. They also agreed that different solutions are appropriate for different situations. In some cases the use of double check valves or alarm check valves are acceptable to both sides.
3. In addition, they agreed that in some situations different standards were appropriate for new versus existing systems.

Two other areas of agreement also emerged during the conference:

1. There was near unanimous agreement that, in the long term, a new backflow device is needed that will satisfy the backflow prevention requirements of the water works

community while simultaneously providing sufficient forward flow to satisfy the fire protection community. The conference attendees agreed to issue a challenge to both industry and regulation associations to develop this new device.

2. There was also agreement that standards and regulations for backflow prevention need to be reviewed and applied more uniformly across the country.

Finally, the conference attendees recognized that there was more work to be done and that additional meetings would be needed in the future. One priority for a future meeting would be a forum in which representatives from the various approval agencies would participate to work toward creating uniform standards acceptable to all of the agencies.

Future Directions

The Fire & Water 1997 Conference can claim to have accomplished several important goals:

1. Several differences between the fire protection and water works communities were identified and made explicit.
2. Several similarities and areas of agreement were also identified.
3. The two groups began the process of building a consensus and arrived at a short-term compromise that was agreeable to nearly all of the conference attendees.
4. The two groups agreed to continue to cooperate in the future.

In the short term, the challenge now is to make the accomplishments of the conference known to the wider community of professionals in both fields and to work toward the implementation of the compromise achieved at the conference.

In the longer term, there are benefits to be gained by future meetings that bring the two groups together in forums that foster cooperation. When planning these future events, the two communities may want to consider applying some techniques of social science that are known to be effective in helping conflicting groups find common ground and build a consensus. These techniques include group model building, in which a group of decision makers work cooperatively to create a dynamic computer simulation model of the problem they are trying to solve (see, e.g., Vennix, 1996) and social judgment analysis, in which the policies applied by individuals to a problem are identified and made explicit through regression analysis of the individual's judgments (see, e.g., Hammond and Adelman, 1976). Both of these techniques help people achieve consensus by making judgment processes and the ideas and assumptions that go into people's decisions -- which are rarely observed in the typical public forum -- explicit and open to inspection.

Of course, the biggest challenge for the future is to carry over the spirit of cooperation that evolved at the conference not just to future conferences but to the everyday working lives of the two professions. Cooperative ventures are more successful the earlier they take place -- if each profession can begin to involve the other profession when designing studies, forming and implementing policies, writing regulations, and so on, the need for conferences to help resolve disputes will eventually come to an end.

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