1 April 2019

MEMORANDUM

TO: Potential Project Stakeholders

FROM: Ann P. Smith, P.E.; Richard L. Bowers, P.E.; GSI Environmental Inc. (GSI)

RE: Request for Participation - *Quantification of Methane Emissions from Marginal (Small Producing) Oil and Gas Wells Project (DOE NETL DE-FE0031702)*

In order to promote appropriate policy making decisions, GSI Environmental Inc. (GSI) is soliciting your participation on an important new study under the U.S. Department of Energy to inform the regulators, the regulated community and others on the relative scale of methane emissions from marginal vs. non-marginal oil and gas wells.

We are seeking data, access to field sites, supplemental funding and/or technical steering committee participation to ensure that study results are unbiased, representative and appropriate to support recent and future proposed amendments to EPA's New Source Performance Standards (NSPS, 40 CFR Part 60, Subpart OOOOa).

This memorandum summarizes the scope and objectives of our study. Please consider the potential value of this study to all public and private stakeholders, and contact us regarding your questions, concerns and interest in supporting this important study.

BACKGROUND

The Environmental Protection Agency (EPA) issued a final rule on June 3rd 2016 (subsequently modified on 11 September 2018) to amend the New Source Performance Standards (NSPS, 40 CFR Part 60, Subpart OOOOa) to reduce methane emissions from new and modified oil and gas facilities. These Standards no longer exempt "low production well sites" (aka marginal or small wells), defined as sites with oil wells that produce <15 bbl per day or gas wells that produce <90 MCF per day, from Leak Detection and Repair (LDAR) requirements. Compliance with these regulations may impact all producers but, in particular, will affect small oil and gas operators of the ~785,000 marginal wells located throughout the United States. EPA's decision to not exclude marginal wells was based on limited methane emissions data. Therefore, a robust unbiased study is needed to quantify methane emissions from non-marginal wells.

Marginal (low producing) gas well in Clay Basin, UT

On 22 October 2018, the Department of Energy – National Energy Technology Laboratory (DOE NETL) selected *Quantification of Methane Emissions from Marginal (Small Producing) Oil and Gas Wells,* for award to GSI Environmental Inc. (GSI) to measure and compare methane emissions from marginal and non-marginal well sites at various basins across the United States. The project will involve i) compilation and evaluation of data from published studies and operators, ii) field measurement of methane emissions from marginal and non-marginal wells, and iii) identification of opportunities to reduce marginal wellsite emissions. As is typical and critical on all DOE NETL projects, technology transfer activities will be facilitated during the course of the project to convey results and gain feedback from critical stakeholders.

OVERALL PROJECT PLAN

The project will be completed within 16 months. Up to three basins, depending on funding availability, will be measured during this study. Basins will be selected considering criteria such as oil-to-gas ratio, wet vs dry gas or other variables. Depending on the availability of additional funding, Field Campaign C could be expedited as long as final data usability is not compromised.

The project includes the following major tasks:

- robust data source assessment to identify critical data gaps;
- Master Workplan to specifically address key data gaps and, accordingly, direct the overall approach of the field data collection, evaluation and reporting process;
- field campaigns in up to three major U.S. region/basins (Regions A/B/C);
- data processing and analysis; and
- Comprehensive Project Report to summarize study activities, results and conclusions.

DATA SOURCE ASSESSMENT AND MASTER WORKPLAN

A robust data source assessment will be completed to address key data gaps and improve understanding of marginal and non-marginal well methane emissions. Key subtasks include:

- Literature survey of published, peer-reviewed scientific articles to assess quantity, quality, representativeness and usability of data from previous studies;
- *Blind* survey of oil and gas producing companies on key site characteristics, metrics and (optional) activity data (*i.e., names of industry participants, locations of sites and site characteristics will remain confidential and will not be provided to anyone outside of the GSI project team*);
- Development of GIS-linked/enabled database of usable data from literature and operator survey;
- Identification of gaps in current understanding of emissions from marginal vs. non-marginal wells.

Specific data we will obtain from oil and gas marginal and non-marginal well facilities includes:

- General location information (site names, identification numbers, County, State and Basin location, Well type (e.g., natural gas, oil))
- Well condition (e.g., storage, injection, producing, shut-in, plugged, abandoned)
- Equipment types and counts (e.g., wells, separators, compressors, storage tanks, dehydrators, flares, thermal conductors)
- Equipment characteristics (e.g., age, size)
- Production rate (e.g., bbls of oil, MCF gas)
- Existing emissions control devices (e.g., vapor recovery units, flares, enclosed combustion devices)

The results of this assessment will support development of a Master Workplan for the remainder of the study to formulate scientific questions to be answered, refine project objectives/scope, if needed, and identify emissions source characterization/classification criteria, site selection criteria, emissions screening and measurement technology options and selection criteria, to establish appropriate levels of accuracy, representativeness and statistical power of data among different regions.

Critical Outcome/Action/Deliverable: *Identification of specific scientific questions to be answered, and/or hypotheses to be tested, during highly focused field investigations. Report combining data source assessment and Master Workplan. Technical steering committee calls with stakeholders to communicate results and solicit feedback.*

SITE/TECHNOLOGY SELECTION AND FIELD CAMPAIGN WORKPLAN – REGIONS A/B

Populations of desirable/candidate regions/basins (e.g., Permian, Appalachian, Uintah, Illinois, Anadarko) will be identified based on operator survey results, geographic factors and other available information, such as publically-available well production data, and screened for selection. GIS algorithms will be used to optimize field site selection, based on criteria established in prior tasks, relevant candidate site attributes (e.g., numbers/types of emission sources), and applicable time and geographic constraints (e.g., geographic distribution, and travel times from site to site,) and to minimize any potential bias.

The key to this approach is the focused, statistically-based selection of *representative* field sites to be included for screening and measurement. We will seek to maximize the representativeness of region-wide emissions estimates from marginal vs. non-marginal oil and gas wells by the optimum selection of sites. Appropriate screening and measurement methodologies will be selected based on the nature and magnitude of specific emission sources for which data are needed.

Critical Outcome/Action/Deliverable: *Region-specific data collection and analysis protocols, health and safety and QAQC plans. Meeting with site owner/operator representatives (via Regional steering committees) and other stakeholder advisory groups, as necessary, to review results and proposed activities.*

FIELD CAMPAIGN - REGIONS A/B

Field campaigns in Regions A and B (to be determined) will include a survey of selected producing well sites to detect, classify, count, and quantify emissions from representative populations of key sources. We expect to characterize emissions from 100 to 200 well sites over a period of five to seven weeks in each region with the goal of applying resultant data to estimate region wide marginal vs. non-marginal well emissions. Actual numbers of well sites where emissions are screened and measured will be dictated by the specific technology employed, the distances among target well site locations, and other possible factors, which may vary by site/region.

A field team of approximately four researchers will characterize populations and the frequency of emissions from key emissions sources at each type of well site. This survey will include a census of all pertinent emission sources (e.g., major equipment components, storage tanks and, if possible, episodic events such as liquids unloadings, based on operator-provided information) and a qualitative screening for observed emissions, comparable to what is performed for a typical LDAR program to first identify leaking sources. Emissions measurements will be carried out by qualified field measurement/data collection teams from participating subcontractor universities using specific measurement methods and technologies determined in prior tasks.

Critical Outcome/Action/Deliverable: *Emissions screening and measurement data from representative populations of marginal vs. non-marginal wells sites in each region.*

DATA PROCESSING AND ANALYSIS – REGIONS A/B

All collected field data will be compiled and validated per applicable quality assurance/quality control (QA/QC) procedures to assess its usability for further analysis in the estimation of representative emissions estimates for each type of well site. Depending on the needs of the study, data will be grouped into related clusters, statistical probability distributions will be determined, and appropriate statistics (e.g., 95% confidence intervals) will be calculated using standard parametric or nonparametric procedures in order estimate equipment or process-specific and/or total methane emission rates from observed operations and activities.

Critical Outcome/Action/Deliverable: *Characterization of region-wide frequency and magnitude of marginal vs. non-marginal wellsite emissions. Technical steering committee calls with stakeholders to communicate results and solicit feedback.*

SITE SELECTION AND FIELD CAMPAIGN WORKPLAN – REGION C

Depending on available funding, a third desirable/candidate region/basin (Region C) will be identified for study similar to Regions A/B. Appropriate screening and measurement methodologies will be selected based on the nature and magnitude of specific emission sources for which data are needed in this region. Depending on the availability of resources, Field Campaign C could be expedited as long as final data usability is not compromised.

Critical Outcome/Action/Deliverable: *Region-specific data collection and analysis protocols, health and safety and QAQC plans. Meeting with site owner/operator representatives (via Regional steering committees) and other stakeholder advisory groups, as necessary, to review results and proposed activities.*

FIELD CAMPAIGN – REGION C

The field campaign in Region C will mirror those in Region A/B incorporating any changes identified at the end of campaigns A/B, as long as they maintain consistency and usability of data. Qualified field measurement/data collection teams from participating subcontractor universities will be engaged based on comparable prior field experience, ability to provide comparable equipment, and geographic proximity to the studied region.

Critical Outcome/Action/Deliverable: *Emissions screening and measurement data from representative populations of marginal vs. non-marginal wells sites in region.*

DATA PROCESSING AND ANALYSIS – REGION C

All collected field data will be compiled and validated in a process similar to Region A/B data, incorporating any changes identified at the end of campaigns A/B, as long as they maintain consistency and usability of data.

Critical Outcome/Action/Deliverable: *Characterization of region-wide frequency and magnitude of marginal vs. non-marginal wellsite emissions. Technical steering committee calls with stakeholders to communicate results and solicit feedback.*

COMPREHENSIVE PROJECT REPORT

The combined study results over all investigated regions (A, B, and C), including operator-provided activity data, frequency of emissions from key sources, and the magnitude of such emissions based on measurements collected at representative fractions of each type of emitting source, will be analyzed and interpreted, as a whole, to assess possible regional differences and,

if feasible, make predictions regarding marginal vs. non-marginal well site emissions in other oil and gas producing regions not included in this study. In addition, study conclusions will focus on opportunities to reduce marginal wellsite emissions at minimal cost so that marginal well production can remain economically viable.

Critical Outcome/Action/Deliverable: *Technical steering committee calls with stakeholders to discuss key findings and conclusions of the study. Final report summarizing and comparing emissions among significant marginal and non-marginal well site populations in all regions. Meeting with site owner/operator representatives (via Regional steering committees) to review methane emission results and sources.*

TECHNOLOGY TRANSFER

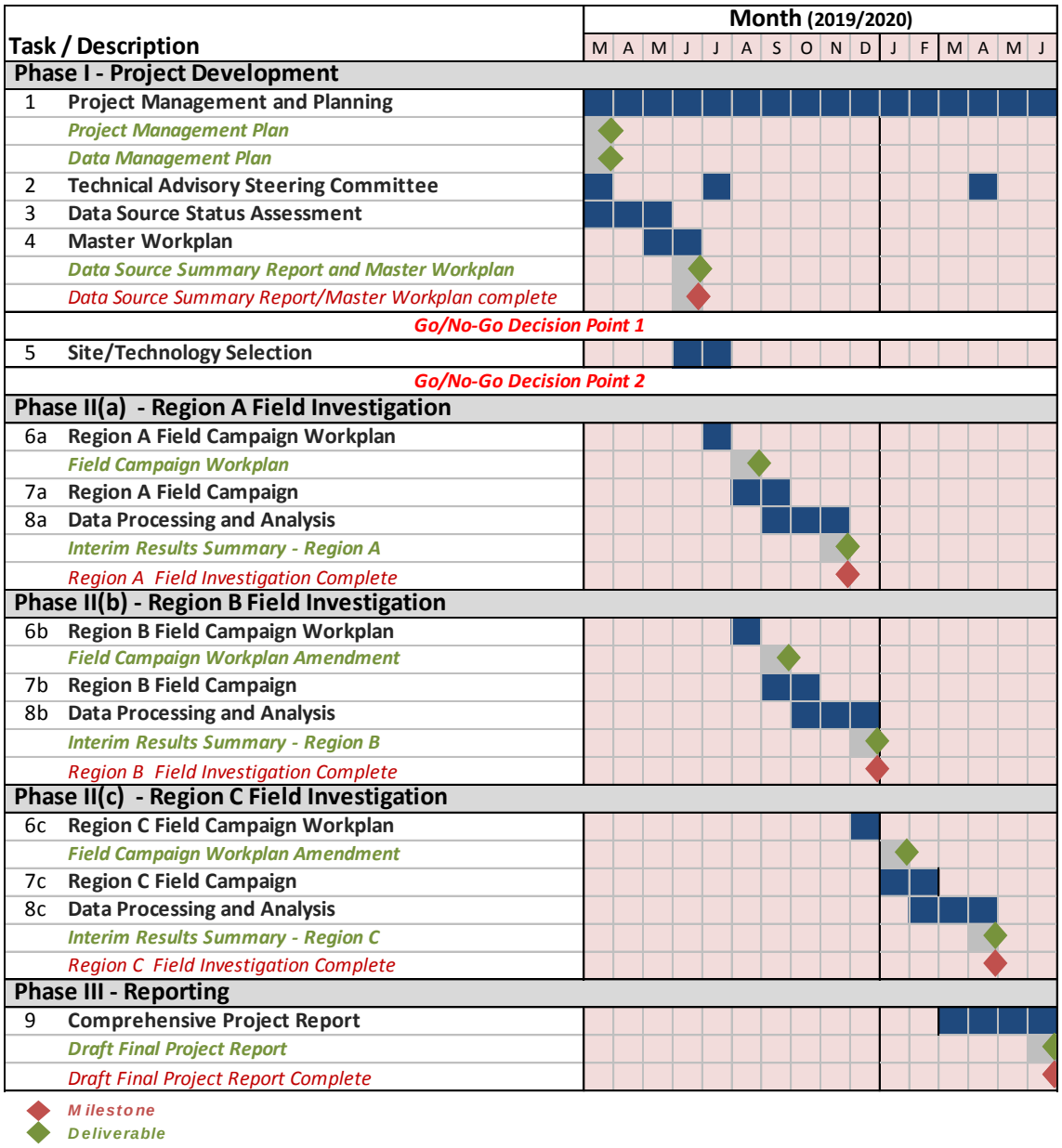
GSI's ultimate goal for technology transfer is to transfer knowledge from this project to industry, regulatory bodies, environmental organizations, research community, and the general public through the following activities:

- Publication of peer-reviewed technical papers (team, annually).
- Presentations at conferences and workshops (team, multiple events annually).
- Public education through academic institutions (CSU, USU etc.)

PROJECT SCHEDULE

The project is being funded by DOE-NETL to investigate up to three regions, depending on funding availability, over a duration of 16 months in accordance with the following schedule of tasks, milestones, and deliverable documents.

Project Schedule



PLEASE CONTACT US FOR MORE INFORMATION ON PARTICIPATION

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