

DOE Bioenergy Technologies Office (BETO) 2019 Project Peer Review

Fulcrum Sierra BioFuels, LLC

Technology Session Area Review

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Sierra BioFuels Project



Goal Statement

- Generate a Renewable Transportation Fuel that Lessens the Reliance on Fossil Fuels
- Convert MSW-Derived Feedstock Into Renewable Transportation Fuels
- Commercialize the Fulcrum Technology that was Demonstrated at a Pilot Scale to Produce Renewable Transportation Fuels from MSW derived Feedstock



Sierra BioFuels – Key Milestones

Item	Date					
Pilot Demonstration Unit Operations	Dec 2013 – Jul 2014					
Biorefinery – Front-End Engineering Design Package	May 2013 – Mar 2014					
LNTP Engineering Design	May 2015 - Aug 2017					
Detailed Engineering	Sep 2017 -					
Feedstock Processing Facility (FPF) Design Package	Aug 2014 – Aug 2015					
Stage 1 FPF Construction	Jan 2016 – Aug 2016					
Stage 1 FPF Performance Testing	Jul 2017					



Sierra BioFuels – Key Milestones, cont'd

Item	Date
Stage 2 FPF Design	Aug 2018 – Jan 2019
Stage 2 FPF Construction and Testing	Feb 2019 – Jul 2019
Biorefinery Construction	May 2018 – Jan 2020
Biorefinery Performance Test	Jan 2020 – Jun 2020
Stage 3 Upgrading	Sep 2019 – Jun 2021



Sierra BioFuels – Master Schedule

Fulcrum Sierra BioFuels, LLC Summary of Master Schedule										Febru	ary 2019					
ID	Task Name		2014		20	015	2016	2017		2	118	2019	2020	1 3	2021	2022
		arter	1st Quarte	r 4ti	h Quarter	3rd Quarter	2nd Quarter	1st Quarter	4tr	Quarter	3rd Quarter	2nd Quarter	1st Quarter	4th Quarter	3rd Quarter May Sep Jan	2nd Q May
1	Sierra BioFuels - Storey County		6/2												10/19	
2	Stage 1 - Feedstock Processing Facility			-											-	
53				i.		1	1		÷ .		1					í.
54	Stage 2 - Biorefinery and Additional Equipment at FPF		i i	i			1		i i	_			1			i i
55	Addditional Equipment at FPF		i I	i i		i i	1	i i	1	5/16	1	8/13	1	i i		
56	Project Evaluation and Data Acquisition					1	1			5/16	8/1					
57	Engineering, Procurement and Delivery			1			1			6/11		4/12			-	
61	Installation			i		1			1		2/1	8/13				
62	Startup, Testing & Performance Testing	1	i	i		i i	1		i -		1	6/10 7/9				i i
63	Biorefinery	1	1			1	1	1	12/4				1/31	1		1
64	Utilities	1		-											-	
65	(WTP) Water Treatment Plant Installation	1	1	i.		1	1		2/1	14	1		12/10			
68	(ASU) Air Seperation Unit	1	i i	i		1	 		i -	7/3	1		11201			1
72	120 kV Substation	1	1	1		1	1	12	2/21		12/21	4/30		1		
77	Natural Gas Interconnection	1		ł								5/7 8/26				
80	Electrical Interconnection	1		i					į			5/7 1	11/1			
83	Engineering, Fabrication Procurement and Delivery	1	i I	i	5/28	1	1	1			1		12/19	1		
84	Limited Notice to Proceeds	1	1	1	5/28					11/22	1			1		1
99	Full Notice to Proceed	1		1			1	10/3	31 10	0/31						
100	Detailed Engineering	1		i			1	11/	<i>r</i> i =			6/3				i i
101	Procurement	1	1	1		1	1	11/	<i>n</i>				12/19	1		1
102	Construction		1	-					1	6/1		8/30				
103	Site Mobilization			ł			1			6/1	6/1					
104	Site Work		 	i		 	 	 	i -	6/2	8/23			 		i i
105	Installation			1		1	1			8/	24	8/30				
106	Commissioning and StartUp	1		ł			1		1		5	/20 \$/20	6/5			
107	Commissioning			i					i i		1	8/15	1/28			
108	Mechanical Completion		i I	i i		1	1	l l	1		1	1/2	9 1/29	1	1	1
109	Substantial Completion	1	1	1		1	1		1		1		6/5 6/5			1
110	Final Completion	1		1			1						۰۱ ک	¢		
111			i	i		i	1	1	i i			10		į	10/19	i i
113	Stage 3 - Upgrading		1	1		1	1	1	1		1	1/5	2/19	i	10113	
114	Preliminary Engineering Package	-	1	-			1		1		1		2010 E110			
115	EPC Bid Package	-					1				1		C(11 C(11			1
115	Notice to Proceed	-	1	i		1	1	 	i.		1		6/11 6/11	11/20		i i
117	Detailed Engineering	-				1	1		1		1		8/7	11/20	5/13	
118	Procurement	_		-					1		1		011	2/20	e(22	
110	Construction	-		i				 	i -		I		1		0123	
120	Commissioning and Testing	_	1	i		1	1	 	í i		1	1		1	×2+ 10/18	1
120	Substantial Completion		1			1	1	1	1		1	1	1	1		1
Fulc	Fulcrum BioEnergy, Inc. Page 1 CONFIDENTIAL															
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Quad Chart Overview

Timeline

Construction Start: 2Q 2018 Production: 2Q 2020

Budget

Approximately \$205 MM

- DoD: \$70 MM
- Fulcrum: Approximately \$135 MM Various Technology Providers

Barriers

- Produce On-Spec Feedstock
- Complete Stage 3 of the Project and Upgrade F-T Liquids into SPK

Project Participants

- Fulcrum Sierra BioFuels, LLC
- DoD



Project Overview



Project Overview

- Overview
 - Convert MSW-Derived Feedstock Into Renewable Transportation Fuels
- Approach
 - Secured Feedstock Contracts
 - Demonstrated Technology at Pilot Scale That Minimized Scale-Up Risk
 - Secured Fixed Cost Engineering, Procurement and Construction (EPC) Contract With Process Guarantees
- Technical Accomplishments/Progress/Results
 - Pilot Demonstration Unit Successfully Demonstrated Technology



Fulcrum – MSW to Low-Carbon Fuels

Technology Performance Guaranteed Zero-Sulfur Fuel 80% Carbon Emissions Reductions Cost Competitive with Fossil Fuel MSW Available Worldwide



Technical Approach

- Technical Approach
 - Develop Process to Convert Feedstock into Fuel
 - Demonstrate Process at Pilot Scale
 - Utilize Commercially Available Technologies
 - Engage EPC Contractor that will Provide a Process and Cost Guarantee (based on Fulcrum Process)
- Critical Success Factors
 - Incorporate Lessons Learned from First of a Kind Process to Future Projects
 - Optimized FPF Process
 - Meet Production Goals
 - Meet Schedule and Budget Constraints



Technical Approach- Cont

- Potential Challenges
 - Skilled Construction/Operations Labor Force in Reno Area
 - Material Inflation
 - Offtake Agreement for F-T Liquids Product



MSW – A Strategic Feedstock

Changing the way Garbage is Handled and Disposed



- Large Volumes, Ideal Locations
- Established Infrastructure
- Carbon-Rich Feedstock Ideal for Biofuel Production
- Predictable Cost
- No Competing Uses
- Resolves Waste Disposal Problems



Feedstock Processing Facility



- In Operations; Stage 1 Construction Completed on Schedule and on Budget
- MSW Delivered by Waste Service Partners Waste Management and Waste Connections
- 350,000 Tons of Waste Processed Each Year
- 175,000 Tons of Prepared MSW Feedstock Produced per Year
- Capacity up to 120 Tons per Hour of Waste Processing



Feedstock Processing Facility *Photos*





Feedstock Processing Facility *Photos, cont'd*



Sierra BioFuels Plant Block Diagram





Sierra BioFuels Plant





Project Management

- EPC Contractor
 - Design, Procurement, Construction and Commissioning with a Fixed-Price and Guaranteed Cost and Production Yield
- Fulcrum Project Management
 - Engaged With EPC Contractor on Daily Basis
 - Weekly Project Review Meetings Ensure Executing Project in Accordance With Project Requirements
 - Conducting Management Oversight to Execution in Accordance With Project Scope, Cost and Schedule



Project Management, cont'd

- Owner's Engineer
 - Provides Supplemental Technical Support to Fulcrum Technical Staff
- Lender Independent Engineer
 - Ensures EPC Activities are Executed in Accordance With Project Requirements
- Research and Development
 - o Fulcrum
- Operator
 - o Fulcrum



Technical Progress and Accomplishments



Technical Progress *Highlights*

- Pilot Demonstration Unit Operated Successfully, Met or Exceeded the Performance Metrics and Demonstrated the Bio-Refinery Technology
- Scale up Risks Minimized due to the Design of the Pilot Demonstration Unit
- Completed 75% of the Detailed Design for the Bio Refinery
- Started Construction on the Bio Refinery
- Feedstock Processing Facility (FPF) Stage 1- Operated for 12 Months and Highlighted Required Processing Changes to Produce In Spec Feedstock



Construction Status *Highlights*

- Completed Stage 2 FPF Process Improvements and Have Begun Construction
- Biorefinery EPC is Advancing With Procurement Nearing Completion, Foundations Being Poured and Equipment Arriving at the Site
- Installation of 120 kV Substation has Began
- Water Treatment Plant Civil Work Began in January 2019
- ASU Civil Work Began in February 2019



Feedstock Processing Facility Stage 2 Construction Highlights

- Construction / Demolition
 - Contractor Mobilized to the Site in December 2018
 - Residual Truck Load-Out Structure Dismantled
 - Concrete Floors Saw Cut for New Trommels and Shredder Foundations
 - Tipping Floor Dust Collector Dismantled
- Procurement
 - Five Containers of Processing Equipment Delivered to the Site Including the Three Secondary Shredders



Biorefinery Construction Site Update

- Construction Activities Completed Since November 2018
 - Gasification Structure Foundations Poured
 - Auxiliary Boiler Foundation Poured
 - Auxiliary Boiler Main Body and Economizer Delivered to the Site and set on Their Foundations
 - o Installed Underground Sewage, Water and Grounding Network
 - Material Handling Equipment Delivered to the Site



Biorefinery Photos – Construction Progress, cont'd



Placement of Auxiliary Boiler



Biorefinery Photos – Construction Progress





Relevance and Future Work



Fulcrum's Process Will Reduce Greenhouse Gas Emissions by More Than 80% Compared to Traditional Petroleum Production

- Creates an Excellent Source of Domestic Renewable Fuels
- Reduces Greenhouse Gas Emissions by More Than 80%
- Lowers Methane Gas Emissions From Landfills
- Reduces Carbon Emissions From Fuel Products
- Very Low Emissions Profile From Fulcrum's Facilities
- Mitigates Need for New Landfills and Greatly Extends Life of Existing Landfills
- Creates a New Generation of Green Jobs

Future Work

• Sierra BioFuels Feedstock Processing Facility

• Complete Phase 2 Construction and Commissioning

- Sierra BioFuels Biorefinery
 - Complete Construction Activities, Commission and Start-Up of Phase 2 Activities
 - Complete Design of Phase 3 Upgrading
 - Construction of Phase 3 Upgrading





