



in conjunction with...



Energy Technology Innovators (Pty) Ltd

South Africa's leading waste-to-energy company

and their partners...



The Problem

NORM – Radioactive Petroleum Sludge



- Oil
- Water
- Radium
- Uranium
- Lead
- Silica

The primary health risk of concern when dealing with NORM, is one of its constituents, Radium, which is a known cancer-causing substance. Exposure to high levels of radium can lead to higher chances of bone, liver and breast cancer.

Radium corrodes in water to become radium hydroxide (RaOH), which is the most soluble of all the hydroxides of the alkali earth metals. It is formed when radium reacts with water ($2\text{Ra} + 2\text{H}_2\text{O} \rightarrow 2\text{RaOH} + \text{H}_2\uparrow$).

Radium has no smell or taste.

The Need

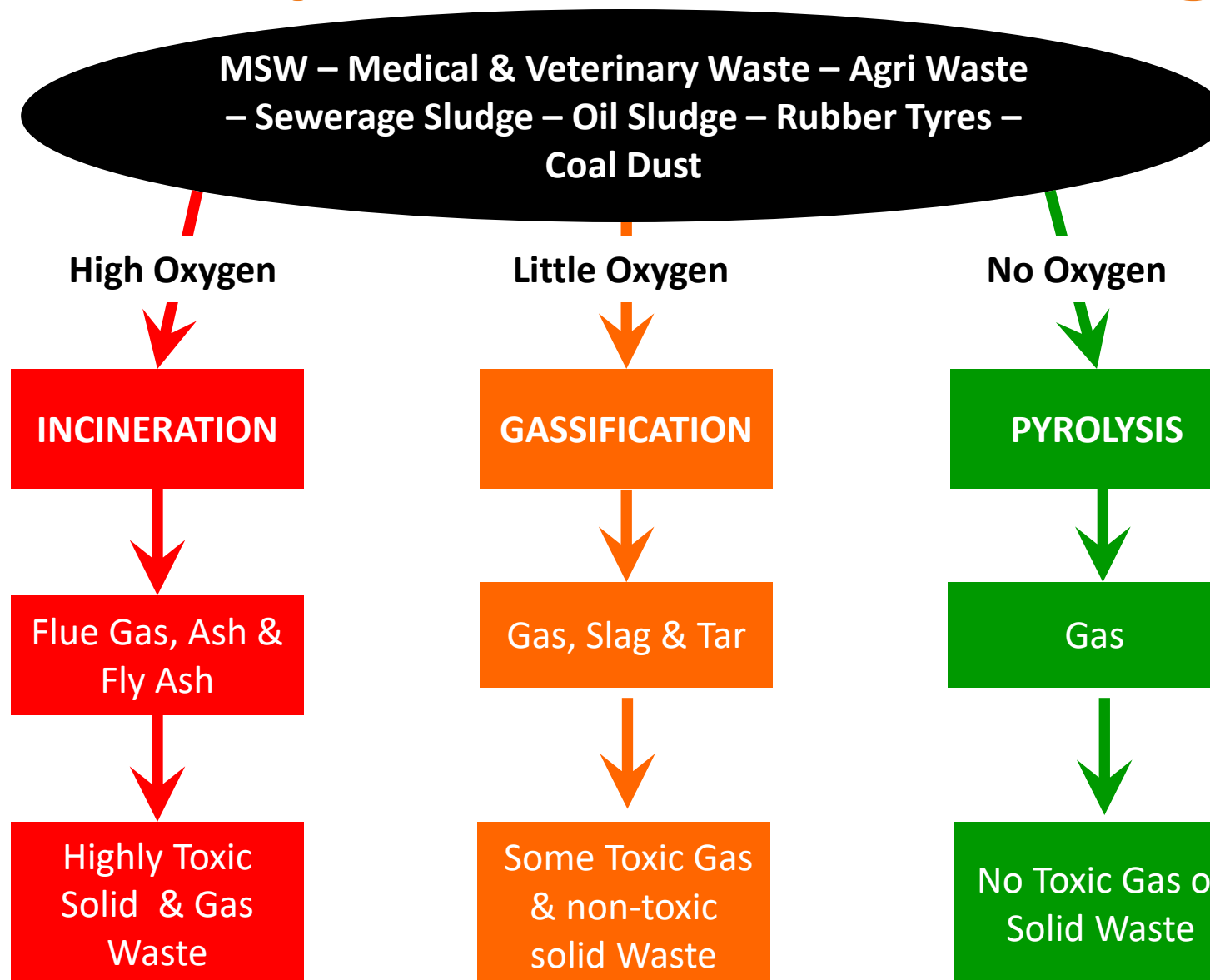
Safe, Reliable , Effective and Long-term solution



Traditional steel barrels with ^{226}Ra activity content $\geq 1 \text{ kBq kg}^{-1}$

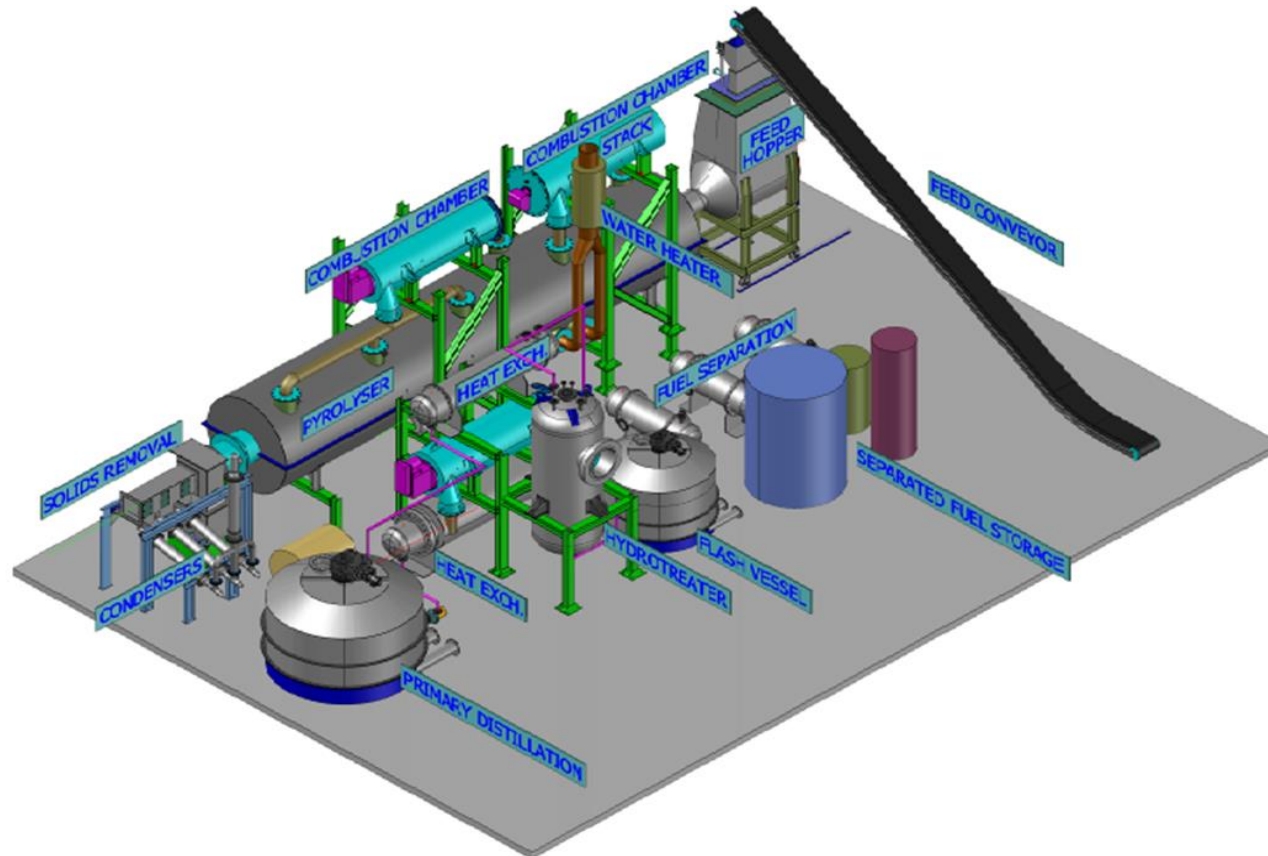
- Fully meets the IAEA's health and safety standards
- Reduces storage volume requirements by at least two-thirds
- Reduces processing and storage costs
- Prevents down-the-line, uncontrolled pollution problems
- Offers long-term process and storage reliability
- Generates revenue streams
- Delivers zero failure tolerance

Waste Output of Three Technologies



The Solution

Tried, Tested and Proven Technology -Worldwide

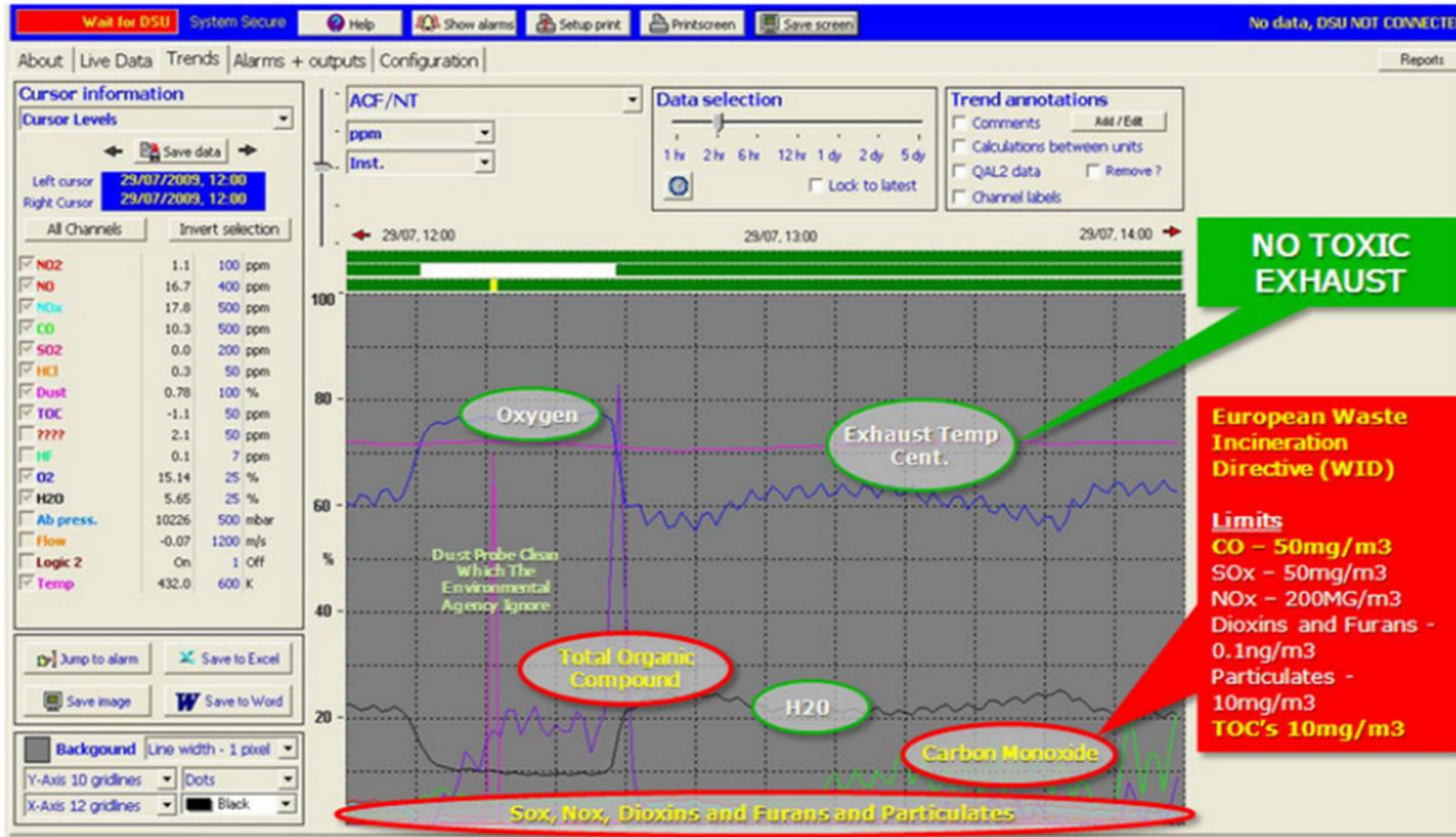


- Well proven and reliable pyrolysis process
- 25-year technology guarantee subject to meeting annual maintenance requirements
- Fully meets the IAEA's health and safety standards
- Oxygen free process environment that produces zero NOx and SOx gasses
- Emission levels below acceptable COP, USA and EU emission levels
- Reduces storage volume requirements by more than two-thirds
- Reduces processing and storage costs
- Prevents down-the-line, uncontrolled pollution problems subject to storage guidelines
- Offers long-term process and storage reliability
- Generates revenue stream

1000 kg of NORM/TENORM produces 1000kW of saleable 11 kvA electricity

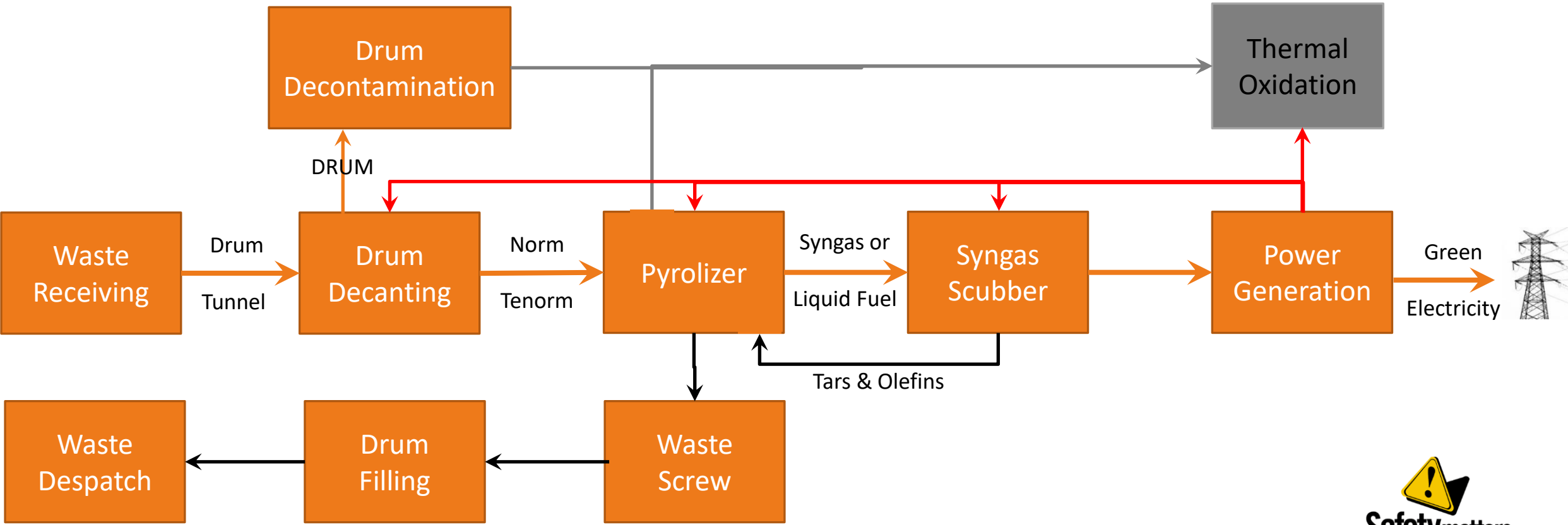
Gas Emissions

Well within European Waste Incineration Directive (WID)



How will it Work ?

The Basic System



How will it Work ?

Process Summary (1)

- The 210 or 160 litre drums arrive at the plant, a suitably equipped forklift will place the drums in a quarantine area.
- Drums, one at a time, will be taken to the double lock drum entry tunnel. The drums will be automatically moved to the decanter system.
- Once decanted, the drum will be ejected to the (optional) drum decontamination facility. The petroleum sludge is moved into the pyrolizer.
- The RPS is converted into 50% oil, 30% residue, 15% water and 5% incondensable gas (assumed) with the water flashed off.
- The plant produces enough gas to drive the engine (generator) to produce 1000kW/Hr electricity.
- The plant will use some (3,6 GJ) while the balance can be exported via 11kVA transmission lines.
- The 20/30% residue is ejected as ash/power that will retain the radioactivity and can be stored in the now decontaminated steel drums at a ratio of three sludge drums reduced into one ash/powder drum.
- The 50% pyro oil can be further distilled (optional) to provide liquid cuts of Naphtha and/or heavy fuel oil, and ULS diesel (optional), for which there are ready markets, or electricity.

How will it Work ?

Process Summary (2)

- The 20/30% ash/powder residue can be processed by a metallurgical refinery to extract the contained heavy metals Radium 224, Radium 226, Radium 228, traces of Pb 210 and Uranium, which can be sold off at market rates (US\$25,000/oz).
- If Saudi Arabia does not have a metallurgical refinery, Raise Global Services can provide a suitably sized metallurgical refinery.
- However, given the discontinuance of Radium, including in medicinal field, it is not recommended that this process step be taken as there is only a very small niche market for the product.
- It would be a better solution to store the radioactive ash/powder, which is non-corrosive (in dry form) residue, in the decontaminated drums, thereby reducing costs and remote storage of radioactive materials by two thirds.
- Care should be taken NOT to pollute or allow pollution of the remote storage facility with water (H₂O) as this will make the ash/powder corrosive.

Cost Model

Costs will vary depending on whether Client buy and own the plant or outsource to a third party, determine over what time period the stockpile in to be eradicated, and whether there will be adequate capacity to deal with the daily production quantity.

The choice also has to be made as to whether electricity only is to be produced or the derivatives Naptha, Heavy Fuel Oil and Ultra Low Sulphur Diesel will be produced.

The assumption is that Client wish to keep their costs to a minimum, reduce the stockpile as quickly as possible and have the capacity to process the daily production quantities as well.

“In the end, it’s a case of economies of scale, and making the right choices”



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GLOBAL SERVICES

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