

Quarterly Research Performance Progress Report

Enchant Energy LLC


Federal Agency and Organization Element to Which Report is Submitted	National Energy Technology Laboratory U.S. Department of Energy
FOA Name	FOA-0002058: Front-End Engineering Design (FEED) Studies for Carbon Capture Systems on Coal and Natural Gas Power Plants
Project Title	Large-Scale Commercial Carbon Capture Retrofit of the San Juan Generating Station
Report Identifier	Research Performance Progress Report (RPPR)
Award Number	DE-FE0031843
Award Type	Cooperative Agreement
PD/PI & Submitting Official Name, Title and Contact Information (e-mail address and phone number)	Peter D. Mandelstam, Principal Investigator Enchant Energy LLC 5101 College Boulevard Suite 5055 Farmington, NM, 87402 (o) 505-436-1828 (c) 917-327-2273 PeterM@EnchantEnergy.com
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Recipient DUNS Number	081518061
Recipient Organization	Enchant Energy LLC 5101 College Boulevard Suite 5055 Farmington, NM, 87402
Project Period	10/15/2019 - 07/31/2021
Period Covered by the Report	Q5: October 1, 2020 – December 31, 2020
Report Frequency	Quarterly
Signature of Submitting Official	 Peter D. Mandelstam

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1. ACCOMPLISHMENTS

1.1. Project Goals

The overall goal of this project is to perform a Front-End Engineering and Design (FEED) study for the retrofit of the San Juan Generating Station (SJGS) with post-combustion carbon capture (the Project). The FEED study will document the initial engineering and cost estimates for the retrofit Project, including the levelized cost of carbon capture on an existing plant, and provide estimates of the technical and economic viability of extending the life of the existing SJGS coal-fired power plant through the installation and operation of post-combustion carbon capture. The FEED study will enable SJGS with carbon capture to move forward into detailed engineering, procurement, financing, installation, and operation in future work.

The milestones for this Project are provided in Table 1-1 below.

Table 1-1. Milestone Status Report

Task/ Subtask	Milestone Title and Description	Planned Completion Date	Actual Completion Date	Verification Method	Comments
1.0	Kickoff Meeting	5/22/2020	5/22/2020	Presentation file	Meeting Occurred
1.0	Updated Project Management Plan	5/30/2020	5/22/2020	PMP file	Detailed PowerPoint presented and submitted to DOE/NETL
2.1	Design Basis Finalized	6/25/2020	7/16/2020	RPPR	The 125-Page Design Basis was submitted by Peter D. Mandelstam to DOE/NETL, titled as follows: OVERALL DESIGN BASIS & CRITERIA ISSUE: FOR DOE INFORMATION, REV. C JULY 16, 2020 PROJECT NO. 13891-010 OVERALL DESIGN BASIS & CRITERIA
2.3	Constructability Review	9/10/2020	8/29/2020	RPPR	Design Basis with detailed input of EPC consortium

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Task/ Subtask	Milestone Title and Description	Planned Completion Date	Actual Completion Date	Verification Method	Comments
					provides evidence of constructability
2.3	HAZOP Review Completed	1/7/2021	N/A	RPPR	Due to on-going delays from COVID-19 and delays in arranging some development capital, this HAZOP Review has not yet been completed.
2.1	Process Island Design Completion	1/21/2021	N/A	RPPR	Due to on-going delays from 1) COVID-19 and 2) delays in arranging some development capital, and 3) the fact that the stack testing was completed in December 2020 and the laboratory analysis is ongoing, this Process Island Design Completion has not yet been completed.
2.2	Balance of Plant Engineering Completion	2/5/2021	N/A	RPPR	Due to on-going delays from 1) COVID-19 and 2) delays in arranging some development capital, and 3) the fact that the stack testing was completed in December 2020 and the laboratory analysis is ongoing, this Balance of Plant Engineering has not yet been completed.
2.3	Studies and Investigations Completion	7/2/2021	N/A	RPPR	No comment

Task/ Subtask	Milestone Title and Description	Planned Completion Date	Actual Completion Date	Verification Method	Comments
2.4	Cost Estimating Completion	7/2/2021	N/A	RPPR	No comment
3.0	FEED Study Package	7/31/2021	N/A	Engineering Drawings	No comment
1.0	Final Report	10/29/2021	N/A	Written Report	No comment

1.2. What Was Accomplished

In this reporting period, Enchant Energy LLC (Enchant) along with its partner, Farmington, worked closely with the other FEED study members, including Sargent & Lundy (S&L) and Mitsubishi Heavy Industries America (MHIA), (collectively, the EPC Team).

Task 1.0 – Project Management and Planning

The Recipient shall manage and direct the Project in accordance with this Statement of Project Objectives (SOPO) and the Project Management Plan (PMP) to meet the project’s technical, schedule, and budget objectives and requirements. The Recipient shall manage, coordinate, and report on the technical scope, budget, risk, requirements of the National Environmental Policy Act (NEPA), and schedule consistent with a task-oriented work breakdown structure (WBS) to effectively accomplish the Project. The Recipient shall ensure that Project plans, results, and decisions are appropriately documented, and Project reporting and briefing requirements are satisfied. The Recipient will work with the DOE Contract Specialist (CS) and Project Officer (PO) to make revisions to the award and its associated documentation when necessary.

In this reporting period, the Principal Investigator and the consultants from Sargent and Lundy continued to revise the Project Management Plan in conformance with the ongoing challenges due to Covid-19. In addition under Task 1.0 relating to the National Environmental Policy Act (NEPA) ongoing consultations occurred with both local and Washington-based Federal officials.

Task 2.0 – Front-End Engineering & Design Study

The purpose of the FEED study is to complete engineering and design work to support developing a detailed cost estimate for retrofitting CO2 capture at SJGS. As part of the overall FEED study, multiple design studies will be performed based on Project-specific details. Various design and engineering packages will be developed which will help define commodity quantities, equipment specifications, and construction requirements to execute the Project. These FEED study packages will be prepared with the intent to develop an overall project Association for the Advancement of Cost Engineering (AACE) Class 2 capital cost estimate with an accuracy of ±15%, requiring approximately 50-75% project definition completed.

Nothing to report.

Subtask 2.1 – Process Engineering and Design

An overall Project Design Basis will be developed which will identify site-specific design characteristics, ambient conditions, fuel and flue gas characteristics, environmental requirements, and site-specific design considerations. Process Engineering and Design will be completed by the carbon capture technology provider and a series of process engineering documents will be developed.

In this reporting period, the Principal Investigator and the consultants from Sargent and Lundy continued and finished the stack testing of the flue gas emissions from San Juan Generating Station Unit 1 & Unit 4. As specific evidence of the challenge of developing a project of this complexity during the COVID-19 Pandemic, the stack testing performed by AST consultants which should've taken one mobilization/demobilization and two days of on-site work, stretched over 87 days with four mobilizations/demobilizations.

In addition to the difficulty of getting people to the site due to COVID-19, the existing Units went down on a number of occasions making the appropriate stack testing impossible.

The testing data are currently being evaluated by a laboratory and this information will further refine the Design Basis and the specific engineering by Mitsubishi Heavy Industries America. Sargent and Lundy was helpful for the repeated scheduling and rescheduling of the stack testing.

Subtask 2.2 – Balance of Plant Engineering

This subtask involves the balance of plant (BOP) planning, design, and engineering to incorporate the CO2 capture technology into the existing SJGS facility. A site-specific Design Criteria Document will be developed which will document the primary design criteria, applicable codes and standards for the civil, structural, mechanical, electrical, and Instrumentation & Controls (I&C) designs.

Nothing to Report.

Subtask 2.3 – Studies and Investigations

Various studies and investigations will be conducted which will provide key decisions on scope of work or selection of project-specific needs. This subtask will also provide detail on the permitting requirements necessary for the specific project development at SJGS.

In this reporting period, the Principal Investigator and the consultants from Sargent and Lundy continued to engage in consultations with Federal environmental officials.

Subtask 2.4 – Cost Estimating

The team will develop an overall project capital cost estimate that is consistent with an AACE Class 2 cost estimate (approximate accuracy of $\pm 15\%$), corresponding to ~50-75% Project definition. As part of the overall project estimate, capital costs will be developed

along with operating and maintenance (O&M) costs. Together, the costs will be used to develop an overall cost of carbon capture.

In this reporting period, the Principal Investigator requested that the consultants from Sargent and Lundy perform a revised cost estimation of the capital cost of the Carbon Capture Island. The cost estimation was professionally performed and included the appropriate cost estimate variability. The Principal Investigator and his colleagues at Enchant Energy, along with its colleagues at Baker Tilly, chose to await the more precise costs embodied in the yet-to-be-finalized engineering procurement and construction contract (EPC). Hence the revised cost estimation was not used in any public documents, nor in any discussions with potential investors.

Task 3.0 – Final FEED Study Package

The final FEED study package will be prepared and submitted in accordance with the SOPO.

Nothing to Report.

1.3. Opportunities for Training and Professional Development

In this reporting period, there was ongoing progress and accomplishment in the realm of training and professional development. Specifically, Enchant Energy, the City of Farmington, and the San Juan College School of Energy (SJC) launched workforce development and job training (WFD). This WFD is beginning with Internet-based training due to COVID-19. Once it is safe to do so, training will continue in-person in the sophisticated hands-on laboratories at San Juan College. Neither Enchant Energy nor City of Farmington and its employees will receive any compensation from this work. All of this WFD is done at zero cost to the training.

1.4. Dissemination of Results to Communities of Interest

Outreach to communities of interest is an organizing principle for Enchant and its partner, the City of Farmington. Due to the innovative nature of this project and its importance to the San Juan County, there is regular media interest in the project. In this reporting period, Hank Adair, Electric Utility Director of Farmington Electric Utility System (FEUS), the City of Farmington's municipal utility, and Cindy A. Crane, Enchant's Chief Executive Officer, have done a number of Communities of Interest presentations (all via COVID-safe methods, and media interviews. All of these can be found on Enchant's web site, <https://www.enchantenergy.com/>.

The full extent of the outreach to communities of interest is too extensive and the files too large to attach as an exhibit. The Enchant website has the complete media items and their outreach to communities of interest outreach for this reporting period.

1.5. Plan for Next Reporting Period

Nothing to Report.

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2. PRODUCTS

As reported above, the main product produced during this reporting period are the wide array of documents submitted to various federal agencies in furtherance of the review of the Connector Route.

2.1. Publications, Conference Papers, and Presentations

There were several presentations during this period, all done via video, due to Covid-19 travel restrictions (shown below).

Presentation Title	Audience	Date	FEED Study Project Presenters
San Juan Generating Station Carbon Capture Update	Lieutenant Governor State of New Mexico	9-Oct-20	Nate Duckett, Mayor, City of Farmington Cindy Crane, CEO, Enchant Energy Peter Mandelstam, COO, Enchant Energy Hank Adair, Director, Farmington Electric Utility System
San Juan Generating Station Carbon Capture Update	Brian Egolf Speaker of the House State of New Mexico	15-Oct-20	Nate Duckett, Mayor, City of Farmington Cindy Crane, CEO, Enchant Energy Peter Mandelstam, COO, Enchant Energy Hank Adair, Director, Farmington Electric Utility System Sean McHone, Sr VP and Project Director, Sargent & Lundy
San Juan Generating Station Carbon Capture Update	Economic and Rural Development Committee New Mexico Legislature	19-Oct-20	Nate Duckett, Mayor, City of Farmington Cindy Crane, CEO, Enchant Energy
San Juan Generating Station Carbon Capture Update	American Coal Ash Association	19-Nov-20	Cindy Crane, CEO, Enchant Energy Peter Mandelstam, COO, Enchant Energy
San Juan Generating Station Carbon Capture Update	26th Annual CO2 Conference Midland, Texas	9-Dec-20	Cindy Crane, CEO, Enchant Energy Peter Mandelstam, COO, Enchant Energy

2.2. Website(s) or other Internet site(s)

As described above, the Enchant Energy [website](#) is a repository of all of the outreach, initial research, and media coverage of ongoing FEED work.

2.3. Technologies or techniques

Nothing to Report.

2.4. Inventions, patent applications, and/or licenses

Nothing to Report.

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2.5. Other products

Nothing to Report.

3. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

Several participants and organizations will be collaborating to achieve the goals of this FEED Study as the nature of work to complete these tasks requires specific technical knowledge and capabilities.

3.1. Individuals

Below is a list of individuals involved in the FEED study, including the PI and each individual who worked at least one person month per year on the project in this last quarter.

Name: Peter Mandelstam

Nearest Person Months Worked: 2.75

Project Role: Chief Operations Officer / (Incoming) Principal Investigator

Contribution to Project: Project Operations and Project Management

State, U.S. territory, country of residence: City of Farmington, New Mexico, U.S.A.

Funding Support: DOE and Enchant

Collaborated with individual in foreign country: Yes

Country(ies) of foreign collaborator: Japan

Travelled to foreign country: No

Name: Hank Adair

Nearest Person Months Worked: 1

Project Role: Co-Applicant

Contribution to Project: Site Coordination

State, U.S. territory, country of residence: City of Farmington, New Mexico, U.S.A.

Funding Support: DOE and Enchant

Collaborated with individual in foreign country: Yes

Country(ies) of foreign collaborator: Japan

Travelled to foreign country: No

3.2. Change in Active Other Support of PD/PI(s) or Key Personnel

In the prior reporting period, Enchant Energy Corporation, hired Cindy A Crane as CEO. During the current reporting period, Ms. Crane was additionally promoted to the Board of Directors and is currently serving as the Interim Chair. Jason Selch, resigned from the board to pursue other outside employment but remains actively engaged with Enchant Energy and continues to be Enchant's largest investor.

While Jason Selch left Enchant day-to-day management he continues to fund development. Enchant reiterates its formal request from last reporting period that we shift the holder of the

Principal Investigator position from Jason Selch to Peter Mandelstam who has been full-time at Enchant since October 2019 as the Chief Operating Officer. This request has verbally been discussed with the DOE and was also followed by a formal written request separate from the previous quarterly report.

3.3. Partner Organizations

Enchant has coordinated a team of highly qualified sub-awardees, independent contractors, vendors and participants to complete the proposed project including particularly in this reporting period, Sargent & Lundy LLC (S&L), Navigant Consulting (Navigant) also referred to as Guidehouse, EJM Associates, LLC (EJM), and Baker Tilly (BT). Additionally, Enchant continues to work with the City of Farmington and Mitsubishi Heavy Industries America, Inc. (MHIA) as sub-recipients of this award. City of Farmington is also a cost-share supporter. Further information on these partner organizations is provided below.

- Mitsubishi Heavy Industries America, Inc. (Sub-Awardee)
 - Location: Houston, Texas
 - Contribution to Project: Collaborative research
 - Additional Detail: vendor to provide commercial engineering services
- City of Farmington (Sub-Awardee)
 - Location: Farmington, New Mexico
 - Contribution to Project: In-kind support
 - Additional Detail: City to provide legal services
- Sargent & Lundy LLC
 - Location: Chicago, IL
 - Contribution to Project: Collaborative research
 - Additional Detail: Vendor to provide engineering and costing services for the FEED Study.
- Navigant Consulting
 - Location: Chicago, IL
 - Contribution to Project: Collaborative research
 - Additional Detail: Vendor to provide generating plant cost and performance evaluation.
- EJM Associates, LLC
 - Location: Washington, D.C.
 - Contribution to Project: Collaborative research
 - Additional Detail: Vendor to provide regulatory review and environmental analysis
- Baker Tilly
 - Location: Austin, Texas
 - Contribution to Project: Other
 - Additional Detail: Vendor to provide accounting services for project.

3.4. Other Collaborators or Contacts Involved

Nothing to report.

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4. IMPACT

4.1. What is the impact on the development of the principal discipline(s) of the project?

Nothing to report.

4.2. What is the impact on other disciplines?

Nothing to report.

4.3. What is the impact on the development of human resources?

As described above, the SJC, Farmington, and Enchant signed a Memorandum of Understanding (MOU) on workforce development and job training in the previous reporting period. This MOU has led to Internet based training in this reporting period. This WFD provides a path to well-paying jobs building the Project, which will require a minimum of 2 million worker hours. The WFD training specifically seeks engagement by members of the Navajo Nation, veterans, and other underserved communities.

4.4. What was the impact on teaching and educational experiences?

Nothing to report.

4.5. What is the impact on physical, institutional, and information resources that form infrastructure?

Nothing to report.

4.6. What is the impact on technology transfer?

Nothing to report.

4.7. What is the impact on society beyond science and technology?

Nothing to report.

4.8. What percentage of the award's budget was spent in foreign country(ies)?

As of December 31, 2020 the cumulative costs incurred amounted to \$1,306,562.74. Of this, 9% of these cumulative budgeted costs were incurred from Mitsubishi Heavy Industries, Japan, however no payment has been remitted or funds actually spent as of the end of this quarter.

5. CHANGES/PROBLEMS

5.1. Changes in approach and reasons for change

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Nothing to report.

5.2. Actual or anticipated problems or delays and actions or plans to resolve them

In the process of the Design Basis, it was determined that stack testing was needed to be done on the site in order to develop the appropriate design. As a result, the design process was delayed. Although the stack testing was expected to begin and be completed in the prior period, the stack testing was impacted significantly by unit outages at the plant, causing mobilization and demobilization four times before the stack testing could be completed which occurred in this reporting period. This period of impact was approximately four months. The results of the stack testing will be assessed and will inform the Design Basis in the coming reporting period.

In addition to delay impacts from stacking testing, Covid-19 has affected our development and fundraising efforts in the current reporting period. These funding delay impacts could cause delays of the FEED Study schedule. Enchant Energy is actively engaged with development capital investors to raise the requisite capital to ensure the timely advancing of the FEED study.

As a result of these impacts, our project and construction schedules are estimated to push out by approximately six (6) to ten (10) months. However, given delays outlined, MHIA's work scope schedule will be delayed.

Enchant will keep the DOE closely updated as we raise the required capital and revise our schedule and continue to move forward with finishing the FEED work.

5.3. Changes that have a significant impact on expenditures

Nothing to report.

5.4. Significant changes in use or care of human subjects, vertebrate animals, and/or Biohazards

Nothing to report.

5.5. Change of primary performance site location from that originally proposed

Nothing to report.

6. SPECIAL REPORTING REQUIREMENTS

Nothing to report.

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7. BUDGETARY INFORMATION

A summary of cumulative budgetary information for the overall project as well as the federal and cost share portions as of quarter ended 12/31/2020 for Phase 1 of the project is provided in Table 7.1 below.

Enchant's share of expenditures reported as of 12/31/2020 is below the 64.15% cost share commitment and is less than planned. On May 22, 2020 Enchant received the first bill from MHIA for their contractual 15% advance payment in the amount of \$903,631.65. To be in conformance with the GAAP matching principle, Enchant has only recognized expenditures for the period ending 12/31/2020 related to cost spend expenditures actually incurred as of that date which amounts to \$ 197,900.39. The other \$450 of cost share recognized is from the City of Farmington for attorney fees incurred in relation to the FEED study as of 12.31.2020.

Table 7-1. Budgetary Information for Quarter Ending 12/31/2020

Baseline Reporting Quarter	Budget Period 1									
	Q1		Q2		Q3		Q4		Q5	
	10/1/2019-12/31/2019	Cumulative Total	1/1/2020-3/31/2020	Cumulative Total	4/1/2020-6/30/2020	Cumulative Total	7/1/2020-9/30/2020	Cumulative Total	10/1/2020-12/31/2020	Cumulative Total
Baseline Cost Plan										
Federal Share	\$ -	\$ -	\$ -	\$ -	\$ 506,109.00	\$ 506,109.00	\$ 1,179,431.00	\$ 1,685,540.00	\$ 1,179,431.00	\$ 2,864,971.00
Non-Federal Share	\$ -	\$ -	\$ -	\$ -	\$ 905,631.00	\$ 905,631.00	\$ 2,110,474.00	\$ 3,016,105.00	\$ 2,110,474.00	\$ 5,126,579.00
Total Planned	\$ -	\$ -	\$ -	\$ -	\$ 1,411,740.00	\$ 1,411,740.00	\$ 3,289,905.00	\$ 4,701,645.00	\$ 3,289,905.00	\$ 7,991,550.00
Actual Incurred Cost										
Federal Share	\$ -	\$ -	\$ 45,843.64	\$ 45,843.64	\$ 577,795.80	\$ 623,639.44	\$ 318,285.64	\$ 941,925.08	\$ 166,287.27	\$ 1,108,212.35
Non-Federal Share	\$ -	\$ -	\$ 82,019.36	\$ 82,019.36	\$ 98,432.75	\$ 180,452.11	\$ 17,448.28	\$ 197,900.39	\$ 450.00	\$ 198,350.39
Total Incurred Costs	\$ -	\$ -	\$ 127,863.00	\$ 127,863.00	\$ 676,228.55	\$ 804,091.55	\$ 335,733.92	\$ 1,139,825.47	\$ 166,737.27	\$ 1,306,562.74
Variance										
Federal Share	\$ -	\$ -	\$ 45,843.64	\$ 45,843.64	\$ 71,686.80	\$ 117,530.44	\$ (861,145.36)	\$ (743,614.92)	\$ (1,013,143.73)	\$ (1,756,758.65)
Non-Federal Share	\$ -	\$ -	\$ 82,019.36	\$ 82,019.36	\$ (807,198.25)	\$ (725,178.89)	\$ (2,093,025.72)	\$ (2,818,204.61)	\$ (2,110,024.00)	\$ (4,928,228.61)
Total Variance	\$ -	\$ -	\$ 127,863.00	\$ 127,863.00	\$ (735,511.45)	\$ (607,648.45)	\$ (2,954,171.08)	\$ (3,561,819.53)	\$ (3,123,167.73)	\$ (6,684,987.26)

8. PROJECT OUTCOMES

Nothing to report.