NOTICE OF INTENT TO AWARD

This Funding Announcement is not a request for applications. This announcement is to provide public notice of the Bureau of Reclamation's intention to fund the following project activities without full and open competition.

ABSTRACT	
Funding Announcement	R11AC80538
Project Title	Concentrate Stream Modeling & Electromagnetic Effects on Crystallization
Recipient	University of Colorado at Boulder
Principle Investigator / Program Manager	Dr. Dr. Pellegrino Pellegrino, Ph.D. Research Professor Department of Mechanical Engineering University of Colorado Boulder, 427 UCB Boulder, CO 80309
Anticipated Federal Amount	$81,000
Cost Share	$0
Total Anticipated Award Amount	$81,000
New Award or Continuation?	New
Anticipated Length of Agreement	1 year
Anticipated Period of Performance	1year
Award Instrument	Cooperative Agreement
Statutory Authority	Omnibus Public Land Management Act of 2009, Public Law 111-11, Subtitle F-Secure Water, Sec. 9504b
CFDA # and Title	15.507
Single Source Justification Criteria Cited	Unique Qualification –Dr. Pellegrino has unique technical expertise related to membrane separations and the kinetics of crystallization and behaviors of complex aqueous solutions. He is widely recognized as the leading expert in this area, evidenced by the fact that he was chosen to review a new handbook published by NIST on aqueous electrolytes. Furthermore, based on reviews of literature relevant to this project, no other researchers have progressed as far as Dr. Pellegrino in understanding the effects of electromagnetic fields on membrane processes
Reclamation Point of Contact	Michelle Maher, Grants Officer Phone: 303-445-2025 Email: mmaher@usbr.gov

OVERVIEW

Purification of sea and brackish water create new sources of water that enhance the nation's conventional water supplies. The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. Water desalination assists Reclamation in achieving its mission with greater success, and is becoming critical for Reclamation to achieve its mission in managing and developing water.

The concentrate generated from membrane desalination contains the particulates and salts that were removed from the feed water. The volumes of these concentrate streams can be anywhere from 50% of the total feed for seawater desalination and up to 15% of the total feed for brackish water desalination. Concentrate disposal is even more difficult in inland areas where ocean discharge cannot be used. Minimization, disposal and management of concentrate streams are necessary to reduce waste disposal costs and increase water production efficiency.

Currently no tool exists to comprehensively model concentrate streams and accurately predict their behavior as the concentrate streams are further dewatered and are reaching super-saturation points. Identification of such a tool can aid researchers in developing better unit operations to manage, reduce, and reuse concentrate streams. Recent research finding suggest that the use of electromagnetic fields on concentrate streams affect the rate of crystallization of sparingly soluble salts. Research is needed to understand how and why magnetic fields affect concentrate streams so that they can most appropriately used to control the kinetics of crystallization in membrane processes to further increase membrane product water recovery. This research will provide valuable insight into the kinetics of crystallization in reverse osmosis concentrate streams and investigate technologies and methodologies that can be used to increase water recovery in membrane processes. The objectives of this project are to validate concentrate models with data from literature and experiments, and characterize and quantify effects of electromagnetic fields on crystallization.

RECIPIENT INVOLVEMENT

Task 1: Compare predicted and observed phase behavior for complex aqueous electrolyte mixtures

The OLI software model is highly regarded in the oil and gas industry for its complex aqueous electrolyte modeling capabilities and has not yet been tested in the water treatment field. A critical evaluation of the strengths, weaknesses, and opportunities for improvement of available modeling tool, with respect to the usefulness for complex aqueous electrolyte systems of interest to the desalination industry needs be made. In addition to evaluating the modeling software, this task will include using the best-available modeling tool to develop

feasible process conditions and configurations for high-efficiency concentrate handling, defined as economically-attractive combinations of waste volume reduction and increased product water recovery.

To support the software evaluation task, comparisons of real streams and OLI modeled streams need to be made. Verification of the model at each stage will lead to a more comprehensive confirmation of the software and its capability. It will provide us with the software's weaknesses and suggestions can be made to the software manufacturer to better improve the software's capability. Parallel to verifying the software with the above process, the model will also be validated by using data from literature about crystallization of salt from sea water. There are a lot of published data on physical properties of water removal from complex aqueous mixtures of seawater.
Once the model is verified, it can then be used to test various conditions that saturation and super-saturation of salts such as calcium sulfate, calcium carbonate and various other salts in the mixture can be driven to precipitation by changing physical and/or chemical properties of the mixtures. These changes could be in the form of pH, temperature, pressure and/or other properties. The relationship between compositions and phase separations observed in experimental data need to be studied against what is predicted by the simulation software at equilibrium to examine the effect of kinetic factors.

Task 2: Describe and quantify the effects of pulsed power electromagnetic (PP-EM) fields on scaling in reverse osmosis (RO) systems

The purpose of this task is to understand how the PP-EM fields affect scaling in RO systems. Bench scale testing will be conducted to measure differences in RO performance with and without PP-EM. Membrane material characterization will be performed in order to characterize the structure of precipitated salt on RO membranes with and without PP-EM fields. A novel real-time, non-invasive, in-situ device will be developed and validated to measure the particle size distribution of salt crystals formed in the RO concentrate. This device will allow us to observe the effects of the process operating conditions on salt crystallization kinetics. Operating conditions such as flow rate, pH salt concentration, and exposure time to the EM field are believed to impact the effectiveness of the hybrid PP-EM/RO process.

A final report will be written summarizing the findings of this study.

RECLAMATION INVOLVEMENT

Substantial involvement on the part Reclamation is anticipated for the successful completion of the objectives to be funded by this award. In particular, Reclamation will be responsible for the following:

a. Reclamation shall collaborate and participate with the Recipient in the management of the project and oversee the Recipient’s activities to ensure that the program objectives are being achieved.

b. Reclamation will provide field assistance or review to support the project.

c. This oversight shall include review, input, and approval at key interim stages of the project as identified in the Recipient's proposal.

SINGLE-SOURCE JUSTIFICATION

DEPARTMENT OF THE INTERIOR **SINGLE SOURCE POLICY REQUIREMENTS**
Department of the Interior Policy (505 DM 2) requires a written justification which explains why competition is not practicable for each single-source award. The justification must address one or more of the following criteria as well as discussion of the program legislative history, unique capabilities of the proposed recipient, and cost-sharing contribution offered by the proposed recipient, as applicable.
In order for an assistance award to be made without competition, the award must satisfy one or more of the following criteria: (1) Unsolicited Proposal – The proposed award is the result of an unsolicited assistance application which represents a unique or innovative idea, method, or approach which is not the subject of a current or planned contract or assistance award, but which is deemed advantageous to the program objectives; (2) Continuation – The activity to be funded is necessary to the satisfactory completion of, or is a continuation of an activity presently being funded, and for which competition would have a significant adverse effect on the continuity or completion of the activity; (3) Legislative intent – The language in the applicable authorizing legislation or legislative history clearly indicates Congress' intent to restrict the award to a particular recipient of purpose; (4) Unique Qualifications – The applicant is uniquely qualified to perform the activity based upon a variety of demonstrable factors such as location, property ownership, voluntary support capacity, cost-sharing ability if applicable, technical expertise, or other such unique qualifications; (5) Emergencies – Program/award where there is insufficient time available (due to a compelling and unusual urgency, or substantial danger to health or safety) for adequate competitive procedures to be followed.

Reclamation did not solicit full and open competition for this award based the following criteria:

(4) UNIQUE QUALIFICATIONS

Single Source Justification Description:

Dr. Dr. Pellegrino Pellegrino has unique technical expertise and extensive experience and knowledge relating to membrane separations and the kinetics of crystallization and behaviors of complex aqueous solutions. He is widely recognized as the leading expert in this area, evidenced by the fact that he was chosen to review a new handbook published by NIST on aqueous electrolytes. Furthermore, based on reviews of literature relevant to this project, no other researchers have progressed as far as Dr. Pellegrino in understanding the effects of electromagnetic fields on membrane processes. Dr. Pellegrino's unique expertise in both of these areas is vital to the success of this multi-disciplinary project.

This project stems from previous collaborative efforts between the Bureau of Reclamation and University of Colorado. A few years ago, we worked with Dr. Pellegrino to conduct preliminary testing of an electro-magnetic device using a Reclamation test skid. Dr. Pellegrino conducted additional work with a private company related to electromagnetic/reverse osmosis (RO) hybrid systems. He has prior experience in using various complex aqueous mixture software models, including OLI Systems software. Dr. Pellegrino can utilize the knowledge gained from these previous efforts however since there are no publically available reports on this work, it would not be possible to transfer this knowledge to another researcher. Even if this information was publically available, the cost and time to educate another researcher would be prohibitive to completing this work on time.

Dr. Pellegrino has access to test set-ups and instruments that are required for this work. For most research efforts, dedicated equipment is customized to meet the specific objectives of the work. The time required to design, construct, and calibrate a new test system would be prohibitive to accomplishing this research effort within the budget and schedule required. Dr. Pellegrino also has access to OLI software license reducing the cost associated with acquiring the software at Reclamation or at another institution. OLI is simulation software for electrolyte chemistry.

The University of Colorado is the only university within 30 miles of the Denver Federal Center that has the access to the equipment and instrumentation required to complete this project, namely an electromagnetic device, dedicated and customized membrane test system, membrane characterization equipment (SEM, zeta potential), and access to a resources and expertise necessary to develop an ultrasonic device for quantifying crystallization kinetics.

Dr. Pellegrino is the only researcher that can conduct the work outlined in the project scope within the budget and time schedule required. His unique combination of past experience, access to equipment, instrumentation, and software is necessary. Additionally, Dr. Pellegrino contributed to the previous research that founded the basis for this new project, therefore, his knowledge and expertise are critical to the continued success of this research.

STATUTORY AUTHORITY

Public Law 111-11, Omnibus Public Land Act of 2009 Subtitle F-Secure Water, Sec 9504b.

(b) RESEARCH AGREEMENTS.—

(1) AUTHORITY OF SECRETARY.—The Secretary may enter into 1 or more agreements with any university, nonprofit research institution, or organization with water or power delivery authority to fund any research activity that is designed—

(A) to conserve water resources;

(B) to increase the efficiency of the use of water resources; or

(C) to enhance the management of water resources, including increasing the use of renewable energy in the management and delivery of water**.**