

DISINFECTION AND TURBIDITY REQUIREMENTS IN OTHER JURISDICTIONS

BACKGROUND

A survey was made of disinfection and turbidity requirements and procedures in jurisdictions in Canada, key US States, and in countries around the world. A two-pronged approach was followed by contacting the regulatory authorities on the one hand and the municipal water sector on the other hand (within Canada this was done by approaching major urban water utilities and in the other countries, an approach was made to national water utility Associations). More than 90 agencies and organizations were contacted, approximately one third responded. A summary of the responses received, sorted by question, is shown below.

SUMMARY OF RESPONSES

Responses received

Canada: Responses were received from all Provinces except New Brunswick and Nova Scotia from either the regulatory Authority or more commonly, from a utility located in the jurisdiction. No responses were received from the three Territories.

USA: Responses were received from the US EPA and the States of Colorado, Illinois, Indiana, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, and Wisconsin. There were no utility or Association responses.

Other: Responses received have been from Australia, Austria, the Caribbean, Finland, France, Germany, Israel, Italy, Japan, Morocco, the Netherlands, South Africa, Spain, Sweden, Switzerland and the United Kingdom. The responses came from either the regulatory Authority or an Association or a utility, and on occasion from more than one organization in a particular country.

Is there a current minimum chlorine/chloramine residual required in your jurisdiction for drinking water in the distribution system? If so, what is it?

Canada: There were 7 positive responses covering 6 Provinces and 1 negative response for 1 Province (Prince Edward Island). With the exception of Prince Edward Island which is totally dependent on groundwater sources and does not require disinfection, all Provinces who responded indicated a requirement to maintain a disinfection residual entering or in the distribution system. These ranged from a measurable level in Newfoundland, to a minimum level of 0.5 mg/L (Manitoba). In most provinces, no maximum Chlorine level is established but where it is, a maximum level of 4 mg/L is established (Alberta). Ontario sets 4 mg/L free chlorine residual as a recommended maximum.

USA: There were 10 positive responses and 0 negative ones. US EPA requirements are that the chlorine residual shall not be less than 0.2 mg/L for any period greater than 4 hours at the entrance to the distribution system, and cannot be undetectable in more than 5% of the

samples taken each month in the distribution system. Most of the US States who reported followed the US EPA requirements. Those requirements are for surface water sources only. The maximum chlorine residual, where specified was 4 mg/L.

Other: There were 13 positive responses from both Regulatory Authorities and Utilities in 6 countries and 7 negative responses from 7 countries. The new European Drinking Water Directives (has to come into effect in 2003) do not directly require that disinfectant residual is present at all times. Instead, it sets microbiological quality standards, which practically need to be achieved either by disinfectant residual or by "Netherlands approach" (see below). Therefore, the water companies in Finland do not need to demonstrate that residual exists (unless the local health authority asks them to do it). Spain and France report minimums of 1.0 mg/L and 0.5 mg/L respectively. Germany's health authorities ask for residual free water in the distribution system and chloramine is prohibited, however, a utility reported that where microbiologically safe water cannot be achieved, a disinfection residual is required but this is considered to be an exceptional circumstance. Austria reports a maximum chlorine residual of 0.3 mg/L (when required) for the consumer and the use of chloramines is prohibited. Switzerland has a minimum of 0.1 mg/L. In the Netherlands, no disinfection is required - the focus is on making the water free of pathogenic micro-organisms, viruses and their indicators and low colony counts through multiple barrier approaches and reducing the AOC (assimilable organic carbon) levels to the point that bacterial growth in the system is unlikely (however disinfected water is required following a main break or repairs). Italy reports a minimum of 0.2 mg/L. Sweden has a maximum of 1.0 mg/L when disinfection is required. Australia reports a requirement and a practice similar to the UK - no maximum levels were indicated. Japan has minimums of 0.1 mg/L at the tap and actual values run from 1.0 mg/L at the plant and 0.6 to 0.7 mg/L at the tap. South Africa reports 1.0 to 2.5 mg/L free residual chlorine directly after treatment (average 1.1 mg/L) and 0.8 to 1.1 mg/L at the point of chloramination (average 1.0 mg/L). The aim in South Africa is to provide drinking water at the tap with not less than 0.1 to 0.3 mg/L of combined residual chlorine (monochloramine). In the Caribbean, the minimum chlorine residual required is 0.2 mg/L at the end of the system. There is no maximum but a chlorine residual level is kept below 2 mg/L. Israel has a minimum of 0.1 mg/L. The Moroccan regulations require a minimum chlorine residual of 0.2 mg/L and a maximum of 1.0 mg/L.

Is there a response required by legislation to a low chlorine/chloramine event? If so, what is the response?

Canada: There were 5 positive responses covering 3 Provinces and 5 negative responses covering 5 Provinces including PEI (Prince Edward Island) which has no chlorine requirement. The requirements are not consistent across the provinces: all require some form of reporting (immediate to monthly) and remedial action which can be set out in regulations or in the Operating Certificates. Remedial actions vary from the sounding of alarms, immediate switching to a back-up chlorinator (Québec), evaluation of cause and repair, to the issuance of a boil water order.

USA: There were 10 positive responses and 0 negative ones. USEPA regulations state: "If at any time the residual falls below 0.2 mg/l in the water entering the distribution system, the system must notify the State as soon as possible, but no later than by the end of the next business day. The system also must notify the State by the end of the next business day whether or not the residual was restored to at least 0.2 mg/l within 4 hours. The residual disinfectant concentration of the water entering the distribution system must be monitored continuously, and the lowest value must be recorded each day, except that if

there is a failure in the continuous monitoring equipment, grab sampling every 4 hours may be conducted in lieu of continuous monitoring, but for no more than 5 working days following the failure of the equipment". In Illinois a boil water order shall be issued; in Michigan, Pennsylvania and Wisconsin public notices of the failure is required for surface water systems. In New York, which requires continuous monitoring in some cases, where the monitoring system fails, grab samples must be collected every four hours, but only for a maximum of 5 days (when the continuous monitoring system must be back on line). Pennsylvania also only allows water systems to collect grab samples up to 5 days when continuous monitoring equipment fails.

Other: There were 8 positive responses covering 5 countries and 1 negative response covering 8 countries. The responses are somewhat confusing and at times at variance with responses given to other questions. It would seem that where disinfection is required, then corrective action to re-assure the residual is the implicit response. Australia, Austria, Finland and the Netherlands report no legislatively required responses. France requires distribution be stopped if there would be no inconvenience to customers and a notice be given to consumers to drink bottled water until corrective action is taken. This seems to contradict responses given to other questions, and is interpreted to mean that the source pump would be stopped, providing the system remains in service from other sources, but the contradiction was not specifically resolved. Japan would require the water supply to be suspended (which seems to contradict responses given to other questions and this contradiction could not be resolved but again, it is interpreted to be a response to a failure of one source in a multi-sourced system). The situation does not arise in Germany and the Netherlands where water distribution systems are to be residual free (although it is known from other comments that disinfection may be required in Germany). In Spain re-testing takes place and if the lack of residual continues, an alert to the public will be given and will remain in force until the residual is restored. In the UK, response is immediately notifying the authority. In South Africa there are only guidelines not standards but they should be met at all times. In the Caribbean, there are no reported requirements following determination of a low residual. It does not appear that there is any requirement to shut down a system completely. However, one component of a multi-component system might be closed if service could be provided from an alternative. In Israel, where that has been a rapid drop in disinfection residual and there is an imminent danger of pollution in the water source, action is taken to close that water source.

Is there a response required procedurally to a low chlorine/chloramine event? If so, what is the response?

Canada: There were 4 positive responses covering 4 Provinces and 8 negative responses. Where procedural responses are set out, they range from reporting the condition and taking remedial action to restore the levels while increasing the monitoring of residuals throughout the system, to flushing distribution systems to restore a satisfactory condition. A boil water advisory is required in Newfoundland. The City of Ottawa reports that many non-regulatory, procedural steps are taken internally intended to restore the level before any need to notify MOE is reached, which include pump shutdowns and process valve closures. The procedural response requires that chlorination be restored and that remedial action as directed by the local Medical Officer of Health, be followed. Buffalo Pound, SK reports that internal guidelines for the operation of the treatment plant include pump shutdown in the treatment plant, in the event of low chlorine residuals.

USA: There were 4 positive responses and 1 negative responses covering 5 of the States; no responses

were received from the others. Colorado indicated that they vary from utility to utility. Minnesota's procedures are reporting to the State and taking corrective action. Ohio's are evaluation as to cause and correction. In Pennsylvania, if chlorine levels are below a regulatory requirement, then the water system would trigger a violation, notify the public, and most likely undergo a follow-up visit by regulators (depending on the type and severity of the violation). Wisconsin reports procedures as being elevation of chlorine levels, flushing and additional sampling.

Other: There were 11 positive responses and 7 negative responses. Again, there appears to be some discrepancy in the way this question was interpreted and responded to, but generally wherever disinfection is required the first procedure assumed was to correct the loss of disinfection. Austria reports that the low value has to be corrected immediately. Germany, Finland and the Netherlands do not require chlorination, so there are no procedures. France requires re-establishment of the residual, and if a shut down is not acceptable to the customers, a health advisory for water consumption is issued. In Italy the local health authority determines the procedural responses. Spain requires that the local health authority establish responses on a case-by-case basis. In the UK, various procedures are reported. These procedures include: increasing sampling throughout the system; isolating the system component with the low levels especially if there is a turbidity issue as well; re-valving the system to reduce retention time while boosting chlorination; switching from free chlorine to chloramine or vice versa; considering a boil notice; and in all cases: keeping authorities notified as to status and actions. Australia reports that failure of a chlorinator requires immediate steps to remedy the situation although it does not specify what. Japan requires the water supply to be suspended, providing the system remains in service from other sources or water trucks. South Africa requires correction by manual over-riding and other corrective actions including immediate sampling for the presence of bacteria. Morocco requires restoration of chlorine levels as a procedure with disinfection levels to be checked twice per day.

If there are no legislated or procedural requirements for response to a low chlorine/chloramine event, is any being contemplated? If so, what are they?

Canada: There was 1 positive, 2 =maybe= responses and 3 negative responses. In BC and MB and NF, it is reported that expanded requirements are being contemplated. In BC, any requirements will be based on empowering local enforcement staff to take appropriate actions; in MB new regulations are being developed. NF reports that it may develop requirements.

USA: There were 3 positive responses and 3 negative responses, and 4 non-responses. USEPA is developing regulations for groundwater on a National level. Indiana reports it is developing regulations that would apply to groundwater. New York will introduce maximum chlorine residual requirements to be in line with US EPA. Pennsylvania expects to have final regulations in place in 2002 to provide primacy on Public Notification requirements.

Other: There were 3 positive responses and 12 negative responses. Italy and Spain indicate new regulations are expected by December 23, 2003 requiring health authorities to implement procedures when requirements are exceeded. This step will bring them into compliance with the European Drinking Water Directive. It is probable that this may apply to other European nations, but was not reported. The Caribbean reports that regulations are expected but does not indicate what they would be. Germany and the Netherlands report that there are no changes to their residual free requirements. Finland believes that regulations are only one part of ensuring the safety. More important and probably

cost-effective are the voluntary efforts, active co-operation between suppliers and authorities, risk assessment procedures, source water protection, quality control systems etc.

Is there a current maximum turbidity level required in your jurisdiction for drinking water in the distribution system? If so, what is it?

Canada: There were 8 positive responses covering 6 Provinces and 2 negative responses: BC and PEI. A range of levels is reported: from no level being specified (BC) to a maximum of 5 NTU in the system and at the tap (ON). A tendency is towards 1 NTU level for water entering the distribution system, which is likely to be lowered. QC has a maximum level of 0.5 NTU with no more than 5% of values higher than 0.5 NTU in any period of 30 consecutive days. Variances are allowed for slow sand filtration systems (1.0 NTU) but for membrane filtration the level is set at 0.1 NTU.

USA: There were 10 positive responses and 0 negative ones. The Enhanced Surface Water Treatment Rule requires varying NTU levels for different treatment technologies (0.3 NTU for conventional and direct systems, 1 NTU for slow sand and diatomaceous earth plants, etc.). The levels given above are levels that must be met by 95% of all monthly samples. In addition, levels cannot exceed 1 NTU (conventional and direct) or 5 NTU (slow sand/DE) AT ANY TIME. The 95th percentile and maximum limits listed above for conventional and direct filtration plants currently applies to systems serving 10,000 or more people. Conventional and direct filtration plants serving fewer than 10,000 people currently have to meet 0.5 NTU (95th percentile) and 5 NTU (max). Beginning January 2005, they will be subject to the 0.3 NTU (95th percentile) and 1 NTU (max) standards.

Other: There were 18 positive responses and 2 negative responses. In Australia although the nominal Guideline level for turbidity is 5 NTU, the next line in the Guideline actually recommends 1 NTU where disinfection is intended. Moreover, the recently launched Water Treatment Alliance (modeled on the AWWA Partnership for Safe Water) sets a goal of 0.1 NTU on the outputs from participating plants. Italy (also counted as negative) reports that turbidity is just an indicator and there is no prefixed limit. European nations (Finland, France and Spain) report the EU Drinking Water Directive is to target less than 1 NTU with a maximum of 5 NTU. In Germany, the standard is set at 1.5 FNU (sic - but equivalent to the NTU) to drop to 1 FNU on January 1, 2003. Switzerland establishes a maximum level after treatment of < 0.2 NTU. The UK has recently established a maximum level of 1 NTU (an indicator value which triggers an investigation) for water entering the system and 4 NTU (compliance requirement) at the tap. Of greater interest is the UK requirement *to react to any increase in turbidity*. The UK water companies report various internal standards from 0.5 NTU entering the system and < 1.0 NTU at the tap; one reported an internal rule of shutting down the particular plant if the level exceeds 0.5 NTU for more than 10 minutes (it is presumed this is within a multiple sourced system). Austria's drinking water supply is mainly from ground water (98% of the total supply); the maximum turbidity level is 1.0 NTU. Netherlands reports a maximum level of 4 NTU at the tap and abnormal changes of turbidity are not allowed. Sweden reports 0.5 NTU entering the distribution system and 3.0 NTU at the tap. In Japan, the national standard is roughly equivalent to 1.2 NTU but turbidity is maintained below 0.06 NTU in order to prevent waterborne cryptosporidiosis. Israel reports 1 NTU as a base, with a single exception, which is set at 3 NTU. South Africa has established a maximum level of 0.5 NTU striving to achieve 0.3 NTU. The Caribbean guideline is based on WHO recommendations and US EPA rules. In Morocco, the turbidity levels at the plant are 0.5 NTU, with a maximum at the consumer of 5.0 NTU.

Is there a response required by legislation to a high turbidity event? If so, what is the response?

Canada: There were 4 positive responses covering 2 Provinces (ON and QC) and 5 negative responses covering 5 Provinces. Most provinces indicate that there are NO required responses to high turbidity levels. BC reports this is discretionary. Ontario and Quebec report a notification requirement when an exceedance of 1 NTU occurs, imposed on each filter unit outlet.

USA: There were 10 positive responses and 0 negative ones. The Enhanced Surface Water Treatment Rule requires a series of explicit notifications and monitoring actions are to be made, including a comprehensive (filter) performance evaluation within specified time periods, and the Safe Drinking Water Regulation requires notification to authorities and the public of any situation where the average of two samples taken on consecutive days exceeds 5 NTU. The Public Notification Rule requires notification of the public within 24 hours when the State determines a Tier 1 notice is warranted. All States reported they followed this rule. PA requires reporting to the regulators within 1 hour, and public notice within 24 hours, although this may be delayed for up to 30 days depending on the condition. IL reports that in the extreme, a boil water advisory be issued when an exceedance is determined. Ohio and Wisconsin consider this a violation requiring public notification.

Other: There were 12 positive responses covering 10 countries and 7 negative responses covering 5 countries. Since the Australian and South African situations are guidelines, no response is required (negative). Europe generally requires only notification of the public with an advisory not to drink the water; Germany and Netherlands add notification to the health authority (due to the lack of disinfection).

In the Netherlands, flushing of the system maybe required with chlorinated water, depending on microbiological tests. The UK requires notification to the authority and remedial actions. One UK water company reported an internal policy to shut down the particular plant. Japan treats a high turbidity level as being the same as a low chlorine level. Sweden requires investigation of any variance from normal conditions. Israel requires notice of high turbidity to health authorities.

Is there a response required procedurally to a high turbidity event? If so, what is the response?

Canada: There were 6 positive responses covering 6 Provinces and 6 negative responses also covering 6 Provinces. Responses varied considerably from none in AB and ON, through a range of discretionary ones in BC (public advisories for immuno-compromised persons and Orders to upgrade treatment plants). NF reported that owners may be asked to prepare action plans to deal with high turbidity events. PE would demand flushing of distribution systems following an event. GVRD and Buffalo Pound report internal procedures to switch sources or shut down water supply where turbidity levels exceed standards (although no requirements are imposed on them). Buffalo Pound reports its internal standards are well below provincial turbidity standards. In Ontario although there is no prescribed procedural response, subsection 8 (8) of O. Reg. 459/00 states that there must be confirmation that appropriate action is being taken

USA: There were 3 positive responses and 3 negative responses. Most States report following the US EPA requirements as procedures. The Enhanced Surface Water Treatment Rule requires a series of explicit notifications and monitoring actions are to be made, including a comprehensive (filter)

performance evaluation within specified time periods, and the Safe Drinking Water Regulation requires notification to authorities and the public of any situation where the average of two samples taken on consecutive days exceeds 5 NTU. The Public Notification Rule requires notification of the public within 24 hours when the State determines a Tier 1 notice is warranted. Colorado notes that the responses vary from utility to utility. New York did not report any procedures. In Pennsylvania, if turbidity levels are above a regulatory requirement, then the water system would trigger a violation, notify the public, and most likely undergo a follow-up visit by regulators (depending on the type and severity of the violation). Ohio procedures include evaluation as to cause and corrective action as appropriate. Wisconsin procedures include flushing, increased dosing and sampling.

Other: There were 14 positive responses covering 10 countries (including some countries who reported no requirements) and 3 negative responses. Where response procedures are followed, they primarily consider cause investigation and implementation of remedial actions as the appropriate steps. Where the focus is on public health, notifications to health authorities are also a feature. Australia reports that this is a customer relations problem, and the response is investigation as to cause and mains flushing. Finland reports that if it is considered on investigation to be a public health problem then remedial measures are instituted including flushing and sampling. France and Spain report similar responses, investigation, flushing and sampling. Germany requires system-wide flushing to prevent back flows. The Netherlands requires flushing, sometimes with chlorinated water depending on microbiological tests. The UK has no specific procedural requirements but the water companies institute a similar range of responses as in Europe. One UK company indicated a plant shut down procedure (presumably within a multi-sourced system). Japan's requirements are the same as those for a low chlorine level. South Africa requires a corrective action, i.e. increase coagulant and flocculant dosages, reduce filter running times as short term measures; as long term measures, upgrading of sand filters, correct selection of coagulants, investigate alternative coagulants, flocculants and filter aids. The Caribbean reports that high turbidity source water may be cut off until the situation corrects itself.

If there are no legislated or procedural requirements for response to a high turbidity event, is any being contemplated? If so, what are they?

Canada: There were 3 positive, 1 =maybe=, and 4 negative responses. A general review of the water program is being made in AB and changes may result. BC is developing new health-based guidelines. MB expects to introduce changes. SK will probably lower the turbidity level. NF may consider changes. ON reported it does not expect to change from its current (new) levels. Quebec did not respond.

USA: There were 2 positive responses and 1 negative response received. Pennsylvania expects to have final regulations in place in 2002 to provide primacy on Public Notification requirements. New York reported changes are planned, that would bring the State into conformity with the US EPA rules, and align it with the other States. Wisconsin reported it was not expecting to introduce new rules.

Other: There were 4 positive responses and 8 negative responses. Austria indicated a technical review would be taking place that may result in changes. The Caribbean indicated new regulations, but did not disclose their nature. France indicated changes maybe made specifically within the Seine-Maritime region. As a result of the EU Directive The Netherlands have changed the Law in the beginning of 2001. Sweden indicates that the EU Directive will be made law on December 23, 2003. It is possible that other European countries may have to change as a result of the EU Directive, but did not report it.

Are the above requirements (actual or contemplated) specifically linked i.e., to a combined low chlorine/chloramine residuals and a high turbidity event? If so, how are they linked?

Canada: There were 2 positive responses covering 2 Provinces and 8 negative responses. Most provinces indicated that there has been no link made between a low chlorine and a high turbidity event, however, some indicate that on a pragmatic basis, the two objectives would be considered together should they occur. BC indicated that Health Officers with their greater future role, may link residual levels and turbidity levels in deciding what actions may be taken. In Ontario as a matter of procedure, when turbidity exceedences are reported to the MOE's Spills Action Centre (where notice is required to be provide under O. Reg. 459/00), MOE officers also request confirmation of chlorine residuals taken at the time of turbidity analysis. This information is then relayed to district (field) offices for evaluation of further action to be taken. An Ontario utility indicated that it did so by internal practices.

USA: There was 1 positive response and 6 negative ones. New York indicated that it will consider this in a forthcoming review of public health objectives. Pennsylvania indicated that although there is no link, the two should be considered when a turbidity problem is detected.

Other: There was only 1 positive response, the rest were negative. The Caribbean noted that chlorine demand will be higher with a high turbidity. The UK reported even though there was no link, a disinfection failure during a high turbidity event would be considered a more serious situation requiring more rapid action depending on the history of the site. The South Africa responses indicate that while there is no formal link, there is an operational link, which would increase the chlorine level when there is an increase in the final water turbidity as a precautionary measure.

Are any of the above requirements specific to source water types (ground, ground under surface influence, surface)? If so, in what way?

Canada: There were 2 positive responses and 7 negative responses. In some provinces, groundwater sources may be treated less stringently: BC requires disinfection of all surface water systems, but allows disinfection (by the local health authorities) for groundwater; PE does not require disinfection, MB waives the contact time requirement for groundwater. ON adjust the frequency of monitoring and reporting of monitoring results. Quebec has differential requirements for surface water and ground water under the influence of surface water and for ground water.

USA: There were 7 positive responses and 1 negative response. The US Surface Water Rule specifically applies to surface water sources and to systems using Ground Water under the direct influence of surface water. In addition, as mentioned above, EPA is currently in the process of developing the Ground Water Rule to expand coverage and microbial protection to systems using only ground water. Wisconsin alone reported that all water sources are treated equally.

Other: There were 2 positive responses and 15 negative responses. Despite Finland's lack of disinfection requirements (considered as a negative response), it notes many of its water sources are shallow wells under surface influence, hence they emphasize UV disinfection at source as the means of protecting public health. In the UK there are no distinctions, although the regulations governing Cryptosporidium are based on risk analysis which is influenced by the character of the water source. In Germany and the Netherlands, both ground and surface water are used, but the no-disinfectant rule applies to both - the focus is on producing microbiologically stable water. Israel and South Africa note

that some sources are high turbidity sources and they are treated differently from others.

Is automated disinfection and turbidity level monitoring required by regulation or by procedure? If so, describe.

Canada: There were 5 positive responses and 2 negative responses. BC indicates that this is procedural only, with encouragement given to larger systems only to move to this level of monitoring; no regulatory requirement is planned. ON can require this on a site by site basis through the Certificate of Approval, and does require continuous chlorine residual monitoring on all surface water systems. PE reports no plans to require this. Quebec requires automated monitoring of turbidity level after each filter unit of a surface water treatment plant. Automated monitoring of free residual chlorine for all continuous chlorinated water treatment plants is required along with an ability to switch to back-up chlorination if a failure occurs.

USA: There were 6 positive responses and no negative responses. US EPA regulations and most States, e.g. Colorado and Illinois require continuous monitoring of chlorine residuals and turbidity with provisions that for systems serving less than 3300 persons with a malfunction can substitute grab samples every four hours. Minnesota and USEPA plan additionally in 2002 to require for systems greater than 10,000 persons that each filter be monitored and in 2004, this requirement will be extended to all surface water systems. New York plans to move to this condition of full monitoring. Pennsylvania is moving to bring its requirements into line with the US EPA rules. Wisconsin requires continuous disinfection monitoring but does not require continuous turbidity monitoring; it notes that most systems do so already.

Other: There were 5 positive responses and 7 negative responses. Austria reports that there is no general requirement, but it does require continuous monitoring of UV systems and frequent monitoring of Ozone systems. France requires automated systems by procedure, not regulation. Israel requires continuous or frequent monitoring of chlorine levels, but not turbidity levels, although it notes in practice, there is continuous monitoring of both. Japan has no requirements, but notes that there is automated monitoring in practice in many utilities. In Finland, although there are no requirements, in practice most large systems do automated monitoring, even in groundwater systems by agreement with the local Health Authority. Germany links this to the frequency of microbiological sampling (i.e. if you want to reduce the frequency). Spain requires continuous monitoring when groundwater wells are started up (in drought seasons). Sweden has no requirement to use continuous monitoring, but many of the larger plants do so as a matter of practice. Sweden also notes that when the new EU rule comes into effect, December 23, 2003, automated monitoring of chlorine and turbidity on surface water source plants will be required. The UK notes automatic monitoring of residuals is required, but that automatic monitoring of both is an accepted practice by the water companies.

If automated monitoring of disinfection or turbidity results in detection of ranges outside the required levels, is there a requirement for pumping systems to be shut down as an automatic response?

Canada: There was 1 positive response (applicable to a utility as an internal multiple sourced system measure) and 9 negative responses. In BC there is no such requirement, but there is a requirement for all water works to have an emergency response plan that would address any potential health hazard -

shutting down ONE source is often one response, but shutting down all sources is not considered appropriate unless there are adequate reserves in the system to maintain services. Public advisories would be the normal response. In MB, the Town of The Pas has a raw water turbidimeter tied into supply pumps that shut down automatically, although operators can over-ride this (while they are on site) if conditions necessitate. St. John's NF, would consider this if their system were supported by more than one source, however their current three source systems are not inter-linked and the system would never be shut down. Ontario notes that it can be required on a site-by-site Certificate of Approval basis. The City of Ottawa notes they have automatic chlorine and turbidity monitors on all their sources, with alarms and in some cases with automatic switching between sources, while investigations take place as to the cause; however, monitoring and maintenance of system pressures is paramount. PE indicates that such shut down systems might be suitable on multiple sourced systems or systems with adequate in-system storage. Quebec has no requirement for shut down, but does have an alarm for a manned response (investigation and remedial measures).

USA: There was 1 positive response (applicable to multi-sourced systems) and 2 negative responses. Illinois reports that automatic shut down is required for unfiltered surface water systems - however such systems no longer exist in the State. They would not consider a shut down requirement due to loss of fire protection and the dangers of back flow present far greater problems. Minnesota would consider this only on a case-by-case basis. Wisconsin states that most of its systems are manned on a 24/7 basis. For systems that are unmanned at night, low chlorine levels result in a system shut down and an emergency call to the standby operator. In some cases Pennsylvania requires only that an alarm alert the operator to the out-of-range levels so that remedial action can be taken.

Other: There were 3 positive responses (related to multiple sourced situations only) and 8 negative responses. Austria allows shutdowns for highly alkaline water that is turbid or for UV failure, but within a multi-source context. France requires warnings not shutdowns, unless supplies can be maintained from other sources. One UK Water Company reports automatic shutdowns for chlorine and alarms for turbidity. Another reports automatic shutdowns for both conditions, but notes that the chlorine shut down points can vary from system to system. In Germany there are redundant in-plant disinfection systems and systems do shut down when the disinfection level has not been achieved. Dutch plants have a permanent surveillance (and alarm systems) on turbidity but generally no disinfection. In Spain there is an alarm in case of low disinfectant residual but wells are not automatically shut down. In Israel, if a particular source has a history of turbidity peaks, then shut downs may be made on those sources automatically, but not otherwise. In Japan, source switching takes place automatically, but system delivery is maintained. In Australia a range of responses are planned that can include sending unchlorinated water to waste, but it does not include shut down of pumps and depressurization.