STATEMENT OF WORK

For

COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENT

Between

The United States Environmental Protection Agency

National Exposure Research Laboratory

And

Water Gen

Title of Project

Goal

The goal of this collaboration is to facilitate the potential use of atmospheric water generators (AWGs) in expanding the availability of water during shortages, contamination events and other interruptions of service. Specific objectives are to assess the quality of produced water and any potential health risks (Task 1) and to identify scenarios where AWGs may provide a viable drinking water source (Task 2). This will ensure sustainable implementation of AWG in a manner protective of human health and in a cost-effective way.

Approach

Task 1: Water Quality Analysis of AWG Condensate

Given the nature of AWGs, high quality produced water is anticipated. The primary health concern is opportunistic pathogens, such as *Legionella* spp. and *Mycobacterium* spp. that are commonly associated with drinking water infrastructure. Untreated condensate and produced water (*i.e.*, including any internal treatment within AWG units) will therefore be analyzed using cultivation-based and molecular methods (qPCR) to detect and quantify organisms of these

species. In addition, next-generation sequencing (metagenomics) will be used to identify any additional risks and to compare the microbial community to that occurring in other water sources. Standard water quality parameters (*e.g.*, pH, conductivity, total dissolved solids, heterotrophic plate counts) and water chemistry (*e.g.*, trace metals, major ions, VOCs) will be monitored to ensure suitability of produced water for potable and non-potable applications. Samples will either be collected by the Cooperator and shipped to the Laboratory for analysis (preferred), or collected from AWG test units to be installed at Laboratory facilities by the Cooperator. Weekly samples of both untreated condensate and produced water will be monitored for a period of three months (approximately 24 samples per AWG unit); however, a larger number of samples could be analyzed at additional cost. Samples will be taken from AWG units that have been in operation for a minimum of one month (or longer per Operator experience) to avoid potential start-up effects.

Laboratory Responsibilities: Provision of laboratory facilities; personnel; analytical equipment and reagents; and technical expertise.

Cooperator Responsibilities: Provision of AWG test units and/or water samples (both untreated condensate and produced water) for analysis; the latter is preferred. If AWG units are provided, untreated condensate within the units must be accessible and the Cooperator will provide necessary installation and operation guidance. To avoid unnecessary duplication, the Cooperator will provide results of any water quality analyses performed in-house.

Task 2: Life Cycle Assessment of AWG Application Scenarios

Description of what types of analyses will be done.

To better understand the feasibility and marketability of AWG, the comparisons with other alternative innovative emerging technologies on a consistent economic basis will provide valuable quantified contrasts, predict most cost-effective solutions and offer more in-depth evaluations. Holistic approaches such as comparative life cycle assessment (LCA) and life cycle costing (LCC) provide tools to measure the trade-offs involved in various AWG scenarios and the opportunity to optimize cost benefits. Data inventory of various AWG system will be developed to assess the life cycle costs and energy impacts for the AWG system used under different scenarios

Objectives:
1) To develop data inventory and operating parameters of selected commercial AWG systems under various scenarios. The life cycle cost and energy analysis requires the consideration of capital investment (including the manufacturing and installation stages) and operating inputs (such as energy, chemicals, labor services and maintenance) for both the AWG system and the treatment alternatives compared. In order to compare all alternatives on a consistent economic basis, the life cycle cost analysis considers the full-time capital and annual operating costs over the planning period (for example, one year continuous operation) to present the present worth/value. ORD's OpenLCA database provides the needed background unit processes for the complete analyses. 2) To create broad comparative framework to assess innovative technology

such as AWG and alternative options under different scenarios and provide understanding of the trade-offs involved and the opportunity to optimize cost benefits. In specific scenario analyzed, the systems that aid AWG as alternative water source may require additional unit processes (i.e., disinfection/sterilization, storage, distribution) and provide/deliver reliable potable water to the end users. The system analysis will include the life cycle inventory of all processes involved to shed lights on the direct and indirect impacts of the innovative technology.

Laboratory Responsibilities: Provide the scenarios to be evaluated; background unit process database in OpenLCA database for the complete analyses: summarize the findings in peer review publications.

Cooperator Responsibilities: Provide all necessary data regarding capital investment (including the manufacturing and installation stages) and operating inputs (such as energy, chemicals, labor services and maintenance, and cost) of AWG. In addition, provide the corresponding site specific climate and meteorological conditions under which AWG units are operated. If applicable, provide relevant data inventory of other unit processes that are required for providing safe and reliable potable water under different scenarios identified.

Task 3: Presentation of Results

Describe how and where results will be presented (e.g., at a workshop).

Laboratory Responsibilities: Summarize the findings in peer review publications (journal articles or EPA reports) and provide public outreach such as webinar or technology workshops.

Cooperator Responsibilities:

Resources
Laboratory
The Laboratory will contribute technical assistance, logistical support, and analysis of samples. This will include use of EPA facilities, supplies, equipment, and personnel.

Estimated total in-kind contributions (TBD)
Estimated total cash contributions $50,000

Cooperator

The Cooperator will provide AWG units and/or samples for analysis at EPA facilities. The Cooperator may also contribute technical assistance and supporting research (including use of facilities, personnel and supplies), as needed.

Estimated total in-kind contributions $
Estimated total cash contribution (if any) $

Deliverables

Identify specific deliverables and the timeline for delivery. This includes the number of days or months for each task from date of final approval of the Agreement.

For example:

Need to define timeline.