WHITE PAPER – **How to stop the Deepwater Horizon Oil Spill**

Research Opportunity Number: Broad Agency Announcement (BAA) HSCG32-10-R-R00019

Agency: United States Coast Guard (USCG) Research and Development Center (RDC)
1 Chelsea Street, New London, CT 06320

Research Opportunity Title - Deepwater Horizon Response

Program Name: Interagency Alternative Technology Assessment Program (IATAP)

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BAA Technology Gap Area Addressed - **Oil Wellhead Control and Submerged Oil Response**

SECTION A: BACKGROUND:

The Deepwater Horizon oil well continues to exhaust oil at an alarming rate, decimating the coastal environment in the gulf area. A number of attempts to stop the undersea gusher have all failed and finding a better solution is urgent. Initially, BP tried to use two versions of containment "domes" but these failed. The type of dome used in those early attempts was considered "too small" by our team, and their design suffered a number of limitation, including from not being able to be deployed while the oil continues to be exhausted, and they would not work with the oil-relief hose in place.

In essence, the current proposal is a much more robust CONTAINMENT STRUCTURE that is easily deployed on the seafloor by gradually stacking reinforced concrete frames.

The following pages comprise this white paper:

1. This cover sheet
2. A textual description
3. Two pages of drawings (may be in a separate PDF file).
4. The Rough Order of Magnitude cost estimate

PROPOSAL:

This proposal is essentially a larger and more robust containment structure which is stacked into place, one layer at a time, rather than being lowered in one piece over the wellhead. The structure is composed of a number of reinforced concrete beams which are bolted together, four at a time, to create frames. The cross-section of each beam is a “zig-zag” (for vertical stacking) or a “T” cross-section (for pyramid stacking). (See the attached drawings on subsequent pages.)

The procedure for using this type of structure is as follows:

1. The beams can be constructed on land using conventional reinforced concrete techniques which are commonly used in buildings and bridges. Internal to each beam is a number of reinforcing steel rods (“rebar”) and there are a number of hoisting points, bolts and steel plates that are placed in the form prior to pouring concrete. The dimensions of each beam is roughly 4 ft high by 20 ft long, or as long as needed to completely surround the wellhead riser. Each beam will weigh about 12 tons, and a frame about 48 tons.

2. After curing, the beams are transported on ship to the vicinity of the Deepwater Horizon wellhead. Final assembly of the frames must occur at sea to allow the frames to be bolted <u>around</u> the existing exhaust hose that will continue to pump oil from the wellhead during construction of the structure.

3. The first frame may require special ports on the bottom to allow pipes to exit the frame once it sits on the ocean floor. It may also be required to pump concrete into the first frame to fill any gaps in those ports and to join it to the ocean floor.

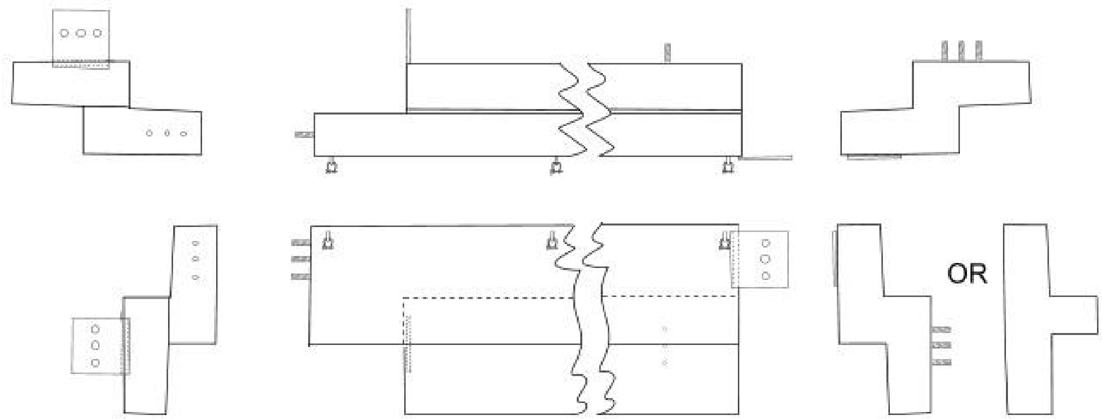
4. Each frame is lowered to the bottom of the ocean with a crane and a single cable and a hoist harness, a set of four cables and open hooks. When the frame is supported by the ocean floor, the open hooks will disengage from hoisting points and the hoist harness can be winched back to the surface to be used for the next frame.

5. In addition to the hoisting cable, there are two guide cables attached to side shackles of the first frame. Each subsequent frame is loosely connected to those cables using sliding shackles. The guide cables will help the frames stack properly on the ocean floor.

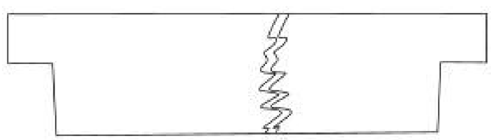
6. Gasket material must line all joints and along the top surface of each seat where subsequent frames will sit. The frames may require additional spring-loaded hooks to engage on lower frames to ensure that they are not pushed apart by the wellhead pressure. If the structure is 30 ft high, it would weigh almost 600 tons (I.e. 1.2 million lbs).

7. As the structure clears the top of the wellhead riser, smaller frames can be utilized with the “T” cross-section to result in a pyramid shape so as to reduce the size of the lid.

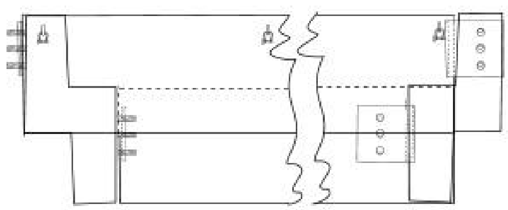
8. Finally, a lid is placed on the structure. The lid must have several ports to a) allow oil to be captured from the well and b) to allow concrete to be injected into the structure to allow it to be permanently sealed, if desired. This will then completely stop the flow of oil from the well, and will allow cleanup efforts to proceed.



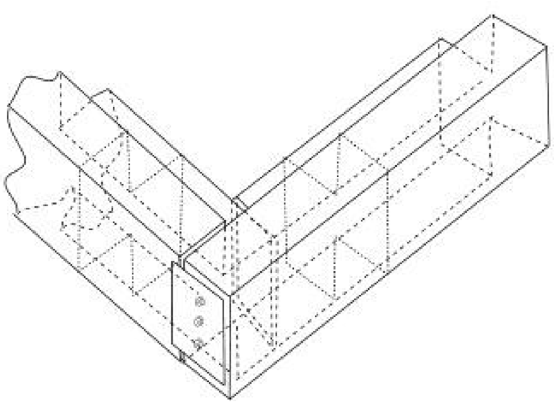
Containment structure is made from reinforced concrete beams, all the same. These beams are fabricated on land using conventional concrete-building and bridge-building techniques. Each beam is about four feet high and as long as necessary to completely surround the wellhead riser, perhaps 20 feet. The metal plates and bolts are approximate.



A lid of reinforced concrete is placed in on the structure once it is completed. Please note that the beams can either stack vertically (zig-zig beam cross section) or can stack like a pyramid (T-cross section) to reduce the size of the lid.



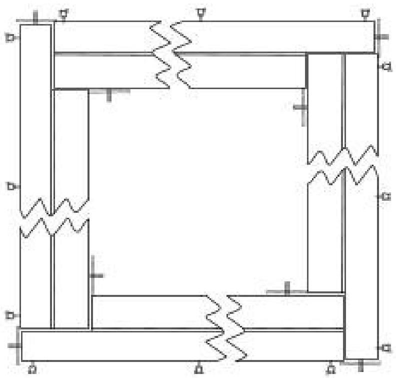
The concrete beams are assembled into square frames after they are transported to the ocean above the wellhead. This is to allow the existing relief hose to continue to pump oil while the containment structure is built.

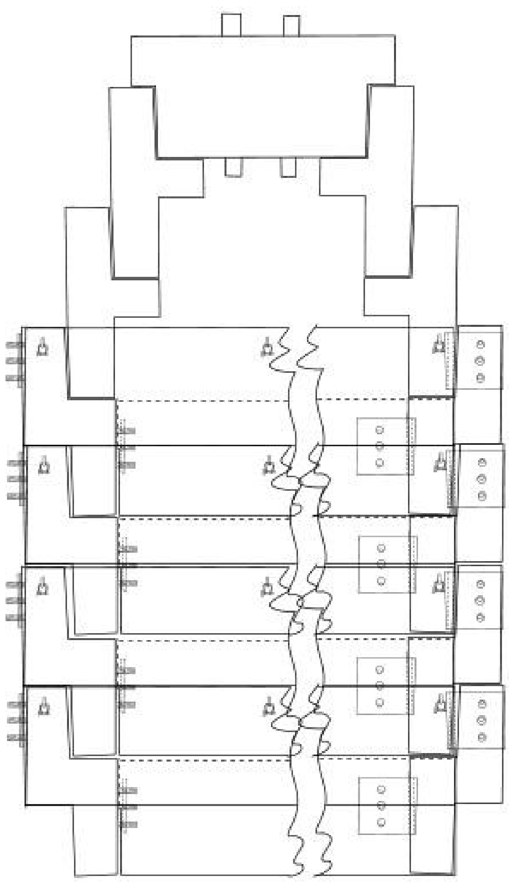


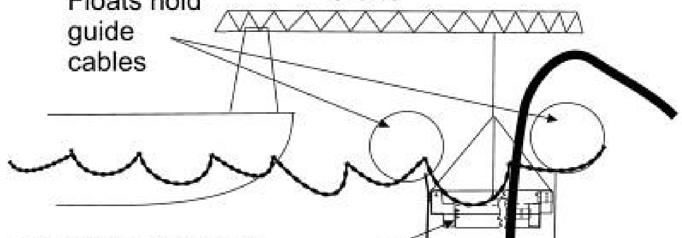
This isometric drawing shows one concept for tying the beams together. Experts in reinforced concrete structures should weigh in on the actual design.

Frames also have a number of steel loops on the sides to allow for hoisting and to allow shackles to be placed on the sides so the frames can be loosely attached to guide cables.

This top view shows how the concrete beams are assembled to form a frame. They are assembled at the surface with gasket material placed in the joints to form an oil-tight connection. Also, gasket material is placed on the “shelf” where the next one sits.







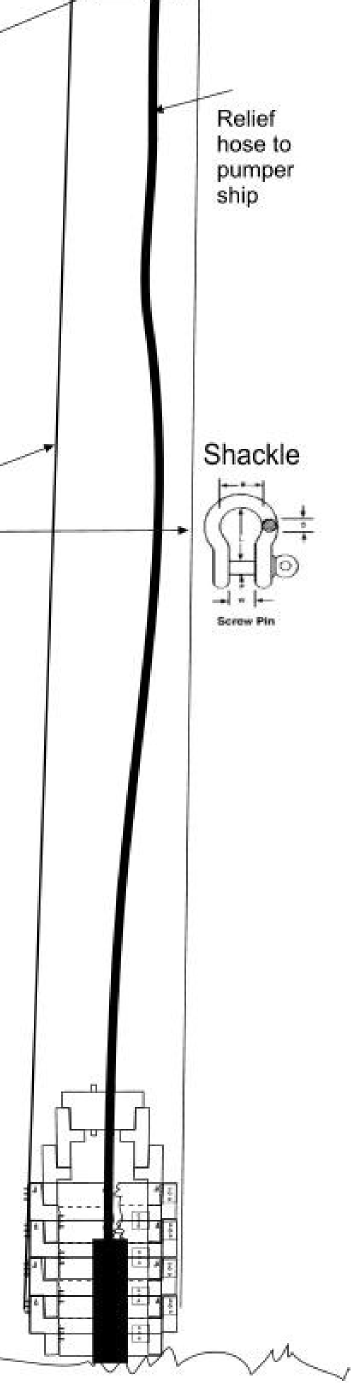
Assemble frames on surface around existing relief hose/pipe that is pumping oil from riser

First frame must be carefully lowered over the wellhead riser. Weight of frame is held by center hoisting cable.

Two guide cables are attached to the first frame. Subsequent frames are loosely attached using shackles on the sides. This guides the frame into place.

The hoisting harness has open hooks on the ends. Once the frames hit bottom, the harness falls off and is winched back to the surface so the next frame can be deployed.

Frames stack on top of each other. Frames can use zig-zag cross-section to stack vertically, or T cross-section to stack like a pyramid. Finally, once the base is secure, the lid is placed on the containment dome, and the discharge of oil will stop.



SECTION B: Rough Order of Magnitude (ROM) Cost:

Reinforced concrete structure are in common use today. As a basis for comparison, a bridge which was much larger than the proposed structure cost $675,000 to build in materials. There are additional costs that are difficult to estimate regarding the use of ship with a crane and the details of lowering the frames into place. However, there is nothing exotic about the proposal and those costs should be less than the cost to operate a drilling platform for a day.

In essence, the cost to repair ongoing environmental damage will exceed any costs of a successfully deployed containment structure. Deploying this containment structure will probably cost less than $2 million.