Statement of Project Objectives
Marcellus Shale Energy and Environment Laboratory (MSEEL)
Revised July 28, 2015

A. OBJECTIVES

The objective of the Marcellus Shale Energy and Environment Laboratory (MSEEL) is to provide a long-term field site to develop and validate new knowledge and technology to improve recovery efficiency and minimize environmental implications of unconventional resource development.

B. SCOPE OF PROJECT

The MSEEL site will provide a well-documented baseline of reservoir and environmental characterization. Access to multiple Marcellus wells separated by sufficient time to analyze data will allow for the collection of samples and data, and the testing and demonstration of advanced technologies. The project's phased approach allows for flexibility to identify and incorporate new, cost-effective technology and science focused on increasing recovery efficiency, while reducing environmental and societal impacts.

Research to be performed at the MSEEL site includes:

- Development of integrated data acquisition and modeling approaches for reservoir-scale simulations based on geophysical data, image logs, and lithology.
- Scrutinizing petrophysical, reservoir and production data to establish the effectiveness of geologic versus geometric based fracture stage design. Evaluating innovative stage spacing and cluster density practices to optimize recovery efficiency.
- Data driven integration of geophysical, fluid flow and mechanical properties logs, microseismic and core data to better to characterize subsurface rock properties, faults and fracture systems to improve our understanding of the extent of the stimulated reservoir volume in unconventional reservoirs.
- Matching reservoir lithology and fracture-fluid types (?) to understand the long-term interaction of fluids and gases with reservoir rock.

The MSEEL project will also use the latest information technology to enable a broad integrated program of open, collaborative science and technology testing and evaluation, as well as broad-based dissemination of project results.

C. TASKS TO BE PERFORMED

Phase 1 – Management Plan: Database Design and Baseline Characterization at the MSEEL Site
Phase I objectives are to characterize the subsurface geological and engineering framework of the two existing wells; and carry out baseline air, water, noise, and light investigations on the surface prior to drilling of additional wells at the MSEEL site. Once baseline studies are complete, the Recipient will develop plans for the placement of a vertical scientific observation well and locations of surface monitoring facilities.

Task 1.1 – Project Management and Planning

The Recipient will work together with the DOE project officer upon award to develop a project management plan (PMP). The PMP will be submitted within 30 days of the project award. The DOE

project officer will have 20 calendar days from receipt of the PMP to review and provide comments to the recipient. Within 15 calendar days after receipt of the DOE's comments, the recipient will submit a final PMP to the DOE project officer for review and approval.

The Recipient will review, update, and amend the PMP (as requested by the DOE project officer) at key points in the project, notably at each go/no-go decision point and upon schedule variances of more than 3 months and cost variances of more than 10%, which require amendments to the agreement and constitutes a re-base lining of the project.

The PMP will define the approach to management of the project including the mechanism(s) and frequency for communication between team members and DOE/NETL as well as technology transfer. In addition, the PMP will include information relative to project risk, timelines, milestones (including dates and verification methods) and deliverables (including planned delivery dates), funding and cost plans, and decision-point success criteria.

The Recipient will execute the project in accordance with the approved PMP covering the entire project period. The Recipient will manage and control project activities in accordance with their established processes and procedures to ensure subtasks and tasks are completed within schedule and budget constraints defined by the PMP. This includes tracking and reporting progress and project risks to DOE and other stakeholders.

Subtask 1.1.1 – MSEEL, Ongoing Project Management: The Recipient will insure timely and accurate reporting of periodic and special topical, budget and final reports in consistent format as required by NETL and the "Federal Assistance Reporting Checklist". Monthly and special meetings of project personnel will be scheduled and held by WEBEX or other online collaborative tools. Briefings will be prepared at all key project decision points and project phase transitions and at the project closeout meeting. A summary of project efforts, findings and conclusions in the context of planned research and project objectives will be generated.

Subtask 1.1.2 – MSEEL, Ongoing Advisory Team: The Recipient will establish an Advisory Team within 30days of project award consisting of, at a minimum, representation from the industry partner, DOE/NETL, and key technical areas from the Recipient’s organization as outlined in the SOPO (e.g., groundwater and air monitoring, geochemical, and microbiological expertise). The Advisory Team will provide the initial plans for the research to be conducted, the sampling, data collection, and monitoring plans, and the selection and implementation of innovative technologies at the MSEEL site.

Subtask 1.1.3 – MSEEL, Ongoing Data Generation and Loading: The Recipient will insure timely and accurate loading of all data covering activities at the MSEEL site and the analyses generated by research personnel.

Task 1.2 – Construct Online Collaborative and Technology Transfer Platforms

Subtask 1.2.1 – MSEEL Relational Geodatabase and Collaboration Platform: The Recipient will build, modify and enhance pre-existing online relational geodatabases to collect, store, preserve, distribute and share technical data and results. The Recipient shall coordinate with the NETL Energy Data Exchange (EDX) (https://edx.netl.doe.gov/) team to identify a logical and appropriate means for EDX to host a MSEEL geodatabase, and investigate other aspects of EDX to support internal coordination and collaboration as well as the goals and needs of the project. The Recipient will test and use the database to store data from surface and subsurface baseline studies. The MSEEL geodatabase is intended to improve coordination and reliable access to information and research products for research teams and NETL collaborators.

Subtask 1.2.2 – Develop MSEEL Online Technology Transfer and Information Transfer Site: The Recipient will use pre-existing online geodatabases to provide regional basin-scale and North America context and improve dissemination (tech transfer) of research-driven products. The Recipient will provide a cross-cutting system to ensure lasting access to research products for future use by external researchers actively engaged in work relevant to shale energy and environmental research and to the interested public.

Task 1.3 – Baseline Economic, Public Opinion and Policy Assessment

Subtask 1.3.1 – Community and Public Perception Baseline Assessment: With two previous wells drilled on the MSEEL site in 2011 there is a history of public policy and perceived sociological risks of unconventional hydrocarbon development at the MSEEL site. Based on public records and interviews, the Recipient will conduct a baseline study to document this history over the last three years.

Subtask 1.3.2 – Regional Economic Impact Baseline Assessment: The Recipient will conduct an economic impact assessment of the rapid increase in gas production. The assessment will document the economic impact of previous horizontal wells and the regional impact of Marcellus unconventional hydrocarbon production at multiple scales from county through state to region.

Task 1.4 – Baseline Environmental Characterization

Subtask 1.4.1 – Statistical Variability Test for Surface Sampling Plan: The Recipient will determine spatial statistical variability of baseline surface and subsurface parameters. Air, meteorological, surface water, noise, and light data will be analyzed from key sub-environments on the sites. Available data from the Environmental Protection Agency will be analyzed. These measurements will be utilized to design the sampling plan to be used in all monitoring throughout the project.

Subtask 1.4.2 – Air Quality Baseline Measurements: The Recipient will measure hydrocarbon levels and particulate matter generated by machinery and vehicular traffic using solar/battery-operated wireless air monitoring systems (WAMS: 4 module units and one base unit) positioned at the MSEEL site. Methane and background meteorology (temperature and humidity, net radiation, sensible heat flux, evaporation, precipitation, and soil moisture) will be measured by a solar- powered meteorological and flux station installed at each site. Meteorological stations and WAMS will transmit data to the central base station.

Subtask 1.4.3 – Noise and Light Baseline Monitoring: The Recipient will conduct photometric and electroacoustic measurements of light and noise levels associated with UOG development on site.

Task 1.5 – Baseline Geologic and Petroleum Engineering Characterization

Subtask 1.5.1 – Collect existing subsurface geologic and engineering data: The Recipient will assemble and analyze geologic, geophysical and engineering data from previously drilled wells at the MSEEL site (MIP 4H and MIP 6H).

Subtask 1.5.2 – Locate vertical well and design sampling plan: The Recipient will design a sampling plan for the two production wells and a scientific observation well to capture and preserve all significant digital data and physical samples. The vertical scientific observation well will be located to help characterize the target horizon along the path of the future horizontal lateral and to provide the best offset for microseismic observation.

Subtask 1.5.3 – Site Remediation and Repair, Observation Well Pad: The Recipient will perform required repairs to the well pad and site of the Observation Well, due to soil slump induced by inclement weather conditions.

Subtask 1.5.4 – Top Hole (Vertical Section) Sampling of MIP 3H: The Recipient will drill the vertical section of the MIP 3H well and collect samples for scientific use. The Recipient will collect 120 feet of four (4) inch whole core over the Marcellus and related units. Full core will be split into 1/3 – 2/3 proportions. The 1/3 part will be preserved and used for descriptive purposes, while the 2/3 part will be used for geochemical, geomechanical and other analyses. Cuttings samples will be collected at regular intervals during drilling, and sidewall cores taken of selected geologic units. Sidewall cores will be preserved for microbial and redox studies as well as more conventional geochemical and physical property analysis. All full core samples will be scanned using X-ray computed tomography (XCT), and gamma ray scanner. Samples, mud logs, geologic logs, and mud samples will be collected and photographed. All well data will be stored and made available through the dedicated MSEEL Web database.

Subtask 1.5.5 – Geophysical Logging: The Recipient will run an extensive suite of geophysical well logs in the vertical portion of the MIP 3H that include a full suite of traditional tools, and geomechanical (full-wave form sonic) and lithologic/organic (e.g., pulsed neutron spectroscopy) logs. All well data will be stored and made available through the dedicated MSEEL Web database.

Subtask 1.5.6 – Drill a vertical scientific observation well and obtain sidewall cores: The Recipient will drill the vertical scientific observation well intended for microseismic observation during the completion of the MIP 3H and 5H laterals. In the vertical scientific observation well traditional logging tools will be run and sidewall cores will be taken.

Task 1.6 – Data Collection, Sampling and Monitoring of MIP 3H and 5H Horizontal Wells

Northeast Natural Energy (NNE), the operator at the Morgantown Industrial Park site (a.k.a., the MSEEL site), will drill and complete two horizontal wells (MIP 3H and 5H) in the summer of 2015. Additional wells are anticipated at approximately two to three year intervals. Direct sampling and logging of the wells will be performed as will indirect monitoring of via the observation science well in order to achieve the following objectives:

- characterize the fracture systems through geophysical logging while drilling and microseismic measurements;
- characterize the subsurface geological and engineering framework and monitor the well completion and performance;
- characterize the natural, drilling, and fracture stimulation fluids in the holes;
- sample and monitor air, water, noise, and light during horizontal drilling; and
- institute long-term monitoring after completion and during production.

All data generated by this project will be posted in the MSEEL database for project participants. Analysis of all surface and subsurface data will be used to develop recommendations for improved best practices that can be tested in the subsequent horizontal wells.

Subtask 1.6.1 – ***Geophysical Logging of NNE MIP 3H and 5H wells:*** The Recipient will gain access to the drilling logs provided by the cooperating operator from a horizontal lateral extending through the target formation. This will include a combination of logging while drilling (LWD) and pipe conveyed

tools including gamma ray, resistivity and density/neutron/photo-electric in the horizontal borehole. Additionally, Recipient will log the horizontal section using Next Generation Imaging (NGI) tools. .

Subtask 1.6.2 – Drilling Fluid and Cuttings Sampling: The Recipient will sample drill cuttings and drill fluid returns for subsequent background chemistry analysis. Fluids recovered from the subsurface will be characterized for major cations and anions, minor and trace metals, pH, alkalinity, total dissolved organics, H_2S, and NORM. Isotopes of O, H, and Sr will be measured. TDS, TSS, pH and alkalinity measurements will be carried out using standard methods. Major, minor, and trace element geochemistry and noble gasses will be conducted on cuttings.. All drill cuttings and drill fluid samples will be collected, analyzed, and stored for future analysis.

Subtask 1.6.3 – Drilling and Well Construction Data Collection: The Recipient will collect data on performance of drilling process and determine the relationship between operating parameters such as weight on bit and rotary speed with the formation characteristics such as hardness, density and porosity within the shale formations and overlaying sediments. In addition, the Recipient will collect data on cement properties to determine strength under operating conditions.

Subtask 1.6.4 – Fiber Optic Temperature and Acoustic Monitoring: The Recipient will utilize a permanent fiber-optic sensing system on the outside of the horizontal production casing to monitor the points of fluid entry into the wellbore during fracture stimulation. The Recipient will also monitor during flowback and production throughout the project to evaluate the amounts coming from each zone and cluster. Under normal gas production, the Recipient will provide information on open perforations and clusters contributing to the total gas volume.

Subtask 1.6.5 – Microseismic Monitoring: During the hydraulic fracture stimulation period of completion of the MIP 3H and MIP 5H, the Recipient will conduct a microseismic survey utilizing the vertical observation well.

Subtask 1.6.6 – Fluid and Gas Sampling: The Recipient will collect, analyze, and store fracture stimulation fluid, flowback, and production fluid and gas samples. Quantitative analyses will be conducted for radioelements, cation, anion, trace elements, TDS, TSS, and other chemical parameters as outlined for the vertical well.

Subtask 1.6.7 – Environmental Monitoring: During drilling, hydraulic fracture stimulation and flowback, the Recipient will conduct surface sampling at repeated, regular intervals, as determined by statistical design. Surface water, light, noise, meteorological parameters, and air sampling will be continuously recorded.

Go/No-go Decision Point. The Recipient will not proceed beyond this point until approval has been granted by the DOE Contracting Officer through a review and concurrence of successful completion of activities to date as outlined in the award under Continuation Application.

Phase 2 – Data Analysis and long-term monitoring during production at the MSEEL site:
The objective of this phase of the project is to conduct long-term, post-production monitoring and to analyze data generated during the Phase 1 drilling and completion of wells 3H and 5H. These data will be used to make recommendations for the development of future MIP wells as well as shale wells throughout the Marcellus play.

Task 2.1 – Geologic, Microbiological and Petroleum Engineering Data Analysis

Subtask 2.1.1 – Rock Mineralogy and Physical Properties Analysis: The Recipient will conduct petrographic, FIB-SEM, BET, porosity, and X-ray computed tomography measurements on core samples that have not been initially preserved for microbial and redox studies. Mercury porosimetry will be used in concert with BET analysis to probe pore structures and pore volume. Dry rock bulk density (ρb) and grain density (ρg) will be determined. Novel neutron scattering methods in concert with electron microscopy will be used to quantify the nanometer-to-macro porosity and connectivity in shale and interface formations as a function of depth. In addition to He (or Kr) gas adsorption as well as Hg intrusion porosimetry, the Recipient will use high-precision steady state, pulse decay transient and image based modeling techniques for shale characterization under well-defined reservoir conditions.

Subtask 2.1.2 – Rock Geochemistry Analysis: The Recipient will determine total organic carbon (TOC) and the C:N ratio of collected core samples, and determine δ13C on the CO_2 evolved from combustion. Quantitative mineralogy will be determined by X-ray diffraction along with detailed textural and elemental mapping using scanning electron microscope. Major, minor, and trace element geochemistry will be conducted on cores with a laser ablation and solution-based ICP-MS analysis. Noble gas geochemistry (e.g., He, Ne, Ar, Kr, Xe and isotopic composition (e.g., 3He/4He, 20Ne/22Ne, 21Ne/22Ne, 20Ne/36Ar, 40Ar/36Ar, 38Ar/36Ar, 84Kr/36Ar, 132Xe/36AR) will be analyzed for cores using a Noble Gas Mass Spectrometer.

Subtask 2.1.3 – Microbial Analysis: The Recipient will sample and preserve sidewall cores in the Devonian Marcellus for microbial studies, including biomass estimates, biosignatures, and community genomic (metagenomic) analyses. Bulk microbial density in pore fluids and the rock matrix will be assessed using phospholipid fatty acid analysis (PLFA), and cell abundances in cores and extracted core materials (fluids, rock matrix) enumerated using microscopy. Nucleic acids from microbial communities will be extracted from rock cores and fluids, and genomes sequenced for analyses of microbial diversity and function.

Subtask 2.1.4 – Analysis and Modeling of Well Drilling and Completion: Analysis and modeling of the drilling and completion process will be conducted by the Recipient. Cement composition and placement processes will be evaluated through consultation with the Advisory Team.

Subtask 2.1.5 – Fracture Modeling: The Recipient will evaluate an integrated fracture model using the microseismic survey with well log, core and fiber optic measurements. Fracture interpretations will be displayed in the context of subsurface geology and well performance. A key goal of these efforts is to determine the relationship of microseismic activity to preexisting faults and fracture systems and completion practices. Existing fracture propagation models will be calibrated using the microseismic survey and fiber optic measurements. Calibrated models will be evaluated during subsequent hydraulic fracturing at the site. Existing fracture propagation and fluid flow models will be used to determine stimulated reservoir volumes and to identify potential improvements to reservoir response and performance.

Subtask 2.1.6 – Reservoir Simulation: The Recipient will model and identify the best practices for field implementation, and assess potential methods that could enhance shale gas recovery through experimental and numerical studies integrated with the results of the production wells at the MSEEL site.

Subtask 2.1.7 – Geostatistical Well Analysis: The Recipient will use the extensive subsurface log and core data developed at the MSEEL site with existing regional subsurface and surface datasets to build stochastic models using geostatistical approaches coupled with spatial analysis or regionalized variables to predict mudrock lithofacies and geomechanical properties that effect reservoir performance at well and basin-scales.

Subtask 2.1.8 – Develop recommendations for the optimal landing and development strategies: Based on analysis of organic content and mechanical properties derived from logs and core in the vertical well, the Recipient will make recommendations for the optimal landing interval and well development strategies for the drilling and completion of future horizontal production well(s) anticipated during Phase III.

Task 2.2 – Long-term Monitoring

Subtask 2.2.1 – Environmental Monitoring: The Recipient will conduct surface sampling at repeated, at regular intervals, as determined by statistical design. Surface water, light, noise, meteorological parameters, and air sampling will be continuously recorded.

Subtask 2.2.2 – Production Monitoring: The Recipient will utilize the permanent fiber-optic sensing system to monitor the points of fluid entry into the well during production. Production of gas and fluid will be collected for advanced geochemical analysis.

Subtask 2.2.3 – Develop techniques for low-cost treatment of flowback and produced water: The Recipient will test various water treatment technologies as discussed with the Advisory Team, potentially including a low-cost passive treatment process comprised of membrane materials, and capacitive deionization. Components previously tested in laboratories that show promising results for removing a wide range of dissolved solids including radioactive elements and salts will be tested.

Task 2.3 - Economic, Public Opinion and Policy Assessment

Subtask 2.3.1 – Community and Public Perception Assessment: The Recipient will evaluate local government policymaking responses and related community impacts to continued unconventional hydrocarbon resource. A longitudinal and comparative assessment of factors shaping local governments' policy making response will be provided.

Subtask 2.3.2 Regional Economic Impact Assessment: The Recipient will evaluate the regional economic impact of the continued unconventional resource development and rapid increase in gas production on the region.

Task 2.4 – Document results:
The Recipient will document results of analyses and studies conducted to date, and develop recommendations to improve environmental and economic performance of subsequent horizontal production wells.

Go/No-go Decision Point. The Recipient will not proceed beyond this point until approval has been granted by the DOE Contracting Officer through a review and concurrence of successful completion of activities to date as outlined in the award under Continuation Application.

Phase 3 – Data Collection, Sampling and Monitoring of Subsequent Additional Horizontal Wells at MSEEL Site

The Phase 3 objectives are to monitor the surface and subsurface during additional horizontal wells anticipated at the MSEEL site as they are drilled and hydraulically fractured and produced. These wells are expected to incorporate the latest technology and may offer an opportunity to demonstrate and verify improvements in economic and environmental performance. Pending economic conditions Northeast Natural Energy plans to drill a minimum of 1 well and up to three (3) additional wells at approximately two to three year intervals at the MSEEL site. The MSEEL project will provide a long-term shale energy

and environment laboratory that will be used to develop, test and validate new science and technology. Insertion of new and innovative science and technology will be determined in coordination with project team members and DOE and may include (but are not limited to):

- new technology and advanced techniques to characterize the fracture systems through geophysical logging/sampling of new horizontal wells and monitoring using a combination of the scientific vertical well and the new horizontal well;
- verification of modeling to characterize the subsurface geological and engineering framework to predict well performance;
- improved drilling and fracture stimulation fluids;
- improved approaches to sample and monitor air, water, noise, and light during horizontal drilling; and
- new technology and advanced techniques for long-term monitoring after completion and during production.

All data generated by this project will be posted in the MSEEL database for project participants. Analysis of all surface and subsurface data will be used to develop recommendations for improved best practices that can be tested in the subsequent horizontal wells.

D. DELIVERABLES

The Recipient will submit periodic, topical, and final reports in accordance with the attached "Federal Assistance Reporting Checklist" and the instructions accompanying the checklist.

All data and deliverables generated by this project will be posted in the MSEEL database for use by project participants. Deliverables other than those identified on the Federal Assistance Reporting Checklist include the following:

Task 1.1- Draft Project Management Plan.
Subtask 1.1.2 - Draft Technology Verification and Field Operations Plan that provides the initial plans for the research to be conducted, the sampling, data collection, and monitoring plans, and the selection and implementation of innovative technologies at the MSEEL site. As research progresses, the Advisory Team will meet to review and modify the plan as required.
Task 1.2 – Online Collaborative Platform
Subtask 1.2.1 - Online relational geodatabase linked to EDX to provide collaborative platform.
Subtask 1.2.2 - External web-site with interactive viewer modeled on the National Atlas of Unconventional Resources (http://www.unconventionalenergyresources.com/).
Task 1.3 – Baseline Economic, Public Opinion and Policy Assessment
Subtask 1.3.1- Draft document of history of public perception and consequences of past unconventional hydrocarbon development at the MSEEL well site.
Subtask 1.3.2 - Draft economic impact assessment.
Task 1.4 – Baseline Environmental Characterization
Subtask 1.4.1 - Results of statistical variability analysis and draft sampling plan
Subtask 1.4.2 - Draft baseline report and data from WAMS air monitoring system, methane emissions and meteorological measurements.
Subtask 1.4.3 - Baseline noise and light level data and analysis results report.
Task 1.5 – Baseline Geologic and Petroleum Engineering Reports
Subtask 1.5.1 - Drilling, logging, completion and production data for the MIP 4H and MIP 6H production wells.

Subtask 1.5.2 - Detailed logging and sampling plan that maximizes data collected from the vertical portion of the MIP3H well, and preserves samples for future analyses.
Subtask 1.5.3 – Repair scientific observation well pad.
Subtask 1.5.4 - Drilling report, collection and curation of samples, and preliminary sample analyses from vertical portion of MIP 3H. Drilling, logging and core data will be collected and posted in digital form to the MSEEL database for analysis. Samples of core will be preserved for future analyses. Photographs, XCT scanned images of the core, and core gamma ray log, mud logs, chip sample analysis will be posted on the MSEEL Web Database. Mud logs and field description of the cuttings will also be made available. Cores and chip samples will be stored at the West Virginia Geological Survey Core Repository where they can be accessed by the public. Results of rock chemical analysis.
Subtask 1.5.5 – Obtain digital geophysical well logs and initial interpretations from the vertical portion of MIP 3H. All log measurements will be posted in log ASCII standard format (LAS) in the MSEEL database.
Subtask 1.5.6 – Drill the scientific observation well and obtain traditional logs and sidewall cores.
Task 1.6 – Sampling and monitoring of horizontal productions wells
Subtask 1.6.1 – Obtain digital geophysical well logs and initial interpretations from MIP 3H and 5H. All log measurements will be posted in log ASCII standard format (LAS) in the MSEEL database.
Subtask 1.6.2 – Sample and preserve drill cuttings and fluids and distribute for analysis.
Subtask 1.6.3 – Collect and distribute digital drilling and well construction data. Drilling information and logs for production wells posted to the MSEEL database.
Subtask 1.6.4 – Design, install and monitor fiber optic temperature and acoustic monitoring in horizontal laterals,
Subtask 1.6.5 – Design and install microseismic system to monitor completion of horizontal laterals. Data and report of microseismic measurements posted to MSEEL database.
Subtask 1.6.6 – Collect, analyze and preserve fracture stimulation and flowback fluids, and production fluids and gas samples.
Subtask 1.6.7 – Environmental measurements collected during drilling of production wells.
Task 2.1 – Geologic, Microbiologic and Petroleum Engineering Data Analysis
Subtask 2.1.1 – Database of detailed rock mineralogical and physical properties and images**.** Laboratory measurements of total and kerogen pore volumes, porosity, permeability, sorption parameters and pore size distribution of shale samples will be posted on the MSEEL Web Database. Thin sections, SEM scans, physical properties, and photomicrographs of core samples will also be made available.
Subtask 2.1.2 – Database of rock geochemical analysis. Tools to produce meaningful, predictable and mappable series of geologic, engineering and environmental models at the core-scale, well-scale and basin-scale using the more limited publically available information.
Subtask 2.1.3 – Database of PLFA, community genomic sequences, and images.
Subtask 2.1.4 – Drilling fluid and cutting samples will be preserved and made available for continued analysis. Analytical results will be posted in the MSEEL database. Data and report on well drilling and cementation of casing.
Subtask 2.1.5 – Data and report of fiber optic measurements, if performed. Report on integration of microseismic with well log for fracture determination.
Subtask 2.1.6 –New strategies and technologies to enhance shale gas recovery efficiency, as identified through reservoir characterization and simulation. Recommendations developed with for optimal landing interval in the Marcellus Shale.
Subtask 2.1.7 – Data and report of microseismic measurements. Report on integration of microseismic with well log and fiber optic measurements for fracture determination.
Subtask 2.1.8 – Database Interpretive report on well drilling and cementation of casing.
Task 2.2 – Long-term Monitoring
Subtask 2.2.1 - Environmental measurements collected during completion (stimulation and flowback) of production wells.

Subtask 2.2.2 – Produced fluid and gas **s**amples will be preserved and made available for continued analysis. Analytical results will be posted to the MSEEL database. Data and report of fiber optic measurements, if performed, will be posted to MSEEL database.
Subtask 2.2.3 – Optimize process configuration and operating conditions using flowback and produced fluid from the MSEEL site.
Task 2.3 – Assessment of Economic. Public Opinion and Policy
Subtask 2.3.1 - Assessment report of factors shaping local government responses to unconventional hydrocarbon development.
Subtask 2.3.2 - A report on the economic impact of the wells at the MSEEL site within the regional framework of the Appalachian basin.
Task 2.4 - A report on the project's findings to date along with recommendations to improve environmental and economic performance of subsequent horizontal wells.

E. BRIEFINGS/TECHNICAL PRESENTATIONS:

- The Recipient will participate in a project kick off meeting to be held at the NETL facility located in Pittsburgh, PA or Morgantown, WV (or at an alternative location or by alternative means, such as web-ex, if mutually agreed upon by the DOE and Recipient) within 90 days of the initiation of the agreement.
- The Recipient will prepare and present briefings at key project decision points, and/or project phase or budget period transitions. Every effort will be made to hold these meetings remotely via web-ex but there may be instances where presentation at an NETL site or other location may be required by DOE. Briefings will be given by the Recipient to explain the status/progress, and results of the technical effort to that point and will clearly identify whether decision point criteria for success has been met and progress warrants continuation of efforts under the project.
- The Recipient will participate in a project closeout meeting to be held at the NETL facility located in Pittsburgh, PA or Morgantown, WV (or at an alternative location to be agreed upon by DOE and Recipient) within the final 60 days of the agreement. The Recipient will, as part of that meeting, prepare and present a summary of project efforts, findings and conclusions in the context of planned research and project objectives.