

Grant Application (G39-01) for the North Dakota Industrial Commission Oil and Gas Research Program

ThermFlo – a novel technology for
complete on-site remediation of
organically contaminated solids



Drake Water Technologies, Inc.

Applicant: Drake Water Technologies, Inc., Helena, MT,
in cooperation with National Oilwell Varco (NOV), Denver,
CO and P&S Fabricators, Inc., Missoula, MT

Principal Investigator: Ron Drake, P.E., Chemical Engineer

Amount of Request: \$329,000

Objective: Construction, mobilization, deployment and
demonstration of a 4 to 6 ton/hr ThermFlo unit at a site
with petroleum contaminated solids requiring treatment

Total Project Cost: \$671,095 (51% contribution from
private industry)

Duration of Project: ~4 months



Drake Water Technologies, Inc.

Why the ThermFlo project is needed:

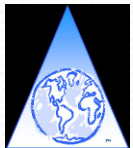
ND DOH lists **1,630** “Oilfield Environmental Incidents” in 2015, mainly organic spills, overtopped waste tanks, truck spills and pipeline leaks.

In 2012, **1.2 million tons** of drill cuttings were disposed of in North Dakota’s special waste landfills.

Remediation is most often excavation, stabilization, and transport to one of **12** permitted disposal facilities.

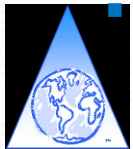
ThermFlo is a “cradle to grave” process for complete on-site remediation of organically contaminated solids, including drill cuttings and soils.

ThermFlo is **NOT** a thermal desorption process. It is a novel catalytic oxidation process that ensures complete destruction of petroleum hydrocarbons with salts significantly reduced.



ThermFlo Advantages Compared to Other Thermal Technologies:

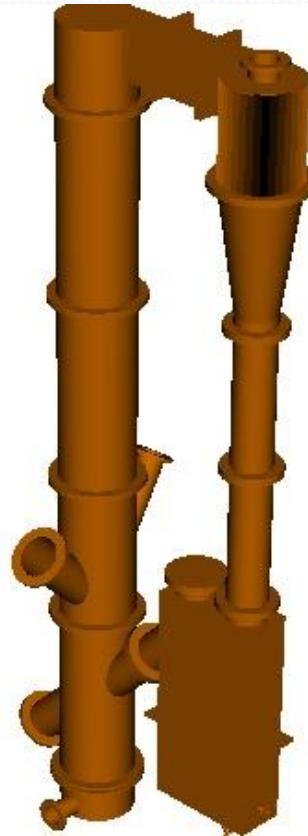
- Total Petroleum Hydrocarbon (TPH) destruction of >100,000 mg/kg to **non-detect** levels
- Circulating Fluidized Bed achieves destruction removal efficiencies of **>99.9999%** at Low Temperature (**850 C**) for Catalytic Oxidation of Contaminated Solids
- Chlorides significantly reduced to levels (**ND limit of <250 mg/L**) that can be left on-site
- **Salts partition** to quench water that can be recycled on site, injected, or dried
- Generates **Clean Off-Gas**, de minimus NO_x, SO_x, and CO
- No Secondary Wastes
- TENORM levels both before and after ThermFlo were less than the **ND limit of 5 pCi/g** and showed no concentration of radiological materials
- **High Throughput** with Small Footprint and **Mobile**
- Omnivorous Consumption of Low-Value and Waste Fuels
- Low CAPEX and OPEX
- Significant **Cost Reduction** compared to current thermal remediation methods or landfill disposal



ThermFlo Pilot Plant



**ThermFlo
Original
Design**



**Portion of
Fluidized Bed
with
Refractory**

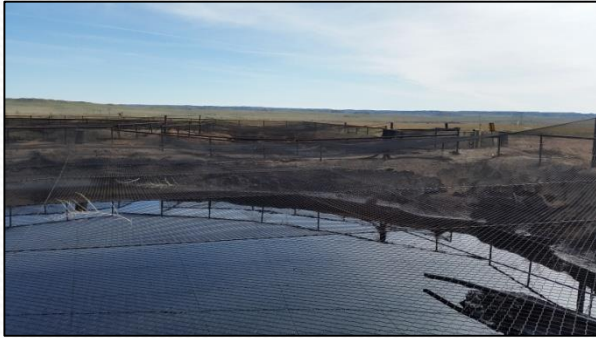
**Fluidized Bed
with Cyclone**



Fluidized Bed



ThermFlo Pilot Run with old (>40 years) Pit Materials- July 30, 2015 (from Montana)



**Pits requiring
cleanup**

**Pit Material Post ThermFlo
Treatment, Augered out of
Lower Sump**



**Derrick Kesy, NOV,
Feeding Pit Material
to Moyno Pump**



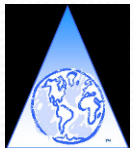
Drake Water Technologies, Inc.

ThermFlo Pilot Plant Successes

Client #1 Cuttings, Before and After 8/17/2015



**ThermFlo
Pilot Unit,
7/2/2015**

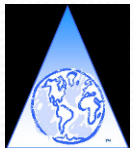


ThermFlo Pilot Plant Successes

**Client #2 Shaker Cuttings & Centrifuge Paste,
Pre and Post Treatment
9/1/2015**



**ThermFlo
Pilot Unit,
7/2/2015**



Drake Water Technologies, Inc.

ThermFlo Pilot Plant Successes

**Client #3 Cuttings and Centrifuge Paste,
Pre and Post treatment
10/01/2015**



**ThermFlo
Pilot Unit,
7/2/2015**



**Lab Samples including
Quench Water**



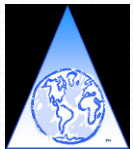
Drake Water Technologies, Inc.

ThermFlo Pilot Plant Successes

**NOV Vortex Cuttings
Pre and Post ThermFlo Treatment
10/7/2015**



**ThermFlo
Pilot Unit,
7/2/2015**



Drake Water Technologies, Inc.

ThermFlo Pilot Plant Successes

**Client #4 Centrifuge and Shaker Material from
14,000 feet, Wyoming 2/18/2016**



**ThermFlo
Pilot Unit,
7/2/2015**



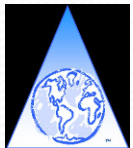
**>18 Mesh Post
ThermFlo Treatment**



**<18 Mesh Post
ThermFlo Treatment**



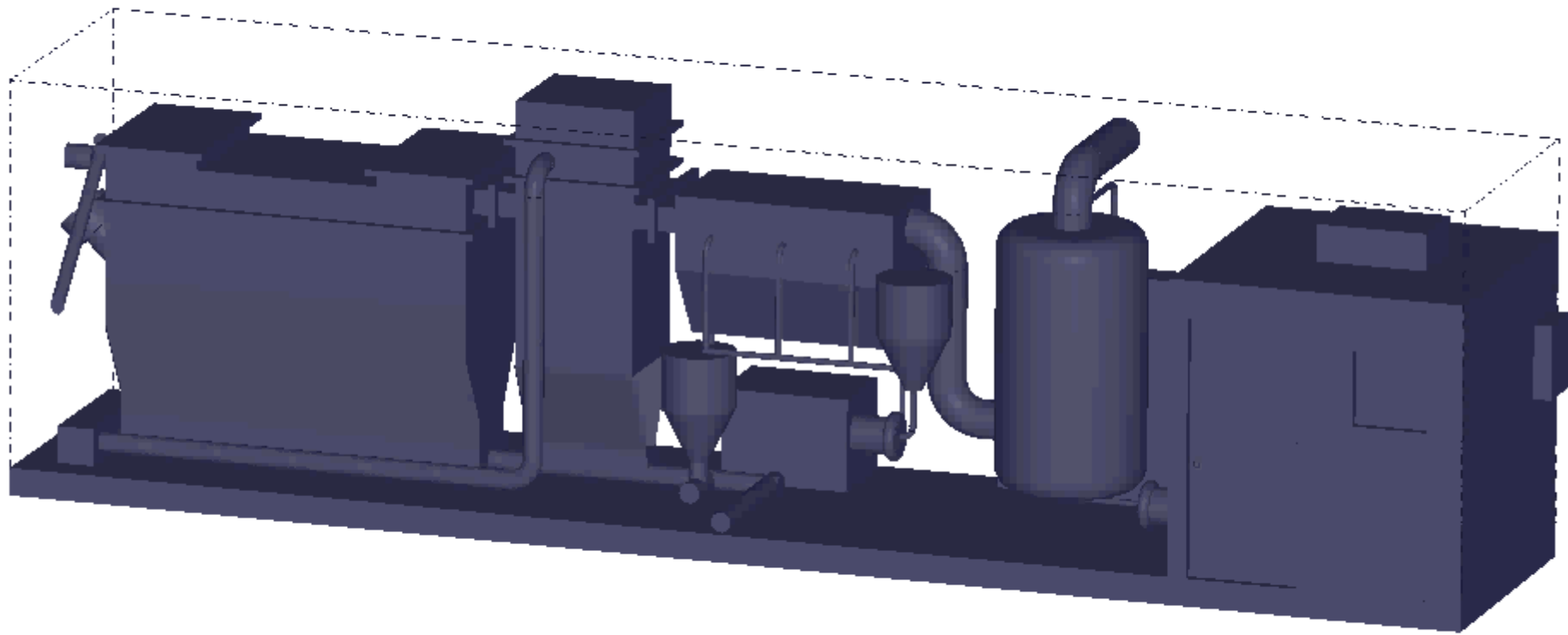
**Combined Post
ThermFlo Treatment**



Drake Water Technologies, Inc.

DATE	SAMPLE	TPH mg/kg	Chloride mg/L	Sodium mg/L
8/17/2015	Client #1 Raw	51,000	215	180
	Client #1 >10 Mesh	16	ND	34
	Client #1 <10 Mesh	ND	3	23
	Client #1 Quench	32	2,330	577
9/1/2015	Client #2 Raw	85,000	328	34
	Client #2 Treated	82	4	11
	Client #2 Quench	50	2,770	190
10/1/2015	Client #3 Centrifuge	110,000		880
	Client #3 Cuttings	39,300		2,080
	Client #3 Treated >10 Mesh	ND		2,730
	Client #3 Treated <10 Mesh	ND		939
	Client #3 Treated	ND		2,230
	Client #3 Quench	ND		17,900
10/8/2015	NOV Vortex Treated	ND	ND	18
	NOV Vortex Quench		1323	
2/18/2016	Client #4 <18 mesh cuttings	ND	12	
	Client #4 >18 mesh cuttings	ND	227	
	#4 50:50 composite leachate		133	
	Quench Water		1,140	

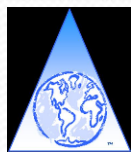




Drake Water Technologies, Inc.

Budget

Project Expense	NDIC's Share	DWT's Share	P&S' Share	NOV's Share	Totals
Engineering & Project Administration	\$99,500	\$28,000	\$10,000	\$45,000	\$182,500
Payroll Benefits	\$6,500	\$1,820	\$500	\$2,275	\$11,095
Travel	\$6,000	\$1,500		\$5,000	\$12,500
Subcontracts	\$5,000				\$5,000
M&S	\$7,000				\$7,000
Equipment	\$205,000			\$240,000	\$445,000
Facilities G&A		\$8,000			\$8,000
TOTALS	\$329,000	\$39,320	\$10,500	\$292,275	\$671,095
Percent	49.0%	5.9%	1.6%	43.6%	100.0%



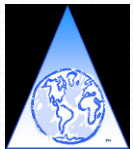
ThermFlo Sunk Costs to Date

Drake has incurred sunk costs of over **\$900,000** over past **6 years** to support fluidized bed operations research, off-gas cleanup technology development, and fluidized bed control system development.

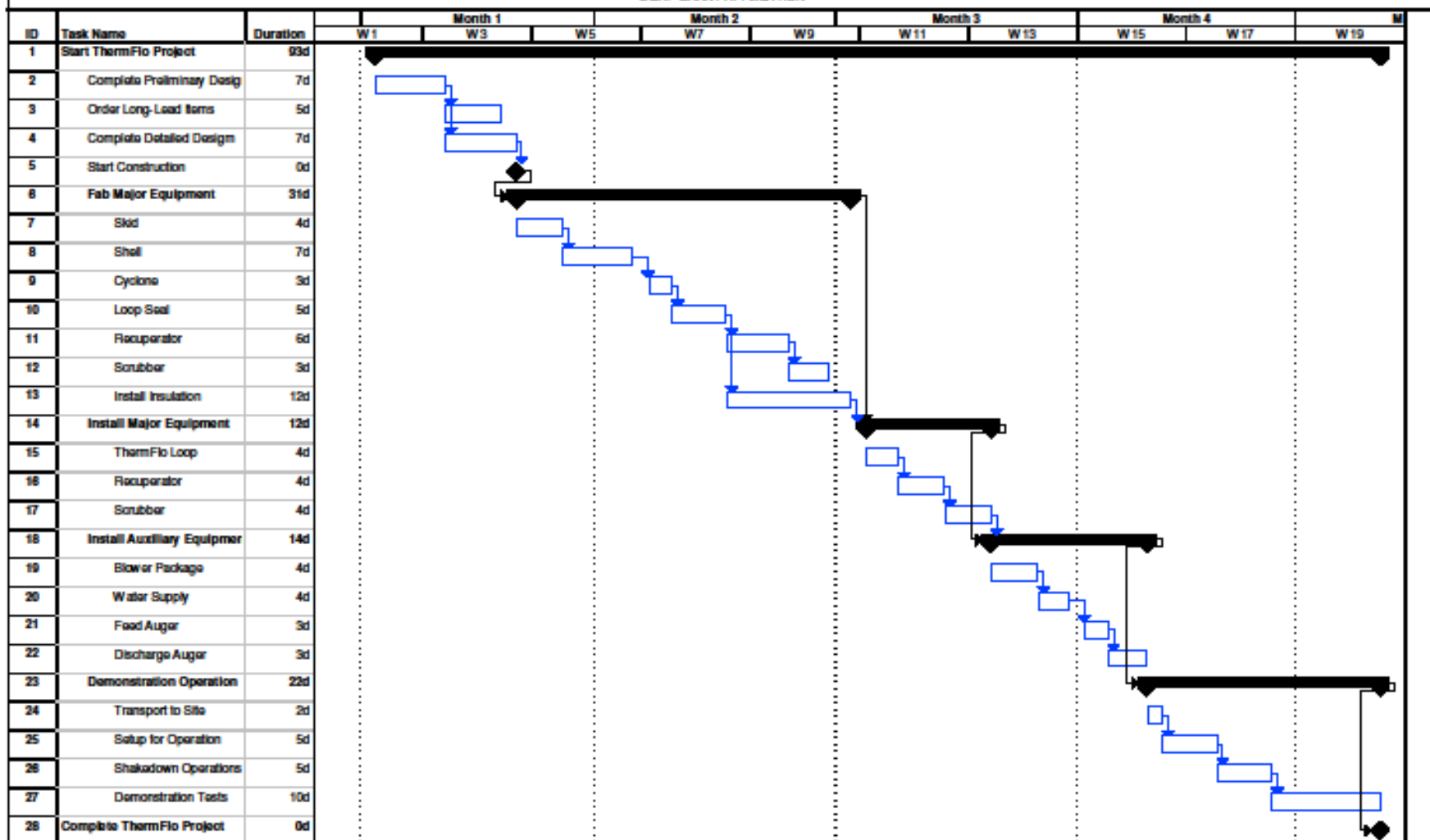
Sunk costs for ThermFlo pilot plant construction and testing, laboratory analyses, engineering, design, and process modeling, exceed **\$1-million** over **2 years** of collaborative development work by **Drake, NOV, and P&S**.

Although the core technology (fluidized bed catalytic oxidation) is well proven, DWT has conceived, developed, tested, and integrated several **innovations** (e.g., low profile reactor, compact high temperature recuperator, chloride partitioning, solids neutralization, omnivorous fueling, feed flexibility, and simple I&C).

The proposed ThermFlo unit is truly a **first-of-its-kind** process system, developed and designed to fulfill a unique oil field mission of providing **economical, single load, on-site treatment and disposition of petroleum contaminated solids**.



OGRP GRANT APPLICATION



Project: ThermFlo Grant.MPP
Date: Fri 10/24/14

Task



Milestone



Rolled Up Task



Rolled Up Progress



Progress



Summary



Rolled Up Milestone





May 4, 2016

Mr. Brent Brannan
North Dakota Industrial Commission
State Capitol – 14th Floor
600 East Boulevard Ave Dept 405
Bismarck, ND 58505-0840

Re: ND Oil and Gas Research Program Grant Application "*ThermFlo, a novel technology for complete on-site remediation of organically contaminated solids*"

Dear Mr. Brannan:

We understand from a communication you have had with Mr. Ron Drake, Drake Water Technologies, Inc. (Helena, MT) that the NDIC review team for the above referenced grant application is requesting assurance that, if the project is funded (with both NDIC and National Oilwell Varco [NOV] funding), the ThermFlo unit will be employed at a drilling or other site in North Dakota for deployment, demonstration, and testing.

As an operating company in North Dakota, we are willing to provide a site, in cooperation with Drake and NOV, to show that the ThermFlo technology will be demonstrated for its intended commercial purpose for an approximately two to three week timeframe.

Please feel free to contact me.

Sincerely,

Cody Duran
5/16/16



ZAVANNA
LLC

Cody Duran
VP Operations

1200 17th Street, Suite 1100
Denver, Colorado 80202
Mobile (303) 690-0790
Office (720) 698-2816
Fax (303) 595-8847

Web: www.zavanna.com
Email: cduran@zavanna.com



Drake Water Technology



Jack Roe
Sakakawea Ventures, LLC
303-526-6050
jackroe@svswd.com

May 4, 2016

Mr. Brent Brannan
North Dakota Industrial Commission
State Capitol – 14th Floor
600 East Boulevard Ave Dept 405
Bismarck, ND 58505-0840

Re: ND Oil and Gas Research Program Grant Application "***ThermFlo, a novel technology for complete on-site remediation of organically contaminated solids***"

Dear Mr. Brannan:

We understand from a communication you have had with Mr. Ron Drake, Drake Water Technologies, Inc. (Helena, MT) that the NDIC review team for the above referenced grant application is requesting assurances that, if the project is funded (with both NDIC and National Oilwell Varco (NOV) funding), the ThermFlo unit will be employed at a drilling or other site in North Dakota for deployment, demonstration, and testing.

Sakakawea Ventures, LLC owns and operates a Saltwater Disposal and Oil Treating Plant in McGregor, North Dakota, and we are willing to provide a site, in cooperation with Drake and NOV, to show that the ThermFlo technology will be demonstrated for its intended commercial purpose for an approximately two to three week timeframe.

Our Facility Details:
SV McGregor
NDIC File Number: 90337
NDIC OWT Order: 23223
Location: NWNW 21-159-95
McGregor, Williams County, North Dakota

Please feel free to contact me.

Sincerely yours,

A handwritten signature in blue ink that reads 'Stanley Jack Roe'.

Stanley Jack Roe



Drake Water Techno



June 15, 2016

Mr. Brent Brannan
North Dakota Industrial Commission
State Capitol – 14th Floor
600 East Boulevard Ave Dept 405
Bismarck, ND 58505-0840

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As an operating company in North Dakota, XTO Energy Inc. (XTO) would be willing, subject to XTO management approval, execution of acceptable agreements (including, but not limited to, Master Services Agreements, indemnities and releases) by all parties working on the project, and locating a suitable test location for the ThermFlo pilot test unit, to participate in the proposed project. XTO also assumes that its only responsibility with respect to the proposed project would be to identify a location for deployment of the ThermFlo test unit for a period of approximately 2-3 weeks per the grant proposal timeline and pay to Drake and/or NOV the negotiated price for services.

Please feel free to contact me if you would like to discuss this matter in additional detail.

Sincerely,

Ross Lubbers
Western Division Drilling Manager
XTO Energy, Inc.



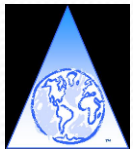
Drake Water Technology



Drake Water Technologies, Inc.

Thank you for your attention!

Questions?



Drake Water Technologies, Inc.