



# Business Proposal **Chemical Emulsifier**

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# 1. Executive Summary

## ③ Purpose

- ✓ Provide a background to this new investment opportunity;
- ✓ Provide information on the proposed emulsifiers technology;
- ✓ Specify and outline the requirements for the preparation of this proposal to accelerate commercial-environmental gain in petroleum industry;
- ✓ Specify the procedures and expected joint-interests.

## ③ Objectives

- ✓ To recommend the latest environmental-friendly technology for continuous commercial sustainability and reduce the environment risk impact;
- ✓ Possible technology-knowledge or skill-set transfer from the introduction of this new technology.

## ③ Current Pain-points

- ✓ How to achieve a practical level of heavy crude oil viscosity reduction;
- ✓ What is the current innovative and economic solutions in sludge treatment to recover hydrocarbon onshore and offshore (Waste Management);
- ✓ Challenges to obtain at or even greater than 70-75% oil content, in the higher shear rate range, and achieve temperature effect control at 30-50°C;
- ✓ How does this new technology fit into Negara Brunei Darussalam's Energy Oil Recovery (EOR) Master Plan.



# 1. Executive Summary

## ③ Key Requirements

- ✓ Seeking opportunity from existing petroleum production oil-well, in which suitable and qualified for joint-invest, build and operate commercial activities within Negara Brunei Darussalam.

## ③ Proponent Consortia [Joint-Venture]

- ✓ PUTERI JAYA SDN BHD [Negara Brunei Darussalam]
- ✓ NPS Engineering (Malaysia) Sdn Bhd [SEA Authorized Reseller-Distributor]
- ✓ Karamay ENZE (China) Petroleum Technology Services Ltd [Principal]

## ③ Contact Points

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		+6012 693 1488



## 2. Technical Approach



### Ⓢ **Temperature-resistance Heavy-oil Viscosity Reducer, with steam stimulation injection**

The technology and products are specifically designed for heavy oil thermal recovery steam stimulation and steam drive and the development of energy-saving technologies and increasing oil products, the production technology and application of chemical agents has applied for national patents.

The technology is applicable to the majority of domestic heavy oil reservoir steam injection, has received the application and popularization of Shengli Oilfield Xianhe, South Shore-oil production plant, Keep-oil production plant Liang, Lu Sheng oil companies, oil companies Dongsheng Seiko; in Liaohe Oilfield Shuguang, Huanxiling oil production plant and cold oilfield has also been applied.

In Hongshan, Xinjiang Oilfield company oil fields, heavy oil company, Windy City Oilfield company, a plant oil, Newport companies have applied for three years in a row, made good results.

## 2. Technical Approach



### Ⓢ Technical Characteristics

- Effectively improves steam throughput efficiency, extend production-cycle, and reduce production costs;
- User-friendly operations, safe and reliable;
- Pollution-free, environmentally friendly.

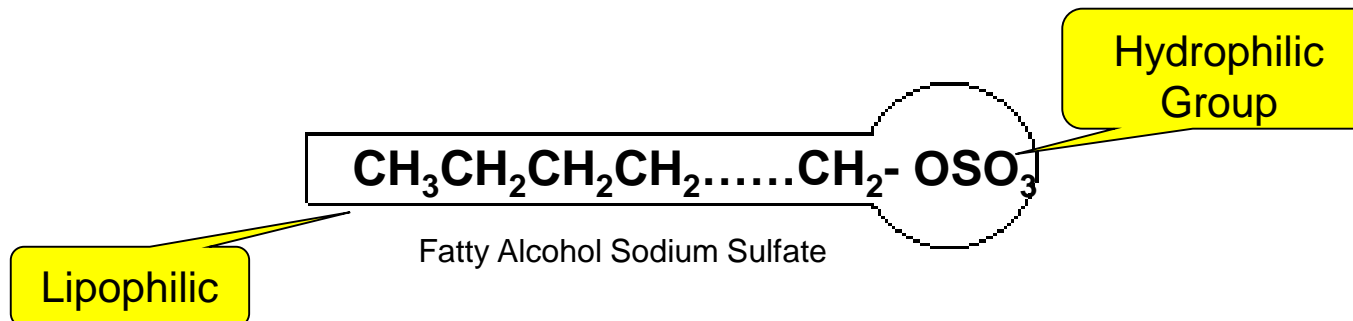
### Ⓢ Technical Principle Overview

Surfactant Molecule Characteristics  
Structure



Amphiphilic

From the chemical structure point of view: the surfactant molecule should have both lipophilic (or hydrophobic) carbon and hydrogen bonds and hydrophilic functional groups.



## 2. Technical Approach



### Ⓢ Technical Principle Overview (*Cont'd*)

The technical measure is to improve the steam throughput efficiency from two aspects:

#### **1. Improve oil washing efficiency**

Under the action of surfactants, the peeling of crude oil from the pores of the reservoir is promoted, thereby improving the washing efficiency of the steam condensate for crude oil;

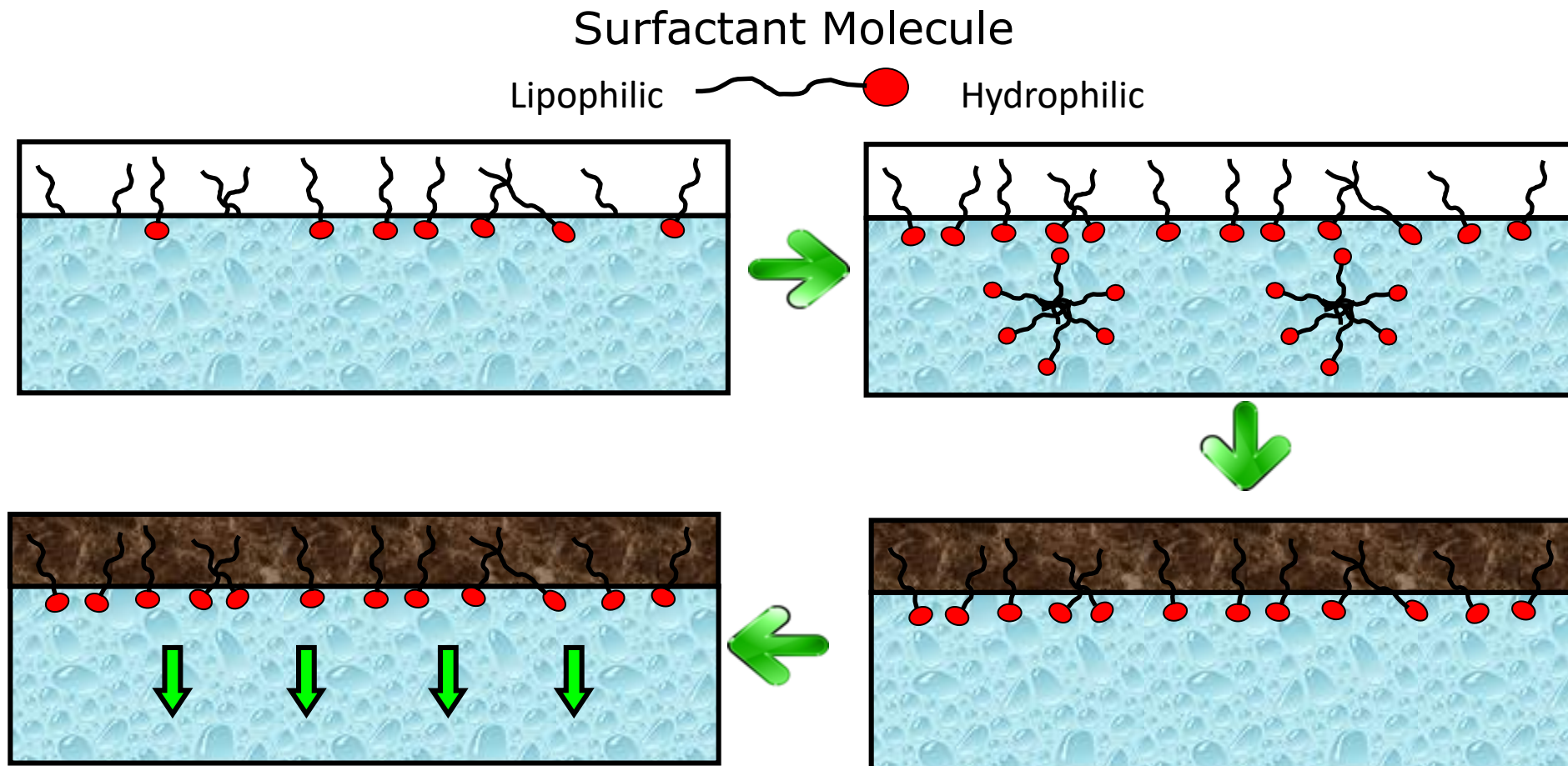
#### **2. Reduce the viscosity of heavy oil**

Under the action of surfactant, crude oil and water form a low-viscosity oil-in-water emulsion system, which effectively reduces the seepage resistance and lifting resistance and improves the recovery efficiency of crude oil.

## 2. Technical Approach



### ⊗ The Principle of Washing Efficiency





## 2. Technical Approach



### ④ Emulsification and viscosity reduction to improve lifting efficiency

Incorporated amount of the heavy oil, an aqueous solution containing a specific surfactant of the heavy oil emulsion is converted into an oil-in-water (O/W) emulsion of water in oil type (W/O), the wetting action of the active agent reduces the resistance of the liquid flow, and the friction between the heavy oil and the heavy oil and the tube is converted into friction with the water film, thereby greatly reducing the flow resistance and achieving reduce the viscosity of the fluid.

In the process of as a companion agent for steam stimulation, the viscosity reduction acts in two places. First, in the underground seepage process, an emulsification system is formed with the steam condensate to improve the seepage efficiency; secondly, during the lifting process, reduces the friction during lifting, which increases the productivity of the steam stimulation process.

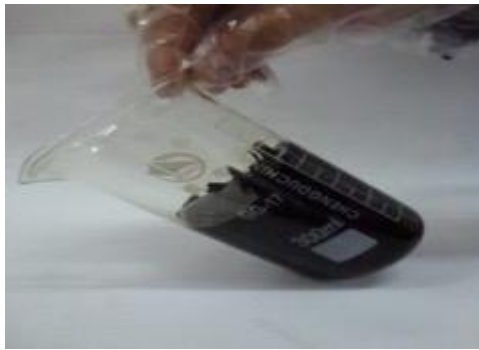


## 2. Technical Approach



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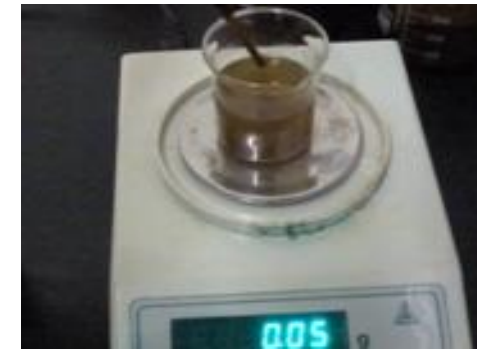
### ③ Emulsification and viscosity reduction to improve lifting efficiency



Heavy Oil



Added in emulsifiers at 50°C

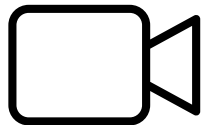


Cooling down after viscosity reduction

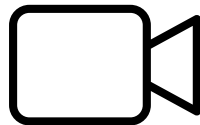


Maintaining good fluidity at 20°C after viscosity reduction

Experiments show that the formed oil-water emulsified viscosity reduction system still maintains good fluidity after the temperature drops.



Video 1



Video 2

## 2. Technical Approach



### ④ Introduction of special chemical agents

This chemical agent is a chemical specially developed for steam stimulation. It is characterized by high temperature resistance. At 300 ° C, the corresponding technical requirements can still be achieved, and an oil-in-water emulsion system can be formed with most heavy oils. When the heavy oil and water form an emulsion system, the system is not because The original viscosity of the heavy oil is restored by the decrease of the temperature, which is particularly important for the lift efficiency of the emulsified system formed by the heavy oil and water during the lifting process.



When the emulsified system of heavy oil and water is lifted to the ground, after a period of sedimentation, the oil and water can be stratified smoothly, and has no effect on the demulsification of crude oil.

Temperature-resistance heavy-oil viscosity reducer			
Item Description			Index
Appearance			Brown liquid
Solubility			Soluble in water
pH Value (at 1% aqueous solution)			7 ~ 9
Condensation point			-10℃
Viscosity reduction rate (50 ℃)	Crude Oil	≤1000	≥95.0%
	Viscosity	1000 ~ 10000	≥98.0%
	mPa•s	10000 ~50000	≥99.0%
Free-setting dehydration rate			≥80%
Temperature resistance, ℃			≤350℃

## 2. Technical Approach



### ③ **Proposal of Emulsifiers Technology**

- ① Temperature-resistance heavy-oil viscosity reducer, with steam stimulation injection;
- ② Dual Oil-displacing Surfactant System;
- ③ Low Steam Stimulation huff-and-puff Block Management Technology;
- ④ Chemical Dewaxing Technology;
- ⑤ Microbial-enhanced Oil Recovery Technology; and
- ⑥ Oil well and Tube variable-frequency Electric heating Technology.

## 2. Technical Approach



### Temperature-resistance heavy-oil viscosity reducer, with steam stimulation injection

- Oil enhancement process and product specifically developed for heavy-oil steam huff-and-puff, for improving efficiency;
- Greatly reduce the viscosity of the viscous crude oil lifting and may achieve rate 95-99% at 350°C temperature resistance;
- Flow catalyst during the viscous oil conveying, to reduce the conveying pressure, improving efficiency and cost-savings.

Item Description	Index
Appearance	Brown liquid
Solubility	Soluble in water
pH Value (at 1% aqueous solution)	7~9
Condensation point	-10°C
Viscosity reduction rate (at 50°C)	≥ 95-99% (varies from initial viscosity of viscous oil)
Temperature resistance, °C	≥ 350
Free-setting dehydration rate	≥ 80%

## 2. Technical Approach



### Dual Oil-displacing Surfactant System

- Interfacial tension between the oil-and-water in most of oilfields below  $10^{-3}\text{mN/m}$ , to sufficiently improve the displacement efficiency;
- The application of binary oil-displacing system composed of polymer (polyacrylamide) shows it will enhance the oil recovery by 12-22%, as compared with water flooding;
- Applicable to the condition when chemical displacement of reservoir oil is carried out for improving, and to other conditions when the tension of interface between oil and water needs to reach the extremely low level.

Item Description	Index
Appearance	Yellowish or Brown liquid
Solubility	Soluble in water
pH Value (at 1% aqueous solution)	7~9
Interfacial tension (at Active concentration is within 0.1%-0.3%)	$\leq 9 \times 10^{-3}\text{mN/m}$

## 2. Technical Approach



### **Low Steam Stimulation huff-and-puff Block Management Technology**

- The combination method of blocking, adjusting and driving is applied to improve the overall efficiency of the steam huff-and-puff block;
- Using heat provided by steam stimulation to improve the fluidity of viscous oil, and injecting hot liquid to improve oil-scavenging efficiency work;
- Chemical agent with remarkable high-temperature resistance characteristics, to increase temperature of stratum with steam stimulation, to ease the residual oil flow during production.
- This can be applied to the management of severe non-homogenous reservoir caused by long-term steam stimulation and declined in throughput efficiency crude oil well.

## 2. Technical Approach



### Chemical Dewaxing Technology

- This technology overcomes the shortcomings of conventional oil-based wax removers and water-based anti-wax agents;
- Uses composite surfactant systems as emulsifiers, and develops anti-wax double-effect agents series – including compound antifreeze wax remover, micro-emulsion heavy wax crystal emulsifying dispersant; to effectively remove and disperse the wax crystal, reduce its disposition, lower operating load of pump, extend hot-wash cycle and increase production in different water-containing and wax-disposition stages of oil wells;
- Wax removal and anti-wax operations for oil wells with high wax content, assisting during the collection and transportation of crude oil.
- Wax Remover Characteristics:

Item Description	Index
Appearance	Milky white or transparent liquid
Flash point (closed), °C	≥ 11
Condensation point, °C	≤ 32
Wax dissolution rate, g/min	≥ 0.016

#### Anti-Wax Agent Characteristics:

Item Description	Index
Appearance	Light yellow, translucent to transparent liquid
Condensation point, °C	< -32
Solubility	Miscible with water in any proportion
Drop of wall sticking volume of cohesive oil, %	≥ 60
Dispersion rate of wax crystal (at 30°C, through standard sieve with pore size of 2mm), %	≥ 80



## 2. Technical Approach



### Microbial-enhanced Oil Recovery Technology

- Optimally cultivated bacteria (microorganism) for heavy oil reservoir and high-waxy oil reservoir;
- In the course of biological metabolism, paraffin, colloid and bitumen and other heavy components are used as nutrients and thus these substances in crude oil are deemed as food of microorganism and decomposed to generate light-component hydrocarbon, thus reducing viscosity and freezing point of crude oil and enhancing its mobility.
- In metabolic process, the microorganism will generate biosurfactant, organic acid and alcohol, ester and other organic solvent substances, which can be used to reduce oil-water interfacial tension; alcohol and organic ester and other organic solvents may alter surface property of rock and physical property of crude oil, release crude oil which is attached to rock surface in the gap, thus smoothening oil leakage channel and increasing production of crude oil;
- Its operating application via:
  1. To inject microorganism in process of oil recovery for single-well gas injection;
  2. Directly inject microorganism into water injection well to remove oil layer by injected water.

Item Description	Index
Appearance	Light pink or brown
Total number of bacteria is no less than	108/mL
Interfacial tension (mN/m) is no more than	$9.99 \times 10^{-2}$

## 2. Technical Approach



### **Oil well and Tube variable-frequency Electric heating Technology**

- The skin-effect principle is applied, whereby oil tube is heated by forming circuit with casing pipe;
- Alternating current generates skin-effect-current on ferromagnetic steel tube, the oil tube will generate heat and heat the crude oil in shaft and thus heats viscous oil, reduces viscosity, removes the blocking and controls paraffin with high-solidification point oil;
- The technology is characterized by simple equipment structure, flexible control, rapid heating, high heating efficiency, long service life, wide application range of oils and wide range of working conditions (with and without poles) and low equipment and production cost, etc.;
- Moreover, it has characteristics of rapid temperature control, uniform heating along the stroke, easy processing of fuse tubes during power failure, high heating efficiency and automatic control.

## 2. Technical Approach



### **Oil well and Tube variable-frequency Electric heating Technology (Cont'd)**

#### **Technology Characteristics**

- Heating depth: depends on down-hole conditions, above 4,000m in general.
- Heating temperature: can be adjusted according to freezing point under the shaft and actual demands in wax-bearing conditions.
- Operating convenience: it is convenient to lift and lay down in process of operation without increasing workload of operating crew.
- Management convenience: workers on site can adjust heating efficiency at any time, easy to operate.

# 3. Project Team



## Joint Venture

**PUTERI JAYA SDN BHD  
(BRUNEI DARUSSALAM)**

**NPS ENGINEERING (MALAYSIA) SDN BHD  
[SEA Authorized Reseller-Distributor]**

Business Director: JEFFREY TAN CHEE SENG

**KARAMAY ENZE (CHINA) PETROLEUM TECHNOLOGY SERVICES LTD  
[Principal]**

Technical Director: HU HAI JUN

# 4. Relevant Experience



## Ⓢ Construction site: 2014 Fengcheng Oilfield Operation Area Measures Site



The above picture shows the slug process plan

The following picture shows the steam accompanying process plan





# 4. Relevant Experience



③ Construction site map of implementation measures: Hong#003 well area of Hongshan Oilfield Co., Ltd.



Slug process physical pipeline connection diagram

# 4. Relevant Experience



## Ⓢ Karamay products production factory





# 5. Benefit Analysis



## ④ Application Results and Benefit Analysis

From November 2013 to the end of 2014, we conducted a test of compound heavy oil-assisted chemicals in 21 wells at the Hongshan Oil Production Plant. The cumulative oil increase was 3545.2 tons, and the input and output reached 1:3.

Main Achievements recorded as follows:

### **1. Effectively extend the production cycle of oil wells and reduce the cost of steam injection**

Take hd9008 and hd9009 wells as examples. Before the admixture was added, the oil well production rotation time was about 4 to 7 months. After the technical measures were adopted in these two wells in 2013, the oil well production time exceeded 12 months, which was equivalent to reducing the normal steam injection; At present, oil wells usually have a steam injection volume of 1600-2000 m<sup>3</sup> and a steam cost of XXXX RMB/m<sup>3</sup>, which saves nearly XXX,XXX – X,XXX,XXX RMB per well.



# 5. Benefit Analysis



## ③ Application Results and Benefit Analysis

### **2. The effect of increasing production is obvious**

From the test results, the average single-well cycle after the measure increased the oil production by about 200 tons. In 2013, the average oil increase per well was as high as 279.6 tons. The application of this technology product is fast and simple, which has played a positive role in the production of oil fields.

### **3. Wide range of technologies**

The technology has good adaptability and can be widely applied to various processes of steam stimulation, lifting and gathering of heavy oil, and the application is simple and the effect is obvious.

# 5. Benefit Analysis



## Ⓜ Application Results and Benefit Analysis

Statistical Table of Effect of Compound Huff and Puff Measures in Fengcheng Oilfield Operation Area in 2014

对比	井号	粘度 mPa.s	轮次	轮注汽t	轮产液t	轮产油t	轮产天数 d	日产油 t/d	油汽比
措施井	F340602	21643	4	2118	955	81	72	1.1	0.04
	FHW34003	21625	8	3332	1302	324	84	3.9	0.10
	FHW34005	25455	9	3061	1331	436	84	5.2	0.14
	FHW34165	14451	4	2958	808	200	60	3.3	0.07
	FHW34185	17916	4	2958	1385	150	60	2.5	0.05
	FHW34088	23701	4	3308	1331	314	50	6.3	0.09
	平均			2956	1185	251	68	3.7	0.08
邻井	F340603	20856	4	2125	916	52	71	0.7	0.02
	FHW34007	22235	8	3164	893	118	58	2.0	0.04
	FHW34009	26764	9	3164	1260	235	62	3.8	0.07
	FHW34166	12466	4	2880	715	139	60	2.3	0.05
	FHW34156	16836	4	2841	1618	209	60	3.5	0.07
	FHW34060	23984	4	2206	682	116	50	2.3	0.05
	平均			2730	1014	145	60	2.4	0.05

Six well measures were implemented in mid-August. By the end of November, five horizontal well measures were not completed. Therefore, the comparison of adjacent wells was carried out, and the measures were effective in comparison with the adjacent untreated wells in the same period (F340602, FHW34003, FHW34005, FHW34165, FHW34088), cumulative oil **increase of 695 tons**, average single well measures to **increase oil by 139 tons**

# 5. Benefit Analysis



## Ⓢ Application data of Xinjiang from 2013-2015 (Hongshan Oilfield)

Statistical Table of Annual Production Increase Measures of Hongshan Oilfield

2013-2017 Hongshan Oilfield Measures Well Effect Table								
Implementation Year	Number of measures	Number of wells	Efficiency	Times	Thickness	50°C Crude Oil Viscosity	Cumulative Throughput	Average single well oil increase
2013	5	5	100	2.8	12.6	12,056	1,398	279.6
2014	15	14	93	4.8	13	9,883	2,776	185.07
2015	20	15	75	5	13.3	7,903	2,324	116.2
2017	8	5	63	7	9	9,111	1,420	177.5
<b>TOTAL</b>	<b>48</b>	<b>39</b>	<b>8</b>	<b>4.9</b>	<b>13.1</b>	<b>9,147</b>	<b>7,918</b>	<b>165</b>

The accumulated data (classified information) as indicated above is recorded and provided by Hongshan Oilfield (Karamay) Co., Ltd., for the year of 2013 till 2017.

# 5. Benefit Analysis



## ⊗ Hongshan Oilfield official result measurement review and recognition

### 4、结论

复合型稠油助采增油技术在克拉玛依红山油田的成功应用说明：

1. 复合型稠油助采增油技术应用于蒸汽吞吐稠油井开采中，增产效果显著。对于降低稠油粘度、改善稠油的流动性，提高油井产能的方法是可行有效的
2. 复合型稠油助采增油技术在克拉玛依油田取得显著成效，为稠油老区稳产奠定坚实基础，为进一步提高特超稠油采出程度提供技术保障。
3. 复合型稠油助采增油技术在克拉玛依红山油田的成功应用，为相似稠油油田的开发提供了一个新的方法与途径，尤其针对难动用储量的开采指出了可行性方向，该技术及产品工业化推广后的经济效益和社会效益非常巨大。

克拉玛依红山油田有限责任公司

生产运行部

2014年10月26日

### 纳米复合型稠油助采技术效果证明

2014年在红山公司红003井区实施纳米复合型稠油助采技术（降粘措施）16口井。截止至2015年6月底，16口井累计增油2930.1吨（表一），单井平均增油183.1吨。

表一 2014年纳米复合型稠油助采效果统计表（数据截止至2015年6月底）

井号	层位	措施时间	注水量	逐月增油量（吨）/吨												合计/吨
				1	2	3	4	5	6	7	8	9	10	11	12	
N01106	7	2014.5.12	k1q	5.3	8	9.7	18.7	88.8	189	12.8						242.1
N01105	7	2014.5.12	k1q	9.8	37.6	25.9	32.4	44			29.2					189
N01117	6	2014.5.12	k1q	5.7	88.8	9.3	25.1	30.2								119.1
N011114	3	2014.9.16	k1q	6.4	13.5					10	12					41.9
N01169	9	2014.6.7	k1q	0.1	0	11.7	15.9	0	15.3	2	39					81
N011714	3	2014.6.21	k1q	26.2	8.5	1.2										36
N01200	8	2014.6.7	k1q	4.8	0	0	6.2	7.7		1.2						28
N012624	2	2014.6.10	k1q	127.1	173.2	92.1	31	8.9	47	13.5		9	11			476.8
N012913	2	2014.6.7	k1q	216.4	96.5	22	20.7	77.2	17							406.9
N013013	3	2014.8.20	k1q	0	0	8.2	4.7		45				10			68
N013016	3	2014.9.17	k1q	139.6	104.2	17.5	0	0	84				35			271.2
N013431	3	2014.9.16	k1q	26.7	33	2.3	0	0	0	0						62
N090014	8	2014.5.3	k1q	11	0	1	1	47	21	39	46	30	30	29	18	294
N090013	5	2014.5.3	k1q	14	73	27	82	28	58	27						330
N090015	4	2014.6.29	k1q	0	88	12	9	0			4					93
N090614	8	2014.6.29	k1q	0	9	35	29	2	0	0	13		1	2		111
合计																2930.1

单位：研究所

时间：2016年1月19日

### 风城超稠油油藏复合型稠油助采降粘效果评价报告

克拉玛依双信有限责任公司于2014年8月中旬在风城油田作业区实施复合型稠油助采降粘措施6口井，选取地质条件相近未措施邻井同期对比来看，措施累计增油695t，平均单井措施增油116t。（见表1）

表1 复合型稠油助采降粘措施井与邻井未措施井对比表

对比	井号	粘度 mPa.s	层位	措施 井	措施 井	措施 井	措施 井	措施 井	措施 井	措施 井	措施 井	措施 井	措施 井	措施 井	措施 井	措施 井	措施 井
措施井	F00002	21842	4	2118	955	81	72	1.1	0.04								
	F00003	21825	8	3327	1382	324	84	5.9	0.18								
	F00005	25455	9	3061	1221	626	81	5.2	0.14								
	F000165	14451	3	2958	908	700	40	3.2	0.07								
	F000163	17916	4	2968	1385	180	60	2.5	0.05								
	F000268	21381	4	3288	1221	214	30	6.2	0.19								
邻井	平均			2966	1285	261	68	5.7	0.08								
	F00003	20838	4	2115	916	52	71	0.7	0.02								
	F000001	22225	8	2144	895	118	24	3.0	0.04								
	F000009	26784	9	2144	1285	235	82	5.8	0.07								
	F0001100	12488	4	2880	715	130	60	2.2	0.05								
	F0001136	10828	4	1811	1818	259	60	5.5	0.07								
合计	F000000	23884	4	2290	882	110	30	2.2	0.05								
	平均			2230	1014	145	68	2.4	0.05								

评价人：邢向荣

审查人：李长忠

单位：克拉玛依双信有限责任公司

日期：2014.10.26

# 6. Schedule



nps

## Ⓢ Implementation Schedule

The method of on-site construction is: before the injection of steam and during the injection, according to the specific conditions of the injected steam, according to the determined construction plan, according to the amount of steam to be injected, the amount of the medicament is calculated, in the form of slugs, respectively. In the process of steam injection, the composite heavy oil is injected into the auxiliary agent to make the agent fully contact with the oil and water under the action of steam, and the effect is achieved.

Understand the situation of the target well (block) and fine tune the product according to the actual oil sample.






The implementation plan is determined based on the adjusted product parameters and compatibility with the target oil.

On-site implementation according to the approved implementation plan.

# 7. Certifications



## 🔍 Technology Copyright and Certifications

No.	Description	Attachment(s)
1.	CN102516971A Product/Technology Copyright	 Copyright.zip
2.	HSE Certification	 HSE CHINESE.pdf
3.	ISO 9001-2015	 ISO 9001-2015 ENGLISH.pdf
4.	ISO 14001-2015	 ISO 14001-2015 ENGLISH.pdf
5.	OHSAS 18001-2007	 OHSAS 18001-2007 ENGLISH.pdf

# Appendixes

## 🔍 Corporate Description

No.	Description	Attachment(s)
1.	NPS Engineering (Malaysia) Sdn Bhd company portfolio	 NPS Engineering Services Sdn Bhd (new).pptx
2.	Karamay ENZE Petroleum Technology Services Ltd company portfolio	 Company Introduction Profile.pptx
3.	Karamay ENZE Field installation and operations portfolio	 CVR instalation and operation.zip

