R E P O R T

Water Quality Excursion Response Plan

ASSOCIATED ENGINEERING

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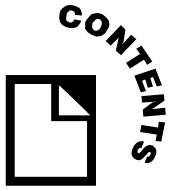

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INTRODUCTION

With increased attention and concern over the safety of drinking water, more utilities are experiencing boil water orders. The responsible public health officials are reacting strongly and swiftly to water quality excursions. Greater media attention is also being given to these events.

Associated Engineering staff have been consulted during a number of these events. In some cases we have been actively involved in assisting in the resolution of the water quality problems. Through this experience, we have identified a number of common characteristics which, if addressed ahead of time, could be of help to either avert a boil water order event or at least assist in resolving it quicker with fewer negative impacts.

The plan was originally outlined in a presentation given by Associated Engineering staff at a Western Canada Water and Wastewater Association workshop. Based on the positive response to the presentation and the number of requests for further information, Associated Engineering is publishing this outline of a Water Quality Excursion Response Plan on our web site where we hope it will be of value to our visitors and possibly contribute in some small way to the health of the public served by water utilities.

The Water Quality Excursion Response Plan must be kept concise and succinct. During a water quality excursion, a large tome of policy and procedures will be unwieldy as the situation will most likely evolve quickly. If a more detailed description is desired, it should be prepared as a reference appendix to a brief point by point plan.

RECOGNIZE THE RISK

SECTION 1

A water quality excursion is any event where the quality of the potable water delivered to the customer falls below the desired standard. This standard may be a regulated limit or may be an internally set limit.

The consequences of an excursion can range from the inconvenience and cost of having to respond quickly to an excursion that exceeds internally set water quality limits, to an event causing sickness and death in the community consuming the water. The goal is to avoid excursions but if one occurs, to steer it towards the former consequences and well away from the latter.

Associated Engineering's experience has been that water quality excursion events most frequently occur when unexpected conditions are encountered. This makes sense as when conditions are "normal", equipment is working and the operators are doing their jobs, the chances of an excursion event are small.

While many utilities go to great lengths to minimize the risk of a water quality excursion, there is always the possibility of either an extreme or unforeseen event occurring. Thus, to some degree, all systems are at risk.

In many cases, the chances of a water quality excursion have also been increased due to the more stringent drinking water quality standards established in many jurisdictions over the past decade or so. Not only is there now less "room" to deviate from normal water quality conditions before standards are not being met but also most water treatment plants are being required to produce a quality of drinking water that may be a magnitude higher than they were originally designed to produce. While the higher standards reduce the chances of negative impacts on public health if an excursion occurs, the impacts on the utility itself are still significant.

During an excursion event, the utility staff can expect the following conditions:

1. Frustration in dealing with the problem. As stated above, an excursion often occurs when the unexpected or unforeseen occurs. Thus, identifying and addressing the condition can be very challenging.

2. Involvement by the regulators. The degree of involvement will depend on the jurisdiction and the role of the regulators. They may be able to offer assistance or it may be more in an enforcement role. Regardless, it is reasonable to expect that the regulators will discharge their duties quite strictly even if they are able to offer help and support.

3. Political involvement. Besides being of concern to public health and attracting media attention, a water quality excursion can leave a significant negative image of the community that can have impacts on trade and commerce. There is also the issue of liability. All of these factors are of concern to elected officials. Depending on the community, the political involvement may be direct or may be through the utility management and administration. Regardless, the pressure will be on.

4. Media involvement. Since the Walkerton, Ontario E.coli outbreak, the media have become very interested in water quality excursions. Once an event is made public, expect significant TV, radio and newspaper media attention. How this is handled may mitigate or exacerbate the impact of a water quality excursion on the public and the community.

5. Very long and difficult working hours. The pressure is on the staff to deal with the problem and to correct it as soon as possible. As noted above, correcting an excursion can be frustrating. Add to this the stress, concern over public health and the regulator, political and media attention.

The primary goal of a Water Quality Excursion Response Plan is to be a tool that helps the utility staff address the above conditions with as few negative impacts as possible. To decide how rigorous a Water Quality Excursion Response Plan should be, the probability of an event must be weighed against the consequences.

While non-financial concerns over public health and liability are strong incentives, a “business case” risk approach may also be used as a tool. This approach compares the costs of preparing a plan, providing training and upkeep of the plan versus the costs to the community associated with a water quality excursion. If one considers the present “cost” of an excursion to be the product of the risk of the event multiplied by the cost of the event, it is possible to start assigning a dollar value for consideration. Complicating the situation is that there are different risks for different consequences. For example, a utility may estimate that the probability of a water quality excursion leading to a boil water order without public health consequences

occurring in any one year is one in 20 and that the cost of an event to the community would be $1,000,000. Thus the product would be $50,000. That same utility may estimate that the probability of a water quality excursion in any one year leading to sickness and death is one in 500. However the costs, as have been demonstrated in those communities experiencing such misfortune, can easily exceed $100,000,000. Based on that number the product would be $200,000. Even if a Water Quality Excursion Response Plan only reduced the risk and the cost by 20%, the value of the plan would be approximately $18,000 in the first case and $72,000 in the latter case.

Accurately determining the risk and the costs or a water quality excursion is difficult. It is also difficult to accurately evaluate the effects of a Water Quality Excursion Response Plan on reducing the risks and the costs. However, using this approach helps to bring the types of numbers involved into perspective.

TRY TO SOLVE THE PROBLEM BEFORE IT IS A PROBLEM

SECTION 2

If we look at the most infamous and severe water quality excursions, water quality problems were either missed or ignored until a widespread impact was felt by the affected community.

A key action then is to try to identify the excursion at its onset. The following measures are suggested:

1. Define the plant treatment criteria. This means establishing the expectations from the treatment process. The parameters will include those that are regulated but they should also include others that are good indicators of potential problems such as particle counts, pH, UV 254 absorbance etc. It is important to measure the criteria for each unit process through the treatment facility.

2. Set internal standards higher than regulated standards. Many larger utilities have been doing this for many years. The benefits (other than superior quality water) are that deviation from the internal standards provides an earlier indication of a problem. This gives the operator(s) some time to try to correct the problem before the regulator must step in and issue a boil water order. A deviation is also often easier to detect as the process is being operated closer to its limits and thus may be more sensitive. It is important that the internal standards are fully integrated into the daily operations of the plant and are not considered as "layered" on top of the regulated standards. Otherwise there is a strong possibility that the internal standards will not be taken as seriously as the regulated standards.

3. Ensure that the operations staff are very familiar with the characteristics of the raw water and also the treatment process. Through records and experience, most operators know what water conditions are likely to be encountered throughout the year and how the plant processes should react to those conditions. As many excursions are the result of the unusual or unexpected, a deviation from the normal conditions or process response can be an early indicator of troubles to come. It is also important to realize that one indicator that changes but is within parameters may portend problems in another part of the process. For example, the operator may note an increase in chlorine demand. This in itself can easily be addressed by increasing the chlorine dose. However, this increase in demand may well be indicating that the total organic carbon level in the raw water is increasing for some reason. Such an increase might result in difficulties in reducing turbidity to required levels. Heeding the increase in chlorine

demand can provide an early indication of difficult clarification allowing the operator to stay on top of the situation and control the process.

4. Ensure that the plant can reliably treat the anticipated raw water conditions. If a difficulty in achieving water quality standards is experienced on a recurring basis this should be reviewed to determine if there is a risk that the standards could be compromised and, if so, what could be done ahead of time to address the difficulty. The operations staff usually have a good idea of the conditions or time around which the challenges occur. Plant records can be reviewed to confirm the history of these challenges, what was done to address them and "how close to the line" the water quality came. If a solution is not readily apparent, involvement of some of the specialists (identified in Part 3) may be of value.

The next step is to define how the operator(s) will react when something out of the norm is detected.

When data is received suggesting a possible problem, the data should be immediately verified. To initiate a response to a water quality excursion with the associated financial and public relations costs only to discover that an instrument or lab test was at fault is expensive, embarrassing and could result in a reduction in the appropriate measures if a real problem occurs (the "cry wolf" effect). However, the data verification needs to be rapid. Sending out a sample for a bacteriological test that could take one to two days is not appropriate for verification purposes here.

Assuming the data is found to be valid, the next step is to try to correct the excursion before the situation evolves further. This is where higher internal standards can really pay off as there is more likely to be time to correct the problem before regulated limits are reached. At this stage, use of some of the resources identified in the next part of the plan may be appropriate.

If, despite the efforts taken, the water quality still appears to be heading towards exceeding the regulated limits the next action is critical. The utility - which may include operators, administrators, owners and/or politicians - should involve the regulators before the water quality limits are exceeded and possibly even request a boil water advisory or order be issued. The important point here is that the utility needs to retain control of the situation. If the utility waits for the quality limits to be exceeded, the regulator has no choice but to issue an order and it will appear that this was done because the utility failed to operate its system correctly. By retaining

control of the situation the utility will be viewed as being very pro-active and putting the best interests of the customers first.

DEFINE THE RESOURCES

SECTION 3

As already established, going through a water quality excursion is a stressful situation that demands a fast and intensive response. Operators do not need to be trying to figure out who they should involve, how to contact them and how to get approval to do this while in the middle of addressing the excursion. This part of the plan involves identification of potential resources ahead of time along with the triggers that would result in their being used.

For the utility operators, their first resource should be the utility management. Management must commit to being a resource and not an inhibitor to resolving the problem. This means that management should not be going on a "witch-hunt" to blame the operator or other party that may have let the excursion occur. This only adds stress to the situation, wastes valuable time, may result in operators being reluctant to alerting the management and does nothing useful towards rectifying and minimizing the excursion at hand. The fact is the utility is facing a potential public health threat and all the other negative consequences previously described. Deal with that first. There will be plenty of time afterwards for a rational analysis of the event and then the best corrective measures can be applied rather than a simple assignment of blame.

The operators need to have the confidence that they can report the problem to management and involve them without fear of recrimination as, besides being a resource, management needs to know about the situation as soon as possible. Otherwise, the managers and administrators may be caught by surprise when politicians and media start contacting them once the situation becomes public.

By getting involved in the situation, the managers and administrators can provide guidance to the operators regarding dealing with the politicians, media, regulators and others and also provide rapid authorization to the operators to bring in other necessary resources.

Outside resources should then be identified and listed. The list should include:

- names of individual contacts
- company names
- addresses
- phone and fax numbers
- e-mail addresses
- a description of what individuals / company / service provides
- what event would trigger accessing the resource
- what approval is needed to access the resource

The list might include some or all of the following types of resources:

1. Other Similar Utilities

   This would include utilities either on the same or similar raw water source and also those with a similar treatment process. An informal agreement can be made ahead of time for mutual assistance between the utilities in the event that one runs into problems.

2. Technical Specialists

   Technical specialists can include academic people with knowledge of specific processes or treatment techniques, consulting engineers or other specialist services. List the particular expertise each specialist can provide.

3. Engineers

   Include the in-house or consulting engineers with in-depth knowledge of the plant infrastructure and systems. Specific engineers with process expertise could be listed here but probably would be better listed with the Technical Specialists.

4. Testing and Laboratory Services

   During an excursion, there may be the need for outside testing of water samples or chemicals either for independent verification of in-house tests or for special tests that the plant is not equipped to perform. A listing of available testing and laboratory services in the region should be prepared along with a list of the tests that they can perform and the turn-around time for results. If specific tests may be needed that involve a testing facility outside of the region, it too should be listed along with how to prepare and ship the sample.

5. Suppliers and Manufacturers

   The various chemical suppliers, along with potential chemicals that could be used during an excursion should be listed along with the specific products of interest. A summary of the equipment manufacturers is usually available in the operations and maintenance manuals. However, for older facilities, this list may require significant updating.

Special process equipment might be brought in quickly to address the excursion or at least make a portion of the water supply available for potable water distribution. For example, some membrane filter and ultraviolet light disinfection system manufacturers have skid mounted packages that can be quickly deployed. Depending on the situation, these may serve to address the water quality excursion. Of course, the manufacturer's hope is that the utility will subsequently purchase that process. Again, depending on the situation this may not be a bad thing.

6. Contractors

   Local and regional contractors should be listed who can provide mechanical, electrical, instrumentation and controls services.

7. Communications Information Officer

   The utility may have, or wish to designate one individual to be the Communications Information Officer (CIO) responsible for all communications with the media.

8. Regulators

   Last but not least, the regulator may be considered a resource in some jurisdictions. Sometimes the regulator has considerable process expertise and experience and is either mandated or at least permitted to offer assistance to the utility.

A Resource List form is available in spreadsheet format along with an example of a fictional list partially completed for reference of the type of information intended.

COMMUNICATION

SECTION 4

A list of contacts and when to contact them is a part of many types of response plans. The need for this information to be at hand is no different in this case. The list should be organized by function and company. Individuals, their roles, contact information (i.e., address, phone, fax, e-mail), working hours, emergency numbers, and what triggers contact with them should be listed. If this information is entered into a spreadsheet or database, it can be easily kept up to date and can be sorted in different ways if desired. If periodic communication is required during a water quality excursion then this also should be noted along with the frequency or events that require communication.

Along with each function should be a summary of what information needs to be communicated and by whom. The specific information will depend on the conditions during the event but guidance can be provided regarding the type of information to be given each contact.

The list should include:

- Regulator(s)
- Public Health officials (if not the Regulator)
- Utility contacts (Administrators, operators, maintenance staff, Communications Information Officer, etc.)
- Owners / Politicians
- Media
- Key industries or other major or significant customers
- Other Resource Contacts as identified in Part 3 above

Communication with the customers is vital, not only to ensure that notice of the boil water is quickly given but also that they understand the problem, the risks, what the utility is doing to rectify the situation and what measures are being implemented to minimize the problem (see Part 6). It is here where a pro-active relationship with the media can be advantageous. Most media are only too happy to convey the message. However, be prepared to also provide supplementary information to the media for their story. Also, in some cases, the portrayal of the situation by the media may not be as the utility intended.

Designating a Communications Information Officer will help with media access, ensure that information provided is consistent, accurate and follows the communication policies established by the utility. It also simplifies media interactions with other staff who can just refer media persons to the CIO. The CIO should be well trained in dealing with the media. The CIO should be familiar with and trained in the procedures outlined in the Water Quality Excursion Response Plan as well as having a good understanding of the utility system, the operation, the problem and the potential consequences. Regardless of having a designated CIO, the media may persist in having some interaction with the decision makers.

The resource individuals and companies that are involved in addressing the water quality excursion may be contacted by the media. They should be made aware beforehand of how the utility wishes to conduct communication with the media.

Regardless of whether or not a CIO is used, draft communication releases may be a useful tool in assisting staff in expediting the plan and also in providing the media with the required information and avoiding problems with issuing inappropriate information.

If the utility or municipality has a web page, posting of the boil water order and then regular updates of the situation are simple to provide and help the customers know what action is being taken.

A Communication List form is available in spreadsheet format along with an example of a fictional list partially completed for reference of the type of information intended.

TROUBLESHOOTING

SECTION 5

Troubleshooting will be a core activity during a water quality excursion. It is important to be as organized as possible ahead of time so that the necessary resources are at hand. In addition to the technical resources identified in Part 3, the following should be gathered and stored or be available in a location that is accessible to the operations staff:

- Plant operations and maintenance manuals
- Technical reference books
- Operating license
- Water quality standards
- Standard operating procedures (SOPs) used by the utility

It is important that the necessary tools to diagnose and correct process problems be available. Aside from mechanical tools, suitable instruments (e.g., turbidimeter, pH meter) should be available in the plant, calibrated and in good working order. If the utility does not have some instruments that might be useful (e.g., a portable particle counter), then a source should be identified on the contact list from where these instruments might be borrowed or rented. Potential sources are other utilities in the region, specialists and suppliers.

Ensure that valved taps or sampling points are made in the plant upstream and downstream of each unit process so that samples may be quickly taken for analysis. These taps are usually very inexpensive to provide and can be quite useful during normal operating conditions to help optimize the plant performance.

As part of the definition of resources, laboratory tests may have been identified that involve taking samples for shipping to an off-site laboratory. Ensure that the correct sampling containers are kept on-site and the staff know the sampling procedures to be followed (or at least a contact to obtain the procedures). When taking a sample that will be shipped off-site, take two samples and store one on-site in suitable storage (refrigerator or as recommended by the lab). If the shipped sample is lost or damaged or if there is question as to the accuracy of the results, the second sample can be used.

In the event of a water quality excursion, it is possible that some of the chemicals normally used in the process are not being very effective. Alternatives may be available that could be tested and applied to help address the water quality problems. Samples of alternative chemicals should be kept in the plant or at a nearby location in quantities suitable for jar testing or other bench scale testing. Contact information for ordering larger quantities should be kept on the

Contact List.

Several caveats apply to keeping alternative chemicals around:

1. Permission to store the chemical at the plant may be needed from the Regulator.

2. Depending on the chemical and the quantity, the local Fire Marshall may also need to know that it is present in the plant.

3. Permission to use the chemical in the process may be needed from the Regulator.

4. Some chemicals have a limited shelf life and so may require periodic testing and/or replacement.

5. Ensure that Material Safety Data Sheets are posted in the appropriate locations.

6. Ensure that staff are trained in the correct handling and application of the chemicals.

A Tools Check List form is available in spreadsheet format along with an example of a fictional list partially completed for reference of the type of information intended.

CONTINGENCIES

SECTION 6

While the utility is busy addressing and solving a water quality excursion, it is important to have plans and procedures in place to minimize the impact and inconvenience on the public. There are a number of steps that can be taken.

1. Inventory Management

   If the water quality excursion is being dealt with pro-actively, there is a strong possibility that there is water in the water treatment plant clearwell(s), and reservoir(s) that is still of potable quality. A first step is to avoid "contaminating" this water with sub-standard water. This action may enable the utility to postpone a boil water order or even avert one if the excursion can be quickly rectified. Issuing lawn watering bans and calling on the customers to conserve water rather than having to boil it is less inconvenient and should do less to damage the public's confidence in the system.

   One caveat to inventory management is that water stored for fire flow should be retained. This may or may not be potable water quality but the volume should be available should it be required.

2. Alternative Supplies

   There may be certain groups of customers who could be more severely impacted by a boil water order or be at higher risk if they consume sub-standard water. Critical users should be identified ahead of time and a procedure identified to provide them with water. For example, in the event of a high turbidity excursion, the primary concern would be that pathogenic protozoa might be in the water. Thus, the very young, very old and the sick would be the highest risk groups. Arrangements might be made to truck in water from an adjacent community to supply hospitals, senior's residences and long term care facilities during the water quality excursion.

   Depending on the situation, it may be possible to truck in water from a nearby community for all residential customers or to bring in a temporary process to address the water quality problem. Failing that, distribution of bottled water by the utility is preferable to the negative impacts that occur when a bottled water supplier offers free product to the community. This is a public relations disaster for the utility and only serves to further undermine the public's confidence in their municipal water supply.

Many industries rely on utility water for their processes. Depending on the situation and the system involved, the water quality excursion may have a significant impact on these industries. The water quality excursion may either result in higher costs or might even shut the industry down during the event. Besides damaging the community, this may result in claims against the utility for lost production.

FOLLOW UP

SECTION 7

Correcting the water quality excursion and getting the plant to produce acceptable quality water is a major achievement. However, there is still work to be done:

1. The extent and duration of the water quality excursion may impact the distribution system, reservoirs and the treatment plant leaving some or all of these containing sub-standard water. This water must be completely dealt with before the boil water order can be rescinded. Necessary actions might range from water quality monitoring across the affected part of the water system through to flushing and disinfection of the entire system. It is important to have the resources and methods necessary identified ahead of time so that the system can be restored as quickly and efficiently as possible.

   If inventory management has been successful and the sub-standard water is confined to the plant, it may be possible to re-treat or dispose of the water there. Further afield, some degree of flushing may be necessary. The flushing itself may create water quality problems as sediment in the piping is stirred up. The Regulator may want it demonstrated that the flushing will be as effective as possible. Having a unidirectional flushing program developed ahead of time will enable the system to be flushed as effectively as possible.

   In the event that the flushing must be done in cold climate conditions, procedures for dealing with the flushing process and the wasted water should be identified.

   If system flushing is necessary, the service lines and plumbing in customers' buildings should also be flushed. Depending on the severity of the water quality excursion, the utility may wish to distribute flyers to residents on how to flush their service lines and plumbing. Alternatively, door to door service may be needed.

2. For water quality monitoring, the "worst" areas in the distribution system (usually the end of system and dead-ends) should be identified. However, other representative points should be tested as it may be possible that the sub-standard water did not yet reach the extremities of the distribution system by the time the water quality excursion has been addressed.

3. Once the water system is fully restored, it is important to restore the confidence of the customers and politicians in the water system. Again, this is a step that helps the utility retain control of the situation and should reduce speculation and rumor. Internal reports may be necessary to satisfy the administrators, managers, regulator(s) and politicians. It is also very beneficial to report to the customers. This should be done by newspaper and also on the utility's or municipality's web site.

   The report contents and style are a matter of preference in each application. If there is a concern over liability, review of the report by legal counsel before publishing it would be appropriate. Obligations and options under freedom of information and privacy legislation must also be considered. However, the following topics are a guide:

   - Explain what caused the boil water advisory or order to be issued and why it was issued. If the action was only precautionary (e.g., high turbidity but no evidence of pathogenic protozoa) then say so. If there was a definitive health concern then also say so. Also state if there was not a health concern identified.
   - Provide a brief summary of the events from identification of the water quality excursion to its resolution, including system restoration.
   - State when and why the boil water advisory or order was lifted.
   - State what is being done to further monitor the quality of the water.
   - State who can be contacted in the utility if there are concerns or questions. Depending on the situation, a public meeting might also be held to allow customers a chance to question the utility and hear first hand about the situation.
   - If operators, other utilities or other resources went out of their way to help resolve the water quality excursion, this is a good place to publicly recognize and thank them.
   - State what actions are being taken to ensure that this situation is not repeated.

4. Perform a "post-mortem" on the water quality excursion to identify what actions are appropriate to avoid a repeat of the problem. This may involve staff training, instrumentation to detect the problem, process adjustments or process changes.

   If the water quality excursion was the result of human error, the situation should be evaluated carefully by the utility management so that the appropriate action is taken in light of the responsible individual's overall performance and conditions. Other staff and

the community will be watching to see that the problem is dealt with fairly and justly.

If the water quality excursion was the result of unexpected water conditions, the cause should be investigated and then steps taken to either prevent re-occurrence of the conditions or put in place the necessary processes to deal with the conditions if and when they re-occur. If the current process can deal with the condition, then the problem may be the need to detect the situation earlier so additional monitoring equipment or procedures may be needed.

The "post mortem" may be documented in a report either by the staff or by engineers. It is important that the recommendations of the report are acted upon and the necessary resources committed, not only so that the problem is addressed but also that the problem is seen to be addressed by the customers, regulators and other stake holders.

TRAINING

SECTION 8

While not specifically a part of a Water Quality Excursion Response Plan, appropriate staff training is important both to reduce the risk of a water quality excursion happening and also to help with the resolution of an event with the minimum negative impacts.

Staff obviously should be trained for the proper operation and maintenance of the water treatment plant. However, relating to preventing and dealing with a water quality excursion, training is needed for the various water quality monitoring tests and equipment that may be needed to detect and track a water quality excursion. Likewise, training is needed for dealing with water treatment needs that may stray outside of normal limits. Operators and maintenance staff need the skills to be able to troubleshoot problems with either the process or the plant equipment.

A major difficulty with the training is that many of the skills may not normally be needed. Thus, over time, the skills will be dulled or lost. Periodic refresher training is appropriate.

During a water quality excursion, any of the utility staff may need to contact or may be contacted by the media. How the staff behave will have a major impact on the way the water quality excursion is reported. Basic training in communication with the media is essential so that staff are clear on the lines of communication, utility policy, how to conduct themselves when approached by the media and how to respond to questions if they are interviewed.

Finally, use of the Water Quality Excursion Response Plan should be rehearsed periodically. This can involve playing out various scenarios either as a group around the table or, better still, as a simulated event at the plant and administrative offices with one individual controlling a "script" of the event as it unfolds, providing feedback such as:

- how the process reacts to the changes made by the operator(s)
- equipment failure(s)
- parts availability or supply
- lab test results
- regulator reaction
- media involvement
- impact on the customers

Following the rehearsal, a de-briefing should provide feedback to those involved and also obtain feedback to refine the Water Quality Excursion Response Plan.