“RECOVERY ACT Production of Algal BioCrude Oil from Cement Plant
Carbon Dioxide”

Final Scientific / Technical Report

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Abstract

The consortium, led by Sunrise Ridge Algae Inc, completed financial, legal, siting, engineering and environmental permitting preparations for a proposed demonstration project that would capture stack gas from an operating cement plant and convert the carbon dioxide to beneficial use as a liquid crude petroleum substitute and a coal substitute, using algae grown in a closed system, then harvested and converted using catalyzed pyrolysis.

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A. Summary.

Sunrise Ridge Algae is the project manager and technology provider under DE-FE-0002734. the contract was funded through Phase 1 with a budget of \$643,262, with 80% Federal share. The work in Phase 1 has been completed, and this Final Technical Report is submitted in fulfillment of the contract for Phase 1.

The agreed Statement of Project Objectives included work scope for four tasks:

- Task 1. Project Management
- Task 2. Research and Development (no scope)
- Task 3. Conceptual Design
- Task 4. Permit Planning

This objectives of Phase 1 included:

- Providing beneficial use of carbon dioxide produced from limestone calcining
- Displacing fossil fuels used in cement manufacturing with bio-renewable fuels, reducing greenhouse gas emissions
- Displacing imported crude petroleum by domestic bio-crude oil, reducing greenhouse gas emissions
- Demonstrating economic attractiveness of the integrated process for capturing carbon dioxide from cement plants, using it to grow algae, harvesting and converting the algae to liquid and solid fuels, with the solid fuel being used in the cement kiln and the liquid fuel sold to a petroleum refinery

In the 5 months duration of Phase 1, we completed all of our milestones

- Engineered conceptual design
- Completed energy and material balances
- Secured a host site for the demonstration project we are now proposing
- Secured feedstocks for our process (CO₂, wastewater, land=sunshine)
- Secured off-take arrangements (for products as well as waste streams)
- Secured EPC contracting for Phase 2
- Prepared permitting plan
- Completed environmental volume
- Wrote and submitted our Phase 2 proposal

The Phase 2 project would have designed, constructed and operated a demonstration facility that will capture carbon dioxide from a cement plant stack, grow algae, and convert the algae to crude oil and char solid fuel. The Phase 2 facility was proposed to be located at the site of a cement company in Midlothian, Texas.

At successful completion of the Phase 2 project, we expected that the facility would be expanded to commercial scale at the demonstration site, and we would start pursuing licensing of the process concept at up to 30 additional sites in the United States.

B. Accomplishments.

The program of work in Phase 1 addressed each point in the Statement of Program Objectives and is reported below under the broad headings of Project Management, Research and Development, Conceptual Design, and Permitting/Partnering.

We met the programmatic milestones, and delivered the two, major deliverables on schedule (Table 1).

Table 1. Deliverables for Phase 1.

Deliverable	Date Delivered	Date Due
Program Management Plan	29 January 2010	30 January 2010
Three Conceptual Designs	31 March 2010	31 March 2010

Task 1. Project management

Subtask 1.1 Project Management Plan

As indicated in Table 1, a Program Management plan was filed with DOE as scheduled and we followed it during the course of this quarter's effort.

Subtask 1.2 Reporting

Monthly technical and financial reports have been filed in a timely fashion during the reporting period.

Subtask 1.3 Sub-Contractor Management

We engaged three subcontractors, URS Corporation, to assist with conceptual design, costing and permitting, Life Cycle Associates to assist with a carbon dioxide life cycle analysis of the envisaged commercial scale design, and Levin & Atwood, who assisted in the commercial contract legal work.

One of our staff set up office at URS to facilitate communications. URS accompanied us on site visits to two potential cement plants and gathered information required to design the growth facility and to customize the permit planning process. URS provided feedback on the Conceptual Designs and arranged discussions with equipment vendors regarding technical performance, cost and scaling of major pieces of process equipment. That information was incorporated into our designs and financial projections.

We communicated regularly with Life Cycle Associates to transmit the conceptual designs; the work product from Life Cycle Associates is included with this Technical Report in Appendix 1.

Levin & Atwood provided input on key commercial contracts being negotiated between SRA and the site owners.

Subtask 1.4 Project Cost Accounting

Our financial reporting system was reviewed by DCAA in January and February, 2010. Findings from the audit were delivered to DOE in March. Financial reports accompanied each of our monthly reports and the program costs were reflected in our monthly invoices to DOE. The work product and invoices from our three subcontractors were reviewed for both technical and financial soundness before they were submitted to DOE.

Subtask 1.5 Risk Management

Our monthly reports included updated assessment of the programmatic and technical risks. The most current version of the risk matrix is presented in Table 2. At the end of the project we had resolved or deferred the last remaining risk factors.

Table 2. Updated risk matrix

<u>Risk Name</u>	<u>Impact</u>	<u>Likelihood</u>	<u>Mitigation</u>	<u>Status</u>
Access to Resources				
Sufficient land for Phase 2 is not available at low cost	5	1	Westward expansion to nearby sand pits. Or, consider off site production of biomass.	Mitigated. New Site is acceptable. Complete.
Aquifer recharge zone limits land use	5	1	TLC is currently outside of recharge zone, but westward expansion may encroach. Consider alternate site if required. Consider offsite biomass production	Investigated. New site is not in Recharge Zone. Complete.
Municipal Wastewater is not available at low cost	4	3	Back up is well water supply or rainwater	Investigated. New site has its own wastewater source and will provide wastewater to the project. Complete.
Unable to obtain low cost additional nutrients	4	1	Seek use of "free" wastewater. Seek use of manure or other low-cost fertilizer. As back up, use commercial fertilizers	Under investigation. Additional wastewater sources are nearby and require more assessment.
Cost of carbon dioxide compression & cooling is too high	4	4	Redesign growth system or redesign CO ₂ treatment system to reduce compression cost	Investigated. Cost is acceptable. Resolved
Cost of carbon dioxide increases	4	1	Negotiate long-term offtake agreement.	Under investigation. Offtake contract secured.
Product Markets				
Oil quality is too low to obtain buyer	5	2	Burn oil in kiln. Identify alternate operating conditions that increase quality. Evaluate hydrogenation processes that increase quality. Find alternate markets, such as No 6 oil.	Under investigation. Testing agreement secured.
Future commodity prices are too low	5	4	Improve product quality, reduce cost of operation; delay project	Identified
Char quality is too low to put in kiln	4	3	Sell as soil amendment; burn in electricity generation	Under investigation. Testing agreements secured.
NEW. Bioleum burning may not be permitted for cement kiln	3	3	Sell to hydrogenation company for upgrading	Under investigation. Testing agreements being investigated

<u>Risk Name</u>	<u>Impact</u>	<u>Likelihood</u>	<u>Mitigation</u>	<u>Status</u>
NEW. Char burning may not be permitted for cement kiln	4	4	Landfill char. Test char as soil amendment	Under investigation. Will require additional char samples (Hg content)
CO ₂ credit prices are too low	3	3	Operate without CO ₂ credits. Wait for legislation that provides clear pricing mechanism.	Investigated. CO ₂ credits for Phase 2 are uneconomic. Resolved.
RFS Implementation is delayed or amended	4	3	Maintain information. Develop technology that does not require price above petroleum market price	Under investigation. RFS standard was updated. For long-term commercialization, this risk is reduced. Resolved.
Operations Plant operability is too low (<80%)	4	3	Identify and redesign systems that lead to failure Design open/closed ratio to allow warmth retention in winter; provide for heat input from waste heat of cement plant; provide evaporative cooling capacity for overheating in summer	Identified
Seasonal production rate is too low	4	3		Identified and incorporated into process design.
Culture contamination occurs	1	5	Use local species that are robust. Use thermolytic process to convert algae.	Investigated. Thermolytic process works well on wide variety of algae and aquatic species. Complete
Flooding/bad weather occurs	5	3	Design capacity for retention ponds; design for high wind resistance; design for lightning resistance	Investigated. Retention design for 25-year storm is included. Resolved.
Cement plant not operating	5	1	Wait for turnaround to complete. Produce biomass for offsite use. Find new site.	Investigated. Site has multiple kilns and we plan to tie to at least two kilns. Likelihood of all kilns being shut down is very low. Resolved.
Low arvesting efficiency	4	2	Adjust to ecological change. Adjust pH, flocculant. Adjust residence time, gas/liquid ratios.	Under investigation. Test rig on offsite algae was successful. Currently being tested at the host site.
Low conversion efficiency	3	3	Adjust operating conditions.	Under investigation. Pilot test results are acceptable. Requires

<u>Risk Name</u>	<u>Impact</u>	<u>Likelihood</u>	<u>Mitigation</u>	<u>Status</u>
Cost of water circulation	5	4	Adjust design and operating conditions. Test using verification and make adjustments in nutrient solution to buffer toxicity	scale up. Under investigation. Engineering approach provides very low energy cost. Requires scale up and verification. Identified. Plans are in place to conduct site test. Test not yet started.
Cement plant gas is toxic to algae Permitting	5	2		
CO ₂ emissions from algae growth facility are regulated	4	4	Seek permits. Measure emissions.	Investigated. We will request permitting by rule for the air emissions. Resolved, pending NEPA review in Phase 2.
Hg and other contaminants are present	4	4	Measure emissions. Identify split to products. Use products in low-risk situation. Seek permits	Identified. More site testing is required. Under investigation. Pywater sample does appear to be hazardous as per RCRA.
Wastewater disposal	5	5	Use polishing ponds. Recycle water as much as possible. Dispose as cement plant cooling water.	Under investigation. Discussions started with site and local community organization.
Community disapproves Economics	4	1	Use community communication program. Seek political support	
CO ₂ lifecycle is not net negative	5	3	Redesign to reduce CO ₂ net production operations	Resolved. The process offers significant GHG reduction. Under investigation. Current models require either a renewable premium for bioleum, or carbon dioxide credits. Mitigation plan underway.
Earnings are not acceptable	5	5	Redesign to reduce costs; seek higher value markets for products. Use alternate biomass (lemna) to reduce capital investment.	Under investigation. Current models show lower than desired return on investment. Mitigation plan underway.
Return on investment is not acceptable	5	5	Redesign to reduce capital costs. Use waste materials. Renegotiate commercial terms. Lower engineering and construction costs.	

<u>Risk Name</u>	<u>Impact</u>	<u>Likelihood</u>	<u>Mitigation</u>	<u>Status</u>
Cost overrun increases capex	4	2	Use good cost estimate techniques. Consider fix price contract for EPCC. Use cost control approaches.	Identified. Will be used in Phase 2
Investor interest delayed	5	5	Make strong proposal for FOA 000015.	Resolved. TETF will participate, if Phase 2 is awarded..
DOE Funding not available	5	5	Improve economics. Seek strategic investors	Proposal submitted.

Subtask 1.6 Phase 2 Application

We submitted a Phase 2 application prior to the deadline.

Task 2. Research and Development

No research and development was planned and none was undertaken under the auspices of this program. In parallel, however, Sunrise Ridge Algae did continue to advance its understanding and control over the cultivation, harvesting and processing of aquatic biomass for beneficiating carbon dioxide by converting it into fuel feed stocks and a soil amendment. For example, we successfully tested new, higher quality samples of bioleum (bioleum production and testing was not completed with Federal funds).

Our process concept extended from the results of our pilot plant experiences in growing and harvesting algae using waste carbon dioxide and outfall water from a wastewater treatment plant located near Austin, Texas. We were able to achieve growth rates of algae of about 30 g/m²/day during the spring, summer and fall seasons (Figure 1).

Figure 1. Algae productivity of SRA's pilot operations

We obtained analyses of the bioleum from a refinery technology provider and from a major refiner of petroleum, both without charge to the project. Those analyses are presented in Appendix 2.

We also formulated hypotheses to explain both the low temperature of the catalyzed thermolysis reaction on which our conversion technology is based. The same hypothesis, namely the implication of the Maillard reactions also nicely accounts for many of the reaction products.

We hypothesize that the Maillard reaction (Figure 2), which is responsible for the browning of meats and starches when they are cooked, operates during our catalyzed thermolysis of algae to couples amines with carboxyl groups of sugars and starches. Subsequent aldol splitting produces smaller moieties, which at high temperature can further react, in part by dehydration, to produce heterocycles, like the ones that we have found in the effluent stream from our catalyzed thermolysis. The result is a complex mixture we call bioleum whose heating value reflects the removal of many of the oxygen atoms present in the starting material but which also presents a high nitrogen content and a high viscosity (sort of like caramel.). We expect that the adverse characteristics can be addressed by hydroprocessing the bioleum.

Figure 2. Schematic of the Maillard reaction

The result is the production of condensable hydrocarbon vapors at temperatures much lower than employed in the pyrolysis of wood, bagasse and stover (Figure 3).

Figure 3. TGA of algae during catalyzed thermolysis

In the course of the conceptual design exercise, it became clear to us that an economic pumping velocity for water through the Helioreactors™ would be so slow that we could not rely on turbulence to mix the contents of the reactors nor to vertically distribute the algae to expose them efficiently to light. We then asked our partner, Environ, to assist us to simulate the flow in the reactors so that we could start to devise effective means of mixing the system. The bulk of those calculations would have taken place during the early part of Phase 2. Here, we present some colorful pictures (Figure 4) that show the circulation in our Generation 5 Helioreactors™. We have found suggestions from the literature on creeping flow in microreactors [1, 2] that we would have adapted to the larger, but still very low Reynolds Number application.

Color contours of axial velocity (cm/s) on mid-plane.

Figure 4. Velocity distributions in SRA's Gen 5 Helioreactors™ at volumetric flow rates used in the Pilot plant operation.

Task 3. Conceptual Design

Subtask 3.1 Conceptual Process Design

We transmitted to the DOE three conceptual designs for growing algae in conjunction with the operation of a cement plant. The designs share a number of common, front-end features Figure 5; they differ in the disposition of the products and in the degree of integration with the cement plant to span a range of tradeoffs among Capex, Opex and Site Specificity (Table 3; Figures 6-8).

Figure 5. Major, common features of our conceptual designs

Table 3. Comparison of the costs, implications and benefits among our conceptual designs

Design option	Relative Capex	Relative Opex	Revenue Potential	Relative cost for mitigating CO ₂	Relative Site Specificity
1.Minimize integration	Low	High	Low	High	Low
2.Maximize product value	High	Medium	High	Low	Low
3.Maximize integration	Low	Low	Medium	Medium	High

Figure 6. Conceptual Design 1; least integrated with the cement plant and hence least site specific.

Figure 7. Conceptual Design 2; maximal product revenue and hence lowest cost of mitigating CO₂.

Figure 8. Conceptual Design 3; most integrated with the cement plant and hence most capable of mitigating CO₂.

All of the designs made use of commercially available, proven technologies for all of the unit operations except for the growth of algae, which was to have been validated in the work to proposed for Phase 2. We resolved to use Option 1 as the basis for our design in Phase 2 since it promised to be easiest to implement and most effective in yielding critical information required to scale up the operation to a pre-commercial level. It offered the extra benefits of being easiest to permit and disrupting as little as possible the commercial operations of our host.

We prepared site plans for the construction of our demonstration scale plant at a host site and discussed those plans with the host. The minor modifications were incorporated in the site plan that accompanied our Phase 2 proposal.

Appendix 3 contains the annotated, large format Process Flow Diagrams for the 500 kg/day demonstration plant and the putative 100 T/day commercial plant. Appendices 4 and 5 contain spreadsheets that estimate the costs of constructing and operating the demonstration plant and the commercial plant. Appendix 6 details the assumptions that enter the cost estimates. Those estimates were incorporated into our budget for Phase 2 and into our financial model for the commercial plant. We also solicited and received budgetary quotations from contractors to assist in the engineering, procurement and construction of the demonstration scale plant, which are presented in Appendix 7. Budgetary estimates from potential off-takers/upgraders of the bioleum are presented in Appendix 8.

Subtask 3.2 Algae Test Verification.

During the reporting period we installed a preparatory scale apparatus at the site that would have hosted the demonstration scale facility. The verification test was designed to determine only whether there were any acute issues that would preclude the cultivation of algae in water saturated with carbon dioxide that was drawn from the flue gas of the host site. We are pleased to report that we were able to culture algae native to region in this preparatory scale apparatus.

Figure 9. Verification test apparatus installed at the host cement plant.

The verification vessel (Figure 9, left panel) was fabricated from the same reinforced polyvinylchloride film as is used the Helioreactors™ in which we have grown algae at larger scale. The verification vessel was equipped with a submersible pump that recirculated the water at a rate of about 100 gal/h. Flue gas was extracted from the flue at the base of the stack through a conveniently located sampling port and conducted to the verification vessel initially through iron pipe. Condensation of acidic water from the flue gas caused significant corrosion of the iron pipes. Changing the gas conduit to Teflon solved that problem. The pressure at the base of the stack was below atmospheric (owing to the natural draft of the rising flue gas). Therefore we used an eductor to draw the gas through the conduit and to immediately contact the gas with the growth medium, as shown schematically in Figure 10. The eductor was constructed from two laboratory scale water aspirators operated in parallel with growth medium pumped through the venturi using an auxiliary recirculation pump operating at about 200 L/h (~1 gal/min). Intimate mixing of the gas and liquid in the venturi provided very effective contacting between the two phases.

Gas injected into a refilled verification vessel lowered the pH of that solution to about 5, a bit higher than the value of 4.3 predicted by the equilibrium of the broth with carbon dioxide at its partial pressure in the flue gas (Equation 1) but consistent with the slow kinetics of dissolution of carbon dioxide in neutral to acidic water.

$$[CO_2]_w = K_h P_{CO_2}$$

$$\frac{[H^+][HCO_3^-]}{[CO_2]_w} = K_{a1}$$

Equation 1.

Figure 10. Schematic of the verification apparatus

We filled the system with about 600 L (160 gal) of water from a slate pit adjacent to the cement plant and adjusted the concentrations of nitrate to 200 mg/L and phosphate to 15 mg/L, levels that we had found to favor the rapid growth of algae in our pilot scale experiments. There was no apparent growth of algae in this system after about 1 week so we raised the pH to neutral using calcium carbonate and we added a bolus of algae cultured from a nearby tank that contained process water used by the cement plant. We “tempered” the inoculum by adding to it about 1/3rd of its volume of water that been circulating in the verification vessel so as to not shock the organisms by diluting them suddenly with the new growth medium. After 2 days, the verification vessel was a healthy green (Figure 9, middle panel). We determined that a sample of the growth medium (Figure 9, right panel) contained approximately 7×10^5 cells/mL of a small (3-4 μ m diameter) spherical alga. That cell concentration is more dilute than we would intend to operate the demonstration scale Helioreactors™ but is satisfactory as an indication that algae can grow under these conditions.

We have identified a source of much larger eductors that can be fabricated from materials consistent with this service and will validate their performance for the demonstration scale plant.

Subtask 3.3 Equipment List and Cost Estimate

Based on Conceptual Design 1, we created an equipment list and estimated the capital costs using scaled cost estimates. We obtained budgeting estimates from vendors for the larger pieces of equipment, which were incorporated into our proposal for Phase 2 and are presented in the appendices.

Table 4. List of major equipment

Unit operation	Equipment	Status
Flue gas treatment	Eductor/saturator	Tested at Preparatory Scale

Water treatment	Mixers, nitrifiers	Commercial
Algae cultivation	SRA Helioreactors	Tested at pilot scale
Algae harvesting	Dissolved Gas Flotation; Belt press	Commercial
Algae drying	Rotary dryer	Commercial
Thermolysis	Kiln, Condenser	Commercial
Waste disposal	Flare	Commercial
Power generation	Diesel gen-set	Commercial

Subtask 3.4 Economics

We estimated the transfer prices for the key inputs: Carbon dioxide, nutrients, water, process heat and land. We projected that the bioleum product will eventually have a value comparable to that of petrocrude, discounted to reflect substitution elasticity and the extra costs of upgrading it to remove metals and heteroatoms.

We constructed a pro forma financial projection for the operation of the pilot plant, which was included in our Phase 2 proposal but which we deem to be business confidential and are not prepared to share in this publicly accessible document.

The project was critical to demonstrating the commercial viability of the proposed technology since crucial learnings of how to manage the ecology that will grow in the helioreactors cannot be extrapolated from small scale experiments but rather must be carried out at the actual site, using actual flue gas, since a core element of our approach is to use native species that grow robustly under the process conditions will be able to offer. Moreover, we recognized that since algae can incorporate many constituents of the flue gas (notably mercury and other RCRA-regulated pollutants), we would need to determine the fate and concentration of those species during the downstream processing.

We targeted the capture and beneficiation of carbon dioxide to produce a fuel feedstock that, according to our experience, should be convertible in fungible transportation fuels using existing refinery operations. We proposed to provide the technology link between the source of the, now wasted CO₂ and the refinery gate. The detailed engineering of that connection would have been explored in the work proposed for Phase 2.

Subtask 3.5 Lifecycle Analysis

This analysis was completed by our subcontractor Lifecycle Associates and is included here in Appendix 1.

Subtask 3.6 Funding Plans

We prepared application materials for Texas Emerging Technology Fund (ETF), and received a commitment to fund \$750,000, included in our Phase 2 proposal, contingent on DOE participation in Phase 2. These funds would have been subject to the Investment Unit and other contract terms required by the State of Texas. SRA has previously received ETF funding, and the terms did differ significantly from prior terms.

Task 4. Permitting and Partnering

Subtask 4.1 Definitive Commercial Agreements

We contacted a 10 potential offtakers for the bioleum product and secured a definitive agreement with two (Cetane Energy and Valero). Several offtakers expressed interest in receiving future product samples, when they were available, but were not in a position to sign a test agreement at this time. Those agreements were incorporated into our Phase 2

proposal. We also contacted 14 companies that blend or use No. 6 fuel oil (bunker fuel). We secured a testing agreement for blend stock that was conditioned on the results of assays of the eventual product.

We discussed off-take and testing programs with three refining technology providers, and secured quotations for test work from two of them. Examples of budget quotes for testing programs are presented in Appendix 8.

We also gathered data on two markets for alternate products that could be supplied by the process, with little modification: heavy fuel oil (Appendix 9) and renewable electricity (Appendix 10).

We interviewed four potential general contractors as a prelude to their bidding on this component of our Phase 2 work plan and their budgetary estimates are included in Appendix 7.

We also solicited candidates for performing a NEPA analysis of the facilities and operations we that we proposed for Phase 2. However, we could elicit no firm quotations because we could not specify the scope of work owing to uncertainties in DOE's requirements for that assessment.

Finally, we secured a lease agreement with a cement plant host site. A formal lease was incorporated in our Phase 2 proposal. In fact we approached 7 possible host sites and were rebuffed by all but 1 for a combination of these reasons:

- 1) The technology still requires development and the risk-weighted cost of the near term business threat or benefits of potential sustainability do not yet meet their concern thresholds.
- 2) The current economic environment is extremely challenging, and management viewed our small facility as a diversion of resources that would be better used to ensure cost control and continuing cement plant operation
- 3) The terms and conditions of working with the DOE are untenably burdensome
- 4) The potential for required, additional environmental reviews would only give their activist abutters and other local critics another forum in which to raise objections to operations at the cement plant.
- 5) The host site did not lend itself to the land requirements of the project

Subtask 4.2 Environmental Permit Plan

We held discussions with the Texas Commission on Environmental Quality and sized our project small enough that it should be permitted by rule, to allow us to gather data that will be factored into the design of emissions controls for the next larger scale of operation. A permitting plan and an Environmental Information Volume were prepared by URS for inclusion with our Phase 2 proposal.

In addition we dispatched samples of our products for analyses that will be required to determine their characteristics with respect to temporary, on-site storage and eventual disposal. Those analyses are presented in Appendix 11.

C. Potential Issues for Program Management

The program evolved smoothly.

D. Budget

Our forecasted and actual expenditures as of 30 September 2010 are presented in Figure 11, below.

The project expended about 100% of the budget, vs. planned expenditures of about 100%. There were no amounts accrued but not invoiced.

Figure 11. Cumulative expenses (forecasted budget and actual)

References

1. Stroock, A.D., et al., *Patterning Flows Using Grooved Surfaces*. Anal. Chem., 2002. **74**: p. 5306-5312.
2. Stroock, A.D. and G.J. McGraw, *Investigation of the staggered herringbone mixer with a simple analytical model*. Phil. Trans. R. Soc. Lond. A., 2004. **362**: p. 971-986.

Appendix 1. Lifecycle analysis for the use of bioleum as a transportation fuel.

Summary

Life cycle greenhouse gas (GHG) impacts associated with Sunrise Algae's design for converting cement kiln CO₂ to renewable diesel were compared to petroleum-based fuels on a well-to-wheels (WTW) basis. Sunrise Algae's process involves the capture of CO₂ from cement kilns and growth of algae from waste water streams. The algae are processed in a thermolysis reactor into bio oil (bioleum) that is transported to an oil refinery for conversion to refined product. The functional unit for comparison is a MJ-worth of diesel, including the CO₂, CH₄ and N₂O emissions from vehicle exhaust. Energy inputs and GHG emissions were calculated over the fuel cycle including capture of CO₂ from the cement plant, algae production, extraction, and pyrolysis, followed by refining, and vehicle end use. Emissions associated with process energy inputs were based on Argonne National Laboratory's GREET model. The GREET model calculates the GHG impacts of a variety of petroleum and biofuels options (Wang). However, the GREET model is not configured for Algal biofuels or Sunrise's technology.

Life Cycle Associates calculated the life cycle GHG emissions from fuel pathway components including diesel fuel, electricity, and other energy carriers in the fuel chain based on the GREET model. GREET provide the calculations for the refining of bioleum to renewable diesel. These life cycle inventory (LCI) data for process inputs are based on the recent release of GREET with year 2015 parameters.

Life cycle GHG emissions were calculated, following the same procedure in GREET. Process energy inputs are combined with direct- and well-to-tank emission factors in order to determine the emissions in each step of the process. Loss factors are applied to feedstock production to take into account downstream losses. The allocation method was applied to co-product thermolysis char and fuel gas as well as oil refinery products; which is the same method applied to renewable diesel pathways in GREET. The primary factors in the process include the life cycle energy required to produce renewable diesel, the electric power for algae production and separation, refinery energy inputs for processing the bioleum oil to renewable diesel, and diesel fuel for transport.

Table 1 shows the preliminary GHG emission results, based on the allocation of energy inputs to refined product in GREET plus a credit for the biogenic char that is used as fuel for the cement plant. The results are shown on a well to tank (WTT) basis plus the vehicle emissions on a g CO₂e/MJ of fuel basis. (1 liter of diesel fuel contains 44 MJ). The comparison of renewable diesel and petroleum diesel is comparable to the per mile emission comparison as the energy consumption per mile would be the same.

The life cycle analysis counts the carbon in fuel as a positive emission and takes into account the biogenic uptake of the CO₂ used to produce the fuel. This is the same convention as applied to other biofuels in the GREET model

Table 1. Life Cycle GHG Results (WTT + Vehicle Fuel)

Co-Product Methods for bio-coal and Py gas	Grid Power	Biolium Gen Set	Hybrid Substitution		U.S. Average Diesel
	Allocation				
Life Cycle GHG Emissions (g CO ₂ e/MJ)					
CO ₂ Uptake	-73.0	-73.0	-73.0	Crude Extraction	8.0
Electric power, combustion	13.1	0.075	0.2	Crude Transport	0.7
Oil Transport	0.4	0.4	0.4		
Refinery Co-processing	13.6	13.6	13.6	Crude Refining	8.8
Fuel T&D	0.6	0.6	0.6	Diesel T&D	0.5
				Fuel	
Fuel Combustion	73.8	73.8	73.8	Combustion	74.8
Thermolysis Fuel Credit			-494		
Total (g CO₂e/MJ)	28.5	15.5	-479	Total Fuel Cycle	92.8
% Reduction from Petro-Diesel	69.3%	83.4%	616%	% Reduction from Petro- Diesel	0.0%

1. Introduction

Life Cycle Associates calculated the life cycle energy inputs and greenhouse gas emissions for Sunrise Algae's renewable diesel process and compared the results to the life cycle results for petroleum derived diesel. The analysis is based entirely on year 2015 parameters for the comparison 2015 timeframe for a commercial plant and is consistent with the analyses conducted under other DOE programs. Note that EISA requires a comparison of biofuels to year 2005 parameters for petroleum. These values are also presented here and the % reduction in GHG emissions is comparable. The latest default GREET model (version GREET1.8c.0) developed by Argonne National Laboratory was used as the basis for this analysis (Wang 2008). In this analysis, the GREET model life cycle components were extracted from the GREET model (a large Excel spreadsheet) and reassembled in a new worksheet.

Objective and Scope

The objective of this analysis was to calculate the life cycle greenhouse gas (GHG) emissions from Sunrise Algae's production process based on process parameters used in the design for a pilot plant. The emissions are reported with a functional unit of g CO₂ equivalent per MJ of renewable diesel and then compared with petroleum diesel on a per MJ basis. Year 2015 parameters in GREET provide the basis for the life cycle analysis and comparison with petroleum fuels.

System Boundary

GHG emissions are counted according the system boundary diagram shown in Figure 2. CO₂ is captured from the cement plant and consumed in the Algae growth process. Some of the CO₂ escapes from the algae processing system. CO₂ derived from algae is also released from the

pyrolysis unit as well as the oil refining step. Finally carbon from the algae derived fuel is burned in the vehicle and converted to CO₂. The WTT calculations include the CO₂ uptake from the cement plant that ends up as vehicle fuel as a credit. This fuel carbon is counted in the vehicle emissions. This system boundary definition nets out the CO₂ emitted from processing or algae cultivation steps and does not count this carbon as uptake from the cement plant either. This accounting choice is consistent with the treatment for other biofuels. For example, the GREET model counts the direct inputs to the corn ethanol process with no biogenic uptake. The model then adds fuel carbon in the WTW calculations to the tank to wheel or vehicle phase. The same calculations provide a credit to the WTT emissions. A similar treatment is provided for dairy digester gas under the California Low Carbon Fuel Standard (ARB). Life Cycle Associates applied the same definition of the carbon balance for other photosynthetic algal biofuel analyses.

The thermolysis process produces bioleum which is converted to renewable diesel as well as char and gas from the pyrolysis reactor. The char and gas are returned to the cement plant as fuel to replace coal. Both the substitution and allocation methods are examined. With the substitution method, a credit for the life cycle GHG emissions associated with coal combustion is applied to the char and gas. With the allocation method, the energy inputs for algae production are allocated between the bioleum and thermolysis fuel.

Bioleum is assumed to be co-processed with petroleum feedstocks in an oil refinery. Therefore, the feed for refinery units will include both. Energy inputs for refining operations are allocated to the bioleum and petroleum feed. The LCA takes into account all of the energy inputs to the operating of the process. The carbon balance takes into account all of the CO₂ in the process that is converted to renewable diesel.

The reference case is petroleum diesel. The alternative fate of the CO₂ from the cement kiln is release into the atmosphere.

The life cycle components include the sum of the process inputs including feedstock production, transport, plant operation, fuel delivery and vehicle operation. These steps include the well to tank (WTT) and tank to wheel (TTW) components that are calculated in the GREET model. The WTT phase includes the upstream or fuel cycle emissions. The TTW phase includes the emissions from the vehicle, including fuel carbon converted to CO₂, as well as N₂O and CH₄ emissions generated by the combustion process.

Figure 2. System boundary diagram showing carbon balance for Sunrise Algae renewable diesel

2. Approach

GHG emissions are summed using the same energy accounting system as in the GREET model. The specific energy or material consumption (S) per unit of renewable diesel from Sunrise provides the consumption rate for the life cycle inventory. The life cycle emissions (E) for each life cycle inventory component step (i) are based on values from the GREET model. Inputs upstream of biorefinery include a loss factor (L). Thus the upstream emissions (EU) over the total fuel cycle are represented by:

$$EU = \sum (S \times E \times L)_i$$

Vehicle emissions are represented by the fuel carbon as CO₂ plus CH₄ and N₂O produced from the vehicle. With this accounting approach, WTT and TTW emissions are treated comparably and report in g CO₂e/MJ.

In this approach, the life cycle inventory (LCI) for each input to the process represents the total upstream energy and emissions for producing a feedstock or fuel. The life cycle values are extracted as vectors (columns of numbers) from the default (unmodified) GREET model configured with the U.S. average electricity mix. The LCI vectors are multiplied by a cumulative loss factor and a process specific energy (or mass), such as the MJ of electric power required per MJ of algae oil.

Since GREET aggregates results in two categories (feedstock and fuel), this approach facilitates calculating results by phase (feedstock collection, feedstock transport, fuel production, etc.) and includes inputs and co-products not included in GREET (gypsum, etc.). By summing GREET LCI data in a comparable spreadsheet organization, the result is the same as a new pathway in GREET, but the inputs and calculations are easier to follow.

3. Life Cycle Inventory

The production of bioleum derived renewable diesel include the steps and life cycle inputs shown in Table 3. The life cycle inventory data are based on values from the GREET model. Electric power is produced from a bioleum fired gen set but can also be purchased from the grid. For the bioleum fired gen set, the life cycle GHG emissions correspond to the CH₄ and N₂O produced from the combustion process. The GHG impacts of using grid power are also examined based on the life cycle value for U.S. grid power. Since the nutrients for Sunrise' process are to be derived from waste water treatment effluent, no GHG emissions were associated with the use of these nutrients (emissions of secondary N₂O may be avoided by capturing waste water nitrogen).

Emissions from bioleum refining in an oil refinery are based on the GREET analysis for co-processed renewable diesel. The GREET calculations allocate the energy inputs to refinery fuel gas and diesel product. Transport and vehicle emissions are based on GREET model values.

Table 3. Life Cycle Steps for Bioleum Derived Fuel

Process	Inputs	Data Source
Inputs		
Algae production	Electric power	Gen Set or GREET U.S. Avg
Algae nutrients	Waste water	Waste product
Algae processing	Electric power	Gen Set or GREET U.S. Avg
Thermolysis	Electric power	Gen Set or GREET U.S. Avg
Bioleum refining	Hydrogen, refinery fuel	GREET RD-I
Transport	Diesel	GREET Transport
Vehicle combustion	Vehicle CH ₄ , N ₂ O	GREET TTW data
Products		
Thermolysis char	Substitute coal	GREET coal
Thermolysis py-gas	Substitute coal	GREET coal

4. Fuel LCA Results

The life cycle GHG emissions for Sunrise Algae are shown in Table 4. The analysis shows the results for three different scenarios. First, grid power is used for algae production and thermolysis. In the second and third cases, electric power is produced from a bioleum fired generator.

Different co-product allocation methods are also applied to the thermolysis fuel. With the allocation method, the electric power for algae production and thermolysis is allocated based on energy between the fuel that is returned to the cement plant and the bioleum. With the substitution method, a credit is applied to substitute life cycle emissions for coal. The substitution method results in a substantial reduction in GHG emissions due to the high carbon content of the coal used in cement kiln.

Vehicle emissions reflect the carbon in fuel plus CH₄ and N₂O produced during combustion. The captured carbon is reflected as a credit.

Table 4. Life Cycle GHG Results (WTT + Vehicle Fuel)

	Grid Power	Biolium Gen Set			
Co-Product Methods for bio-coal and Py gas	Allocation		Hybrid Substitution		U.S. Average Diesel
Life Cycle GHG Emissions (g CO ₂ e/MJ)					
CO ₂ Uptake	-73.0	-73.0	-73.0	Crude Extraction	8.0
Electric power, combustion	13.1	0.08	0.2	Crude Transport	0.7
Oil Transport	0.4	0.4	0.4		
Refinery Co-processing	13.6	13.6	13.6	Crude Refining	8.8
Fuel T&D	0.6	0.6	0.6	Diesel T&D	0.5
				Fuel	
Fuel Combustion	73.8	73.8	73.8	Combustion	74.8
Thermolysis Fuel Credit			-494		
				Total Fuel Cycle	92.8
Total (g CO₂e/MJ)	28.5	15.5	-479		
% Reduction from Petro-Diesel	69.3%	83.4%	616%		0.0%

5. References

ARB (2009) Detailed California-Modified GREET Pathway for Liquefied Natural Gas (LNG) from Landfill Gas, California Air Resources Board, Stationary Source Division, Release Date: September 23, 2009, Version 2.0

Wang, M. (2008) GREET Model version 1.8c.0. Argonne National Lab, Contract No. DE-AC02-06CH11357 with the Department of Energy (DOE).

Appendix 2. Compositional analysis of bioleum.

SAMPLE DESCRIPTION	Sun Rise Ridge Algal Pyrolysis Oil		
COMMENTS	odor, liquid at temp >45 C		
SAMPLE DISPOSITION	DISCARD		
Method	METALS TRACE IN OILS U389 ICP		
40011			
1 RESULTS CALCULATED AS	RECEIVED		
COMMENT			
1 Al	26.7	MASS-PPM	
1 Ca	88	MASS-PPM	
1 Co	< 0.3	MASS-PPM	
1 Cr	< 0.3	MASS-PPM	
1 Cu	8.2	MASS-PPM	
1 Fe	62	MASS-PPM	
1 Mg	55	MASS-PPM	
1 Mn	1.3	MASS-PPM	
1 Mo	< 0.3	MASS-PPM	
1 Na	219	MASS-PPM	
1 Ni	0.4	MASS-PPM	
1 P	68	MASS-PPM	
1 Pb	1.2	MASS-PPM	
1 Sn	0.6	MASS-PPM	
1 Sr	0.3	MASS-PPM	
1 Ti	0.9	MASS-PPM	
1 V	1.3	MASS-PPM	
1 Zn	17.6	MASS-PPM	
1 K	322	MASS-PPM	
Method	NITROGEN PPM LIQ D4629		
1 NITROGEN (D4629)	SEE TEXT	MASS-PPM	
sample analyzed for nitrogen by CHN D5291: 10.4% N			

Client: SUNRISE RIDGE ALGAE INC
Job Number: 120594

Sulfur by SOP 7040, Rev 10
Quantitative Analysis Report
Inductively Coupled Plasma-Mass Spectrometry

Sample preparation: 0.5 g weighed sample portions were mixed with 3 mL nitric acid and 1 mL hydrochloric acid, then heated at a hotblock setting of 110°C for 1 hour. After cooling, 1 mL of 30% hydrogen peroxide and 1 mL hydrochloric acid were added and heating continued for 30 minutes (the material mostly dissolved). After cooling, internal standard solution was added and dilution was made to 100 g producing solutions for ICPMS analysis.

Parts Per Million ($\mu\text{g/g}$)

<u>Sample ID</u>	<u>Sulfur</u>
Blank	ND
JM-2-1,15	4400
JM-2-16,20	3000
Detection Limit:	200

Date Analyzed: 02-25-10

Quality Control Summary

Sample: JM-2-16,20

<u>Analyte</u>	<u>Sample Result</u>	<u>Duplicate Result</u>	<u>Average Result</u>	<u>Sample RPD</u>	<u>Spike Conc</u>	<u>Spike Result</u>	<u>Spike % Rec</u>
Sulfur	2990	2960	2980	NA	20000	22200	96

Date Analyzed: 02-25-10

Sample: Laboratory Fortified Blank (LFB)

<u>Analyte</u>	<u>Blank Result</u>	<u>Spike Conc</u>	<u>Spike Result</u>	<u>Spike % Rec</u>
Sulfur	ND	20000	20100	100

Date Analyzed: 02-25-10

Data other than that contained in the final signed report should be considered preliminary and may not reflect final reported values.

Client: SUNRISE RIDGE ALGAE INC
Job Number: 120594

Metals Screen by SOP 7040, Rev 10
Inductively Coupled Plasma - Mass Spectrometry

Sample ID: JM-2-1,15

	<u>ppm</u>	<u>Detection</u> <u>Limit</u>		<u>ppm</u>	<u>Detection</u> <u>Limit</u>
Aluminum	27	0.8	Molybdenum	ND	0.02
Antimony	ND	0.02	Neodymium	ND	0.02
Arsenic	1.2	0.02	Nickel	0.24	0.02
Barium	0.07	0.02	Niobium	ND	0.02
Beryllium	ND	0.02	Osmium	ND	0.02
Bismuth	0.08	0.02	Palladium	ND	0.02
Boron	4.7	0.1	Phosphorus	7.9	4
Bromine	ND	2	Platinum	ND	0.5
Cadmium	0.20	0.02	Potassium	ND	5
Calcium	35	6	Praseodymium	ND	0.02
Cerium	ND	0.02	Rhenium	ND	0.02
Cesium	ND	0.02	Rhodium	ND	0.02
Chromium	ND	0.02	Rubidium	ND	0.02
Cobalt	ND	0.02	Ruthenium	ND	0.02
Copper	37	0.02	Samarium	ND	0.02
Dysprosium	ND	0.02	Selenium	1.4	0.2
Erbium	ND	0.02	Silver	ND	0.02
Europium	ND	0.02	Sodium	42	3
Gadolinium	ND	0.02	Strontium	0.13	0.02
Gallium	ND	0.02	Tantalum	ND	0.02
Germanium	ND	0.02	Tellurium	ND	0.02
Gold	ND	0.02	Thallium	ND	0.02
Hafnium	ND	0.02	Thorium	ND	0.02
Holmium	ND	0.02	Thulium	ND	0.02
Iodine	0.03	0.02	Tin	0.94	0.02
Iridium	ND	0.02	Titanium	0.16	0.08
Iron	17	0.3	Tungsten	ND	0.02
Lanthanum	ND	0.02	Uranium	ND	0.02
Lead	4.4	0.02	Vanadium	ND	0.06
Lithium	ND	0.4	Ytterbium	ND	0.02
Lutetium	ND	0.08	Yttrium	ND	0.02
Magnesium	13	0.3	Zinc	15	0.2
Manganese	0.30	0.02	Zirconium	ND	0.02
Mercury	ND	0.02			

Date Analyzed: 02-25-10

Elements Not Analyzed: All Gases, C, Si, Sc, In, Tb

Data other than that contained in the final signed report should be considered preliminary
and may not reflect final reported values.

Client: SUNRISE RIDGE ALGAE INC
Job Number: 120594

Metals Screen by SOP 7040, Rev 10
Inductively Coupled Plasma - Mass Spectrometry

Sample ID: JM-2-16,20

	<u>ppm</u>	<u>Detection</u> <u>Limit</u>		<u>ppm</u>	<u>Detection</u> <u>Limit</u>
Aluminum	46	0.8	Molybdenum	ND	0.02
Antimony	0.16	0.02	Neodymium	ND	0.02
Arsenic	2.0	0.02	Nickel	0.08	0.02
Barium	0.13	0.02	Niobium	ND	0.02
Beryllium	ND	0.02	Osmium	ND	0.02
Bismuth	0.07	0.02	Palladium	ND	0.02
Boron	7.3	0.1	Phosphorus	12	4
Bromine	ND	2	Platinum	ND	0.5
Cadmium	0.48	0.02	Potassium	ND	5
Calcium	42	6	Praseodymium	ND	0.02
Cerium	ND	0.02	Rhenium	ND	0.02
Cesium	ND	0.02	Rhodium	ND	0.02
Chromium	0.06	0.02	Rubidium	ND	0.02
Cobalt	ND	0.02	Ruthenium	ND	0.02
Copper	14	0.02	Samarium	ND	0.02
Dysprosium	ND	0.02	Selenium	1.1	0.2
Erbium	ND	0.02	Silver	ND	0.02
Europium	ND	0.02	Sodium	81	3
Gadolinium	ND	0.02	Strontium	0.16	0.02
Gallium	ND	0.02	Tantalum	ND	0.02
Germanium	ND	0.02	Tellurium	ND	0.02
Gold	ND	0.02	Thallium	ND	0.02
Hafnium	ND	0.02	Thorium	ND	0.02
Holmium	ND	0.02	Thulium	ND	0.02
Iodine	0.09	0.02	Tin	0.72	0.02
Iridium	ND	0.02	Titanium	0.19	0.08
Iron	18	0.3	Tungsten	ND	0.02
Lanthanum	ND	0.02	Uranium	ND	0.02
Lead	6.8	0.02	Vanadium	ND	0.06
Lithium	ND	0.4	Ytterbium	ND	0.02
Lutetium	ND	0.08	Yttrium	ND	0.02
Magnesium	12	0.3	Zinc	30	0.2
Manganese	0.29	0.02	Zirconium	ND	0.02
Mercury	ND	0.02			

Date Analyzed: 02-25-10

Elements Not Analyzed: All Gases, C, Si, Sc, In, Tb

Data other than that contained in the final signed report should be considered preliminary
and may not reflect final reported values.

Client: SUNRISE RIDGE ALGAE INC
 Job Number: 120594

Quality Control Summary

Sample: JM-2-16,20

Parts Per Million (µg/g)

Analyte	Sample Result	Duplicate Result	Average Result	Sample RPD	Spike Conc	Spike Result	Spike % Rec
Aluminum	45.8	47.6	46.7	3.9	20	85.8	NR
Antimony	0.16	0.16	0.16	NA	20	15.7	78
Arsenic	1.98	2.01	2.0	1.5	20	24.3	112
Barium	0.13	0.14	0.14	NA	20	19.2	95
Beryllium	ND	ND	ND	NA	20	19.4	97
Boron	7.29	6.97	7.13	4.5	20	30.9	119
Cadmium	0.48	0.49	0.49	2.1	20	20.2	99
Calcium	41.5	46.9	44.2	NA	2000	1970	96
Chromium	0.06	0.04	0.05	NA	20	20.8	104
Cobalt	ND	ND	ND	NA	20	19.1	96
Copper	14.5	14.2	14.4	2.1	20	31.4	85
Iron	18	16.8	17.4	6.9	2000	1860	92
Lead	6.75	6.89	6.82	2.1	20	26.3	97
Lithium	ND	ND	ND	NA	20	20.3	102
Magnesium	11.9	13.1	12.5	9.6	2000	2030	101
Manganese	0.29	0.29	0.29	NA	20	19.5	96
Mercury	ND	ND	ND	NA	2	1.87	94
Molybdenum	ND	ND	ND	NA	20	19	95
Nickel	0.08	0.06	0.07	NA	20	19.8	99
Phosphorus	11.7	7.42	9.56	NA	2000	2000	100
Potassium	ND	9.02	NA	NA	2000	1990	100
Selenium	1.09	1.42	1.26	NA	200	230	114
Silver	ND	ND	ND	NA	20	19.8	99
Sodium	81.1	90.5	85.8	11	2000	2190	105
Strontium	0.16	0.16	0.16	NA	20	19.4	96
Thallium	ND	ND	ND	NA	20	16.5	83
Titanium	0.19	0.2	0.2	NA	20	19.7	98
Vanadium	ND	ND	ND	NA	20	20.1	101
Zinc	30	29.2	29.6	2.7	20	41.7	NR

NR - Not Reported; sample concentration is larger than spike.

Date Analyzed: 02-25-10

Data other than that contained in the final signed report should be considered preliminary and may not reflect final reported values.

Client: SUNRISE RIDGE ALGAE INC
Job Number: 120594

Quality Control Summary

Sample: Laboratory Fortified Blank (LFB)

Parts Per Million ($\mu\text{g/g}$)

<u>Analyte</u>	<u>Blank Result</u>	<u>Spike Conc</u>	<u>Spike Result</u>	<u>Spike % Rec</u>
Aluminum	0.65	20	19	92
Antimony	ND	20	19.6	98
Arsenic	ND	20	18.7	94
Barium	ND	20	19.8	99
Beryllium	ND	20	19	95
Boron	ND	20	19.6	98
Cadmium	ND	20	20	100
Calcium	ND	2000	1950	98
Chromium	ND	20	20.6	103
Cobalt	ND	20	19.6	98
Copper	ND	20	19.6	98
Iron	ND	2000	1920	96
Lead	ND	20	21	105
Lithium	ND	20	20.3	102
Magnesium	ND	2000	2040	102
Manganese	ND	20	19.3	97
Mercury	ND	2	1.84	92
Molybdenum	ND	20	20.1	101
Nickel	ND	20	19.6	98
Phosphorus	ND	2000	1900	95
Potassium	ND	2000	2050	103
Selenium	ND	200	183	92
Silver	ND	20	20	100
Sodium	ND	2000	2080	104
Strontium	ND	20	19.2	96
Thallium	ND	20	20.2	101
Titanium	ND	20	20.3	102
Vanadium	ND	20	20.6	103
Zinc	ND	20	19.2	96

Date Analyzed: 02-25-10

Data other than that contained in the final signed report should be considered preliminary
and may not reflect final reported values.

Client: Sunrise Ridge Algae Inc
Job No.: 120594

Carbon, Hydrogen, and Nitrogen by SOP 5900 Rev. 3
Elemental Analyzer

Percent

<u>Sample ID</u>	<u>Carbon</u>	<u>Hydrogen</u>	<u>Nitrogen</u>
JM-2-1,15	65.82	8.17	8.26
JM-2-1,15 Duplicate	67.14	7.83	7.72
JM-2-1,15 Triplicate	56.27	8.03	7.74
JM-2-1,15 Quadruplicate	61.14	8.35	8.21
JM-2-16,20	48.04	8.32	6.50
JM-2-16,20 Duplicate	57.91	7.90	6.83
JM-2-16,20 Triplicate	56.67	8.57	6.60
JM-2-16,20 Quadruplicate	55.85	8.17	6.53

Quality Control Summary

Percent

Sample ID: 6770

<u>Element</u>	<u>Acetanilide</u>	<u>Theoretical</u>	<u>Absolute Difference</u>
Carbon	71.15	71.09	0.06
Hydrogen	6.68	6.71	0.03
Nitrogen	10.24	10.36	0.20

Data other than that contained in the final signed report should be considered preliminary
and may not reflect final reported values.

Metals (ppm) by ICP

	Na+	Mo	Zn	Cu	Fe	K	Mg	Ca
Top Layer (9.91 API)	10	1	37	130	75	7	2	93
Bottom Layer (2.48 API)	45	2	1	3	79	5	3	10

* Unable to set-up D-2887 on Bottom Layer - Insoluble in Carbon Disulfide

D-2887 on Top Layer

	TBP
IBP	378.52
5%	483.97
10%	528.56
15%	562.29
20%	591.55
25%	627.10
30%	660.60
35%	684.73
40%	703.43
45%	725.28
50%	747.48
55%	773.56
60%	801.77
65%	830.87
70%	879.15
75%	914.58
80%	963.92
85%	1031.50
90%	1113.30
95%	1281.80
FBP	1415.40

Appendix 3. Annotated large format PFDs for a 500 kg/day and 100 T/day plants.

Stream Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	
Name	Flue Gas from Plant	Flue Gas to Helio reactors	Flue Gas to DGF	Helio reactor Vent	Helio reactor Feed	Helio reactor Effluent	DGF Vent	DGF Float	DGF Effluent	Belt Wash	Filter Cake	Filtrate	Water Blowdown	Dryer Fuel Gas	Dried algae	Dryer Vent	Catalyst	Char Slurry to Thermolyzer	Thermolyzer Overheads	Char	Cooling Water Return	Pygas	Bioleum	Pywater	Char Slurry to Disposal	Fertilizer	Sweep Gas	Makeup water	Evaporation	Stack to Atmosphere	Flare air	Flare fuel	Thermolyzer Combustion Air	
Temperature (C)	177	51.27	51.27	31.03	25.43	31.03	31.04	31.04	31.04	25	31.04	31.04	31.04	25	99.99	99.99	25	48.89	48.89	48.89	28.05	48.89	48.89	48.89	48.89	48.89	25	177	25	24.94	631.3	25	25	
Pressure (kPa)	99	120	120	101.3	120	101.3	101.3	101.3	101.3	113.6	101.3	101.3	101.3	103	101.3	101.3	113.6	101.3	101.3	101.3	101.3	101.3	101.3	101.3	120	99	120	101.3	101.3	120	110	113.6		
Mass Flow (kg/h)	267.06	165.43	18.38	164.86	105890.67	105901.94	14.50	158.42	105747.39	200	42.43	317.00	305.30	0.72	23.66	19.44	1	1.62	28.81	10.66	3271.93	17.71	5.58	5.52	14.56	21	8.00	1092.26	52820.71	29.39	11.52	0.16	5.76	
N2 (kg/h)	108.31	93.29	10.37	93.67	1.45	1.07	10.13	0.002	1.31	0	0.0002	0.0015	0.0013	0.53	0	0.53	0	0	9.17	0	0.05	9.17	0.0002	0	0	4.68	0	40268.19	18.13	8.96	0	4.48		
Char (kg/h)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.96	0	9.61	0	0	0	0	0	0	0	0	0	0	0	0	0	
Pygas (kg/h)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.84	0	0	1.84	0.0002	0.0001	0.0001	0	0	0	0	0	0	0	0	
Bioleum (kg/h)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5.34	0	0	0.002	5.33	0	0	0	0	0	0	0.002	0	0	0	
O2 (kg/h)	26.76	23.32	2.59	60.25	0.11	0.24	2.71	0.0002	0.12	0	0.0001	0.0001	0.0001	0.15	0	0	0	0	0.21	0	0.004	0.21	0	0	0	0	0.85	0	11499.91	1.27	2.56	0	1.28	
CO2 (kg/h)	53.80	44.69	4.97	6.40	2.17	2.96	1.27	0.0087	6.85	0	0.42	0.0074	0.0066	0	0	0.57	0.42	0.0001	4.42	0	0.0003	4.42	0.002	0.0008	0.0007	1.99	0	6.64	6.35	0	0	0		
HNO3 (kg/h)	0	0.002	0.0002	0.015	9.75	1.07	0.0013	0.0014	1.07	0	0.0002	0.0012	0.0011	0	0	0.0002	0	0	0	0	0.007	0	0	0	0	9.54	0	0	0.85	0	0	0	0	
NO2 (kg/h)	0.004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0016	0.54	0	0	0.52	0.004	0.016	0.014	0	0.0035	0	0	0.52	0	0	0	
Phosphoric Acid (kg/h)	0	0.0001	0	0.002	0.64	0.06	0	0.0001	0.06	0	0	0.0001	0.0001	0	0	0	0	0.0002	0.04	0	0.0004	0.03	0.009	0.002	0.002	0.63	0	0	0.04	0.03	0	0	0	
H2O (kg/h)	78.20	4.13	0.46	4.53	105869.61	105868.82	0.40	137.63	105731.25	200	20.64	316.99	305.29	0	2.31	18.34	0	0.55	6.67	0	3271.66	1.15	0.03	5.50	4.95	10.84	0.48	1092.26	1045.07	2.73	0	0	0	
Algae (kg/h)	0	0	0	0	6.93	27.71	0	20.78	6.93	0	0	20.78	0	0	20.78	0	0	0	0.10	0	1.04	0.21	0	0	0	0.94	0	0	0	0	0	0	0	0
Catalyst (kg/h)	0	0	0	0	0	0	0	0	0	0	0.58	0	0	0	0.58	0	0.58	0.0003	0.58	0	0	0.37	0.20	0.003	0.003	0	0	0	0	0.37	0	0	0	
Methane (kg/h)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.16	0	0	

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DEPT. DATE

PROJECT DATE

CLIENT DATE

SCALE NOTED
SCALES SHOWN FOR 30"x24" SHEET

URS

SUNRISE RIDGE ALGAE INC.

PROCESS FLOW DIAGRAM
DEMONSTRATION PLANT

JOB NO. 40819244

DWG NO. 40819244-F-A005

REV. A

AUSTIN, TEXAS

Stream Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Name	Flue Gas from Plant	Flue Gas to Helio reactors	Flue Gas to DGF	Helio reactor Vents	Helio reactor Feed	Helio reactor Effluent	DGF Vent	DGF Float	DGF Effluent	Belt Wash	Filter Cake	Filtrate	Water Blowdown	Waste Heat	Dried Algae	Dryer Vent	Catalyst	Char Slurry to Thermolyzer	Thermolyzer Overheads	Char	Cooling Water Return	Pygas	Pywater	Char Slurry to Disposal	Fertilizer to Helio reactors	Sweep Gas	Make Up Water	Evaporation	Stack to Atmosphere	Flare Air	Flare Fuel	Thermolyzer Combustion Air	Bioleum to Generator	Exported Bioleum
Temperature (C)	177	51.24	51.24	31.21	25.59	31.27	31.28	31.28	31.28	25	31.28	31.28	31.28	315	54	54	25	48.89	48.89	48.89	27.16	48.89	48.89	48.89	25	177	25	25.09	610.4	25	25	48.89	48.89	
Pressure (kPa)	99	120	120	101.3	120	101.2	101.3	101.3	101.3	101.3	101.3	101.3	101.3	103	101.3	101.3	113.6	101.3	101.3	101.3	101.3	101.3	101.3	120	99	120	101.3	101.3	120	110	113.6	101.3	101.3	
Mass Flow (kg/h)	51822	32954	3662	32872	20904217	20933803	2895	31336	20903234	1000	8233	24104	21794	19300	4617	22916	1	321	4696	2131	870609	2542	1079	2889	4210	160	217620	10440004	3691	1148	1729	537	537	
N2	20758.59	18593.49	2065.94	18668.40	286.37	211.28	2018.92	0.34	257.97	0	0.05	0.29	0.26	13322.62	0	13322.67	0	0.001	1438.30	0	12.23	1438.24	0.01	0.01	0	93.67	0	7960000	2331.52	893.28	0	1344.62	0.02	0.02
Char	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	192.19	0	1921.91	0	0	0	1729.72	0	0	0	0	0	0	0	0	0	
Pygas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.003	368.36	0	0	368.28	0.03	0.02	0	0	0	0	0	0	0	0	0.02	0.02
Bioleum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1066.73	0	0	0.38	0	0	0	0	0	0	0.38	0	0	533.17	533.17	
O2	5183.22	4647.18	516.35	12007.65	22.74	46.97	539.4596	0.03	23.83	0	0.005	0.03	0.02	4047.38	0	4047.38	0	0	17.74	0	0.97	17.74	0.0001	0.0001	0	16.98	0	2270000	99.02	255.10	0	384	0.0006	0.0006
CO2	10372.17	8890.99	987.89	1280.66	447.97	586.55	255.0008	1.72	1317.72	0	0.68	1.46	1.31	0	0	0.68	0.42	0.01	442.15	0	0.03	441.78	0.11	0.10	0	39.71	0	1315.73	739.94	0	0	0	0.13	0.13
HNO3	31.00	0.25	0.03	2.82	1933.71	203.71	0.2496	0.26	203.22	0	0.04	0.22	0.20	0	0.0001	0.04	0	0	0.0001	0	0.93	0.0001	0	0	1911.68	0	0	161.19	0.0001	0	0	0	0	0
NO2	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.41	107.10	0	0	102.08	4.09	3.68	0	0.07	0	0	102.08	0	0	0	0.46	0.46
Phosphoric Acid	0	0.06	0.01	0.41	133.28	46.28	0.04	0.06	46.19	0	0.009	0.05	0.05	0	0.0002	0.009	0	0	8.34	0	0.31	5.87	0.56	0.50	125.88	0	0	34.98	5.87	0	0	0.96	0.96	
H2O	15477.26	821.57	91.29	912.21	20900000.00	20927168.99	80.98	27179.20	20900000.00	1000	4076.88	24102.32	21792.09	1930	461.76	5545.12	0	107.49	1246.79	0	870536.23	167.49	1074.56	987.11	2172.44	9.56	217620	208492.09	411.59	0	0	2.37	2.37	
Algae	0	0	0	0	1392.60	5539.12	0	4154.34	1384.78	0	4154.34	0	0	0	4154.34	0	0	20.88	0	208.76	58.03	0	0	187.88	0	0	0	0	0	0	0	0	0	0
Catalyst	0	0	0	0	0	0	0	0	0	0	0.58	0	0	0	0.58	0	0.58	0.0004	0.58	0	0	0.36	0.004	0.004	0	0	0	0	0.36	0	0	0.11	0.11	
Methane	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.16	0	0	0	0

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JOB NO. 40819244

DWG NO. 40819244-F-A004

REV. A

URS

SUNRISE RIDGE ALGAE INC.

PROCESS FLOW DIAGRAM
COMMERCIAL PLANT

AUSTIN, TEXAS

30x24 A001 U-300

Appendix 4. CAPEX and OPEX for a 500 kg/day demonstration plant.

Appendix 5. CAPEX and OPEX for a 100 T/day commercial plant.

Equipment Tag	User Description	User Details	Demonstration		Exponent**	Commercial	
			Size	\$/Unit Material		Size	\$/Unit Material
B-101	Flue Gas Compressor	55 acfm flue gas at 115 F, 120 kPa, Grainger part no. 2EPP4, Speedaire positive displacement blower, 12 psig max discharge pressure, 57 to 186 CFM	267.1	\$ 1,350	0.59	20758.6	\$ 17,609
E-801	Thermolysis Condenser		28.8	\$ 145,000	0.44	4695	\$ 1,363,813
F-501	Algae Dryer	Fenton CM 4/1 4 tpd, 25.5 hp	4	\$ 245,000	0.4	100	\$ 887,855
F-801	Pygas Flare	480 VAC, 3-phase, 2 A	17.71	\$ 30,000	0.6	1079	\$ 353,186
P-1001	Char Feed Pump	12 gal/hr, LMI C141 series pump, plus LMI complete liquid end assembly	16.16	\$ 1,501	0.33	3210	\$ 8,604
P-101	Cooling Tower Recirc Pump	150gpm @50' TDH, Goulds straight center discharge pump, 316 stainless steel wetted parts, Grainger part no. 4UB88	150	\$ 1,097	0.33	30000	\$ 6,303
P-1201	Cooling Pond Recirc Pump	350 gpm @ 50 ft TDH	350	\$ 3,000	0.33	70000	\$ 17,237
P-1301	Fertilizer Feed Pump	20 gal/hr, LMI C141 series pump, plus LMI complete liquid end assembly	21	\$ 1,501	0.34	4210	\$ 9,100
P-402	Flocculant Feed Pump	1 gal/hr, LMI C141 series pump, plus LMI complete liquid end assembly	200	\$ 1,501	0.34	1000	\$ 2,594
P-601	Catalyst Feed Pump	1 gal/hr, LMI C141 series pump, plus LMI complete liquid end assembly	1	\$ 1,501	0.34	1	\$ 1,501
P-901	Truck Unloading Pump	150gpm @50' TDH, Goulds straight center discharge pump, 316 stainless steel wetted parts, Grainger part no. 4UB88	5.584	\$ 1,097	0.33	537.2	\$ 4,951
P-xxxx	Service Water Pump	75 gpm @ 30 psi, Goulds Prime line self-priming pump, Grainger part no. 1XMA8, including suction flange Grainger part no. 1XMA8	75	\$ 1,501	0.33	15000	\$ 8,624
R-201 thru R-2XX	Helioreactors	PVC bags, 5 ft x 8 in x 500 ft (w x h x l)	106000	\$ 600,000	0.6	20900000	\$ 14,290,766
R-801	Thermolysis Reactor	55 hp total	12	\$ 835,000		100	\$ 4,465,000
T-101	Cooling Tower	135 acfm flue gas at 460 F 1" DIA 10' Tall	267.1	\$ 11,800	0.62	20758.6	\$ 175,391
TK-1001	Char Collection Tank	300 gal (3 day residence time), Plastic mart model no. 300VERT, 42" dia. X 57" H, self-aligning bulkhead fittings part no. SF10200T, 6" inspection lid, part no. 6" whitecollar/clearlid	10.66	\$ 730	0.57	2131	\$ 14,955
TK-1301	Fertilizer Storage Tank	4000 gal (8 day residence time), Plastic mart model no. NW4000VERT, 102" dia. X 125" H, self-aligning bulkhead fittings part no. SF10200T, 6" inspection lid, part no. 6" whitecollar/clearlid	21	\$ 2,759	0.57	4210	\$ 56,614
TK-301	Float Storage Tank	1500 gal (1 day residence time), Plastic mart model no. NW1500VERT, 64" dia. X 116" H, self-aligning bulkhead fittings part no. SF10200T, 6" inspection lid, part no. 6" whitecollar/clearlid	158	\$ 1,390	0.57	31300	\$ 28,330
TK-401	Flocculant Tank	150 gal (8 day residence time), Plastic mart model no. NW150VERT, 30" dia. X 56" H, self-aligning bulkhead fittings part no. SF10200T, 6" inspection lid, part no. 6" whitecollar/clearlid	200	\$ 630	0.57	1000	\$ 1,577
TK-601	Catalyst Storage Tank	150 gal (8 day residence time), Plastic mart model no. NW150VERT, 30" dia. X 56" H, self-aligning bulkhead fittings part no. SF10200T, 6" inspection lid, part no. 6" whitecollar/clearlid	1	\$ 630	0.57	1	\$ 630
TK-901	Bioleum Storage Tank	200 gal (1 day residence time), US Plastic model no. 7310, 32" dia. X 69" H, with (1) 2" dia. Flanged connection, and (1) 3" dia. Flanged connection, with white fiberglass removable lid	5.584	\$ 1,242	0.57	1074.4	\$ 24,901
U-401	Belt Filter	Ashbrook Klampress KP0.5, 480 VAC, 3-phase, 30 A	158.4	\$ 145,000	0.6	31300	\$ 3,458,131
V-301	Dissolved Gas Flotation Unit	ETS Model RT150LA, 400 gpm (nominal), 25 hp	106000	\$ 160,000	0.6	20900000	\$ 3,810,871
V-801	Thermolysis Knock Out Drum		28.8	\$ 10,000	0.6	4695	\$ 212,494
	Air Compressor Dryer	60cfm@150psig, Vanair Viper stationary air compressor, Grainger part no. 4TZW2, with AKG air cooled aftercooler, Grainger part no. 4UJE5, with \$5k allowance for dessicant dryers	60	\$ 14,600	0.79	120	\$ 25,244
	Propane Tank	Self Contained	0.2	\$ 20,500	0.6	40	\$ 492,461
				\$ 2,238,329			

** Scale factor exponents and ratio factors were taken from "Plant Design and Economics for Chemical Engineers, Peters and Timmerhaus, 3rd Edition"

Ratio Factors**	
\$ 29,738,742	Purchased Equipment 100
\$ 11,598,109	Purchased Equipment Installation 39
\$ 3,866,036	Instrumentation and Controls (installed) 13
\$ 9,219,010	Piping (installed) 31
\$ 2,973,874	Electrical (installed) 10
\$ 8,624,235	Buildings (including services) 29
\$ 2,973,874	Yard Improvements 10
\$ 16,356,308	Service facilities (installed) 55
\$ 1,784,325	Land 6
\$ 87,134,513	Total Direct Cost
\$ 9,516,397	Engineering and Supervision 32
\$ 10,111,172	Construction expenses 34
\$ 106,762,083	Total Indirect Costs
\$ 5,352,974	Contractor's fee 18
\$ 10,705,947	Contingency (~10% of Indirect Costs) 36
\$ 122,821,003	Total Capital Costs
\$ 32,028,625	Contingency at ~30%
\$ 144,143,681	Total Capital Costs

Appendix 6. Assumptions employed in the CAPEX and OPEX estimates.

Sunrise Ridge - 0.5TPD cost estimate for installation at Cement Plant: Assumptions and Clarifications

	Area/Item	Discipline	Assumption	Clarifications
1	Construction	General	This cost estimate is URS' opinion of probable costs to install the type and quantities of materials and equipment in the bill of quantities in accordance with the assumptions contained within this list.	Direct labor hours have been estimated assuming a 5 x10 hour work week.
2	Construction	Civil	Estimate assumes existing clay bed materials will be used for the pond. No liner.	Excavated material will be disposed of on site.
3	Construction	Civil	Deep groundwater dewatering systems are not included.	
4	Construction	Civil	Estimate assumes process equipment area will have top soil scraped clear, covered by a 6" deep gravel bed, with a 20 mil HDPE liner under gravel.	
5	Construction	Civil	New concrete foundations will be poured for the cooling tower, flare, and transformer. All other equipment is assumed to be skid mount, set on the gravel.	Concrete foundations shall be designed in accordance with the American Concrete Institute ACI 318-05.
6	Construction	Civil	Timbers and tiedowns will be used as pipe and cable raceways.	
7	General	Facilities	No potable water services included in estimate. Use of portable restrooms or Cement Plant restrooms are assumed.	
8	General	Facilities	Propane tank has been included and it is assumed that gas service will be contracted as operating cost.	
9	General	Facilities	Self-contained safety shower has been included.	
10	General	Facilities		
11	Construction	Civil	Steel banding and rebar posts will be used to anchor all tanks.	
12	Construction	Civil	Pumps are assumed skid mount to pallets. Pallets will be anchored using steel banding and rebar posts.	
13	Construction	Civil	There are no existing undergrounds requiring relocation to install the equipment.	
14	General	Civil	There will be no handling or disposal of contaminated soil.	
15	General	Civil	Remediation of this material if found will be by Cement Plant.	
16	Construction	Electrical	A single armored cable (no conduit) will be routed from the Cement Plant designated electrical bus to the new transformer.	
17	Construction	Electrical	A pre-fabricated electrical room will be procured that will include the power panels, panelboards, and breakers for the new equipment.	
18	Construction	Electrical	All conduit assumed to be galvanized rigid steel for compliance with NEC.	
19	Construction	Electrical	Host Site to provide adequate construction power near work areas and support facilities.	Temporary Power design, studies, specifications, drawings or engineering is not included.
20	Construction	Electrical	No area lighting has been included in the estimate. It assumed operating hours will be daylight only.	
21	Construction	Electrical	No heat tracing is included in the estimate.	
22	Controls	Electrical	No UPS is included.	
23	General	Electrical	No motor heaters assumed to be required.	
24	General	Electrical	All conduits 2" and smaller shall be field routed. General conduit routing locations shall be provided.	
25	General	Electrical	The cost estimate is based on a non-hazardous and unclassified area.	
26	General	Electrical	Lightning protection design, studies, specifications, drawings or engineering is not included.	
27	General	Electrical	A grounding grid will be installed in the process equipment island.	
28	General	Electrical		
29	Controls	I&C	Control of new equipment is assumed to be from the new operator trailer via a PLC and desktop computer.	
30	Controls	I&C	No instrument cabinets are provided. Transmitters will be installed outdoors with NEMA 4X housings.	
31	Controls	I&C	All instruments are assumed to be light industrial/commercial grade from Omega.	
32	Controls	I&C		
33	General	Mechanical	All rotating equipment assumed to be light industrial or commercial grade equipment.	
34	General	Mechanical	All tanks, except for bioleum tank, are assumed to be polyethylene tanks.	
35	General	Mechanical	The bioleum tank is assumed to be FRP.	
36	General	Mechanical	Piping is assumed to be CPVC, except for the flue gas line.	
37	General	Mechanical	Flue gas piping is assumed to be insulated carbon steel.	
38	General	Mechanical	Hoses for process water services are assumed to be lay-flat type with pressure ratings between 100 and 150 PSIG, with camlock fittings and wire gear hose clamps.	
39	General	Mechanical	Hoses for fertilizer and flocculant are assumed to be reinforced polyethylene chemical hoses.	
40	General	Mechanical	An air compressor, aftercooler and dessicant dryer system will be installed in the processing island to provide service and instrument air.	
41	General	Mechanical	No plumbing/septic systems are included in the office trailer.	
42	General	Mechanical	All equipment sizing based off of material balance information provided to URS by SRA.	
43	General	Mechanical	Piping will be in service tested. No allowance has been included for hydrotesting of piping.	No x-ray or stress relief of piping in the field is included.

Sunrise Ridge - 0.5TPD cost estimate for installation at Cement Plant: Assumptions and Clarifications

	Area/Item	Discipline	Assumption	Clarifications
44	Services	URS services	URS costs have been escalated based on approved government escalation rates to account for the span of the project over which URS will provide support.	Current schedule assumes Phase 2 work begins Sept 2010 and goes until Feb. 2012.
45	Services	URS services	URS has included costs for a Construction manager to be on site full time for 6 months.	
46	Services	URS services	URS has included time to provide some periodic support during the operation of the facility.	Approximately 16/hrs per month for a mid-level engineer over 2 yr operational phase plus 80 hrs for final reporting assistance
47	Services	URS services	URS assumes a total of 10 vendor surveillance trips will be performed during the fabrication and assembly of the major packaged systems such as the DAF, Thermolyzer, belt filter, and flare.	
48	Services	URS services	URS assumes a total of 6 trips for up to 4 URS staff will be required from Austin to Midlothian, TX during the preliminary and detailed design phases of the project. Trips are assumed to be 2-days in duration.	

Appendix 7. Budgetary estimates for EPC.

URS

3-May-10

Sunrise Ridge Algae Phase II

URS Job No. 40819244

Engineering Account	MH	Wage Rate	Labor Cost		Total Cost
Engineering Services					1,137,920
CFD License Fee					
Travel/ODC's					22,420
Total Loaded Engineering Cost					1,160,340
Construction Management					111,760
Travel/ODCs					40,098
Total Loaded Construction Management Cost					151,858
Engineering Procurements					2,560,592
Freight Based on Freight Analysis					89,621
Bonds					
Total Direct Procurement Cost					2,650,213
Total Direct E&P Cost					3,962,411
Construction Account	MH	Wage Rate	Labor Cost	Equipment cost	Total Cost
(2) Equipment	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
(3) Piping	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
(4) Civil	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
(5) Steel	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
(6) Instruments	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
(7) Electrical	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
(8) Insulation	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
(9) Paint	#VALUE!		#VALUE!	#VALUE!	#VALUE!
Total Direct Construction Costs	#VALUE! (TDMH)		#VALUE! (TDL)	#VALUE!	#VALUE! (TDC)
(10) Small Tools Consumables (Covered in Rate)	#VALUE!				
(11) Scaffolding (Covered In Rate)					
(12) Contractor Supervision Indirects (Covered In Rate)					
(13) Contractor OH and fee 10% (Covered in Rate)					
(14) Startup Budget					144,900
(15) Casual, Shutdown, and Commissioning Overtime	#VALUE!		#VALUE!		#VALUE!
Total Contractor Indirect Construction Costs	#VALUE! (TIMH)				#VALUE!
Contractor Purchased Materials					176,907
Freight on Contractor Materials 3.5%					6,192
Bonds					#VALUE!
Total Construction Cost					#VALUE!
Engineering Contingency	10%				\$ 116,034
Construction Management Contingency	10%				\$ 15,186
Procurement Contingency	Per Rate Table				\$ 389,488
Construction Contingency	Per Rate Table				#VALUE!
Total Project Composite Contingency	#VALUE!	Of Total Direct Cost			#VALUE!
Engineering Escalation		(Included Above)			\$ -
Procurement Escalation					\$ -
Construction Escalation					#VALUE!
Total Project Escalation					#VALUE!
Engineering G&A	15.8%	(only applied to Travel/ODCs)			\$ 3,542
Construction Management G&A	15.8%	(only applied to Travel/ODCs)			\$ 6,335
Procurement G&A					\$ -
Construction G&A					#VALUE!
Total Project G&A					#VALUE!
Engineering Fee	12%	(Applied to Cost+Contingency+Escalation+G&A)			\$ 153,590
Construction Management Fee	12%	(Applied to Cost+Contingency+Escalation+G&A)			\$ 20,806
Procurement Fee	6%	(Applied to Cost+Contingency+Escalation+G&A)			\$ 182,382
Construction Fee	6%	(Applied to Cost+Contingency+Escalation+G&A)			#VALUE!
Total Project Fee					#VALUE!
Professional Liability					\$ -
Package Policy					#VALUE!
Total Insurance					#VALUE!
Sales Tax 0%					
Grand Total EPC Project Cost					#VALUE!
Engineering/Permitting Services (URS Scope)					#VALUE!
Construction Contractor Scope					#VALUE!
Procured Equipment					\$ 3,222,083

Appendix 8. Budgetary estimates for testing the upgradability of bioleum.

From: Michael Hackett Intertek <michael.hackett@intertek.com>
Date: Wed, May 12, 2010 at 11:58 AM
Subject: RE: Budgetary estimate for hydroprocessing "bioleum"
To: Bob Weber <bob.weber@sunrise-ridge.com>
Cc: Robert Absil Intertek <robert.absil@intertek.com>

Bob,

Following up our conversation from yesterday here are the highlights:

- SRA will provide the chloride content and is attempting to test 'wash' the feed to reduce TAN.
- PARC will need to be comfortable with the TAN/chloride content before considering introducing the feed to our 316SS units.
- Preliminary corrosion coupon testing may be necessary in advance of the program and also during any runs should we proceed.
- SRA forecasts to test to catalyst samples side by side which should prove to be a good candidate for PARC unit P106-109, see attached PFD and reactor schematic.
- P106-109 rates:
 - 3,000 USD operating fee per day.
 - 8,500 USD setup fee per two reactor catalyst load.
 - 300 USD project management fee per day.
- Typical runtimes are 2 days for catalyst activation, 2-3 days for stabilization/on-stream at each test point.
- Nitrogen and sulfur performed in-house at PARC by D4629 and D5453, respectively.
- Depending on the analytic measure selected to control the units we can determine if a unit has stabilized fully based on consecutive repeats results.

If I have omitted any important topics please update as necessary. If you require any additional information about of units, rates, etc., please let me know.

Best Regards,

Michael P. Hackett
Manager, Business Development
Intertek PARC

From: David Griffith [mailto:david.c.griffith@comcast.net]

Sent: Saturday, May 15, 2010 8:35 AM

To: Norman Whitton

Subject: [Fwd: RE: KBR Technology Center Contact]

David,

I have established that your work would need to be done in a manner that could be audited as KBR needs done. My rough guess is that adds \$50K. I am going thru that now with a \$450K revenue job, which includes a \$100K modification fee to one of the units.

I guess that you are asking for 5 days on the Coker, 7 days on FCC, and 10 days on our Multi-Purpose Unit doing hydro treating. Priced as a for-profit job, no links to the license potential or EPC, budget is \$400K. We are very good and costly and slow in this case due to the auditing trail required.

Regards,

John

Appendix 9. Market potential of bioleum as a substitute for bunker fuel.

To: Norman Whitton

From: Jack Szallai

Subj: Identification of Possible Blending Opportunities for Bioleum

Date: May 15, 2010

Since April 28, 2010, fourteen (14) contacts have been made to contacts involved in the fuel oil business, marine transportation, and / or trading to identify possible blending opportunities for bioleum. Approximately thirteen (13) response were received. These responses provided input as to possible avenues of investigation to pursue including but not limited to:

1. Identifying possible blenders.
2. Areas where vessel operators may have an interest.
3. Bunker managers at vessel operators.
4. Bunker specification and questions concerning bioleum's compatibility designation.

Of the responses received approximately five (5) solid leads were identified and are being pursued. Scheduling is hampering efforts for follow-up.

Meeting was held with Clear Consulting, a company actively involved with bunker supply organizations. Meeting resulted in identifying areas to pursue as well as information needed to be developed when meeting with blenders. Also suggestions where made with regard to testing a blend of bioleum. In this regard, it was felt a blender might be more receptive to providing a "sample" of fuel for Sunrise Ridge to use and blend with testing being done by an independent laboratory such as Saybolt, SGS, etc. Once this testing was done then the results could be provided to a blender allowing them to make an educated evaluation to determine their receptiveness to a larger blending trial.

One area of concern was the API gravity of bioleum. It was felt the sulphur content was good and an advantage. The acidity was capable of being handled. However, the API gravity was a concern. According to ISO 8217 API gravity minimum is 11.1 and bioleum's 10.0 gravity might reduce the gravity below its minimum requirement.

Follow-up discussions are being arranged with other respondents to continue pursuit of possible opportunities to blend bioleum.

Appendix 10. Market in Texas for renewable electricity.

**Electric Power Assessment
Power Produced in
Ellis County, Texas**

May 15, 2010

Outline

- Executive Summary
- Electric power in Texas
- Public Utility Commission of Texas
- Electric Power Transmission
- Power Generation
- Power Off-Take Companies
- Wholesale Power Prices
- Energy Credits
- Outlook

Executive Summary

The Texas electric market is a friendly market for power generation. It was deregulated in 2002 by the enactment of SB7 which allowed some freedom to generate power to sell to the ERCOT market subject to market price, regulatory risk and operational risks.

Electric power generation in Ellis County is provided by Oncor for delivery of service and TXU who serves as the incumbent electric utility. Oncor has a 138 KV electric transmission line near the SRA site in Ellis County for delivery of power to the ERCOT market. An interconnect and load flow study will verify the capacity but It is not unusual for a 138KV power line to have the capacity of 50 to 100 MW.

SB7 established the REC program in Texas that allows the generation of RECs for every megawatt-hour of renewable electric energy generated. At the SRA site heavy biofuel will be available to drive a small 100kw electric generator. This should qualify as a DG (distributed power generator) with QF status generating power and RECs. For this small project, two options are available;

- 1) Self generate saving the cost of retail energy, use some RECs for you own account and sale the remaining to the market, and buy backup power from TXU.
- 2) Buy power needed to operate the SRA facility, sell DG power to TXU at avoided cost, and sale RECs to the market. (TXU may be willing to negotiate a higher price for both energy and RECs.)

For a phase two of the SRA project in Ellis County, a bigger project up to 100 MW using waste heat from the cement plant may be desirable. If so, the project could qualify as QF and register as a generating unit with the PUCT/ERCOT. Energy and RECs could be sold to the market. Oncor would be obliged to provide delivery service and TXU may want the power and pay above avoided cost prices to obtain both the power and RECs.

Market Price Risk: For the small project, market price risk is not much of an issue if the small project has a need of at least 100KW and the project will have the right to self generate. However, the price of backup power may be an issue. A market price analysis is very important for a bigger project. Negotiation of a long term contract with TXU or one of the other large REPs may be advisable to reduce the market price risk.

The REC Price Risk: The REC Texas Program Goal of adding 10,000 MW of renewal energy to ERCOT is currently met. This could indicate that the demand for RECs is low driving a low REC price. However, a recent set aside of 500 MW for non-wind RECs may give support to higher non-wind REC prices.

Regulatory Risk/Operational Risk: The qualification to maintain QF status is dependent on meeting certain fuels specifications. If the SRA project is not reliable and causes the fuel mix ratio (heavy biofuel/fossil fuel) to fall outside the QF specifications, the QF status may be at risk.

Electric Power in Texas

The state of Texas is the largest electricity market in the United States; Texas also ranks as the 11th largest worldwide market, falling between Great Britain and Spain in terms of annual consumption.

In 1999, Governor George W Bush signed Senate Bill 7 laying out the groundwork for Texas energy deregulation. On January 1, 2002, Texas officially opened the deregulated energy market, giving residents and organizations the power to choose their electric provider. In addition to giving Texans the power to choose an energy provider, this has created renewable energy choices.

Incumbent power companies like TXU and Reliant favored deregulation. It allows them to expand their market inside Texas as well as enabling more effective energy load forecasting, which increases efficiency and saves money. As required by SB 7, each incumbent split into three companies: a Retail Electric Provider (REP), a Transmission Distribution Service Provider (TDSP), and a Wholesale Generator. These three companies operate as separate entities.

As a result, most Texas power customers (those served by a company not owned by a municipality or a utility cooperative) can choose their electricity service from a variety of "Retail Electric Providers" (REPs) which includes the incumbent utility (usually a subsidiary thereof). The incumbent utility in the area still owns and maintains the local power lines (and is the company to call in the event of a power outage) and is not subject to deregulation. Customers served by cooperatives or municipal utilities can choose an alternate REP only if the utility has "opted in" to deregulation; to date, only the area served by the Nueces Electric Cooperative has chosen to opt in.

The law designated the Electric Reliability Council of Texas (ERCOT) to be the authority to oversee grid reliability and operations so as to ensure no particular buyer or seller would gain an unfair advantage in the marketplace.

Public Utility Commission of Texas

For Electricity, the PUC is responsible for:

- Regulating rates and terms for intra-state transmission service and for distribution service in areas where customer choice has been introduced.
- Oversight of the ERCOT market, including market monitoring and the ERCOT administrative fee.
- Adopting and enforcing rules relating to retail competition, including customer protection, and the renewable energy goal.
- Licensing of retail electric providers and registration of power generation companies, power marketers and aggregators.
- Reviewing proposals for the construction of new transmission facilities.
- Regulation of rates and service for integrated utilities.

Wholesale Market Activities

The purpose of the Commission's wholesale market activities is to facilitate competition in the Texas electricity markets by fostering a vibrant competitive market through an efficient market design and preventing the exercise of market power and other anticompetitive behavior.

ERCOT Market Design Summary

Since July 2001, ERCOT has operated a wholesale energy market with a single control area. ERCOT uses a zonal congestion management design with a real-time balancing energy market. ERCOT procures ancillary services in a day-ahead auction for those market participants that do not self-provide their share of ancillary service requirements. ERCOT will move to a nodal market design in 2009.

Electric Reliability of Texas (ERCOT)

ERCOT manages the flow of electric power to 22 million Texas customers - representing 85 percent of the state's electric load and 75 percent of the Texas land area. As the independent system operator for the region, ERCOT schedules power on an electric grid that connects 40,000 miles of transmission lines and more than 550 generation units. ERCOT also manages financial settlement for the competitive wholesale bulk-power market and administers customer switching for 6.5 million Texans in competitive areas.

ERCOT offers a variety of services to Texas electricity market participants and prospective participants. ERCOT helps participants enter the market smoothly with registration, qualification and training.

ERCOT performs two very important functions in the competitive market. First, it maintains reliability by constantly monitoring and fine-tuning the system through the use of ancillary services. Second, ERCOT manages congestion that can occur because there may be insufficient transmission capacity between clusters of customers and generators.

ERCOT provides registration to participate in the ERCOT market as a load serving entity (LSE); a qualified scheduling entity (QSE); a resource entity (RE); transmission/distribution service provider (TDSP); or a congestion revenue rights (CRR) account holder in the upcoming nodal market. The holders of CRRs are entitled to receive compensation or be charged for congestion rents in the nodal market. LSEs provide electric service to end-users and wholesale customers. QSEs are qualified by ERCOT to submit balanced schedules, bid for ancillary services bids and settle payments. An RE owns or controls a generation resource or behaves as a load acting as a resource. TDSPs own or operate equipment or facilities to transmit and/or distribute electricity.

The ERCOT wholesale market is currently designed around bilateral transactions across its high voltage transmission grid with the management of power flow based on a “Zonal” model. The “zonal” approach partitions the transmission grid and associated interconnected load and generation points into areas or zones.

The current ERCOT market model is “Zonal” based. The transmission grid and associated interconnected load and generation points are grouped into four areas or zones. The figure below depicts the five zone boundaries:

The zonal model is based primarily on the transfer capability of the 345 KV transmission system. Transmission flow studies are performed with the outcome used to group load and generation transmission points into groups of similar impact on flow across those major transmission paths that reach limits during established system contingencies (load, generation dispatch, outages). These major transmission paths form the means to establishing what is called Commercially Significant Constraints or CSCs. These CSCs then become the basis to forming the zones.

September 2003, the PUCT ordered ERCOT to develop a nodal wholesale market design. The redesigned grid will consist of more than 4,000 nodes, and will replace the current congestion management zones (CMZs). The implementation of the nodal market design is expected in 2010 and to deliver the following benefits: Improved price signals; Improved dispatch efficiencies; Direct assignment of local congestion.

Electric Power Transmission

Texas transmission system reliability is governed by four reliability councils as shown on the map below. ERCOT manages 85% of the load in Texas and is isolated from the USA transmission system except for HVDC ties that interconnect to the north, east, and smaller ties connect to Mexico.

The Electric Transmission and distribution (T&D) companies in Texas are:

- Oncor – TXU System, northeast
- AEP-CPL – CSW/CPL, South
- AEP-WTU – CSW/WTU, West

- Centerpoint - HL&P, Southeast
- TNMP /PNM – TNP, (small scattered service territory)

Oncor is the electric T&D Company that delivers service to Ellis County which is:

- The nation's sixth-largest U.S. transmission and distribution company, operating in a high-growth service area, DFW metropolis,
- Supplies electricity to approximately 7 million consumers, about one third of the state's population,
- Operates in a service area in east, west and north central Texas with 401 incorporated municipalities and 91 counties.
- Serves cities that include the Dallas-Fort Worth area and surrounding cities, Midlothian, Odessa, Midland, Killeen, Waco, Wichita Falls and Tyler,
- Operates in the U.S.'s highest-growth region in electric demand, according to the North American Electric Reliability Council (NERC), with an underlying annual growth rate of 2.5 percent.

Oncor delivers power to Ellis County which is home for several major cement manufactures and other major industries. Prior to 1929 and the Great Depression, a number of businesses flourished in the city. The two largest business enterprises centered around cotton and cattle-raising. The region was transformed in later years by the arrival of the cement industry. Midlothian became a prime area for cement quarrying due to the Austin Chalk Escarpment, a unique geological formation that runs north-south through the City. Three of the top ten largest cement factories in the United States operate in the city: Texas Industries ("TXI"), Holcim and Ash Grove. Gerdau Ameristeel, formerly Chaparral Steel, a large steel factory is adjacent to TXI's cement plant.

Interconnection in Ellis County near Ash Grove Cement plant:

There appears to be an Oncor 138 kV transmission line just south of the Ash Grove Cement plant according to Google Earth. Oncor would investigate an interconnection with this line; however the final determination would be made through studies performed in accordance with the ERCOT Generation Interconnection Procedure found on the ERCOT web site <http://www.ercot.com/gridinfo/generation>. The studies would evaluate the capability of the transmission system to accommodate the generation and define how Oncor would connect to the proposed generating plant.

T & D Utilities

Power Generation

Two options exist to generate and sale power to the grid, distributed generation or wholesale power as a power generator.

What is Distributed Generation?

Distributed generation (DG) is generation that is "distributed around" the electric utility's distribution system. DG is usually powered by solar, wind, landfill gas, diesel fueled engines, natural gas fueled micro-turbines, etc. DG refers to an electrical generating facility located on Customer's premise, which may be operated in parallel with the utility, ten megawatts (10 MW) or less and connected at a voltage less than or equal to 60 kilovolts (kV).

Distributed generation generally fall into four basic categories:

- 1) Small power production facilities (solar, wind, waste or geothermal) which are usually classified as "qualifying facilities",
- 2) Backup power which can be synchronized with the utility upon restoration from utility outages (closed transition),
- 3) Generation for self-service of customer's own load through parallel operation with the utility and peak shaving of demand,
- 4) Generation that is for exporting (landfill gas, large wind farms, etc.).

This is by far not the complete scope of distributed generation but it does give you some idea of the subject. More information may be found through the Internet and also through the Public Utility Commission of Texas (PUCT).

The PUCT has created state regulations concerning distributed generation that can be accessed through their web site. In particular two substantive rules apply to DG. They are:

Substantive Rule §25.211 Interconnection of On-Site Distributed Generation (DG),

Substantive Rule §25.212 Technical Requirements for Interconnection of On-site Distributed Generation (DG).

What is wholesale generation?

Power generation companies own and operate power plants, including plants fueled by coal, nuclear power, natural gas, wind, water, solar power, or other renewable sources. Power generation companies sell this power at wholesale to REPs, who package the power with

transmission and delivery service for sale to retail customers. REPs are not permitted under Texas law to own power plants; however, they can be affiliated with a power generation company.

The Public Utility Commission of Texas conducts oversight of the intrastate wholesale electric market in Texas by participating in activities related to market design and by evaluating market performance and taking enforcement actions, when appropriate. Market design activities are carried out by the Competitive Markets Division. Market monitoring is conducted by an independent market monitor that is funded by the Electric Reliability Council of Texas. The Commission's oversight and enforcement activities are carried out by the Oversight and Enforcement Division.

Power Off-Take Companies

Small Power Providers – less than 10MW

Retail Electric Providers (REPs) / Electric Companies:

With electric competition, Retail Electric Providers (REPs) buy power from DG (distributed generators) and sell electricity to retail customers and handle customer service and billing. REPs compete for business by offering a variety of different pricing options, renewable energy options, added customer service benefits, or other incentives.

Note: Not all areas of the state are open to competition. The Public Utility Commission (PUC) has delayed retail competition for customers of Entergy Gulf States, Southwestern Public Service Company, El Paso Electric Company, and AEP SWEPCO . Electric cooperatives and city-owned utilities may decide whether their customers will have a choice of REP's. List of REP's are numerous and are shown on the website www.PowettoChoose.org.

TXU Energy is the incumbent retail electric provider in the North region of Texas, Dallas Fort Worth metroplex including Ellis County. When Texas deregulated the retail electric market TXU broke off of their pole and wires company to only sell retail electricity along with their power generation division. Oncor Electric Delivery became the name of what was previously called TXU Electric Delivery which services and owns the meters, poles and wires. The Texas state government and ERCOT have worked out an agreement with TXU Energy that if any Retail Electric Provider in this region were to go bankrupt the electric customers would be automatically switched to the POLR or TXU as way to insure continued electricity service to those affected. TXU has first rights to small power produced in Ellis County at avoided cost.

Independent Power Producer or Power Generator (PG):

The PG registers with the PUCT as a Power Company and provides power to an REP on a bilateral contract at either a contract price or market price on an hourly, daily, or long term contract basis. Energy, capacity, and ancillary services are products sold into the ERCOT electric market.

Power Prices

Small power producer (< 10 MW):

Power prices are based on the avoided cost or marginal cost of power that the incumbent electric company replaces. In the case where the power is sold to an independent REP the price is based on negotiation and energy credits created by the generation source such as waste heat generation or biofuel generation that qualifies as a QF.

Wholesale power (> 10 MW):

Independent power project or power generators sell excess power to an REP on a negotiated contract basis. The wholesale prices vary with time of day (on peak and off peak pricing). The wholesale prices vary between \$12/mwh in off-peak time to \$60/mwh in on peak times. During hot days when the system is loaded the peak prices may spike up to \$250/mwh in rare case it will spike to \$1000/mwh for very short durations.

Heat Rate impact to Wholesale Prices:

Natural gas is the marginal fuel in ERCOT and the wholesale price is a function of the natural gas price. The market heat rate (electric price /marginal gas price) in ERCOT varies from about 5600 btu/kwh in off-peak to about 12000 btu/kwh in on-peak summer. This represents on average a wholesale price at \$5/mmbtu gas of about \$28/mwh to \$60/mwh.

Energy Credits

Renewable Energy Credits (RECs)

In 2005, the Texas Legislature passed a "Renewable Portfolio Standard" that requires electric utilities and Retail Electric Providers (REPs) to generate and sell specific target levels of renewable power over time, with a target of 10,000 MW in renewable energy capacity by 2025.

With each megawatt hour of renewable power generated, a "renewable energy credit" (REC) is produced. Utilities and retailers are required to meet certain renewable generation targets and they can meet those targets by generating renewable power or by purchasing RECs, which are openly bought and sold in the environmental commodities market. Additionally, businesses and individuals may voluntarily purchase RECs to offset their carbon footprints and to support the development of clean energy sources.

Question: When can I start trading RECs?

Answer: You can trade RECs immediately, as long as the buyer and the seller agree on a price, either between each other directly or through an intermediary like a broker. However, the actual Transfer of the RECs cannot occur until the RECs are allocated into the seller's account (this occurs at least 59 days after the end of each quarter).

Question: How do I know what my requirement is?

Answer: ERCOT will post the exact RPS Requirements for each REP on March 1 of the year FOLLOWING the year in question. For example, a REP will know exactly what their RPS Requirements for 2002 are on March 1 of 2003. The REP then has until March 31st to comply with that requirement.

However, ERCOT provides several ways for a REP to estimate their RPS Requirement throughout the year. Consider that for the first two years of compliance, the RPS mandates that 400 MW of new renewable be built in Texas. This requires that approximately 1.2 million RECs are retired by the end of 2002. If a REP knows what percentage they serve of the total competitive load in Texas, they know what percentage of the total amount of RECs they will be required to retire for their facility. For example, if a REP estimates that they will serve 2% of the total load in Texas, then they must retire approximately $2\% \times 1.2 \text{ million} = 24\text{k}$ RECs for 2002.

For a more accurate estimation of one's requirement, ERCOT will post the monthly total competitive load served in the state, to which a REP may compare their exact monthly load served. At the end of each month, therefore, the REP can calculate exactly what percentage they served of the total competitive load in Texas for that month. With this percentage, they can calculate a more exact number of RECs they will be required to retire for that month.

If a REP is purchasing RECs on a monthly or quarterly basis, then the true-up period between March 1 and 31st should be relatively painless.

Outlook

If Sunrise Ridge Algae (SRA) invests in a small internal combustion or external combustion electric generating unit using waste fuel from the Algae biofuel refining process (or in the bigger case, waste heat from the cement plant), the project will qualify as a QF if it;

(1) Meets the maximum size criteria specified in §292.204(a); generally less than 80MW.

(2) Meets the fuel use criteria specified in §292.204(b); (i) 75 percent or more of the total energy input must be from biomass, waste, renewable resources, geothermal resources, or any combination thereof these sources.(ii) Any primary energy source which, on the basis of its energy content, is 50 percent or more biomass shall be considered biomass

(3) Has filed with the Commission a notice of self-certification, pursuant to §292.207(a);

The certification as a QF has one advantage in ERCOT. It gives the QF a “put” to the incumbent electric power company (TXU). That is the QF is guaranteed to have a customer a place to sale the power but at the avoided cost of TXU. ERCOT is deregulated and TXU as an REP does not have its own plants. It buys power at wholesale market price or in some cases contracted long term prices (normally 2 to 5 years). In most cases, TXU’s avoided cost is the marginal cost TXU pays for wholesale power. For distributed generation, if TXU agrees SRA may be able to seek power sales with other REPs. In the case for the small (100kw), SRA may want to generate power for its own use and offset retail prices which are \$100 to \$120 per MW. However, there will be cost for backup power, ancillary services, and transmission interconnection cost.

For the potential larger project (waste heat from the cement plant), SRA may want to sign-up as a Power Generator (PG) and have the right to negotiate the sale of power to any REP. In addition, ERCOT buys ancillary services from the PG creating another source of income to the PG

RECs are stock-like certificates that correspond to actual megawatts of renewable energy. Each REC represents one megawatt-hour of renewable energy produced. Producers of renewable energy can earn and sell the renewable energy credits to retailers on the open market as a separate commodity.

The range of REC prices is fairly wide since their cost is a function of demand. Prices in 2009 ranged from \$1 to about \$5 each during the year with some going higher, so the financial impact of the REC trading program in the Texas market could be estimated somewhere between \$22 and \$108 million.

Under the Texas program, retail electric providers must acquire and retire RECs based on their load-ratio share of the renewable portfolio standard annual mandate. Electric providers may also voluntarily retire RECs to substantiate claims of green energy to consumers.

Texas has led the nation in wind capacity since 2006. The ERCOT region currently has 9,117 MW of installed wind capacity. In 2009, the state's 150 competitive retail electricity providers retired 6.79 million renewable energy credits (RECs) to satisfy the state renewable portfolio standard's annual mandate. An additional 8.14 million RECs were retired in the voluntary market to substantiate "green energy" purchases, surpassing 2008's record of 6.77 million.

With more than 10,000 megawatts (MW) of new renewable generation in the REC program, Texas has exceeded the Texas Legislature's goal 15 years early. The program currently includes 103 REC generation accounts representing 10,069 MW of renewable generation from throughout Texas. In 2009, the REC program tracked 21.6 million megawatt-hours (MWh) of renewable energy, an increase of approximately 26 percent over 2008.

The near future price of RECs may stay depressed due to meeting the REC program capacity goals unless PUCT increases the goal above 10,000 MW. For non-wind RECs, 500 MW has been set aside to stimulate the non-wind REC market.

Appendix 11. RCRA analysis of pywater and char.

ANALYTICAL REPORT

Job Number: 560-19905-1
SDG Number: April 15, 2010
Job Description: Py Water Analysis

For:
Sunrise Ridge Algae
211 Seaton Glen
Suite 109
Houston, TX 77094
Attention: Mr. Norm Whitton

Approved for release.
Timothy L. Kellogg
Project Manager II
5/5/2010 11:30 AM

Timothy L. Kellogg
Project Manager II
tim.kellogg@testamericainc.com
05/05/2010

cc: Mr. Josh Morgan

The test results entered in this report meet all NELAC requirements for accredited parameters. Any exceptions to NELAC requirements are noted in the report. Pursuant to NELAC, this report may not be reproduced except in full, and with written approval from the laboratory. TestAmerica Corpus Christi Certifications and Approvals: NELAC TX T104704210-TX, NELAC KS E-10362, Oklahoma 9968, USDA Soil Permit P330-08-00033.

TestAmerica Laboratories, Inc.

TestAmerica Corpus Christi 1733 N. Padre Island Drive, Corpus Christi, TX 78408
Tel (361) 289-2673 Fax (361) 289-2471 www.testamericainc.com

Job Narrative
560-19905-1

Comments

Please note that due to the nature of the sample matrix, several of the parameters were analyzed on a dilution. Elevated reporting limits are provided.

Receipt

All samples were received in good condition within temperature requirements.

Metals

Method(s) 3010A: It was noted that sample 560-19905-1 was received with insufficient preservation (pH >2). additional 1:1 nitric acid was added to the metals aliquot until the pH was less than 2 (as per the method). The sample was then allowed to equilibrate for 24 hours before the preparation process was performed. No other analytical or quality issues were noted.

General Chemistry

Method(s) 9040C: This analysis is normally performed in the field and has a method-defined holding time of 15 minutes. All associated samples have been qualified with the "HF" flag to indicate they were performed in the laboratory outside the 15 minute time frame. No other analytical or quality issues were noted.

EXECUTIVE SUMMARY - Detections

Client: Sunrise Ridge Algae

Job Number: 560-19905-1

Sdg Number: April 15, 2010

Lab Sample ID Analyte	Client Sample ID	Result / Qualifier	Reporting Limit	Units	Method
560-19905-1	PY-WATER				
Aluminum		3.45	0.500	mg/L	6020
Arsenic		0.436	0.0500	mg/L	6020
Barium		0.211	0.0500	mg/L	6020
Boron		1.87	1.00	mg/L	6020
Calcium		19.4	5.00	mg/L	6020
Copper		1.11	0.0500	mg/L	6020
Iron		3.79	2.50	mg/L	6020
Lead		0.0651	0.0500	mg/L	6020
Magnesium		18.5	5.00	mg/L	6020
Phosphorus		105	0.500	mg/L	6020
Sodium		501	10.0	mg/L	6020
Zinc		3.90	0.250	mg/L	6020
pH		9.74 HF	0.100	SU	9040C

METHOD SUMMARY

Client: Sunrise Ridge Algae

Job Number: 560-19905-1

Sdg Number: April 15, 2010

Description		Lab Location	Method	Preparation Method
Matrix	Water			
Metals (ICP/MS)		TAL CC	SW846 6020	
Preparation, Total Metals		TAL CC		SW846 3010A
Mercury (CVAA)		TAL CC	SW846 7470A	
Preparation, Mercury		TAL CC		SW846 7470A
COD		TAL CC	Hach 8000	
COD		TAL CC		Hach 8000
pH		TAL CC	SW846 9040C	

Lab References:

TAL CC = TestAmerica Corpus Christi

Method References:

Hach = Hach Company

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

METHOD / ANALYST SUMMARY

Client: Sunrise Ridge Algae

Job Number: 560-19905-1

Sdg Number: April 15, 2010

Method	Analyst	Analyst ID
SW846 6020	Reyes, Eddie D	EDR
SW846 7470A	Fletcher, Starla	SRF
Hach 8000	Gonzalez, Sonia	SG
SW846 9040C	Gonzalez, Sonia	SG

SAMPLE SUMMARY

Client: Sunrise Ridge Algae

Job Number: 560-19905-1

Sdg Number: April 15, 2010

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
560-19905-1	Py-Water	Water	04/15/2010 0000	04/17/2010 0936

Analytical Data

Client: Sunrise Ridge Algae

Job Number: 560-19905-1

Sdg Number: April 15, 2010

Client Sample ID: Py-Water

Lab Sample ID: 560-19905-1

Client Matrix: Water

Date Sampled: 04/15/2010 0000

Date Received: 04/17/2010 0936

6020 Metals (ICP/MS)

Method:	6020	Analysis Batch: 560-46981	Instrument ID:	Micpms
Preparation:	3010A	Prep Batch: 560-46815	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	5 mL
Date Analyzed:	04/28/2010 0508		Final Weight/Volume:	50 mL
Date Prepared:	04/21/2010 0930			

Analyte	Result (mg/L)	Qualifier	RL
Aluminum	3.45		0.500
Arsenic	0.436		0.0500
Calcium	19.4		5.00
Chromium	<0.0500		0.0500
Copper	1.11		0.0500
Magnesium	18.5		5.00
Zinc	3.90		0.250

Method:	6020	Analysis Batch: 560-47146	Instrument ID:	Micpms
Preparation:	3010A	Prep Batch: 560-46815	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	5 mL
Date Analyzed:	05/03/2010 2331		Final Weight/Volume:	50 mL
Date Prepared:	04/21/2010 0930			

Analyte	Result (mg/L)	Qualifier	RL
Barium	0.211		0.0500
Cadmium	<0.0250		0.0250
Iron	3.79		2.50
Lead	0.0651		0.0500
Phosphorus	105		0.500
Selenium	<0.0500		0.0500
Silver	<0.0500		0.0500
Tin	<0.250		0.250

Method:	6020	Analysis Batch: 560-47186	Instrument ID:	Micpms
Preparation:	3010A	Prep Batch: 560-46815	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	5 mL
Date Analyzed:	05/04/2010 1122		Final Weight/Volume:	50 mL
Date Prepared:	04/21/2010 0930			

Analyte	Result (mg/L)	Qualifier	RL
Boron	1.87		1.00
Sodium	501		10.0

7470A Mercury (CVAA)

Method:	7470A	Analysis Batch: 560-46904	Instrument ID:	Mhg1
Preparation:	7470A	Prep Batch: 560-46894	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	5 mL
Date Analyzed:	04/23/2010 1506		Final Weight/Volume:	50 mL
Date Prepared:	04/23/2010 0930			

Analyte	Result (mg/L)	Qualifier	RL
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Analytical Data

Client: Sunrise Ridge Algae

Job Number: 560-19905-1

Sdg Number: April 15, 2010

Client Sample ID: Py-Water

Lab Sample ID: 560-19905-1

Client Matrix: Water

Date Sampled: 04/15/2010 0000

Date Received: 04/17/2010 0936

7470A Mercury (CVAA)

Analyte	Result (mg/L)	Qualifier	RL
Mercury	<0.0200		0.0200

Analytical Data

Client: Sunrise Ridge Algae

Job Number: 560-19905-1

Sdg Number: April 15, 2010

General Chemistry**Client Sample ID: Py-Water**

Lab Sample ID: 560-19905-1

Date Sampled: 04/15/2010 0000

Client Matrix: Water

Date Received: 04/17/2010 0936

Analyte	Result	Qual	Units	RL	Dil	Method
Chemical Oxygen Demand	<80000		mg/L	80000	2000	8000

Analysis Batch: 560-46765

Date Analyzed: 04/20/2010 0930

Prep Batch: 560-46764

Date Prepared: 04/20/2010 0900

Analyte	Result	Qual	Units	RL	Dil	Method
pH	9.74	HF	SU	0.100	1.0	9040C

Analysis Batch: 560-46772

Date Analyzed: 04/20/2010 1000

DATA REPORTING QUALIFIERS

Client: Sunrise Ridge Algae

Job Number: 560-19905-1

Sdg Number: April 15, 2010

Lab Section	Qualifier	Description
General Chemistry	HF	Field parameter with a holding time of 15 minutes

QUALITY CONTROL RESULTS

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19905-1

Sdg Number: April 15, 2010

Method Blank - Batch: 560-46815

Method: 6020

Preparation: 3010A

Lab Sample ID: MB 560-46815/1-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 04/28/2010 0431
Date Prepared: 04/21/2010 0930

Analysis Batch: 560-46981
Prep Batch: 560-46815
Units: mg/L

Instrument ID: Micpms
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Aluminum	<0.0500		0.0500
Arsenic	<0.00500		0.00500
Calcium	<0.500		0.500
Chromium	<0.00500		0.00500
Copper	<0.00500		0.00500
Iron	<0.250		0.250
Magnesium	<0.500		0.500
Zinc	<0.0250		0.0250

Method Blank - Batch: 560-46815

Method: 6020

Preparation: 3010A

Lab Sample ID: MB 560-46815/1-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/03/2010 2320
Date Prepared: 04/21/2010 0930

Analysis Batch: 560-47146
Prep Batch: 560-46815
Units: mg/L

Instrument ID: Micpms
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Barium	<0.00500		0.00500
Cadmium	<0.00250		0.00250
Iron	<0.250		0.250
Lead	<0.00500		0.00500
Phosphorus	<0.0500		0.0500
Selenium	<0.00500		0.00500
Silver	<0.00500		0.00500
Tin	<0.0250		0.0250

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19905-1

Sdg Number: April 15, 2010

Method Blank - Batch: 560-46815

Method: 6020

Preparation: 3010A

Lab Sample ID: MB 560-46815/1-A

Client Matrix: Water

Dilution: 1.0

Date Analyzed: 05/04/2010 1111

Date Prepared: 04/21/2010 0930

Analysis Batch: 560-47186

Prep Batch: 560-46815

Units: mg/L

Instrument ID: Micpms

Lab File ID: N/A

Initial Weight/Volume: 50 mL

Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Boron	<0.100		0.100
Sodium	<1.00		1.00

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19905-1

Sdg Number: April 15, 2010

Lab Control Sample - Batch: 560-46815

Method: 6020

Preparation: 3010A

Lab Sample ID: LCS 560-46815/2-A

Analysis Batch: 560-46981

Instrument ID: Micpms

Client Matrix: Water

Prep Batch: 560-46815

Lab File ID: N/A

Dilution: 1.0

Units: mg/L

Initial Weight/Volume: 50 mL

Date Analyzed: 04/28/2010 0441

Final Weight/Volume: 50 mL

Date Prepared: 04/21/2010 0930

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Aluminum	4.00	3.982	100	80 - 120	
Arsenic	0.400	0.3936	98	80 - 120	
Calcium	40.0	40.51	101	80 - 120	
Chromium	0.400	0.3874	97	80 - 120	
Copper	0.400	0.3862	97	80 - 120	
Iron	40.0	43.45	109	80 - 120	
Magnesium	40.0	44.49	111	80 - 120	
Zinc	0.400	0.3679	92	80 - 120	

Lab Control Sample - Batch: 560-46815

Method: 6020

Preparation: 3010A

Lab Sample ID: LCS 560-46815/2-A

Analysis Batch: 560-47146

Instrument ID: Micpms

Client Matrix: Water

Prep Batch: 560-46815

Lab File ID: N/A

Dilution: 1.0

Units: mg/L

Initial Weight/Volume: 50 mL

Date Analyzed: 05/03/2010 2326

Final Weight/Volume: 50 mL

Date Prepared: 04/21/2010 0930

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Barium	0.400	0.3936	98	80 - 120	
Cadmium	0.400	0.3881	97	80 - 120	
Iron	40.0	36.75	92	80 - 120	
Lead	0.400	0.4079	102	80 - 120	
Phosphorus	4.00	3.483	87	80 - 120	
Selenium	0.400	0.3653	91	80 - 120	
Silver	0.400	0.3876	97	80 - 120	
Tin	0.400	0.4121	103	80 - 120	

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19905-1

Sdg Number: April 15, 2010

Lab Control Sample - Batch: 560-46815

Method: 6020

Preparation: 3010A

Lab Sample ID: LCS 560-46815/2-A

Client Matrix: Water

Dilution: 1.0

Date Analyzed: 05/04/2010 1117

Date Prepared: 04/21/2010 0930

Analysis Batch: 560-47186

Prep Batch: 560-46815

Units: mg/L

Instrument ID: Micpms

Lab File ID: N/A

Initial Weight/Volume: 50 mL

Final Weight/Volume: 50 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Boron	0.800	0.7626	95	80 - 120	
Sodium	40.0	37.97	95	80 - 120	

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19905-1

Sdg Number: April 15, 2010

Method Blank - Batch: 560-46894

Lab Sample ID: MB 560-46894/4-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 04/23/2010 1449
Date Prepared: 04/23/2010 0930

Analysis Batch: 560-46904
Prep Batch: 560-46894
Units: mg/L

Method: 7470A Preparation: 7470A

Instrument ID: Mhg1
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Mercury	<0.00200		0.00200

Leachate Blank 1 - Batch: 560-46894

Lab Sample ID: LB1 560-46777/1-C
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 04/23/2010 1454
Date Prepared: 04/23/2010 0930
Date Leached: 04/20/2010 1500

Analysis Batch: 560-46904
Prep Batch: 560-46894
Units: mg/L

Leachate Batch: 560-46777

Method: 7470A Preparation: 7470A

Instrument ID: Mhg1
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Mercury	<0.00200		0.00200

Lab Control Sample - Batch: 560-46894

Lab Sample ID: LCS 560-46894/5-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 04/23/2010 1452
Date Prepared: 04/23/2010 0930

Analysis Batch: 560-46904
Prep Batch: 560-46894
Units: mg/L

Method: 7470A Preparation: 7470A

Instrument ID: Mhg1
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Mercury	0.00500	0.004860	97	80 - 120	

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19905-1

Sdg Number: April 15, 2010

Method Blank - Batch: 560-46764

Method: 8000

Preparation: 8000

Lab Sample ID: MB 560-46764/4-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 04/20/2010 0930
Date Prepared: 04/20/2010 0900

Analysis Batch: 560-46765
Prep Batch: 560-46764
Units: mg/L

Instrument ID: No Equipment Assigned
Lab File ID: N/A
Initial Weight/Volume: 2 mL
Final Weight/Volume: 2 mL

Analyte	Result	Qual	RL
Chemical Oxygen Demand	<40.0		40.0

Lab Control Sample - Batch: 560-46764

Method: 8000

Preparation: 8000

Lab Sample ID: LCS 560-46764/3-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 04/20/2010 0930
Date Prepared: 04/20/2010 0900

Analysis Batch: 560-46765
Prep Batch: 560-46764
Units: mg/L

Instrument ID: No Equipment Assigned
Lab File ID: N/A
Initial Weight/Volume: 2 mL
Final Weight/Volume: 2 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Chemical Oxygen Demand	60.0	54.88	91	80 - 120	

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19905-1

Sdg Number: April 15, 2010

Lab Control Sample - Batch: 560-46772

Method: 9040C

Preparation: N/A

Lab Sample ID: LCS 560-46772/2
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 04/20/2010 1000
Date Prepared: N/A

Analysis Batch: 560-46772
Prep Batch: N/A
Units: SU

Instrument ID: No Equipment Assigned
Lab File ID: N/A
Initial Weight/Volume:
Final Weight/Volume: 20 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
pH	4.99	5.000	100	98 - 102	

Duplicate - Batch: 560-46772

Method: 9040C

Preparation: N/A

Lab Sample ID: 560-19905-1
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 04/20/2010 1000
Date Prepared: N/A

Analysis Batch: 560-46772
Prep Batch: N/A
Units: SU

Instrument ID: No Equipment Assigned
Lab File ID: N/A
Initial Weight/Volume:
Final Weight/Volume: 20 mL

Analyte	Sample Result/Qual	Result	RPD	Limit	Qual
pH	9.74	9.750	0	20	

Page 1 of 1
CHAIN OF CUSTODY RECORD

Page 1 of 1

ambient 19905

[illegible]

Login Sample Receipt Check List

Client: TestAmerica Corpus Christi

Job Number: 560-19905-1
SDG Number: April 15, 2010

Login Number: 19905

List Source: TestAmerica Corpus Christi

Creator: McDermott, Vivian

List Number: 1

Question	T / F / NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	N/A	
The cooler's custody seal, if present, is intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	False	
Cooler Temperature is acceptable.	False	NP voa's for cod & pH should have been iced.
Cooler Temperature is recorded.	False	Rec'd Ambient
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	False	No sx time provided on coc. No sx date or time provided on containers.
Appropriate sample containers are used.	False	only voa's rec'd for cod,pH,metals analysis.
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	True	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Is the Field Sampler's name present on COC?	True	
Sample Preservation Verified	True	

ANALYTICAL REPORT

Job Number: 560-19943-1

SDG Number: 04/21/10

Job Description: Waste Characterization

For:

Sunrise Ridge Algae

211 Seaton Glen

Suite 109

Houston, TX 77094

Attention: Mr. Josh Morgan

Approved for release.
Timothy L. Kellogg
Project Manager II
5/13/2010 7:55 AM

Timothy L. Kellogg
Project Manager II
tim.kellogg@testamericainc.com
05/13/2010

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Job Narrative
560-19943-1

Receipt

It was noted that the time of collection for samples 560-19943-1 through -5 were not noted on the chain of custody (COC). As a result, a sample collection time of 12:00 a.m. on the date of collection has been used. All other samples were received in good condition within temperature requirements.

Metals

Method(s) 6020: It was noted that the continuing calibration verification (CCV) recoveries for arsenic and selenium in analytical batch 56047247 exceeded control limits. The data have been qualified and reported. No other analytical or quality issues were noted.

EXECUTIVE SUMMARY - Detections

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Lab Sample ID Analyte	Client Sample ID	Result / Qualifier	Reporting Limit	Units	Method
560-19943-1	JM-1-15O				
Aluminum		102	5.00	mg/Kg	6020
Arsenic		3.52 ^	0.500	mg/Kg	6020
Barium		3.83	0.500	mg/Kg	6020
Boron		34.2	10.0	mg/Kg	6020
Calcium		151	50.0	mg/Kg	6020
Copper		2.46	0.500	mg/Kg	6020
Iron		71.3	50.0	mg/Kg	6020
Lead		0.715	0.500	mg/Kg	6020
Phosphorus		33.8	5.00	mg/Kg	6020
Sodium		585	100	mg/Kg	6020
Zinc		6.94	2.50	mg/Kg	6020
560-19943-2	JM-1-15SW				
Aluminum		1.67	0.0500	mg/L	6020
Arsenic		0.0578	0.00500	mg/L	6020
Barium		0.00852	0.00500	mg/L	6020
Boron		6.07	1.00	mg/L	6020
Cadmium		0.00669	0.00250	mg/L	6020
Calcium		1.12	0.500	mg/L	6020
Copper		0.0124	0.00500	mg/L	6020
Iron		0.469	0.250	mg/L	6020
Lead		0.0811	0.00500	mg/L	6020
Phosphorus		0.394	0.0500	mg/L	6020
Sodium		16.4	1.00	mg/L	6020
Zinc		0.298	0.0250	mg/L	6020
560-19943-3	JM-1-15SO				
Aluminum		14.0	5.00	mg/Kg	6020
Barium		0.969	0.500	mg/Kg	6020
Calcium		72.2	50.0	mg/Kg	6020
Copper		1.91	0.500	mg/Kg	6020
Phosphorus		8.64	5.00	mg/Kg	6020
Zinc		7.39	2.50	mg/Kg	6020

EXECUTIVE SUMMARY - Detections

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Lab Sample ID Analyte	Client Sample ID	Result / Qualifier	Reporting Limit	Units	Method
560-19943-4	JM-1-43SW				
Aluminum		0.126	0.0500	mg/L	6020
Arsenic		0.0188	0.00500	mg/L	6020
Barium		0.0178	0.00500	mg/L	6020
Calcium		5.20	0.500	mg/L	6020
Copper		0.00990	0.00500	mg/L	6020
Magnesium		0.974	0.500	mg/L	6020
Phosphorus		1.42	0.0500	mg/L	6020
Sodium		13.9	1.00	mg/L	6020
Zinc		0.0675	0.0250	mg/L	6020
560-19943-5	JM-1-43SO				
Barium		0.662	0.500	mg/Kg	6020
Copper		1.90	0.500	mg/Kg	6020
Phosphorus		6.30	5.00	mg/Kg	6020

METHOD SUMMARY

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Description		Lab Location	Method	Preparation Method
Matrix	Waste			
Metals (ICP/MS)		TAL CC	SW846 6020	
Preparation, Metals, Microwave Assisted		TAL CC		SW846 3051
Mercury (CVAA)		TAL CC	SW846 7471A	
Preparation, Mercury		TAL CC		SW846 7471A
Matrix	Water			
Metals (ICP/MS)		TAL CC	SW846 6020	
Preparation, Total Metals		TAL CC		SW846 3010A
Mercury (CVAA)		TAL CC	SW846 7470A	
Preparation, Mercury		TAL CC		SW846 7470A

Lab References:

TAL CC = TestAmerica Corpus Christi

Method References:

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

METHOD / ANALYST SUMMARY

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Method	Analyst	Analyst ID
SW846 6020	Reyes, Eddie D	EDR
SW846 7470A	Fletcher, Starla	SRF
SW846 7471A	Fletcher, Starla	SRF

SAMPLE SUMMARY

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
560-19943-1	JM-1-15O	Oil	04/19/2010 0000	04/20/2010 1255
560-19943-2	JM-1-15SW	Water	04/19/2010 0000	04/20/2010 1255
560-19943-3	JM-1-15SO	Oil	04/19/2010 0000	04/20/2010 1255
560-19943-4	JM-1-43SW	Water	04/19/2010 0000	04/20/2010 1255
560-19943-5	JM-1-43SO	Oil	04/19/2010 0000	04/20/2010 1255

Analytical Data

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Client Sample ID: JM-1-150

Lab Sample ID: 560-19943-1

Client Matrix: Oil

Date Sampled: 04/19/2010 0000

Date Received: 04/20/2010 1255

6020 Metals (ICP/MS)

Method:	6020	Analysis Batch: 560-47247	Instrument ID:	Micpms
Preparation:	3051	Prep Batch: 560-47136	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	0.25 g
Date Analyzed:	05/05/2010 2216		Final Weight/Volume:	25 mL
Date Prepared:	05/03/2010 1400			

Analyte	DryWt Corrected: N	Result (mg/Kg)	Qualifier	RL
Aluminum		102		5.00
Arsenic		3.52	^	0.500
Barium		3.83		0.500
Cadmium		<0.500		0.500
Calcium		151		50.0
Chromium		<0.500		0.500
Copper		2.46		0.500
Iron		71.3		50.0
Lead		0.715		0.500
Magnesium		<50.0		50.0
Phosphorus		33.8		5.00
Selenium		<0.500	^	0.500
Silver		<0.500		0.500
Sodium		585		100
Zinc		6.94		2.50

Method:	6020	Analysis Batch: 560-47373	Instrument ID:	Micpms
Preparation:	3051	Prep Batch: 560-47136	Lab File ID:	090SMPL.D#.raw
Dilution:	1.0		Initial Weight/Volume:	0.25 g
Date Analyzed:	05/10/2010 2137		Final Weight/Volume:	25 mL
Date Prepared:	05/03/2010 1400			

Analyte	DryWt Corrected: N	Result (mg/Kg)	Qualifier	RL
Boron		34.2		10.0

7471A Mercury (CVAA)

Method:	7471A	Analysis Batch: 560-47141	Instrument ID:	Mhg1
Preparation:	7471A	Prep Batch: 560-47125	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	0.600 g
Date Analyzed:	05/03/2010 1412		Final Weight/Volume:	50 mL
Date Prepared:	05/03/2010 1100			

Analyte	DryWt Corrected: N	Result (mg/Kg)	Qualifier	RL
Mercury		<0.200		0.200

Analytical Data

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Client Sample ID: JM-1-15SW

Lab Sample ID: 560-19943-2

Date Sampled: 04/19/2010 0000

Client Matrix: Water

Date Received: 04/20/2010 1255

6020 Metals (ICP/MS)

Method:	6020	Analysis Batch: 560-46981	Instrument ID:	Micpms
Preparation:	3010A	Prep Batch: 560-46897	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	50 mL
Date Analyzed:	04/27/2010 1905		Final Weight/Volume:	50 mL
Date Prepared:	04/23/2010 0900			

Analyte	Result (mg/L)	Qualifier	RL
Aluminum	1.67		0.0500
Arsenic	0.0578		0.00500
Barium	0.00852		0.00500
Cadmium	0.00669		0.00250
Calcium	1.12		0.500
Chromium	<0.00500		0.00500
Copper	0.0124		0.00500
Iron	0.469		0.250
Lead	0.0811		0.00500
Magnesium	<0.500		0.500
Phosphorus	0.394		0.0500
Selenium	<0.00500		0.00500
Silver	<0.00500		0.00500
Sodium	16.4		1.00
Zinc	0.298		0.0250

Method:	6020	Analysis Batch: 560-47373	Instrument ID:	Micpms
Preparation:	3010A	Prep Batch: 560-46897	Lab File ID:	079SMPL.D#.raw
Dilution:	10		Initial Weight/Volume:	50 mL
Date Analyzed:	05/10/2010 2030		Final Weight/Volume:	50 mL
Date Prepared:	04/23/2010 0900			

Analyte	Result (mg/L)	Qualifier	RL
Boron	6.07		1.00

7470A Mercury (CVAA)

Method:	7470A	Analysis Batch: 560-46970	Instrument ID:	Mhg1
Preparation:	7470A	Prep Batch: 560-46894	Lab File ID:	N/A
Dilution:	50		Initial Weight/Volume:	50 mL
Date Analyzed:	04/27/2010 1028		Final Weight/Volume:	50 mL
Date Prepared:	04/23/2010 0930			

Analyte	Result (mg/L)	Qualifier	RL
Mercury	<0.100		0.100

Analytical Data

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Client Sample ID: JM-1-15SO

Lab Sample ID: 560-19943-3

Date Sampled: 04/19/2010 0000

Client Matrix: Oil

Date Received: 04/20/2010 1255

6020 Metals (ICP/MS)

Method:	6020	Analysis Batch: 560-47247	Instrument ID:	Micpms
Preparation:	3051	Prep Batch: 560-47136	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	0.25 g
Date Analyzed:	05/05/2010 2210		Final Weight/Volume:	25 mL
Date Prepared:	05/03/2010 1400			

Analyte	DryWt Corrected: N	Result (mg/Kg)	Qualifier	RL
Aluminum		14.0		5.00
Arsenic		<0.500	^	0.500
Barium		0.969		0.500
Cadmium		<0.500		0.500
Calcium		72.2		50.0
Chromium		<0.500		0.500
Copper		1.91		0.500
Iron		<50.0		50.0
Lead		<0.500		0.500
Magnesium		<50.0		50.0
Phosphorus		8.64		5.00
Selenium		<0.500	^	0.500
Silver		<0.500		0.500
Sodium		<100		100
Zinc		7.39		2.50

Method:	6020	Analysis Batch: 560-47373	Instrument ID:	Micpms
Preparation:	3051	Prep Batch: 560-47136	Lab File ID:	089SMPL.D#.raw
Dilution:	1.0		Initial Weight/Volume:	0.25 g
Date Analyzed:	05/10/2010 2131		Final Weight/Volume:	25 mL
Date Prepared:	05/03/2010 1400			

Analyte	DryWt Corrected: N	Result (mg/Kg)	Qualifier	RL
Boron		<10.0		10.0

7471A Mercury (CVAA)

Method:	7471A	Analysis Batch: 560-47141	Instrument ID:	Mhg1
Preparation:	7471A	Prep Batch: 560-47125	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	0.724 g
Date Analyzed:	05/03/2010 1415		Final Weight/Volume:	50 mL
Date Prepared:	05/03/2010 1100			

Analyte	DryWt Corrected: N	Result (mg/Kg)	Qualifier	RL
Mercury		<0.166		0.166

Analytical Data

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Client Sample ID: JM-1-43SW

Lab Sample ID: 560-19943-4

Date Sampled: 04/19/2010 0000

Client Matrix: Water

Date Received: 04/20/2010 1255

6020 Metals (ICP/MS)

Method:	6020	Analysis Batch: 560-46981	Instrument ID:	Micpms
Preparation:	3010A	Prep Batch: 560-46897	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	50 mL
Date Analyzed:	04/27/2010 1911		Final Weight/Volume:	50 mL
Date Prepared:	04/23/2010 0900			

Analyte	Result (mg/L)	Qualifier	RL
Aluminum	0.126		0.0500
Arsenic	0.0188		0.00500
Barium	0.0178		0.00500
Cadmium	<0.00250		0.00250
Calcium	5.20		0.500
Chromium	<0.00500		0.00500
Copper	0.00990		0.00500
Iron	<0.250		0.250
Lead	<0.00500		0.00500
Magnesium	0.974		0.500
Phosphorus	1.42		0.0500
Selenium	<0.00500		0.00500
Silver	<0.00500		0.00500
Sodium	13.9		1.00
Zinc	0.0675		0.0250

Method:	6020	Analysis Batch: 560-47373	Instrument ID:	Micpms
Preparation:	3010A	Prep Batch: 560-46897	Lab File ID:	080SMPL.D#.raw
Dilution:	10		Initial Weight/Volume:	50 mL
Date Analyzed:	05/10/2010 2036		Final Weight/Volume:	50 mL
Date Prepared:	04/23/2010 0900			

Analyte	Result (mg/L)	Qualifier	RL
Boron	<1.00		1.00

7470A Mercury (CVAA)

Method:	7470A	Analysis Batch: 560-46970	Instrument ID:	Mhg1
Preparation:	7470A	Prep Batch: 560-46894	Lab File ID:	N/A
Dilution:	50		Initial Weight/Volume:	25 mL
Date Analyzed:	04/27/2010 1030		Final Weight/Volume:	50 mL
Date Prepared:	04/23/2010 0930			

Analyte	Result (mg/L)	Qualifier	RL
Mercury	<0.200		0.200

Analytical Data

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Client Sample ID: JM-1-43SO

Lab Sample ID: 560-19943-5

Client Matrix: Oil

Date Sampled: 04/19/2010 0000

Date Received: 04/20/2010 1255

6020 Metals (ICP/MS)

Method:	6020	Analysis Batch: 560-47247	Instrument ID:	Micpms
Preparation:	3051	Prep Batch: 560-47136	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	0.25 g
Date Analyzed:	05/05/2010 2151		Final Weight/Volume:	25 mL
Date Prepared:	05/03/2010 1400			

Analyte	DryWt Corrected: N	Result (mg/Kg)	Qualifier	RL
Aluminum		<5.00		5.00
Arsenic		<0.500	^	0.500
Barium		0.662		0.500
Cadmium		<0.500		0.500
Calcium		<50.0		50.0
Chromium		<0.500		0.500
Copper		1.90		0.500
Iron		<50.0		50.0
Lead		<0.500		0.500
Magnesium		<50.0		50.0
Phosphorus		6.30		5.00
Selenium		<0.500	^	0.500
Silver		<0.500		0.500
Sodium		<100		100
Zinc		<2.50		2.50

Method:	6020	Analysis Batch: 560-47373	Instrument ID:	Micpms
Preparation:	3051	Prep Batch: 560-47136	Lab File ID:	086SMPL.D#.raw
Dilution:	1.0		Initial Weight/Volume:	0.25 g
Date Analyzed:	05/10/2010 2113		Final Weight/Volume:	25 mL
Date Prepared:	05/03/2010 1400			

Analyte	DryWt Corrected: N	Result (mg/Kg)	Qualifier	RL
Boron		<10.0		10.0

7471A Mercury (CVAA)

Method:	7471A	Analysis Batch: 560-47141	Instrument ID:	Mhg1
Preparation:	7471A	Prep Batch: 560-47125	Lab File ID:	N/A
Dilution:	1.0		Initial Weight/Volume:	0.824 g
Date Analyzed:	05/03/2010 1417		Final Weight/Volume:	50 mL
Date Prepared:	05/03/2010 1100			

Analyte	DryWt Corrected: N	Result (mg/Kg)	Qualifier	RL
Mercury		<0.146		0.146

DATA REPORTING QUALIFIERS

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Lab Section	Qualifier	Description
Metals	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA, DLCK or MRL standard: Instrument related QC exceeds the control limits.

QUALITY CONTROL RESULTS

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Method Blank - Batch: 560-46897

Method: 6020

Preparation: 3010A

Lab Sample ID: MB 560-46897/1-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 04/27/2010 1741
Date Prepared: 04/23/2010 0900

Analysis Batch: 560-46981
Prep Batch: 560-46897
Units: mg/L

Instrument ID: Micpms
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Aluminum	<0.0500		0.0500
Arsenic	<0.00500		0.00500
Barium	<0.00500		0.00500
Cadmium	<0.00250		0.00250
Calcium	<0.500		0.500
Chromium	<0.00500		0.00500
Copper	<0.00500		0.00500
Iron	<0.250		0.250
Lead	<0.00500		0.00500
Magnesium	<0.500		0.500
Phosphorus	<0.0500		0.0500
Selenium	<0.00500		0.00500
Silver	<0.00500		0.00500
Sodium	<1.00		1.00
Zinc	<0.0250		0.0250

Method Blank - Batch: 560-46897

Method: 6020

Preparation: 3010A

Lab Sample ID: MB 560-46897/1-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/10/2010 2009
Date Prepared: 04/23/2010 0900

Analysis Batch: 560-47373
Prep Batch: 560-46897
Units: mg/L

Instrument ID: Micpms
Lab File ID: 077SMPL.D#.raw
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Boron	<0.100		0.100

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Lab Control Sample - Batch: 560-46897

Method: 6020

Preparation: 3010A

Lab Sample ID: LCS 560-46897/2-A

Analysis Batch: 560-46981

Instrument ID: Micpms

Client Matrix: Water

Prep Batch: 560-46897

Lab File ID: N/A

Dilution: 1.0

Units: mg/L

Initial Weight/Volume: 50 mL

Date Analyzed: 04/27/2010 1746

Final Weight/Volume: 50 mL

Date Prepared: 04/23/2010 0900

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Aluminum	4.00	3.925	98	80 - 120	
Arsenic	0.400	0.4071	102	80 - 120	
Barium	0.400	0.3892	97	80 - 120	
Cadmium	0.400	0.3916	98	80 - 120	
Calcium	40.0	41.51	104	80 - 120	
Chromium	0.400	0.3910	98	80 - 120	
Copper	0.400	0.3964	99	80 - 120	
Iron	40.0	39.96	100	80 - 120	
Lead	0.400	0.4050	101	80 - 120	
Magnesium	40.0	40.16	100	80 - 120	
Phosphorus	4.00	4.068	102	80 - 120	
Selenium	0.400	0.4105	103	80 - 120	
Silver	0.400	0.3955	99	80 - 120	
Sodium	40.0	42.96	107	80 - 120	
Zinc	0.400	0.3902	98	80 - 120	

Lab Control Sample - Batch: 560-46897

Method: 6020

Preparation: 3010A

Lab Sample ID: LCS 560-46897/2-A

Analysis Batch: 560-47373

Instrument ID: Micpms

Client Matrix: Water

Prep Batch: 560-46897

Lab File ID: 078SMPL.D#.raw

Dilution: 1.0

Units: mg/L

Initial Weight/Volume: 50 mL

Date Analyzed: 05/10/2010 2019

Final Weight/Volume: 50 mL

Date Prepared: 04/23/2010 0900

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Boron	0.800	0.7427	93	80 - 120	

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Method Blank - Batch: 560-47136

Method: 6020
Preparation: 3051

Lab Sample ID: MB 560-47136/1-A
Client Matrix: Waste
Dilution: 1.0
Date Analyzed: 05/05/2010 2139
Date Prepared: 05/03/2010 1400

Analysis Batch: 560-47247
Prep Batch: 560-47136
Units: mg/Kg

Instrument ID: Micpms
Lab File ID: N/A
Initial Weight/Volume: 0.25 g
Final Weight/Volume: 25 mL

Analyte	Result	Qual	RL
Aluminum	<5.00		5.00
Arsenic	<0.500	^	0.500
Barium	<0.500		0.500
Cadmium	<0.500		0.500
Calcium	<50.0		50.0
Chromium	<0.500		0.500
Copper	<0.500		0.500
Iron	<50.0		50.0
Lead	<0.500		0.500
Magnesium	<50.0		50.0
Phosphorus	<5.00		5.00
Selenium	<0.500	^	0.500
Silver	<0.500		0.500
Sodium	<100		100
Zinc	<2.50		2.50

Method Blank - Batch: 560-47136

Method: 6020
Preparation: 3051

Lab Sample ID: MB 560-47136/1-A
Client Matrix: Waste
Dilution: 1.0
Date Analyzed: 05/10/2010 2042
Date Prepared: 05/03/2010 1400

Analysis Batch: 560-47373
Prep Batch: 560-47136
Units: mg/Kg

Instrument ID: Micpms
Lab File ID: 081SMPL.D#.raw
Initial Weight/Volume: 0.25 g
Final Weight/Volume: 25 mL

Analyte	Result	Qual	RL
Boron	<10.0		10.0

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Lab Control Sample - Batch: 560-47136

Method: 6020

Preparation: 3051

Lab Sample ID: LCS 560-47136/2-A

Analysis Batch: 560-47247

Instrument ID: Micpms

Client Matrix: Waste

Prep Batch: 560-47136

Lab File ID: N/A

Dilution: 1.0

Units: mg/Kg

Initial Weight/Volume: 0.25 g

Date Analyzed: 05/05/2010 2145

Final Weight/Volume: 25 mL

Date Prepared: 05/03/2010 1400

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Aluminum	400	396.2	99	80 - 120	
Arsenic	40.0	43.36	108	80 - 120	^
Barium	40.0	40.24	101	80 - 120	
Cadmium	40.0	39.63	99	80 - 120	
Calcium	4000	4133	103	80 - 120	
Chromium	40.0	41.47	104	80 - 120	
Copper	40.0	42.30	106	80 - 120	
Iron	4000	4264	107	80 - 120	
Lead	40.0	42.78	107	80 - 120	
Magnesium	4000	3826	96	80 - 120	
Phosphorus	400	401.1	100	80 - 120	
Selenium	40.0	41.20	103	80 - 120	^
Silver	40.0	44.45	111	80 - 120	
Sodium	4000	4278	107	80 - 120	
Zinc	40.0	41.16	103	80 - 120	

Lab Control Sample - Batch: 560-47136

Method: 6020

Preparation: 3051

Lab Sample ID: LCS 560-47136/2-A

Analysis Batch: 560-47373

Instrument ID: Micpms

Client Matrix: Waste

Prep Batch: 560-47136

Lab File ID: 085SMPL.D#.raw

Dilution: 1.0

Units: mg/Kg

Initial Weight/Volume: 0.25 g

Date Analyzed: 05/10/2010 2107

Final Weight/Volume: 25 mL

Date Prepared: 05/03/2010 1400

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Boron	80.0	80.70	101	80 - 120	

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Matrix Spike/

Matrix Spike Duplicate Recovery Report - Batch: 560-47136

Method: 6020

Preparation: 3051

MS Lab Sample ID: 560-19943-5
Client Matrix: Waste
Dilution: 1.0
Date Analyzed: 05/05/2010 2157
Date Prepared: 05/03/2010 1400

Analysis Batch: 560-47247
Prep Batch: 560-47136

Instrument ID: Micpms
Lab File ID: N/A
Initial Weight/Volume: 0.25 g
Final Weight/Volume: 25 mL

MSD Lab Sample ID: 560-19943-5
Client Matrix: Waste
Dilution: 1.0
Date Analyzed: 05/05/2010 2203
Date Prepared: 05/03/2010 1400

Analysis Batch: 560-47247
Prep Batch: 560-47136

Instrument ID: Micpms
Lab File ID: N/A
Initial Weight/Volume: 0.25 g
Final Weight/Volume: 25 mL

Analyte	% Rec.		Limit	RPD	RPD Limit	MS Qual	MSD Qual
	MS	MSD					
Aluminum	100	100	75 - 125	0	20		
Arsenic	103	105	75 - 125	2	20	^	^
Barium	113	112	75 - 125	1	20		
Cadmium	98	97	75 - 125	1	20		
Calcium	104	104	75 - 125	0	20		
Chromium	103	104	75 - 125	2	20		
Copper	99	100	75 - 125	0	20		
Iron	102	103	75 - 125	1	20		
Lead	106	106	75 - 125	0	20		
Magnesium	95	96	75 - 125	1	20		
Phosphorus	98	101	75 - 125	4	20		
Selenium	100	102	75 - 125	2	20	^	^
Silver	110	108	75 - 125	2	20		
Sodium	96	97	75 - 125	1	20		
Zinc	99	102	75 - 125	3	20		

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Matrix Spike/

Matrix Spike Duplicate Recovery Report - Batch: 560-47136

Method: 6020

Preparation: 3051

MS Lab Sample ID: 560-19943-5
Client Matrix: Waste
Dilution: 1.0
Date Analyzed: 05/10/2010 2119
Date Prepared: 05/03/2010 1400

Analysis Batch: 560-47373
Prep Batch: 560-47136

Instrument ID: Micpms
Lab File ID: 087SMPL.D#.raw
Initial Weight/Volume: 0.25 g
Final Weight/Volume: 25 mL

MSD Lab Sample ID: 560-19943-5
Client Matrix: Waste
Dilution: 1.0
Date Analyzed: 05/10/2010 2125
Date Prepared: 05/03/2010 1400

Analysis Batch: 560-47373
Prep Batch: 560-47136

Instrument ID: Micpms
Lab File ID: 088SMPL.D#.raw
Initial Weight/Volume: 0.25 g
Final Weight/Volume: 25 mL

Analyte	<u>% Rec.</u>		Limit	RPD	RPD Limit	MS Qual	MSD Qual
	MS	MSD					
Boron	104	110	75 - 125	5	20		

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Method Blank - Batch: 560-46894

Lab Sample ID: MB 560-46894/4-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 04/27/2010 1011
Date Prepared: 04/23/2010 0930

Analysis Batch: 560-46970
Prep Batch: 560-46894
Units: mg/L

Method: 7470A Preparation: 7470A

Instrument ID: Mhg1
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Mercury	<0.00200		0.00200

Lab Control Sample - Batch: 560-46894

Lab Sample ID: LCS 560-46894/5-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 04/27/2010 1014
Date Prepared: 04/23/2010 0930

Analysis Batch: 560-46970
Prep Batch: 560-46894
Units: mg/L

Method: 7470A Preparation: 7470A

Instrument ID: Mhg1
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Mercury	0.00500	0.004840	97	80 - 120	

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19943-1

Sdg Number: 04/21/10

Method Blank - Batch: 560-47125

Lab Sample ID: MB 560-47125/4-A
Client Matrix: Waste
Dilution: 1.0
Date Analyzed: 05/03/2010 1405
Date Prepared: 05/03/2010 1100

Analysis Batch: 560-47141
Prep Batch: 560-47125
Units: mg/Kg

Method: 7471A Preparation: 7471A

Instrument ID: Mhg1
Lab File ID: N/A
Initial Weight/Volume: 0.600 g
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Mercury	<0.200		0.200

Lab Control Sample - Batch: 560-47125

Lab Sample ID: LCS 560-47125/5-A
Client Matrix: Waste
Dilution: 1.0
Date Analyzed: 05/03/2010 1408
Date Prepared: 05/03/2010 1100

Analysis Batch: 560-47141
Prep Batch: 560-47125
Units: mg/Kg

Method: 7471A Preparation: 7471A

Instrument ID: Mhg1
Lab File ID: N/A
Initial Weight/Volume: 0.600 g
Final Weight/Volume: 50 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Mercury	0.417	0.4650	112	80 - 120	

Ambient Metals 19943

Customer Information				Project Information				Analyses / Methods Requested											
Call No.	Project Name																		
Requisition No.	Lab Number																		
Company	Bill To																		
Send Report To:	Invoice Attn																		
Address:	Address:																		
City/State/Zip	City/State/Zip																		
Phone	Phone																		
Fax	Fax																		
Sample Description	Sample Date	Sample Time	Sample Matrix	Container Type	Preservative	No. of Bottles	A	B	C	D	E	F	G	H	Comments / Instructions				
<i>JM-1-15W</i>	<i>4/19/2010</i>			Glass Vial		1	X	X											
JM-1-15O	4/19/2010			Glass Vial		1	X	X											
JM-1-15SW	4/19/2010			Glass Vial		1	X	X											
JM-1-15SO	4/19/2010			Glass Vial		1	X	X											
<i>JM-1-16W</i>	<i>4/19/2010</i>			Glass Vial		1	X	X											
<i>JM-1-16S</i>	<i>4/19/2010</i>			Glass Vial		1	X	X											
<i>JM-1-16SW</i>	<i>4/19/2010</i>			Glass Vial		1	X	X											
<i>JM-1-16SO</i>	<i>4/19/2010</i>			Glass Vial		1	X	X											
Sampler(s):	Shipment Method: UPS			Airbill No.: <i>172 R43 3R703 82829537</i>															
Relinquished by: Josh Morgan				Date 4-19-2010	Relinquished by:			Date	Relinquished by:			Date	Date						
Company Name:				Time	Company Name:			Time	Company Name:			Time	Time						
Received by: <i>Olivia J. Nagel</i>				Date <i>04/19/2010</i>	Received by:			Date	Received by:			Date	Date						
Company Name:				Time <i>1255</i>	Company Name:			Time	Company Name:			Time	Time						

TESTAMERICA LABORATORIES, INC. 1733 NORTH PADRE ISLAND DRIVE CORPUS CHRISTI, TX 78408 (361) 289-2673 FAX (361) 289-2471

CHAIN OF CUSTODY RECORD Page 2 of 2

CHAIN OF CUSTODY RECORD Page 2 of 2

05/13/2010

Login Sample Receipt Check List

Client: TestAmerica Corpus Christi

Job Number: 560-19943-1

SDG Number: 04/21/10

Login Number: 19943

List Source: TestAmerica Corpus Christi

Creator: Magee, Alice J.

List Number: 1

Question	T / F / NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	N/A	
The cooler's custody seal, if present, is intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	False	
Cooler Temperature is acceptable.	True	Ambient Metals
Cooler Temperature is recorded.	N/A	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	False	COC container type is wrong on sx's 2 & 4.
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	False	No sx times provided on coc or containers.
Appropriate sample containers are used.	False	Metals should be in pl container w/hno3.
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Is the Field Sampler's name present on COC?	True	
Sample Preservation Verified	True	No sx's were preserved. They all should have been.

ANALYTICAL REPORT

Job Number: 560-19994-1

Job Description: Char Sample

For:

Sunrise Ridge Algae

211 Seaton Glen

Suite 109

Houston, TX 77094

Attention: Mr. Norm Whitton

Approved for release.
Timothy L. Kellogg
Project Manager II
5/4/2010 2:43 PM

Timothy L. Kellogg
Project Manager II
tim.kellogg@testamericainc.com
05/04/2010

The test results entered in this report meet all NELAC requirements for accredited parameters. Any exceptions to NELAC requirements are noted in the report. Pursuant to NELAC, this report may not be reproduced except in full, and with written approval from the laboratory. TestAmerica Corpus Christi Certifications and Approvals: NELAC TX T104704210-TX, NELAC KS E-10362, Oklahoma 9968, USDA Soil Permit P330-08-00033.

Job Narrative
560-19994-1

Receipt

All other samples were received in good condition.

Metals

Method(s) 7470A: It was noted that the matrix spike and matrix spike duplicate (MS/MSD) recoveries for 560-19994-1 were outside of the control limits. Matrix interferences inherent tot he sample are suspected to be the cause of the recoveries. The associated laboratory control sample (LCS) recovery met acceptance criteria. No other analytical or quality issues were noted.

EXECUTIVE SUMMARY - Detections

Client: Sunrise Ridge Algae

Job Number: 560-19994-1

Lab Sample ID Analyte	Client Sample ID	Result / Qualifier	Reporting Limit	Units	Method
560-19994-1 <i>TCLP</i> Barium	CHAR	0.0602	0.00500	mg/L	6020

METHOD SUMMARY

Client: Sunrise Ridge Algae

Job Number: 560-19994-1

Description		Lab Location	Method	Preparation Method
Matrix	Solid			
Metals (ICP/MS)		TAL CC	SW846 6020	
TCLP Extraction		TAL CC		SW846 1311
Preparation, Total Metals		TAL CC		SW846 3010A
Mercury (CVAA)		TAL CC	SW846 7470A	
TCLP Extraction		TAL CC		SW846 1311
Preparation, Mercury		TAL CC		SW846 7470A

Lab References:

TAL CC = TestAmerica Corpus Christi

Method References:

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

METHOD / ANALYST SUMMARY

Client: Sunrise Ridge Algae

Job Number: 560-19994-1

Method	Analyst	Analyst ID
SW846 6020	Reyes, Eddie D	EDR
SW846 7470A	Mathewson, John E	JEM

SAMPLE SUMMARY

Client: Sunrise Ridge Algae

Job Number: 560-19994-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
560-19994-1	Char	Solid	04/20/2010 0000	04/26/2010 1317

Analytical Data

Client: Sunrise Ridge Algae

Job Number: 560-19994-1

Client Sample ID: Char

Lab Sample ID: 560-19994-1

Client Matrix: Solid

Date Sampled: 04/20/2010 0000

Date Received: 04/26/2010 1317

6020 Metals (ICP/MS)-TCLP

Method:	6020	Analysis Batch: 560-47070	Instrument ID:	Micpms
Preparation:	3010A	Prep Batch: 560-47057	Lab File ID:	N/A
Dilution:	1.0	Leachate Batch: 560-47033	Initial Weight/Volume:	50 mL
Date Analyzed:	04/29/2010 2149		Final Weight/Volume:	50 mL
Date Prepared:	04/29/2010 0900			
Date Leached:	04/28/2010 1430			

Analyte	DryWt Corrected: N	Result (mg/L)	Qualifier	RL
Arsenic		<0.00500		0.00500
Barium		0.0602		0.00500
Cadmium		<0.00250		0.00250
Silver		<0.00500		0.00500
Chromium		<0.00500		0.00500
Lead		<0.00500		0.00500
Selenium		<0.00500		0.00500

7470A Mercury (CVAA)-TCLP

Method:	7470A	Analysis Batch: 560-47085	Instrument ID:	Mhg1
Preparation:	7470A	Prep Batch: 560-47063	Lab File ID:	N/A
Dilution:	1.0	Leachate Batch: 560-47033	Initial Weight/Volume:	50 mL
Date Analyzed:	04/29/2010 1618		Final Weight/Volume:	50 mL
Date Prepared:	04/29/2010 1130			
Date Leached:	04/28/2010 1430			

Analyte	DryWt Corrected: N	Result (mg/L)	Qualifier	RL
Mercury		<0.00200		0.00200

DATA REPORTING QUALIFIERS

Client: Sunrise Ridge Algae

Job Number: 560-19994-1

Lab Section	Qualifier	Description
Metals	F	MS or MSD exceeds the control limits

QUALITY CONTROL RESULTS

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19994-1

Method Blank - Batch: 560-47057

Method: 6020

Preparation: 3010A

Lab Sample ID: MB 560-47057/1-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 04/29/2010 2043
Date Prepared: 04/29/2010 0900

Analysis Batch: 560-47070
Prep Batch: 560-47057
Units: mg/L

Instrument ID: Micpms
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Arsenic	<0.00500		0.00500
Barium	<0.00500		0.00500
Cadmium	<0.00250		0.00250
Silver	<0.00500		0.00500
Chromium	<0.00500		0.00500
Lead	<0.00500		0.00500
Selenium	<0.00500		0.00500

Lab Control Sample - Batch: 560-47057

Method: 6020

Preparation: 3010A

Lab Sample ID: LCS 560-47057/2-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 04/29/2010 2048
Date Prepared: 04/29/2010 0900

Analysis Batch: 560-47070
Prep Batch: 560-47057
Units: mg/L

Instrument ID: Micpms
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Arsenic	0.400	0.3867	97	80 - 120	
Barium	0.400	0.4081	102	80 - 120	
Cadmium	0.400	0.3877	97	80 - 120	
Silver	0.400	0.3917	98	80 - 120	
Chromium	0.400	0.3849	96	80 - 120	
Lead	0.400	0.4133	103	80 - 120	
Selenium	0.400	0.3830	96	80 - 120	

Quality Control Results

Client: Sunrise Ridge Algae

Job Number: 560-19994-1

Method Blank - Batch: 560-47063

Lab Sample ID: MB 560-47063/4-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 04/29/2010 1559
Date Prepared: 04/29/2010 1130

Analysis Batch: 560-47085
Prep Batch: 560-47063
Units: mg/L

Method: 7470A Preparation: 7470A

Instrument ID: Mhg1
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Mercury	<0.00200		0.00200

Lab Control Sample - Batch: 560-47063

Lab Sample ID: LCS 560-47063/5-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 04/29/2010 1601
Date Prepared: 04/29/2010 1130

Analysis Batch: 560-47085
Prep Batch: 560-47063
Units: mg/L

Method: 7470A Preparation: 7470A

Instrument ID: Mhg1
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Mercury	0.00500	0.004450	89	80 - 120	

Matrix Spike/ Matrix Spike Duplicate Recovery Report - Batch: 560-47063

Method: 7470A Preparation: 7470A TCLP

MS Lab Sample ID: 560-19994-1
Client Matrix: Solid
Dilution: 1.0
Date Analyzed: 04/29/2010 1628
Date Prepared: 04/29/2010 1130
Date Leached: 04/28/2010 1430

Analysis Batch: 560-47085
Prep Batch: 560-47063

Leachate Batch: 560-47033

Instrument ID: Mhg1
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

MSD Lab Sample ID: 560-19994-1
Client Matrix: Solid
Dilution: 1.0
Date Analyzed: 04/29/2010 1630
Date Prepared: 04/29/2010 1130
Date Leached: 04/28/2010 1430

Analysis Batch: 560-47085
Prep Batch: 560-47063

Leachate Batch: 560-47033

Instrument ID: Mhg1
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	% Rec.		Limit	RPD	RPD Limit	MS Qual	MSD Qual
	MS	MSD					
Mercury	78	79	80 - 120	2	20	F	F

[illegible]

Login Sample Receipt Check List

Client: TestAmerica Corpus Christi

Job Number: 560-19994-1

Login Number: 19994

List Source: TestAmerica Corpus Christi

Creator: Magee, Alice J.

List Number: 1

Question	T / F / NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	N/A	
The cooler's custody seal, if present, is intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	False	
Cooler Temperature is acceptable.	True	Metals only
Cooler Temperature is recorded.	N/A	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	False	TCLP could be used for a variety of parameters. Client was contacted.
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Is the Field Sampler's name present on COC?	True	
Sample Preservation Verified	True	