Cleaning Up the Oil from the Gulf Coast

Darrell Duffy
6 June 2010

The oil coming ashore on the gulf coast is making a terrible mess. In order to save the wetlands, the wildlife and the seafood industries of the area it is clear that the oil will need to be cleaned up, but this is not going to be the same problem as we faced in Alaska. Men in haz-mat suits with brushes and steam hoses are not going to be able to tackle the problem. So how might this problem be solved?

I recently saw a program on HD Theater channel which described the De Beers diamond mining dredge called Peace in Africa. This ship mined diamonds from the ocean at the rate of about 240,000 carats per year. See: http://www.theartofdredging.com/peaceinafrica.htm and http://www.debeersgroup.com/en/Exploration-and-mining/Mining-operations/South-African-Sea-Areas/

Here is a picture, copyright De Beers, of Peace in Africa.

If we, as a civilization are willing to go to this time and trouble for diamonds, surely we can go beyond these lengths to restore the ecology, the wildlife and livelihoods of the folks of the gulf coast after this tragic accident. This paper looks at some of the problems involved in building cleaning dredges to

solve the problem of cleaning up the Gulf Coast.

Caveats

While I am not a process design engineer, I am making a proposal for some of the problems that will be encountered along with some candidate approaches. The intent of this document is to encourage debate of the process required to clean up the Gulf coast after the Deep Horizon oil spill.

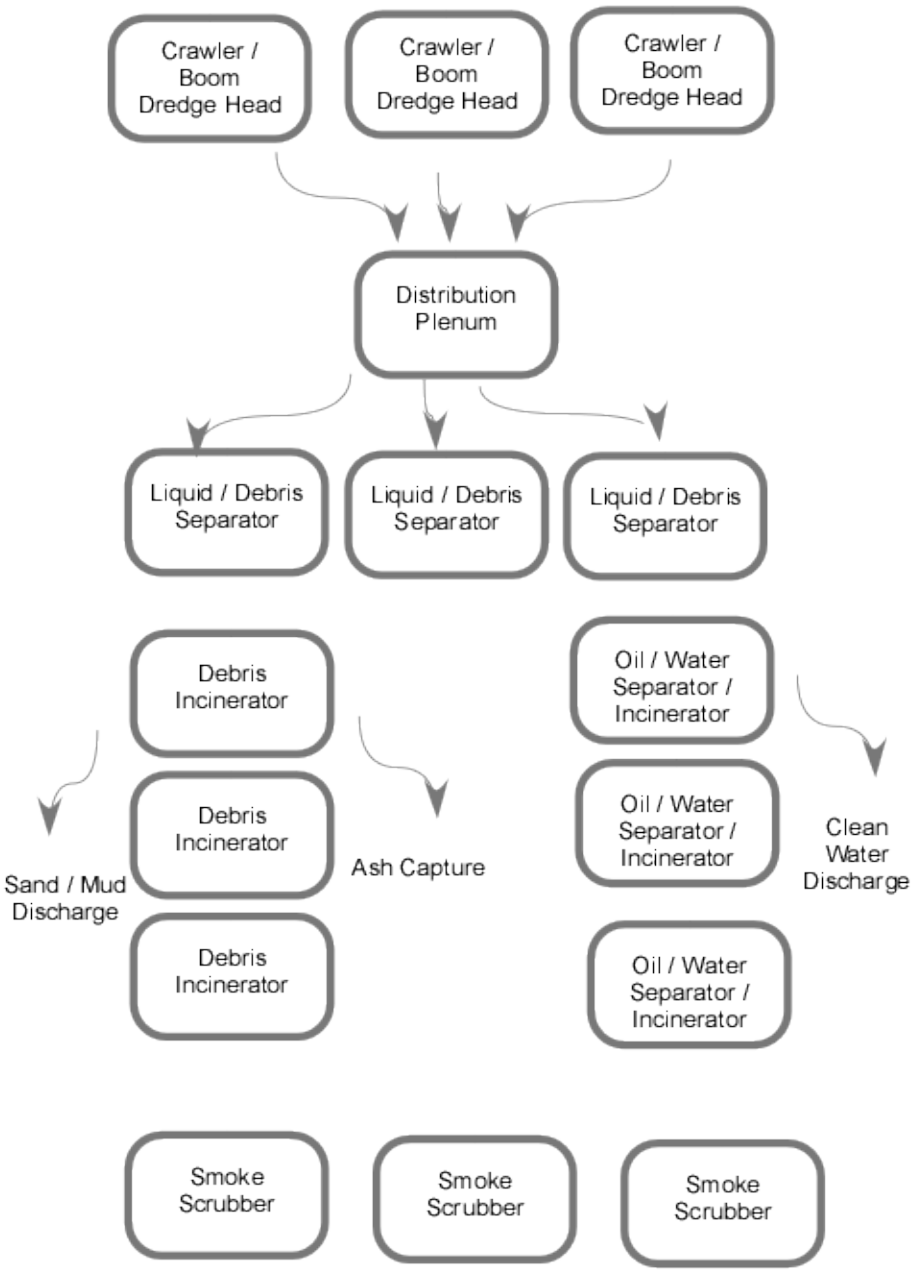
Describing the Problem

There are a number of challenges to be solved to clean up the oil from shallow water, wetlands and beaches:

1. The water is shallow. Any processing dredge must be able to operate over mud as well as shallow water and narrow passages. It is possible to consider that the ship will make its own channel to travel, but it must be able to operate with very shallow draft.
2. Large volumes of water, mud and sand, with many types of vegetation must be processed and clean sand and water must be returned to the environment. This means that heavy metals, dispersant and other toxins as well as oil must be removed from the sand, water, and scrubbed from any smoke that is the result of burning processes.
3. It is going to take more energy to incinerate the millions [billions] of tons of coastline than will be provided by the oil that is present, so fuel must be provided, and this is most effectively be unprocessed crude oil from nearby wells delivered by shallow water tankers or by pipelines that are towed behind the dredge.
4. Wetlands are excellent filters so only the margins are expected to be affected by the oil.
5. Since only the margins are affected, the length of coast line affected in wetlands is very much larger compared with the straight coastline between two points.
6. Wetlands must be protected once they are cleaned, probably by a well designed set of shallow water sand bars that trap further oil coming ashore.
7. Once the oil threat is gone, these sand bars must be removed or redesigned to allow the wetlands to flush normally with the tides. These bars can form part of a barrier bar system to mitigate and control future hurricane damage and should be designed with that in mind.
8. During some times of its operation, such as low tides and when operating in narrow channels, there will not be enough water locally at the dredge for proper processing, so a continuous pipeline will be required to the dredge from deeper water to provide additional water for processing. If this water contains oil, that is no problem since the dredge will clean all of its effluent completely of oil and toxins, such as dispersant, before discharging it into the estuary.
9. There are three components in the material dredged from the estuary: mud sand and possibly gravel which is heavier than water, organic debris which is lighter than water, and water with entrained or emulsified oil. The heavier and lighter components can be burned together, but for this to work effectively, most of the water/oil mixture must be separated. If the water/oil is not removed, then the other debris will cook a long time before it reaches a high enough temperature to burn the oil / toxins out.

10. A likely approach to removing the oil from the water would be to using a large continuous belt of a thick mesh filter which is made of a substance which will trap oil / toxins. The belt will move continuously from entrapping oil / toxins to a furnace where it will be heated to a very high temperature to burn off the oil / toxins and back to the entrapment zone of the dredge.
11. All smoke from the incinerators is scrubbed to move any particulates and any toxic gasses. A modified version of scrubbers for coal fired electric power plants seems promising for this technology.
12. All processing areas of the dredge are provided with double or triple redundancy so that any failure or maintenance would reduce capacity, but not stop the processing.

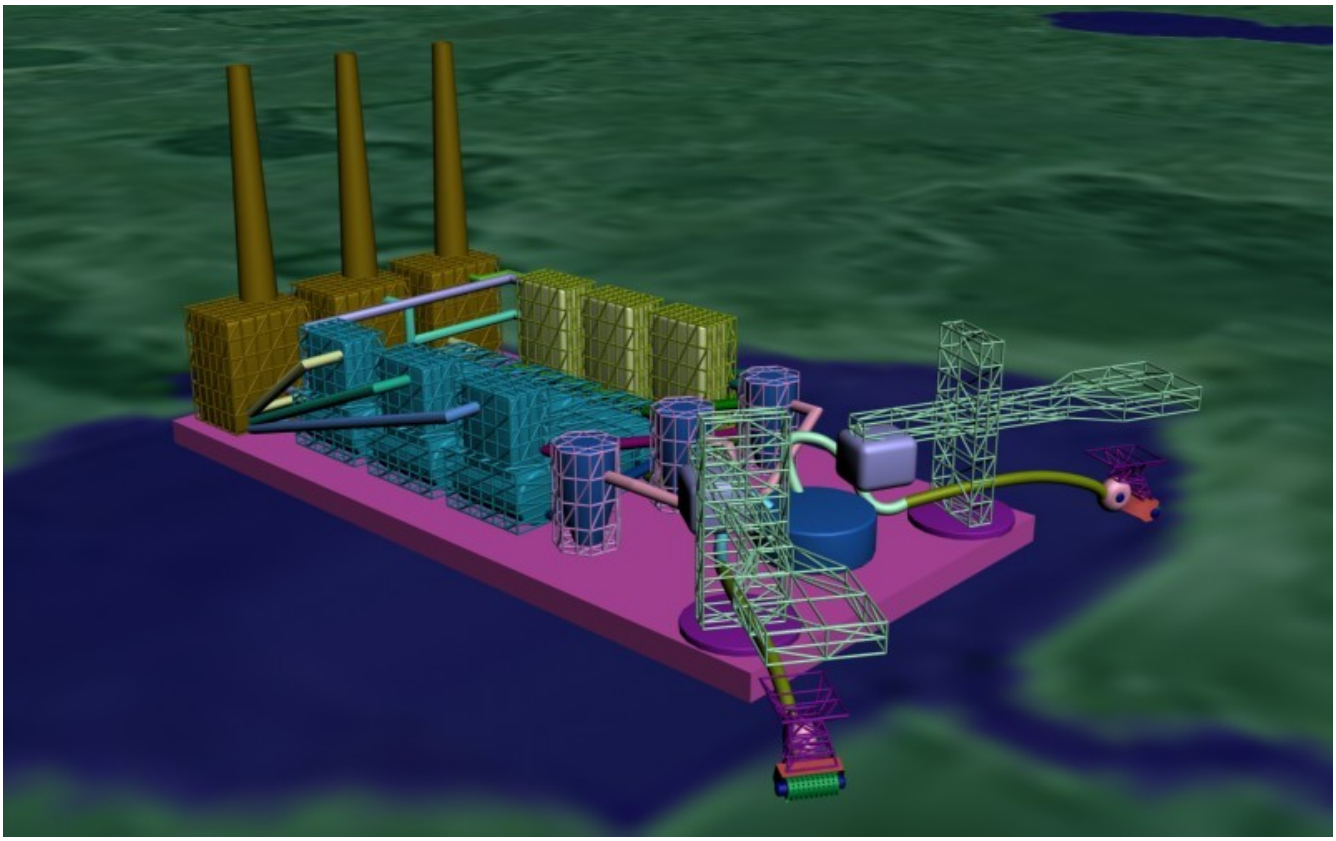
Schematic Design of the Dredge



This diagram depicts the likely processing steps from top to bottom of the diagram.

Example Renders of a Dredge

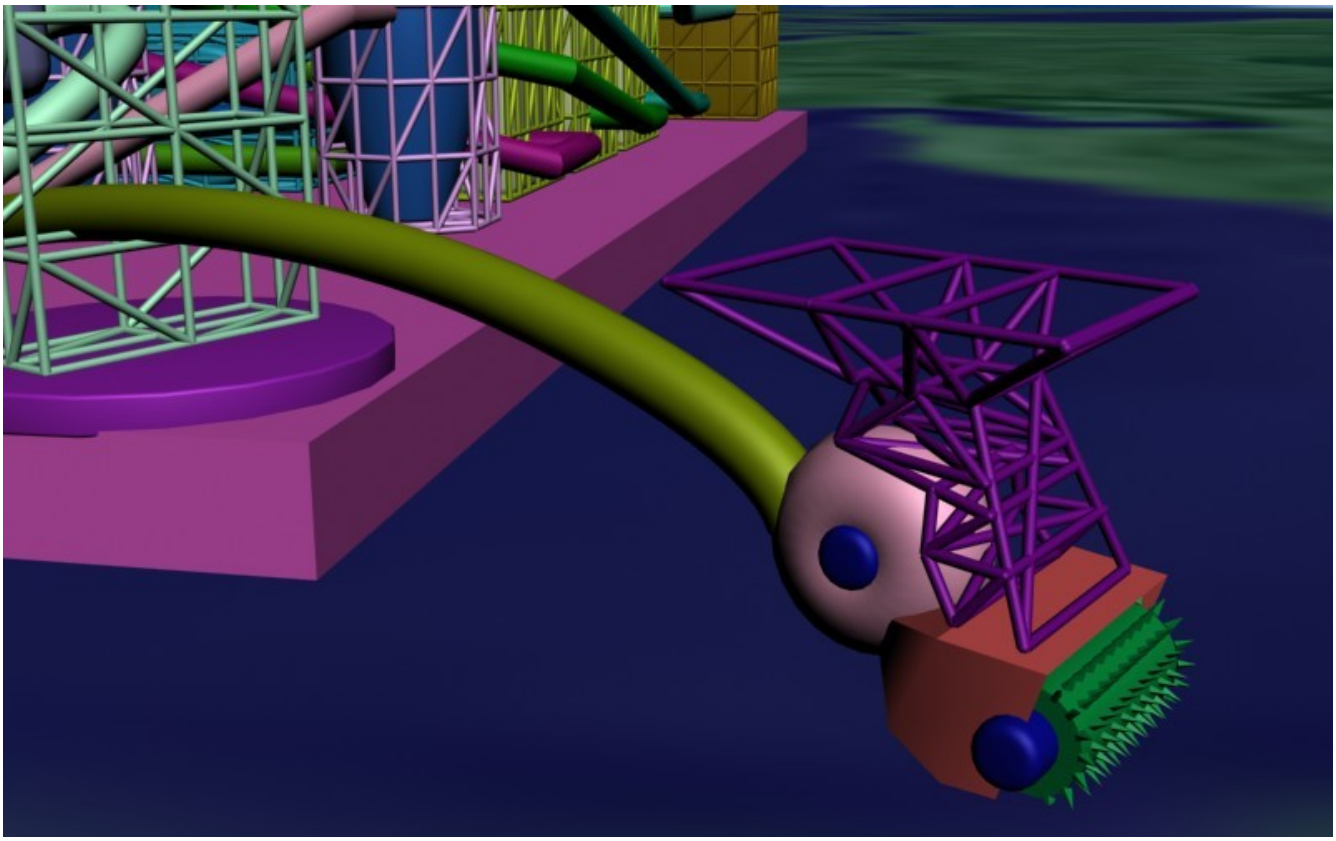
Overview



This example shows a platform 100m x 50m with two dredge booms. The processing plant may require a platform twice that size. For comparison, the diamond dredge mentioned above is over 200m long.

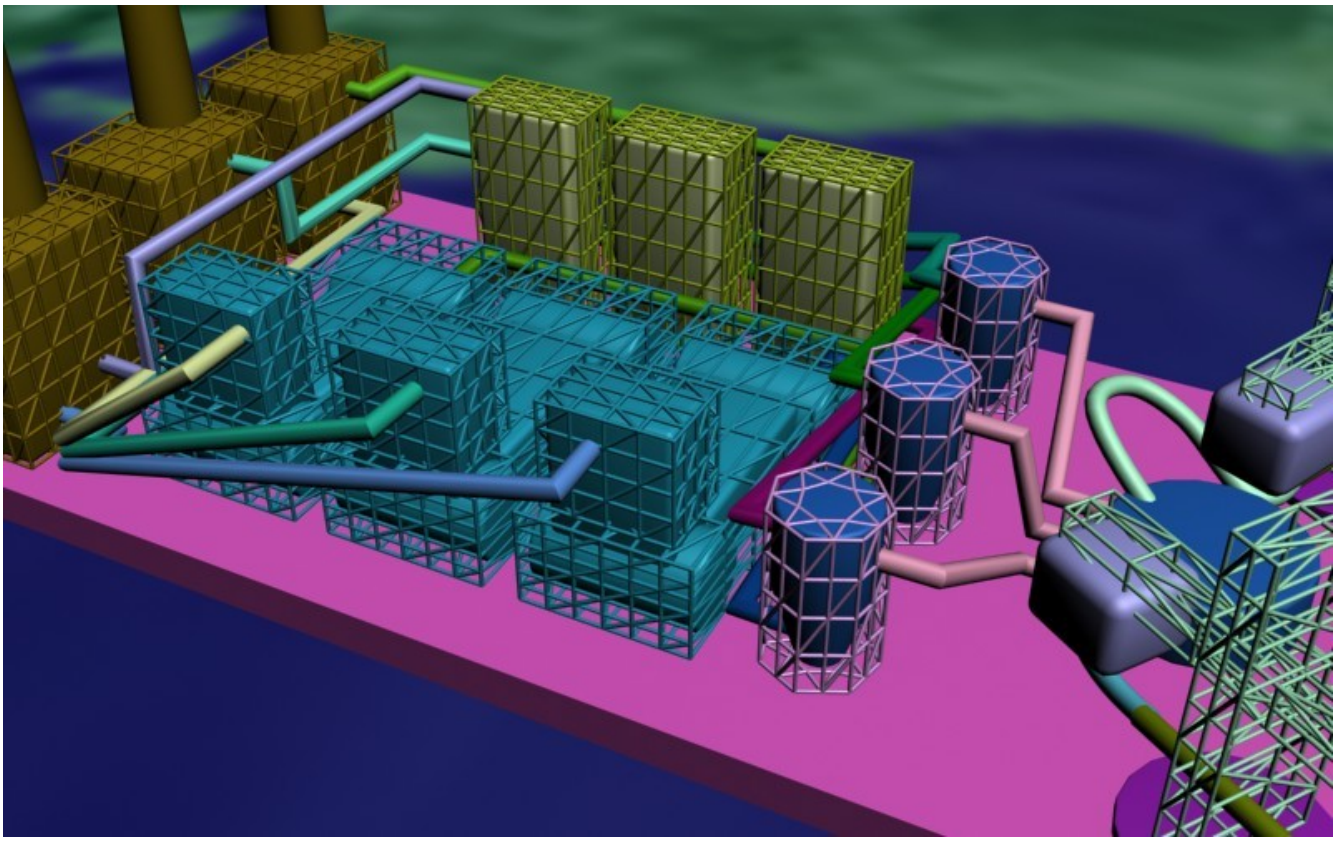
I have not tried to design any way to move the dredge through the marsh. It seems clear that either towing with anchors or walking with legs will be required.

Crawler Detail



The recovery head is suspended from the booms which move back and forth and can direct the head via cables from above. Each head contains a cutter head to process sand, mud and vegetation including small trees as well as powerful rotary pump to recover the debris with sufficient water to avoid loss of the contaminated debris.

Processing Detail



The processing plant is likely to be more complex than a diamond dredge, which cost about $110m to convert from a cargo ship completed in 2007. But with BP company profits exceeding $20BPounds in 2007, it seems clear that money is not a problem. Many of these dredge platforms are going to be required to clean up the marshes in a reasonable amount of time.

Crawler Dredge Head

The dredge heads do not ride in the marsh but are suspended above it to avoid stirring the mud and making the oil harder to recover. The platform floats over land that is already cleaned. The boom head is steered by cables from the boom above it.

The dredge heads resemble vacuum cleaner heads with grinders that cut up vegetation including grass and trees, as well as mud and sand and then using a large blower to pump the contaminated debris and water for processing.

Distribution Plenum

The distribution plenum allows parts of the dredge to be taken offline for repair or maintenance.

Liquid / Debris Separator

It is essential to separate water/ oil from the sand / vegetation for incineration. A rotary separator probably will work for this. Essentially spin dry the debris out of the liquid. Any vapors are sent on with the debris for incineration.

Liquid / Oil Separation / Incineration

The water and oil must be separated so that clean water can be returned to the marsh. Removing salt is not done, but toxic metals should be separated with the oil. This might be done by a large blanket of absorbent material which will survive the high temperatures required to incinerate the oil. Oil is trapped in the blanket and then burned off the blanket while the water does not stick to the blanket and is discharged. Further cleaning may be required of the water but the blanket should be designed to remove the oil to a very large extent.

The smoke is sent to the stack scrubbers.

Debris Incineration

The debris, including all sand, mud, shells and vegetation are incinerated to remove all oil and other toxic materials. It may not be necessary to remove the ash since this may not be very harmful to the environment. The smoke from this incineration is sent to the stack scrubbers.

Stack Scrubbers

Before releasing any smoke from the platform, it is scrubbed using a suitable method to remove any toxic gases and metal oxides. This technology is similar to that used in coal fired power plants.

Energy and Water Supplies

The oil recovered will not be enough to supply the energy requirements of the platform. An oil pipeline dragged behind the platform to a mother ship offshore will provide the energy and pump clean sea water from offshore to aid in the processing. Additional water will be required at low tide for the dredging. As the rig operates, it adds a large amount of water to the marsh which washes back out to sea taking the silt stirred up by the operation to mitigate the drowning of uncontaminated marsh with silt.

Where Do We Go From Here?

I hope this paper spurs debate and design. No matter what happens from now on, at least one such clean-up dredge will be required to clean up the Gulf Coast marshes. The sooner we start design, testing and construction, the sooner we will have the mess cleaned up. It seems clear that a multi-disciplinary team of ecologists, process engineers and heavy equipment construction contractors are required to complete such a large project.

Darrell Duffy
Coos Bay, OR
6 June 2010