REQUEST # GC9130239

Reduced Use of Water in Onshore Oil and Gas Operations

RESPONSE DUE DATE: September 24, 2015

OPPORTUNITY & FINANCIALS:
Total prize pool of up to $500,000 USD available in the form of initial cash prizes (from an initial prize pool of up to $125,000 USD) and a discretionary pool of development funds (of up to $375,000 USD).

Up to 5 winning respondents will each receive an initial cash prize of $25,000 USD. Each winning respondent also will have an opportunity to receive additional funding for a six (6) month period (from a total prize pool of up to $375,000 USD) to continue further development and/or commercialization of respondent's Entry technology provided winning respondent enters into a mutually agreeable business relationship with Grant Sponsors which includes an agreed upon plan for guided funding.

TIMELINE:
Entries must be submitted by September 24, 2015 at 5pm Eastern Time.
Winners will be announced on or about the end of November 2015.

SUBMIT AN ENTRY
SEE OFFICIAL RULES

POWERING COLLABORATION
GE Statoil

MANAGER: Alfred T. Malouf, Ph.D.

QUESTIONS?

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REQUEST FOR PROPOSAL DESCRIPTION

GE and Statoil are seeking to use less fresh water for the production of oil and gas in onshore operations.

Focus areas for this Challenge include:

1. **Onsite treatment of Produced/used water.** Recovered water often is too salty to recycle or reuse for beneficial purposes without treatment. *Wastewater treatment technologies are needed that can cost-effectively reduce the concentration of sodium chloride ("NaCl") and other dissolved salts from recovered /processed water*. The recovered water may be treated either to a moderate level that can be reused for drilling new wells or treated to a higher level of purity that will allow it to be used by nearby towns, businesses and agricultural communities. The waste streams from any treatment would preferably be non-toxic and/or a source for producing or extracting valuable product(s).

2. **Inject less water downhole during production/inhibit halite deposition in pipes.** Oil and gas production must be halted to remove salt deposits from blocked pipes and other equipment when insufficient water is injected to prevent halite (crystalline NaCl) precipitation. The returning saline water cools as it approaches the surface, which in turn reduces salt solubility and enhances its precipitation and scaling. Injecting excess water or electric heating of pipes can reduce scaling but these approaches are

either expensive or not sustainable. *New technologies are needed to increase salt solubility and/or minimize salt deposition in tubing so that less water can be injected downhole while maintaining high production rates for oil and gas*.

BACKGROUND

GE and Statoil are collaborating to accelerate the development of more environmentally friendly and economically sustainable oil and gas production. The current Challenge focuses on finding innovative technologies that will maintain or increase the production of oil and gas while using less water. To achieve this goal, the Sponsors of this Challenge seek novel ways to efficiently and cost-effectively clean and reuse water (Focus Area 1) or to use less fresh water during production (Focus Area 2). Together, these two approaches could substantially reduce the amount of fresh water currently required to produce oil and gas.

APPROPRIATE RESPONSES TO THIS CHALLENGE

Responses from companies (small to large), academic researchers, other research institutes, consultants, venture capitalists, entrepreneurs, or inventors are welcome.

Appropriate responses will address the following:

- **Brief non-confidential description of proposed technology**:
  - Scientific background supporting the proposed technology
  - Preliminary non-confidential evidence
- **Technical maturity of approach**
- **Expertise and capabilities of responder** (include any relevant prior projects or experiences)

ENTRY GUIDELINES AND REQUIREMENTS

Entries will serve as an introduction to respondent's technology and expertise and should address the following:

The approach set forth in your Entry should have a commercialization timeline ranging from one (1) to five (5) years, be able to demonstrate proof of concept (which may include feasibility studies, prototypes, etc.) within 6 to 24 months while solving for one or more of the following Focus Areas:

FOCUS AREA 1

1. **Reduce fresh water use and wastewater disposal: wastewater treatment options to reuse water for either drilling operations, hydraulic fracturing operations or other beneficial uses** *(Your Entry may address Focus Area 1a only, 1b only, 1c only, 1 d only or a combination of several)***:**

   a) **Wastewater treatment technology to produce water that is clean enough to reuse for drilling new wells**. The technology should not produce any toxic waste products. Your Entry should provide a non-confidential explanation of how the proposed technology will reduce salts - total dissolved solids (TDS) in wastewater to levels that will allow it to be reused for completing new wells or to use as maintenance water during production in an environmentally friendly way. The proposed technology should be able to accomplish all of the following:

      a. Reduce TDS from up to 300,000 mg/L TDS to <30,000 mg/L;
      b. Reduce concentrations of the below listed constituents to:
         i. Ca 400 mg/L,
         ii. Ba 50 mg/L,
         iii. Mg 400 mg/L,
         iv. SO_4 250 mg/L,
         v. Sr 50 mg/L,

vi. Oil and grease <35 mg/L (10 mg/L preferred);

c. Process between 50 – 1,500 barrels / day (1 barrel = 159 liters) or greater volumes;
d. Be currently or able to achieve commercial viability and sustainability within the timeframe mentioned above;
e. Be environmentally friendly and produce no toxic byproducts.

b) **Wastewater treatment technology to produce clean water** for surface water discharge, agricultural irrigation or other beneficial uses for local communities and businesses. Your Entry should provide a non-confidential explanation of how the proposed technology will reduce salts - total dissolved solids (TDS) in wastewater to levels that will allow it to be surface discharged or reused by local communities. The proposed technology should be able to accomplish all of the following:

a. Reduce TDS from up to 300,000 mg/L TDS down to <500 mg/L TDS;
b. Process between 50 – 1,500 barrels / day(1 barrel = 159 liters) or greater volumes;
c. Be currently or able to achieve commercial viability and sustainability within the timeframe mentioned above;
d. Reduce oil and grease levels <35 mg/L (10 mg/L preferred);
e. Be environmentally friendly and produce no toxic byproducts.

c) **Technology extracting valuable products waste fluids from wastewater treatment technologies** (1a and/or 1b). In order to make a wastewater treatment solution more economically viable, it would be preferable to combine any treatment technology in 1a) and 1b) with a technology to extract or produce a valuable product (.e.g. hydrochloric acid, sodium hydroxide, potassium carbonate, lithium, rare earth elements and more).

d) **Real time water analysis system**. Your Entry should provide a non-confidential explanation of how the proposed technology provides real-time water analysis system to quantify the amount of NaCl, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), and other anions and cations. An onsite treatment unit should be able to use this information to determine appropriate treatment protocols required to produce water that is clean enough for reuse. The goal is to reduce produced water trucking and disposal into wastewater disposal wells. Automated or semi-automated processes are preferred.

Suitable approaches for 1a), 1b) and 1c) may include (but are not limited to):

- Ion exchange media
- Energy efficient evaporative technologies
- Ultrasonic technologies
- Nanotechnologies
- Electrochemical
- Electromagnetic
    - Infrared heating
    - Microwave heating
- Renewable energy (e.g., heat pump/temperature differential, solar, wind)
- Glow plasma discharge
- Ion concentration polarization
- Adsorption desalination
- Clathrate hydrates
- Self-cleaning or easy cleaning filters
- Additives (*should either be effective in small quantities or reusable*)
    - Bio-based materials
    - Polymers
    - Dendrimers
    - Aptamers
    - Chemicals
    - Resins
    - Clays

Suitable approaches for 1d) may include (but are not limited to):

- Ion sensitive electrodes (ISE)
  - Technologies to prevent fouling of electrodes
- Selective ion exchange
- Crystallization
- Graphene oxides
- Lab-on-a-chip
- MEMS
- Microfluidics
- Colorimetrics
- Spectroscopy
- Optics
- Computer Software Interface
- Other Software

FOCUS AREA 2

2. **Inject less water downhole during production by preventing scaling by halite**
   Your Entry should provide a non-confidential explanation of how the proposed technology prevents pipes from being blocked by salts and salt crystals without adding fresh water. Non-Confidential data to support the proposed technology's ability to prevent salt deposition in tubing is strongly encouraged. The technology should accomplish all of the following:
   - Prevent salt deposition in tubing:
     - Increase the solubility of NaCl,
     - Technologies that prevent salt from adhering to tubing;
   - Exhibit little or no toxicity;
   - Exhibit little or no disruption to oil and gas production.

Suitable approaches for improving salt solubility or prevent scale on tubing may include (but are not limited to):

- Anti-scale coatings for pipes
  - Abrasion resistant to sand
- Mechanical scale removal
- Ultrasonic technologies
- Nanotechnologies
- Electrochemical
- Electromagnetic
  - Infrared heating
  - Microwave heating
- Renewable energy (e.g., heat pump/temperature differential, solar, wind)
- Additives *(should be effective in small quantities or reusable*)
  Combination of approaches

Approaches Not Of Interest:

- Halite inhibitors currently used by oil and gas industry

SUBMITTING A RESPONSE

All Entries must be submitted online at NineSights, the NineSigma open innovation community, according to the instructions in the Response Template. Supplemental files may be submitted in additional to the response itself.

For assistance, please contact the Solution Provider Help Desk (grandchallenge@ninesigma.com).

RESPONDING TO THIS CHALLENGE

By submitting an Entry, respondents agree to the Official Challenge Rules, which include but are not limited to the following requirements:

Confidentiality
Respondents confirm that their Entry does not contain any confidential information.

Selection and Review Process
Respondents acknowledge that GE and Statoil reserve the sole and absolute right and discretion to award prizes as stated in the Challenge, including awarding prizes to less than five (5) respondents.

The Judging and award determination will be made by an internal GE and Statoil team.

See Official Rules for details. Contest opens on July 7, 2015. Must submit at least one Entry by September 24, 2015 to be eligible. Must be 18 years of age or older to participate. No purchase necessary. Void where prohibited.

Awards and Opportunities
A total prize pool of up to $500,000 USD available in the form of initial cash prizes (from an initial prize pool of up to $125,000 USD) and a discretionary pool of development funds (of up to $375,000 USD) will be awarded by GE and Statoil as described below:

Up to five (5) respondents will each receive an initial cash prize of $25,000 USD.

Each winning respondent also will have an opportunity to receive additional funding for a six (6) month period (from a discretionary pool of development funds of up to $375,000 USD) to continue further development and/or commercialization of respondent's Entry technology provided the winning respondent enters into a mutually agreeable business relationship with Grant Sponsors which includes an agreed upon plan for guided funding.

Additional Developmental Funding:

Allocation of the additional development funding from the discretionary development pool of up to $375,000 USD will be determined based upon, but not limited to, the following considerations: degree of innovation, level of commercial readiness, nature of the technology, total number of winners continuing to co-development stage, experience and expertise of winning respondent.

An agreed upon plan to guide the development funding will be required. The agreed upon guided funding plan will need to define scope, co-development/commercialization objectives, co-development relationship, timeline and deliverables for the six (6) month funding period, and will also require submission of a final report at the conclusion of the funding period,. This final report must summarize results, compare outcomes to the initial proposed results, and, ideally, show proof of concept.

Upon completion of the 6 month funding period, Grant Sponsors may, at their own discretion and based on the merits of the proposed technology, explore funding further development and/or commercialization and/or purchase or licensing of the winning technology. In addition, Grant Sponsors may consider technologies with which might require longer than 24 months to show proof of concept.

ADDITIONAL INFORMATION

Table 1. Parameter ranges in processed water (mg/L)

Analyte	Lo	High
Chloride	27,118	210,000
Sulfate	6	40
Barium	20	35,000
Calcium	400	50,000
Iron	10	6000
Strontium	10	9,000
Sodium	17,000	170,000
Potassium	200	5,500
Magnesium	20	12,000
pH	5	8
Total Dissolved Solids (TDS)	35000	350,000
Total Suspended Solids (TSS)	5	1,100
Hardness as Calcium Carbonate	7,000	60,000
CO2 (Dissolved)	250	600
HCO3	40	550

NOTE:
Wastewater / Produced water =
Flowback + production water