Alternative disposal methods using waste management recycling solutions

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Clean Waste /Cutting Solutions

Disposal Practices and Challenges with drilling wastes

The Problem

- Most countries have ZERO discharge regulations for drilling waste, particularly on land, marshlands and SHELF waters .
  - In Deep Water, some countries allow cuttings to be discharged with OOC below 5% or 6.2% (USA)
- All SLOPS, cuttings & boat cleaning waters are classified as E&P wastes and must be disposed at approved disposal sites .
- Logistics of transporting and disposing of drilling wastes are environmentally risky and usually regulated.
- Transport and disposal practices can create long-term environmental liabilities
- Operators retain full responsibility and all liabilities for cuttings
- Most countries are requiring improvement in environmental practices to receive waste disposal permits for drilling operations

The Solution

- Synthetic oil to is used to improve overall environmental impact from drilling wastes
- Thermal Units allow for base oils to be recycled, brines re-used as make-up water and clean solids can be processed into gravel or construction fill as a Beneficial reuse .
- Contaminated/produced water can be cleaned and reused by new technologies
- Disposal can be avoided via Beneficial Re-Use Permits so that all waste streams from cuttings/water can be recovered and recycled

CLEAN WASTE - ENVIRONMENTAL SERVICES

Associated with Edison Chouest Offshore (ECO), recognized in the oil Industry as the leading, most diverse and dynamic marine solutions provider

- **Manages and can process nearly the totality of GOM's E&P exempt waste**
- **Their facility provides disposal methods that recover, recycle and convert these E&P waste streams into viable products via Beneficial Reuse permits**
- **Its improved environmental performance eliminates risk and significantly reduces overall carbon footprint**
- **Regulatory agencies have granted CLEAN WASTE operating permits for cuttings processing and specific water treatment technologies**

INTEGRATED TECHNOLOGIES TO PROCESS DRILLING WASTE

Tank Cleaning Waters

SLOPS - Muds

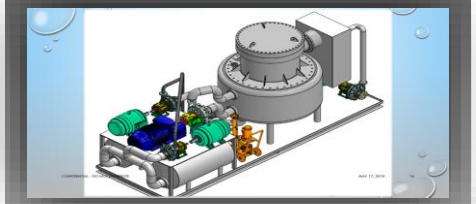
Cuttings and Solids

DE 6400 Centrifuge

Flock - Unit

Hyper-Pool Shaker

Ovation Nest Processor for Water Cleaning



DE 1000 Centrifuge

Oil Water Separator

To Storage

To Disposal

Slop Oil

Thermal Desorption Unit

Water

Clean Solids

Base Oil

Solids Phase

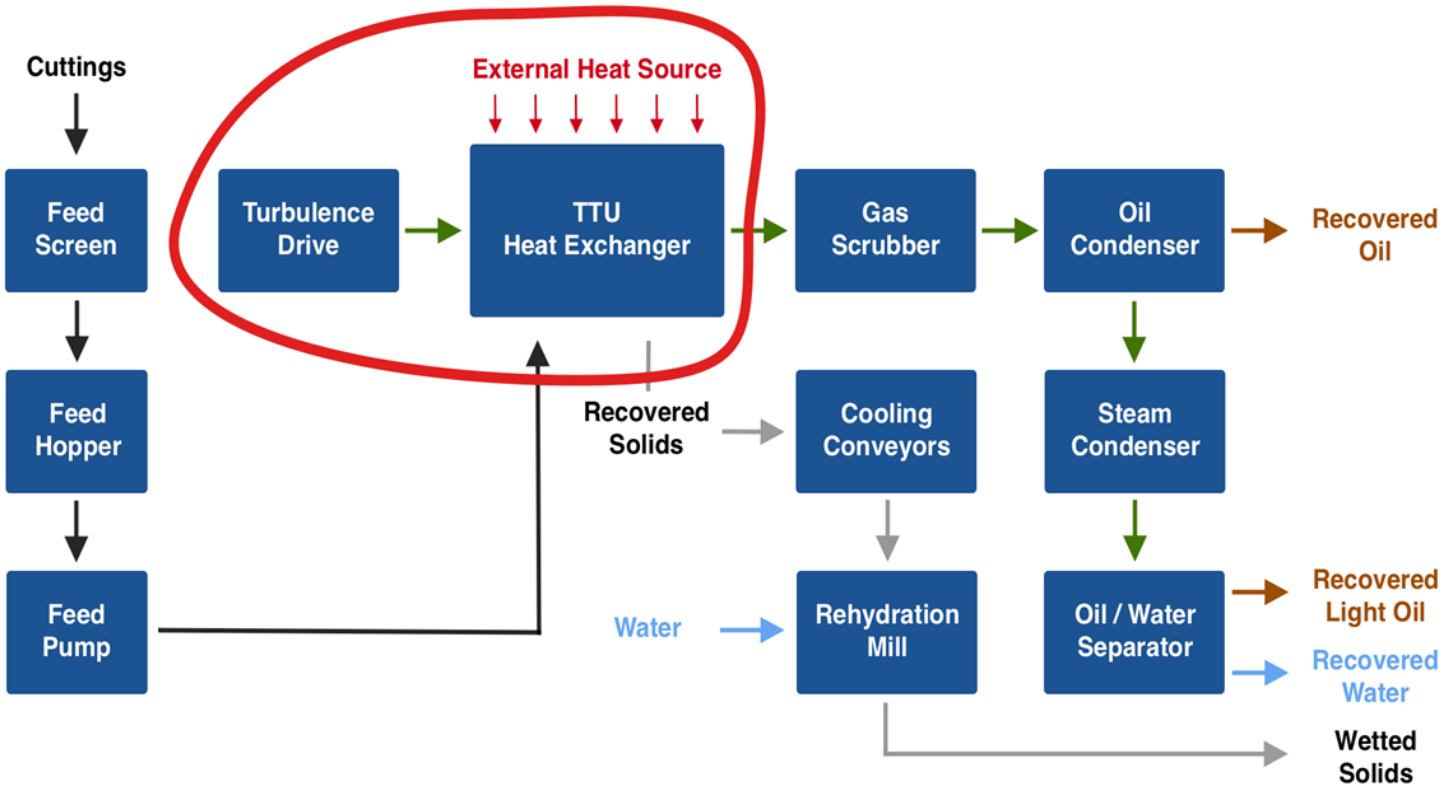
Liquid Phase

New Thermal Technology Solutions – Hellenes HTTU

Hellenes our Norwegian partner, has manufactured, best-in-class, processing units for drilling waste for more than 15 years for both, onshore and offshore services

- The Hellenes HTTU contains a novel “heat exchanger” that represents a new and unique technology.
- The proprietary design for heat application includes a turbulence rotor that optimizes milling and mixing of material.
- It increases the heat transfer at the chamber and avoids any ‘heated transport” of cuttings utilizing 100% of surface area for heating.
- This reduces the size of the unit and therefore its cost.
- It uses ***waste heat*** to complement its own energy source
- It reduces overall energy needs, costs and emissions discharged to the atmosphere

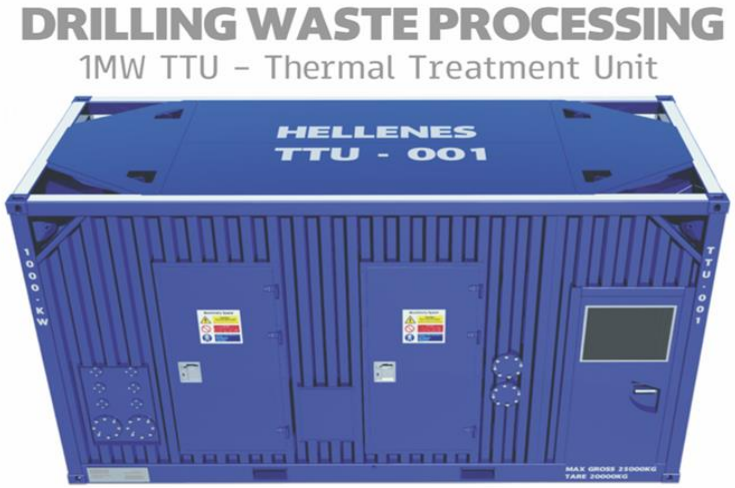
What is different?



Flash evaporation of the base oil and a two-stage condenser system ensure highest quality base-oil recovery

HTTU - New Technology Improvements

Small footprint:	Normally half the size of competing technologies.
Flexible energy source:	Huge flexibility regarding energy sources including ability to utilize waste heat.
Low operation costs:	Significantly reduced opex due to low energy consumption (when using waste heat) and simplified operation which reduces manning.
Low carbon emissions:	When utilizing waste heat, carbon emission will be reduced by more than 50%.
Low Noise Levels:	The absence of a large diesel engine reduce noise significantly.
Easy maintainence onsite:	Product designs that ease maintainence work onsite.
Reduced wear:	Reduced wear on heat exchanger compared to friction based solutions.
Start-up and cooling:	Rapid start-up (15 minutes) and cooling for maintenance (1 hr). Possible to run only on days or night shift .



Capacity, cost and emissions comparisons of other technologies w/ HTTU Unit

	1000kW Units			1500 kW Units		
	electric energy- Other TDU Units	gas energy-Other TDU Units	HTTU-waste Heat Units	electric energy-Other TDU Units	gas nergy-Other TDU Units	HTTU-waste Heat Units
Process capacity at 70/15/15 solid/oil/water percentage	5 Mt/hr	5 Mt/hr	5 Mt/hr	8 Mt/hr	8 Mt/hr	8 Mt/hr
Process capacity at 50/20/30 solid/oil/water percentage	3.2 Mt/hr	3.2 Mt/hr	3.2 Mt/hr	5 Mt/hr	5 Mt/hr	5 Mt/hr
Process capacity at 50/30/20 solid/oil/water percentage	4 Mt /hr	4 Mt /hr	4 Mt /hr	6 Mt/hr	6 Mt/hr	6 Mt/hr
Energy Comsumption/hr	1100	1100	400	1650	1650	600
Kg CO2 emissions/hr	818	714	266	1226	1071	399
Energy Cost USD/hr	$ 479.00	$ 232.00	$ 174.00	$ 718.00	$ 497.00	$ 261.00
Energy Cost USD/Mt	$ 95.80	$ 46.40	$ 34.80	$ 89.75	$ 62.13	$ 32.63

Cloudburst International

Desalination Technologies for Water Recovery, and Waste Minimization

Applications / Uses

- Produced Water Treatment for Discharge / Beneficial Reuse
- Drilling and Oilfield Waste Management (Drill Fluid, Flowback, Tank cleaning,
- Produced Water Treatment for Enhanced Oil Recovery (EOR) & Steam Flooding

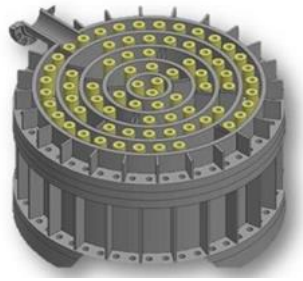
Differentiation

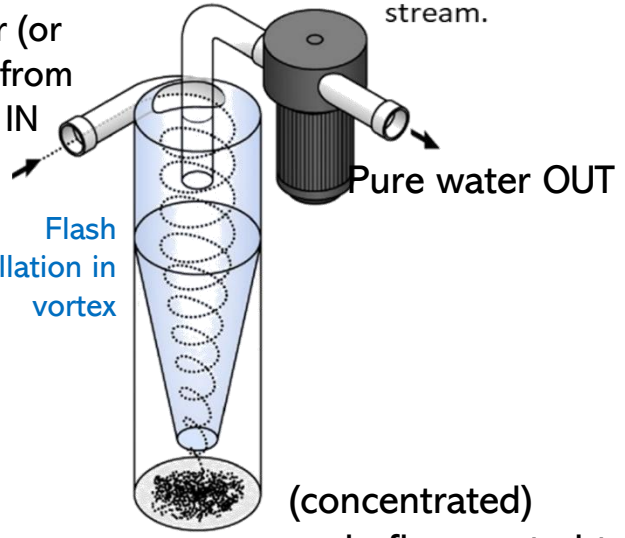
- Lowest cost desalination to discharge standards
- ***Low power requirements, fuel-efficient, fuel flexible***
- ***Only technology optimally suited for high salinity water - up to 250K⁺TDS***
- ***Minimal waste stream, typically <90% less volume***
- *High freshwater recovery factors: ~90% + versus 15%-70%*
- Direct cost and liability reduction: landfill, trucking, road traffic, etc.
- Green, closed loop solution with lower personnel exposure and environmental risks
- ***Readily uses available waste heat to reduce fuel costs*** (from, treated
- effluent water, compressors, cooling towers, other sources)

Cloudburst Ovation™ Unit

The 20,000 bpd Cloudburst Ovation system is designed for highly saline or complex waste where demand for freshwater is high, and Ovation™ waste minimization is key. Dial-in treatment quality allows for potable, agricultural, discharge quality, and beneficial use applications with a minimal waste stream.

HYDROCYCLONE NEST MODEL



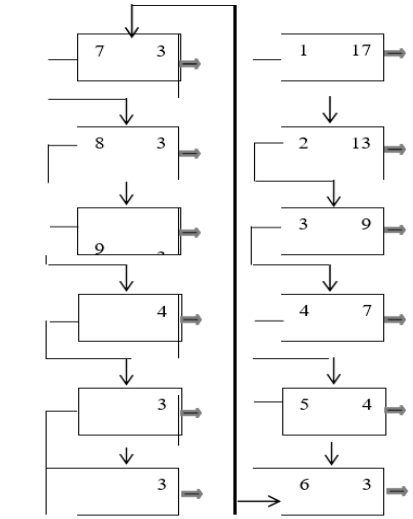


Cloudburst *Ovation* Process Principles

"Distributed Distillation"

Heating the fluid prior to distillation in Hydrocyclone Nest:

1) Separate out hydrocarbons and VOCs, and burn to use as additional energy source
2) Vapor phase input to CBI Hydrocyclone Nest extends the operating envelope to smallest particle sizes
3) Superheating kills Pathogens and Bacteria immediately and completely
4) Novel pressure management achieves distillation at a low temperature and cost



Hydrocyclone arrangement

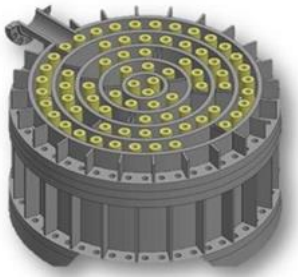
Multiple Stages in Series

Multiplicative effect – each stage in sequenced process both condenses waste, and increases freshwater output

Each stage within a series:

- Clean stream is further purified
- Waste stream is further purified and condensed
- Very low energy cost

HYDROCYCLONE NEST MODEL



Hydrocyclone Concepts

2-69 hydrocylones tightly sequenced per Nest dramatically improves:

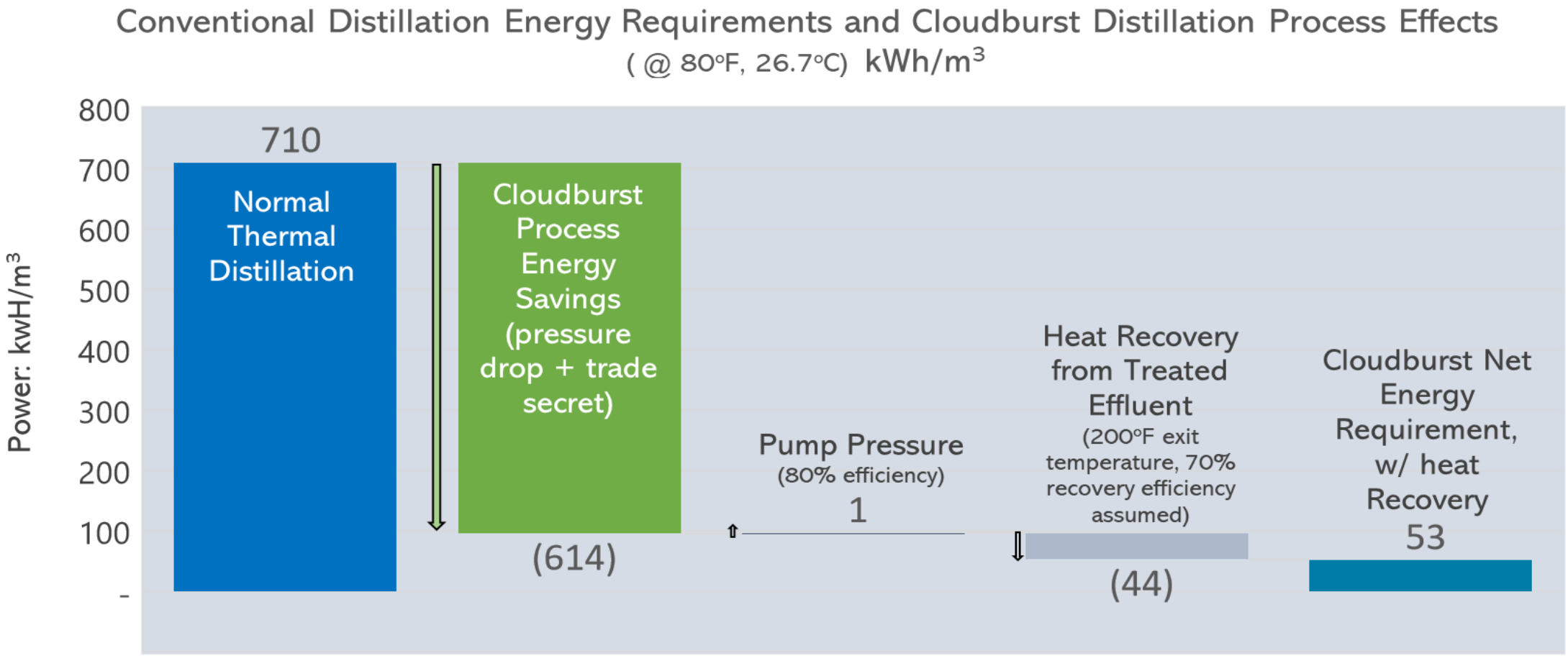
- **Recovery factor**: 90-95%+ fresh water – each stage boosts recovery
- **Throughput** – optimized geometry allows 7 series to run in parallel
- **Energy Efficiency** – enhanced w/ "vacuum effect" separation
- **Novel Pressure Management** –Phase change of vapor when processed within hydrocyclones lowers the distillation temperature

Waste Heat and VOC Energy Capture

Low energy use to begin with, plus reuse of available waste heat offsets energy requirements by as much as 59%, depending on configuration.

Energy Buildup: Applying Heat from Influent Fluid

1) Vacuum effects lower distillation energy,
2) Extensive use of heat recovery internal to CBI system
3) Leverage of waste heat from nearby pumps, compressors, cooling towers, etc.

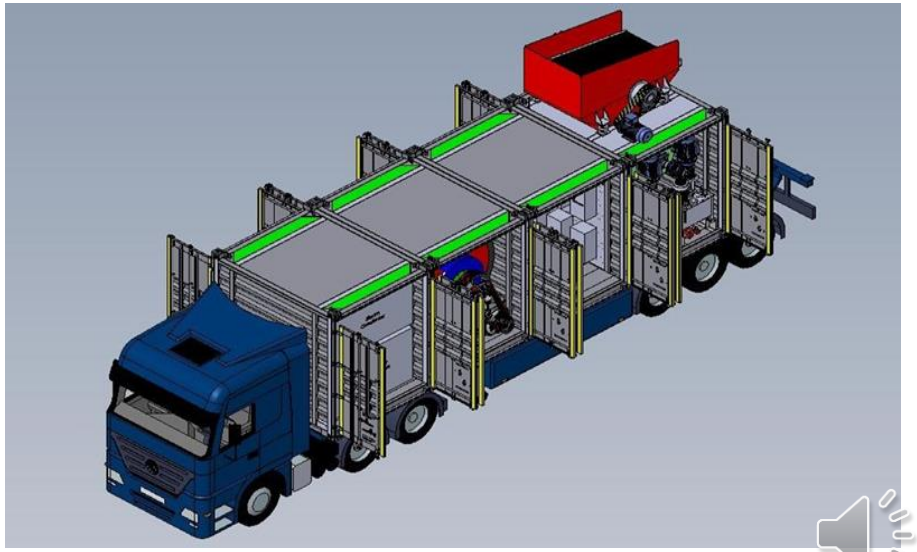


CLEAN WASTE/CUTTING SOLUTIONS SUMMARY

Recycling of components can eliminate future disposal liabilities presently retained by operators.

This can be accomplished by avoiding disposal on land sites and processing the waste streams instead, so that the components can be recycled as Beneficial Reuse Products.

- Hellenes HTTU(s) and Cloudburst Ovation Units are the latest versions of available technologies and comparatively, the most efficient and cost effective in the marketplace (BAT).
- A combined operational approach optimizes logistics, energy utilization and processing at the lowest possible cost
    A. Hellenes HTTU Unit(s) accomplish management of waste through recycle and reuse of base-oil, water and clean solids.
    B. Cloudburst Units provide clean water solutions with low energy utilization, high volumes and water quality as required.
    C. HTTU and Ovation Units can be deployed offshore / onshore.
- Accountability of the original waste volumes and disposal of its components are documented and reconciled by the end-use of the recovered base-oil, water, and clean solids.



CONCLUSIONS

Technologies are available to recycle non-aqueous drilling-fluid cuttings to their basic components of oil, water and solids.

- Thermal Technologies are not new, but take advantage of energy saving strategies that ultimately reduce carbon footprint and emissions to the atmosphere from two perspectives:
  - lower energy required for same mass of drilled cuttings processed; and
  - lower energy due to the ability to recycle components.

- Specific to Cloudburst, it removes whatever TDS in the water, and safely and efficiently converts to reusable quality water.