



Agenda Report

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SUBJECT:

SUPERCRITICAL WATER OXIDATION RESEARCH OPPORTUNITY

GENERAL MANAGER'S RECOMMENDATION

RECOMMENDATION: Recommend to the Board of Directors to:

- A. Approve a Professional Services Agreement to 374Water Systems, Inc. for the Supercritical Water Oxidation Demonstration at Plant No. 1, Project No. RE21-01, to provide goods and services for demonstration of the 374Water AirSCWO Nix6 System, for an amount not to exceed \$5,139,000; and
- B. Approve contingency funds for Project No. RE21-01 for a combined total not to exceed \$514,000 (10%).

BACKGROUND

The Orange County Sanitation District (OC San) collects and processes 185 million gallons of wastewater every day. Cleaning this water results in concentrated solids called sludge and scum. These energy rich solids are processed through anaerobic digestion to create methane-rich gas and biosolids. The methane-rich gas is cleaned and used in the treatment plants to make electricity and heat. Biosolids are the residual material commonly used in the agricultural industry as a soil amendment.

OC San continues to actively pursue management options to maintain a long-term program that promotes beneficial use of biosolids. In accordance with the principles of its biosolids management policy (Resolution No. OCSD 13-03), OC San maintains a diverse portfolio of biosolids management options that utilize multiple contractors, facilities, and product markets, while maintaining fail-safe, back-up options. This portfolio ensures that we have reliable options for managing the material should regulations, market conditions, severe weather, or other situations impact any one management option.

Most of OC San's biosolids are either composted to create a soil amendment or directly applied to agricultural land. Consistent with our policy to maintain diverse biosolids options, staff has been actively researching new and innovative technologies. For example, in July 2021, OC San entered into an Agreement with the Rialto Bioenergy Facility for a pilot project to process up to 100 tons per day of its biosolids in a thermal conversion process.

Staff has also been following a new technology for solids treatment for several years that takes advantage of a unique property of water at high temperature and pressure. The technology presents an opportunity to convert all complex organic material (including plastics and PFAS) to more basic and benign compounds like nitrogen, water, carbon dioxide, and mineral salts.

A new company, 374Water Systems, Inc. (374Water), with a novel, simpler process design, is moving to scale-up the process technology from a one-ton-per-day unit patented and operating at Duke University in North Carolina. Assistant General Manager Rob Thompson witnessed the operation of the unit in North Carolina in May. Staff is in discussions with 374Water to engage in a research program to scale up and operate a six-ton-per-day unit and, if successful, potentially a thirty-ton-per-day unit. These first of their kind units at these flow rates will require testing under real-world wastewater plant conditions. Staff believes it is worth pursuing a demonstration scale project due to the process and mechanical simplicity.

It is also important to note that this process will only treat concentrated solids streams, not the entire water flow. Part of the research process will be to document the ability of the system to destroy plastics, PFAS type compounds, and other constituents of emerging concern that can be concentrated in sludge streams. The proposed research/demonstration program would be capable of treating raw primary and secondary sludge, biosolids, and food waste.

OC San has a long history of researching new and innovative technologies to improve wastewater treatment and resource recovery. OC San's budget contains a Master Research Program line item which can be found on page A-9 of the Fiscal Year 2021-22 Budget Update. This line item is the intended funding source for this research opportunity.

RELEVANT STANDARDS

- Provide technology leadership to the wastewater industry
- Search for technology solutions to neutralize constituents of emerging concern
- Maintain a culture of improving efficiency

PROBLEM

OC San's Biosolids Master Plan, Biosolids Policy, and 2019 Strategic Plan support diversification of biosolids management options including researching new technology. Potential future regulations could target emerging pollutants such as PFAS compounds present at low levels in biosolids and could require treatment or destruction of PFAS in biosolids.

PROPOSED SOLUTION

In continuing OC San's course of providing leadership and innovation with the evaluation of emerging technology, staff recommends entering into an Agreement with 374Water to demonstrate the efficacy of the supercritical water oxidation process by procuring and operating an AirSCWO Nix6 Demonstration Unit as part of Project No. RE21-01.

TIMING CONCERNS

OC San has a unique opportunity to team with 374Water to demonstrate this emerging technology with a six-ton-per-day process unit. As part of the shared commitment with 374Water, the costs for supplying, commissioning, operating, and maintaining this unit are significantly discounted. Initiating this project now will demonstrate OC San's commitment to this emerging technology and will provide guidance for the planning and implementation of solids treatment processes in the future.

RAMIFICATIONS OF NOT TAKING ACTION

N/A

PRIOR COMMITTEE/BOARD ACTIONS

November 2021 - Operations Committee requested additional information regarding this item.

July 2021 - Operations Committee Information Item.

ADDITIONAL INFORMATION

The site and utilities work for this project will be designed by 374Water under this Agreement. The execution of the Public Works site and utilities work will be competitively bid by OC San under a separate procurement.

Staff presented a research opportunity to the Operations Committee in November 2021. The Committee discussed the issue in some detail and directed staff to bring back additional information about the commercial terms regarding the opportunity. Staff has continued to work with 374Water to refine and improve the commercial terms to the Agreement to reduce OC San's risk and improve the reward for investing in this technology.

The proposed demonstration scale installation has the potential to solve several challenges facing OC San. These challenges include solids processing costs, air emissions requirements for methane and power generation equipment, and emerging contaminants such as PFAS compounds and microplastics, food waste utilization, and efficient use of OC San's treatment plant properties.

Staff has been working with 374Water and its partners to share the risk and rewards associated with moving from the previous 1-ton per day pilot unit to a 6-ton per day demonstration scale facility (Nix6). The proposed Agreement deal points include:

On the risk side of the ledger:

- OC San pays \$900K for the sludge preprocessing unit which represents 374Water's costs with reduced profit for the sub vendor.
- OC San pays a reduced cost for engineering of the facility integration plans.

- OC San will withhold 25% of the equipment cost from the progress payments until the unit operates successfully for 1,000 hours.
- OC San pays the anticipated future “mass produced price” of the unit in an amount not to exceed \$2.2 million. It is estimated that 374Water’s price for the demonstration unit will be \$3.5 million. This provision limits OC San’s risk. 374Water plans to invest \$1.3 million to develop this first Nix6 unit, but 374Water must invest what is necessary to make the unit functional at no additional cost to OC San.

On the reward side of the ledger:

- OC San receives perpetual, royalty free use of the Intellectual Property for all future purchases of Air Supercritical Water Oxidation units from 374Water.
- OC San gets to fully test and understand the ability of the technology to destroy emerging contaminants.
- OC San gets to validate the operations and maintenance costs, opportunities, and limitations of this new technology. This is important for long-term solids processing planning in the future. OC San will be spending hundreds of millions of dollars on solids processing and energy production in the next 20 to 30 years.
- OC San has the opportunity to sell back the Nix6 portion of unit to 374Water for list price. This can be used for a credit toward the purchase of a larger, 30-ton- per-day Nix30 upgrade should the demonstration plant work successfully.
- OC San gets the benefit of processing 6 tons per day of solids during the testing cycle. Staff project that the cost for biosolids processing will be roughly equivalent and the cost to treat raw sludge will be \$100 per ton more for Air Supercritical Water Oxidation. This is due to the economies of scale in the treatment plant and the unoptimized nature of the initial Nix6 unit.

The point of investing to scale up this technology is to position OC San to solve the technical problems it is facing in the long term. Our research program is focused on solving problems faced by our operations. Past research includes:

- An 800kw fuel cell that produced transportation hydrogen from digester gas.
- A sludge cell destruction technology to improve the digestibility of sludge.
- Water scrubbing of Digester Gas.
- Odor control chemical addition techniques (resulted in a Patent).
- Central Generation Engine dual catalyst on digester gas (allowed us to keep our engines).
- Enzyme additions to break up scum blankets.

These investments, whether the technology was successful or unsuccessful, have been beneficial in helping to guide our capital program decision-making. The successes and failures are important learning opportunities at a small scale. It is important to keep in mind that OC San makes about 550

wet tons per day of biosolids. Which means that we settle out closer to 1,400 wet tons of raw solids that are sent to our digesters. Learning at small, demonstration scale and scaling up is critical to managing risk, rather than jumping into a full-scale installation. Some technologies fail initial small-scale testing, some fail scaling-up, and some deliver in ways never expected.

At the November 2021 Operations Committee meeting, staff was asked to look into potentially negotiating an equity stake in 374Water to share in future revenues, should the demonstration scale facility prove successful. Looking into this possibility, staff found that some public utilities have established a separate corporation to retain an equity stake in private ventures. OC San has not established such an entity and moving into this presents a public agency like OC San with several challenges. This will require significant legal analysis to form a final opinion, which has not yet been done.

In addition, there may be limited value for pursuing this complicated commercial relationship since the underlining patented technology is owned by Duke University with 374Water licensing and selling packaged Nix6 units. 374Water has agreed to pay all licensing fees and provide any developed intellectual property to OC San for free on all future Air Supercritical Water Oxidation purchases.

CEQA

The project is exempt from CEQA under the Class 6 categorical exemptions set forth in California Code of Regulations Section 15306. A Notice of Exemption will be filed with the OC Clerk-Recorder after OC San Board approval of the Professional Services Agreement.

FINANCIAL CONSIDERATIONS

This request complies with authority levels of the OC San Purchasing Ordinance. This item will be funded through the Research Program (M-RESEARCH) and has been budgeted. (FY2021-22 Update, Appendix A, Page A-9).

<u>Date of Approval</u>	<u>Contract Amount</u>	<u>Contingency</u>
12/15/2021	\$5,139,000	\$514,000 (10%)

ATTACHMENT

The following attachment(s) may be viewed on-line at the OC San website (www.ocsan.gov) with the complete agenda package:

- Draft Agreement
- Presentation