

**Microbial Enhanced Oil Recovery Demonstration Project
Cook Inlet, Alaska**

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Partners: Cook Inlet Energy ("CIE")--Field Pilot
University of Alaska Fairbanks ("UAF")--Validation

Total Project Cost:	Preliminary Expense	\$ 200,000
	UAF Analyses	\$ 30,000
	Field Application	<u>\$1,200,000</u>
	Total:	\$1,430,000

Use of EETF Funds:	UAF	\$ 30,000
	CIE	<u>\$ 700,000</u>
	Total:	\$ 730,000

Matching Contributions: CIE (excludes in-kind) \$ 700,000

Grant Assistance Requested: \$730,000

Potential Benefit to the State: \$4,500,000,000

Previous EETF Projects and Abstracts: None

Project Summary

Description: The Project will demonstrate at commercial scale the efficacy of the Titan Process® for Microbial Enhanced Oil Recovery (“MEOR”) for potential future use on Alaska’s Cook Inlet oil fields. It aims to increase significantly both the current rate of production and the ultimate amount of oil recovered in the Cook Inlet, thereby furthering the core objective of the Emerging Energy Technology Fund “to promote, develop, and advance the general prosperity and welfare of the people of the State.”

Problems Addressed: Alaskan oil production--the economic lifeblood of the State--is declining steadily at approximately 7% per year. New sources of oil production must be found to offset the current decline. This is, without question, the most serious energy issue facing the State today. While doing all it can to foster exploration and the development of new production generally, the State should also encourage the application of emerging energy technologies to an important concomitant problem: About 65% of the oil in Alaska’s mature fields remains in place, classified as “trapped” or “unrecoverable” resources after conventional primary and secondary recovery processes have run their course. Methods for producing portions of this unacceptably large residual volume comprise the technical category of Enhanced Oil Recovery (“EOR”).

The MEOR Solution: Titan’s Microbial Enhanced Oil Recovery is an economical, environmentally benign form of EOR that utilizes microbes as the means of mobilizing oil that is un-productive by conventional techniques. Proprietary, scientifically robust and thoroughly field-tested, Titan’s new process works within the natural bio-ecology of the oil reservoir by selectively stimulating the formation’s indigenous microbes with custom-formulated, bio-degradable, organic nutrients. The targeted beneficial microbes proliferate as a result of these specialized nutrients and, near the end of their life cycles, interact with globules of trapped oil, affecting their surface tension and reducing the oil to microscopic droplets that flow more freely through the reservoir to the producing wells. (For more on Titan’s revolutionary process, please visit <http://www.titanoilrecovery.com/meor-titan-difference.html>.)

Structure of the Project: Titan will team with Cook Inlet Energy to execute a demonstration of the MEOR process in a major oil region of Alaska, the (primarily offshore) Cook Inlet. Titan will provide its technology and scientific expertise; the operator will provide its field apparatus, wells, facilities and operating know-how as well as the matching share of the projected cost of the Project not defrayed by the requested grant. Engineers at the Petroleum Development Laboratory, UAF, will validate baseline current production at the targeted fields--essential for the computation of actual results--and will be engaged to analyze the results of the demonstration projects for the Grant Authority utilizing grant funds.

Expected Benefits: Preliminary assessments indicate that Titan’s MEOR process may increase current production at the targeted Project wells by approximately 30% and increase ultimate recovery of the original-oil-in-place by 3-10%. Importantly, an EETF grant would provide a “jump-start” incentive for wider application of MEOR on other State resources. A review of currently active oil fields in the Cook Inlet indicates the likelihood of acceptable conditions in six of the eight producing fields. If a 10% increase in recovered reserves could be achieved on these promising fields of this province using Titan’s MEOR, more than 90 million barrels of additional oil would be produced. State tax and royalty revenue generated from such incremental production over the next decade or so would be more than \$4.5 billion at today’s oil price. Such large potential returns, and MEOR’s recent history of successful applications in the field (See the Project Innovation section, below.) generate an exceptional risk/reward ratio justifying the requested \$730,000 grant-investment of State funds.

Eligibility: The proposed field demonstrations effectively meet the Authority's applicable eligibility criteria. Titan's MEOR conserves energy, requiring the construction of no new infrastructure; only the transportation of temporary storage tanks to each well-treatment site and the temporary operation of a single pump to introduce nutrients to each reservoir. In this respect, in its proven efficacy on suitable resources, and in its environmentally benign character, the Titan process is a distinct improvement over other, less energy-efficient (and more expensive) EOR techniques, including reservoir floods of steam, CO₂ and surfactant polymers. Although Titan's process was tested preliminarily on a North Slope field in 1996, with promising results, the operator elected not to proceed with full-scale application in that period of low oil prices. Titan's MEOR has therefore not yet been demonstrated in Alaska on a commercial scale. By elegantly changing the character of residual oil-in-place to increase its flow, the Titan process generates an extraordinarily "efficient and effective use of hydrocarbons." We assess Titan's "technology readiness" as meeting the definition of Level TRL8 on the Department of Energy's relevant scale. Success in the proposed demonstrations will lift the technology to Level TRL9 through application "under actual deployment conditions."

Innovation: The Titan process is at the cutting edge of innovation in the field of EOR. Since 2007, MEOR has been applied 185 times on 20 different fields with positive results on 88% of treated wells, no decreases in oil-production, and an average increase in production of just over 100% when effective. Our expectation of a 30% increase in the current rate of production in Alaska is purposely conservative, anticipating that results may moderate at the proposed scale of application. (Confirming a more precise estimate of improved production within the Cook Inlet is a key outcome of this EETF project.) With positive demonstration results, Titan's MEOR may join the ranks of standard operating procedures for treating declining fields. This would be an innovation of State-wide (and global) significance.

Priority: The proposed Project meets all requirements for priority consideration by the Grant Authority. Titan is now duly licensed to do business in Alaska and our partner company, CIE, has been a member of the State's petroleum sector since 2009. Engineers at the Petroleum Development Laboratory at UAF are prepared to generate a formal validation of baseline production rates at the Project's targeted sites and, further, to receive regular reports of progress that will be useful in preparing a formal assessment of final results for the Authority. The matching contributions of CIE will be substantial, both in-cash and in-kind. The significant potential for widespread deployment of Titan's MEOR in Alaska has already been discussed.

Validation and Methodology

Objectives: The Project's primary goal is to demonstrate the efficacy of Titan's process on Alaskan Cook Inlet resources with the ultimate aim of widespread follow-on applications in the State. Our secondary goals, the milestones enabling the above, are: 1) to research the characteristics of candidate fields in Alaska; 2) to develop optimal field-specific nutrients for promising oil reservoirs; and 3) to demonstrate commercial efficacy on the selected fields through a statistically significant time-period and volume of "new" oil produced.

Methodology: We will execute Titan's established procedures according to the schedule below, beginning with a validation of prior production rates by UAF engineers who, together with the Grant Authority, will receive regular reports of operations completed and milestones achieved. The two sites currently targeted for demonstrations are the Redoubt Unit and the West MacArthur River Field. Operating infrastructure and reservoir characteristics at both sites appear to be conducive to smooth execution based on current observations. (Should problems arise during the

testing and analysis steps in the chart below, other candidate sites have been identified as alternates). The Project will conclude with a formal report of results to the Authority in a format suitable for assessment by the UAF team or other third-party experts, as appropriate.

Summary of Major Tasks, Schedule and Budget

Work can begin quickly since no new infrastructure (pipelines, compressors, wells, pumps, etc.) will be needed. The basic structure is as follows.

Task	Duration	Cost
1. Field Screening (paper exercise).	(Completed pre-approval.)	NA
2. Well Testing and Laboratory Analysis.	3months (Completed pre-approval.)	\$20,000
3. Initial Field Tests: Nutrient Formulations. Transport and Logistics. Well Treatments.	1 month 1 month 0.5 month	\$180,000
4. Analysis of Field-test Results *	3 months	Included above
5. Pilot Projects: Cyclical MEOR Applications and Benefit Analysis	12 months	Cook Inlet: \$1,200,000 UAF: \$30,000
TOTALS	20.5 months	\$1,430,000

* Steps 1-4 will be paid by CIE before any award of EETF funding.

Project Leadership Qualifications

(More-detailed biographies of the participants are available on request.)

Brian W. G. Marcotte, CEO, Titan. Mr. Marcotte has over 40 years of experience in the oil and gas industry ranging from technical positions to executive management, including President Unocal Thailand, President Unocal Indonesia, and President Unocal the Netherlands. He is a Distinguished Member of the Society of Petroleum Engineers and currently serves as chair of the International Business Council of The Nature Conservancy.

Bradley R. Govreau, COO, Titan. Mr. Govreau had over 35 years’ experience with Unocal Corporation, including service as Senior Vice President and General Manager of Unocal Indonesia and Vice President of Unocal Geothermal, where he directed 400 employees and was responsible for \$600 million in assets.

Alan Sheehy, Vice President and Principal Scientist, Titan. Mr. Sheehy is Professor of Microbiology at the Microbiology Research Unit, Sunshine Coast, Queensland, Australia. Professor Sheehy has been nominated twice for Australia’s premier national science award, the Clunies Ross National Science and Technology Award, for his work in petroleum microbiology.

David Hall, CEO, Cook Inlet Energy. Mr. Hall was formerly Vice President and General Manager of Alaska Operations for Pacific Energy Resources LTD. He also served as Production Manager in Alaska for Forest Oil Corp. Mr. Hall has over 20 years' experience in oil and gas production and drilling as well as an industrial and electrical engineering background.

Post-project Commercialization of Titan's MEOR

Given the expected positive results, the Grant Project will have provided full-scale demonstrations of MEOR's efficacy in the legacy Cook Inlet of Alaska. Operators in the State's other fields with favorable characteristics may then consider testing the technology on their resources with strong expectations of success, and the Project will have provided the hoped-for "jump-start" toward wide deployment—and increased production—across the State. Early assessments indicate that at least 10 other large fields in both the Cook Inlet and on the North Slope have favorable characteristics for the application of Titan's MEOR process. If an additional 10% of the original-oil-in-place could be recovered from these fields using MEOR, about 1.5 billion "new" barrels could be produced—the equivalent of the third-largest find in Alaska's history. With sufficient demand, Titan would likely build laboratory and mixing facilities in Alaska; an undertaking requiring no more than a year to complete. There are thus no foreseeable barriers to Titan's supplying services on a significant scale in Alaska within the next five years. The market for an increased flow of Alaskan oil is not in doubt.

Signatures/Applicant Certification

By our signatures on this application, we certify that we are complying and will comply with the amount of matching funds being offered.

Brian W. G. Marcotte
President and CEO
for
Titan Oil Recovery
Grant Applicant

David Hall
CEO
for
Cook Inlet Energy
Matching Participant