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Division of Drinking Water, Recycled Water Unit
State Water Resources Control Board
P.O. Box 100
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Subject: **Comment Letter: A Proposed Framework for Regulating Direct Potable Reuse in the State of California**

Dear Ms. Rosilela

I am writing this letter on behalf of Separation Processes, Inc. and as a registered Professional Engineer in the State of California who is experienced with advanced water treatment processes and its associated State of California regulations. For the past 38 years, Separation Processes, Inc. (SPI) has been involved in the piloting, design, start-up and operational support of drinking water and recycled water facilities that use membrane technologies such as microfiltration (MF), Ultrafiltration (UF) and reverse osmosis (RO). SPI has made contributions to publications regarding membrane technology for USEPA, AWWA and WE&RF. SPI, like many others in the environmental and engineering community, has eagerly awaited the development of the above document which will be referenced as the DPR Framework.

This letter assumes the reader is familiar with the basic terminology and concepts associated with IPR/DPR and the acronyms contained in the DPR framework.

Our comments will focus on some of the underlying issues and terminology that are contained in existing regulations that should be addressed in the development of subsequent DPR regulations. From our experience from with working with the existing regulations and IPR facilities, there are areas where improved definition is needed to more accurately reflect the level of treatment. In the context of this letter, Advanced Treatment (AT) is used to describe water of wastewater origin that has treated through the reverse osmosis / advanced oxidation process (RO/AOP). AT water, which no longer exhibits the characteristics of its origin, is used as for Subsurface Injection and proposed Surface Reservoir Augmentation Projects. AT water represents the basis of treatment contained in the DPR Framework.

Comment 1: Address the technical misnomer associated with the regulatory term "diluent" water.

Explanation: Existing water quality data from IPR facilities suggest that for the overwhelming majority of chemical constituents, it is the water quality of the receiving water that is being improved (diluted). The use of the term diluent is misleading as it implies that the water from an IPR/DPR is of lesser quality and that is not the circumstance based on the available data.

Comment 2: Recognize that there is a natural disconnect between the Wastewater and the AT process.

Explanation: Wastewater treatment facilities are designed to accommodate peaking events associated with rainfall and variations in flow. An AT facility is normally designed for base loading with a constant rate of production. This disconnect (decoupling) provides an important element of separation and provides an additional risk and safety mitigation feature that appears to have been overlooked in the DPR Framework. Upsets can occur in wastewater processes for a variety of reasons, and the ability to isolate or bypass an AT facility is an important element of the overall design.

Comment 3: Evaluate the impact of AT on the receiving water.

Explanation: The use of AT will improve the overall quality of the receiving water. However, because of the water quality differences, the consequential impacts need to be identified to evaluate changes in surface water facility operation. This includes, but is not limited to coagulation chemistry, disinfection by product formation and corrosion control strategies. Under a flange to flange scenario there should be mixing (reservoirs) and limits for attenuation of water quality since the underlying water chemistry can be substantially different.

Comment 4: Be more specific as to the type of water and level of treatment required that may be eligible for use under the DPR scenario.

Explanation: Under current IPR regulations, the minimum treatment process prior to AT is oxidation. Not all secondary treatment processes produce the same quality of water. It may be beneficial to further categorize the three types of secondary effluent; (e.g. oxidized, nitrified, and nitrified/denitrified), and require membrane filtration (MF-UF) for turbidity and pathogen control. Conceptually, filtration/ disinfection could be used, however that is unlikely given the known water quality and operational differences. It may be appropriate to consider adding a nitrogen requirement or specify an additional process (e.g. ozone/BAC) for lesser quality water that is to be processed for subsequent DPR use as part of the risk mitigation strategy. The underlying rationale is that the diagram shown after page 38 indicates AT++ after the AT process, whereas a more appropriate treatment location may be before the AT process. As a practical matter, it is the general consensus that there are fewer engineering and operational issues with the use of a more highly treated secondary effluent before AT. Furthermore, the issue of short term chemical peaks raised in the DPR Framework may have been mitigated with a higher level of secondary treatment.

Comment 5: Consider the use of Treatment Techniques Credits in lieu of Log Removal Value (LRV) calculations.

The current State of California regulatory framework requires the cumbersome calculation of LRV for pathogen removal credits on an on-going basis when it is well established that under normal operations these requirements are exceeded. The data for RO indicates that greater than 4-log pathogen removal is obtained. There is difficulty associated with demonstrating 2-log removal with the common surrogate indicators using current methods of calculation. The same rationale exists for proposed facilities that would use MBR to obtain pathogen removal credits, although it is recognized that the issues are different.

It is well established at the Federal (USEPA) level that treatment processes may receive credit as a treatment technique. A common membrane related reference associated with the issue can be found in the SWTR Guidance Manual (pg. 104).

> "Reverse osmosis is a membrane filtration method which is used for desalination and/or removal of organic contaminants. The treatment process is effective for the removal of Giardia cysts and viruses and no such demonstration is necessary."

There are numerous examples of treatment techniques within the drinking water framework (e.g. virus removal by coagulation/flocculation/sedimentation). The use of a Treatment Technique approach would facilitate implementation and address the on-going compliance challenges.

Comment 6: Probabilistic Risk Analysis models should be based on the maximum reduction below the LRV and not the complete failure of an individual treatment process.

Explanation: Treatment process are not binary (all or nothing) in nature. In the event of non-compliance, significant removal is still obtained. In a typical facility, failure normally occurs at the unit, not system level. Overall process removal may be exceeded by the performance of other units operating above the removal requirement. Models that use a binary approach for risk analysis simply do not exist in practice, and will produce misleading results.

A risk assessment is important when evaluating unknown circumstances. It is important to recognize that there may be another way to approach this issue. Operational data associated with existing IPR/AT facilities can be used to better quantify risk and process vulnerability issues. These facilities have exhibited very high reliability, and are the underpinning of the proposed DPR Framework.

The MF-UF/RO/AOP process has been in operation at IPR/AT facilities for approximately 10 years. The PATTP data associated with operational facilities can be used to confirm reliability under actual conditions, categorize the events affect treated water quality, and project compliance under a DPR framework. Because of the concern about pathogen removal, occurrence information on membrane integrity and advanced oxidation system reliability should be developed and used for risk analysis.

The DPR Framework raises the issue of short term chemical peaks. A more methodical analysis of existing facilities is required to further quantify/qualify these events to determine occurrence, magnitude and response alternatives under the DPR scenario. Previously, there was an extensive discussion of this issue by the Expert Panel. However, it should be pointed out that the event was detected using existing methodology that has a sample frequency of every 4 minutes. Inherent to the AT process, is the ability to identify constituents that would not have been detected in a drinking water facility.

Comment 7: As a minimum, Drinking Water concepts should be used as the basis for the monitoring in AT facilities.

Current regulatory requirements for filtration are based on an average over 24 hours or exceedance of a "maximum limit at any time". Compliance with drinking water monitoring requirements is based on exceeding 2 consecutive readings at 15 minute intervals. It is suggested that this point to point definition be used or an alternative definition be established to define compliance in the DPR Framework. SPI participated in the WRF Project 13-03, and Chapter 7 discusses the issues associated with point to point versus other type of monitoring compliance strategies.

Filtration process within drinking water facilities are regulated at the unit and system level. This requirement is an accepted practice that assures water treatment objectives are obtained.

There are numerous examples where drinking water and recycled water definition and practice are different. (e.g. T_{10} versus modal contact time for disinfection). The use of the drinking water standard as a basis for monitoring is suggested, and other concepts could also be incorporated to characterize performance. For example, the results of the disinfection/inactivation profile would convey the actual level of pathogen removal/ inactivation achieved under the DPR Framework.

Comment 8: Establish water quality limits based on anticipated treatment process performance, not maximum MCL's.

Explanation: The use of MCL's as a basis of regulatory compliance has been the historical approach for the permitting AT water quality, and results in a significant discrepancy between the average water quality produced and the permit level. The tables published in Annual Reports indicate that compliance is easily obtainable. However, this approach reveals a scenario whereby a facility could be operated within its permit and produce water that would be associated with unacceptable operating practice. Thus, it is suggested that the permit levels be established at a level that reflects the water quality that would be consistent with proper operational practice. Permit requirements should reflect the anticipated performance over the operational lifetime and would initiate membrane and/or lamp replacement when required. Removal of EC as percentage is a simple yet effective way to accomplish this objective for RO.

Fundamentally, it is more appropriate to characterize the performance RO using percentage removal. The use of maximum limits can pose challenges for some facilities, and be inconsequential for others. The TOC requirements are one such example and a percentage removal basis in lieu of the 0.25 mg/L/0.5 mg/L requirement is more appropriate.

Under this scenario, it is important to understand that requirements have to be developed for each process. For example, RO performance is affected by membrane age, water temperature, membrane cleaning, and start-up shut down.

Comment 9: Consider linking integrity monitoring requirements to pathogen removal credits

Explanation: Fundamental to the operation of membrane and AT processes is the monitoring of integrity. A review of current regulations suggest that State may be relying too heavily on the individual operational monitoring plan to address specific integrity related issues. Since the monitoring techniques are known for membrane filtration (direct integrity testing), reverse osmosis (conductivity profiling and others) and advanced oxidation (UVT/lamp function/age and dose), it may be beneficial to require ongoing integrity verification as a part of the DPR framework that reflect good operational practice. The following table is offered as a suggestion as to how a monitoring could be associated with a DPR facility using a tiered approach based on pathogen removal credit.

Pathogen Removal Credit	*Monitoring Frequency*
2 log	Monthly or by Approved Surrogate
3 log	Weekly
4 log	Daily
> 4 log	Continuously

Comment 10: Maintain water quality after AT prior to the point of mixing.

Drinking water treatment requires operation of the distribution system until the point of consumption. A basic source water characterization of the effluent quality from an IPR facility would indicate is suitability for use as a drinking water supply. In a DPR flange to flange scenario, the maintenance of water quality (e.g. disinfection residual, corrosion control, coliform testing) is essential, and a similar strategy should be adopted.

Final Comment

In summary, proper operation of any type of water treatment facility is fundamentally dependent upon focusing on four elements; 1) effective pretreatment, 2) proper operation, 3) regular process monitoring, 4) periodic and preventive maintenance. We recognize that additional treatment or risk mitigation strategies may be required for DPR facilities. However, requirements should be based on occurrence information that is available, or can be developed through the evaluation of existing operational data. Under some circumstances engineering and operation strategies may be sufficient to mitigate risk. There are many components associated with the AT process, the requirement for additional treatment should be based on necessity to satisfy treatment objectives and should not be used as backstop to address a deficiency associated with proper operation. Simplicity of operation can be more reliable than complexity when issues arise.

Please contact me if you have any questions.

Respectfully submitted for your consideration,

James C. Vickers

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Vice President