Guidelines to improve DPR treatment processes

Reliability, redundancy, robustness, and resilience – the 4Rs – are key aspects of guidelines developed to improve the resilience of direct potable reuse (DPR) treatment processes. **Kelsey Beveridge** of The Water Research Foundation reports on the results of a research project that aims to protect the integrity of DPR processes and ensure water quality.

A failure of treatment processes at facilities is a risk that cannot truly be eliminated, yet an upset in a treatment train can result in costs to the facility as well as potential public health risks. Ensuring a safe water supply is a top priority for utilities, and potable water reuse can offer a sustainable and dependable water supply if systems are designed and operated properly. Establishing guidelines for resiliency in direct potable reuse (DPR) process trains from wastewater source through advanced water treatment is vital to protect the integrity of the process and the quality of the product water.

A project by the former Water Environment & Reuse Foundation (now The Water Research Foundation), "From Collection Systems to Tap: Resiliency of Treatment Processes for Direct Potable Reuse" (Reuse-14-13), developed guidelines to improve the resilience of DPR treatment processes. This research was led by Dr. Sharon Waller of Sustainable Systems LLC, along with Patti Craddock of Short Elliot Hendrickson and Dr. Stuart Khan of the University of New South Wales.

Wastewater, stormwater, and industrial wastewater can include organic or inorganic contaminants that pose a risk. Therefore, characterizing the quality of these waters is an important step for communities considering DPR. The research team adapted four aspects, previously identified by Dr. Brian Pecson and others at Trussell Technologies, to characterize assets and determine their effectiveness: reliability, redundancy, robustness, and resilience (the 4 Rs) to characterize treatment processes:

- *Reliability:* Ability to provide water that meets and consistently exceeds treatment objectives for public health protection
- *Redundancy:* Use of measures beyond the minimum requirement to ensure treatment
- *Robustness:* Ability of a potable reuse system to resist catastrophic failures and to address a broad variety of contaminants and changes in concentrations in source water through a combination of treatment technologies
- *Resilience:* Ability of treatment trains to successfully adapt to failure through rapid recovery (i.e., emergency response plan, mutual aid agreements, and backup power capacity).

Evaluating treatment assets in terms of these characteristics can help predict whether an asset will be able to delay or prevent a hazardous event. In this case, hazardous events could be a process upset, wastewater source variability, natural disaster, or dependence on a third-party vendor for power, data communication, and equipment. When a hazardous event occurs, the source discharge may impact a treatment process if proper procedures are not in place. Among these procedures is process monitoring that can help ensure resiliency by detecting an upset before it becomes a threat to public health. To ensure the ability of monitoring to identify upsets, such mechanisms should be installed as far upstream as possible. These measures give a facility enough time to recognize a failure and react accordingly before it moves further down the treatment train.

In application, resilience should be considered at two levels: first, for the utility as a whole; and second, for specific hazardous event. A utility resilience index measures the utility's ability to adapt to an incident and quickly return to normal operations.

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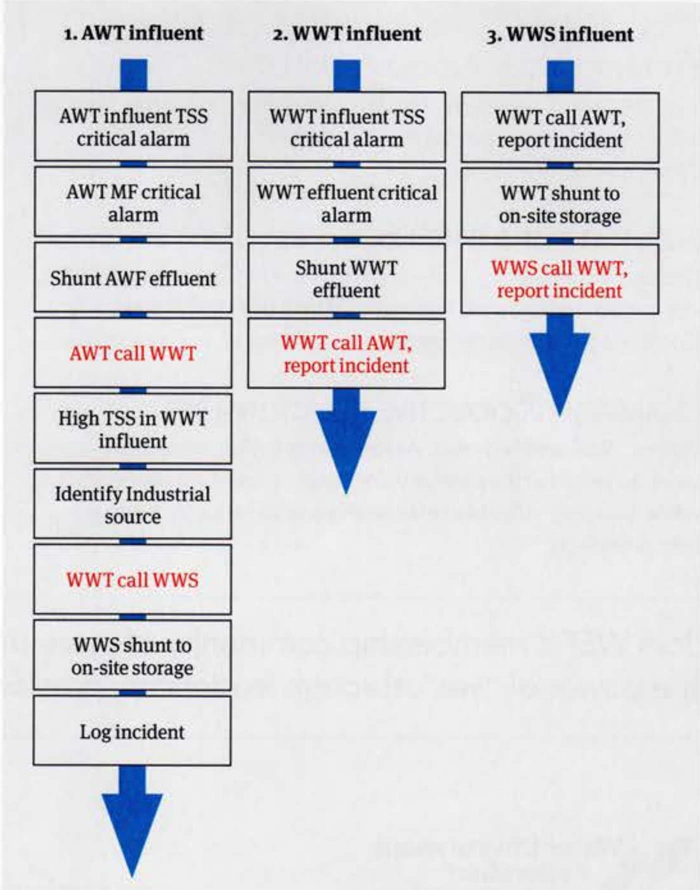
Taking historic trends into account can also help utilities better predict hazardous events and identify potential correction options based on the 4 Rs.

The research team used different treatment trains as process examples including membrane-based treatment with reverse osmosis and non-membrane treated based on ozone and biofiltration. The team presented different hazardous events that can occur during membrane treatment and how the 4 Rs can be used to ensure a proper response to treatment upsets and



Example of a communications flow chart that can be used to identify various scenarios that may require intra-agency communication and any potential differing communication points of contact that may be useful for agencies.

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improve resiliency. For example, if online monitoring fails, it can result in membrane damage due to additional chemicals or over-pressurization of membrane fibers. To prepare for and correct this problem, replacement analyzers can be kept onsite to replace a deficient sensor, develop cross-checking processes for monitors of related contaminants, and ensure that correction factors such as temperature and pH are properly applied. For instance, a treatment plant in Wichita Falls, Texas, United States, monitors filtrate turbidity of each microfiltration train independently but also provides a second turbidity monitor in the combined microfiltration train. This process demonstrates redundancy, where the failure of one monitor does not put the entire treatment train at risk.

In the United States, drinking water and wastewater are commonly treated separately and in many cases managed by different agencies. The DPR water cycle has three stages—wastewater source control, wastewater treatment, and advanced water treatment – and can be complicated if these stages are managed by different agencies. Under a One Water paradigm, these treatment steps would ideally be operated by the same agency. Until then, there needs to be a concerted effort between agencies to monitor and communicate failures as they arise, especially if a risk is posed to public health. Guidance on communications has previously focused on public communication to build consumer trust, but there is a gap in information regarding a communication process between agencies, particularly during hazardous events.

This project featured Australian agencies that have established a system to detect DPR treatment failures and communicate with other agencies that are involved with other phases of the treatment process. Together, they adopted an inter-agency approach to communication, which has proved integral to maintaining the effectiveness and safety of treatment systems. Seqwater is the scheme manager of the Western Corridor Recycled Water Scheme (WCRW), along with users of advanced treated water. Sequester, the Queensland Government statutory authority that provides drinking water supply for 3.1 million people across South East Queensland, Australia, is also the water service provider responsible for the receiving body, Lake Wivenhoe, for augmentation of drinking water supply for the Scheme and the associated drinking water treatment plants.

In its current role, Seqwater is responsible for reporting and following audit obligations under the Water Supply (Safety and Reliability) Act 2008. It schedules regular meetings to encourage communication and information flow between stakeholder groups. The Water Supply Act also mandates that facilities part of the Scheme report incidents that would impact the supply of feed water. For instance, if Queensland Urban Utilities becomes aware of an incident that impacts its ability to supply feedwater of quality or another event that presents unacceptable risk to the WRCW Scheme, it is required to notify the scheme manager, determine where the error is, and request a formal investigation into potential causes.

Such communications protocols can be vital during hazardous events to facilitate proper response among the affected agencies to ensure that public health is not put at risk. The report for this project provides a framework for these protocols and other procedures to ensure that upsets to a treatment process or other events outside the control of a utility do not upset overall utility operations.

Author's Note
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