

Lesson Learned from BP's Gulf of Mexico Oil Spill

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Background: The following comments are based in part on my 45+ years experience in structural dynamics/mechanical engineering from Georgia Tech and extensive design/project management experience including offshore oil platforms, oil pipelines, conventional/nuclear DOD weapons effects and combat weapons designs, and environmental fate and transport of chemical/oil plumes.

History: In 1983, I served as a Senior Program Mgr for Shell Oil Company for the design of Shell's Eureka Offshore oil platform. This offshore oil platform is in 760 ft of water (13 miles out from San Pedro, Ca) and at the time it was the deepest offshore oil platform in the world. Twenty-seven years later we are drilling wells in 5000 feet to 9000 feet of water in the Gulf Mexico using semi-submersible drilling rigs where the wells are often greater than 15000 feet below the seabed. Over the past three years, about 26% of the entire oil leases in the Gulf of Mexico are in water depths in excess of 5000 ft. In part, Government regulations and environmental groups have forced the oil companies to go explore in deepwater versus drilling "pristine lands". The potential damage issues to the environment/economic well-being of the population have probably increased by a factor of a 1000+ in the event of a major deepwater oil well blow-out.

Until the Deepwater Horizon accident, it was probably believed by the majority of Congress and the American public that deepwater oil drilling/production could be safely regulated by the Federal Government and performed satisfactorily by the Big Oil Majors. How little did the public know the real extent to which the entire safety of the Gulf coast has been compromised/destroyed by a major oil well blow-out in deepwater (>4,500 ft).

Remarks: A sudden, high pressure "discharge" of 12,000 psi fluid is not a spill, it is an explosion. A continuous discharge of high pressure oil and gas could be classified as a "volcano" if it continues for months without

stopping it. If you hear someone calling it a “very, very modest spill” – most likely a Big Oil CEO or a lawyer with the EPA/OSHA.

I. Oil/Gas Wellhead Characteristics for Mississippi Canyon in GOM

- A. Hydrocarbon source rocks are rich and widespread in the Gulf of Mexico. Hydrocarbons are trapped in a variety of structural settings including salt flanks (Bullwinkle), salt/fault (Auger), fault (Vancouver), salt thrust (Joilet) and stratigraphic (Ram-Powell). The hydrocarbon mix is fairly even between oil and gas and much of the free gas is bacterial methane. This has significant implications for the current BP wellhead blowout.
- B. Most deepwater oils are only moderately sour (< 2.0 wt % sulfur) and excellent for Gulf Coast refineries. Relatively large pockets of oil are found trapped between a salt canopy on top and sandstone or Miocene rock formations (17,000 ft?). The deepwater GOM oil deposits are now believed to be a world class find and much of it follows the US continental shelf 5000 ft (and deeper).
- C. Deepwater oil production is important economically to the region and a major energy source of oil and gas for the US. Oil companies would very much like to follow this “oil” shelf around the Florida coastline.
- D. New wells can show high (record) flow rates now exceeding 17,000 barrels per day. BP mentioned that its “Thunder Horse” platform had wells delivering over 50,000 bpd. This is a whole new realm of technical challenges which may be well beyond what can be economically achieved in a safe environment.

II. Mitigation/Clean-Up of GOM Well Blowouts

- A. For deepwater wells which blowout (wellhead gas explosion on the surface), there needs to be an immediate response by large tankers (think super tanker) equipped with deepwater skimmers and oil/water separators. The idea of a barge loaded with some oil booms is totally inadequate response and carryover from the 1970s with regard to ever addressing a high pressure oil/gas well blowout with flow rates exceeding 15,000 barrels per day (and more likely 50,000 bpd for ultra deep wells). The Government should have mobilized Super Tankers 40 days ago with major oil skimming equipments (not a fleet of shrimp boats – that’s only a pointwise or local defense for bays or near shoreline)
- B. You will be dealing with a 5,000-ft “water column” filling with oil and gas in a deepwater wellhead blowout. We are dealing with a totally new animal with these high pressure wells in deep water where the seabed pressures may exceed 2,000 psi. The water column separates the light ends of the oil out and this oil floats to the top. However, 70%+ of the oil can remain underwater (trapped in/on the surface of giant gas bubbles) and could float hundreds of miles at depths of 3,000 ft before eventually surfacing in much shallow waters. We need super tankers to suck up these large plumes while they are still in deepwater instead of allowing BP to deny they exist.
- C. The benzene gas is water soluble and is a carcinogen at levels of 1 ppm. If an oil glob is approaching or hits your coastline you need to know the water is safe to swim from dissolved benzene.
- D. Large amounts of methane gas may result in depleted oxygen layers in deeper waters. We know very little as to the chemical make-up (and fate and transport) of large underwater oil/gas plumes (see ongoing measurements at <http://gulfblog.uga.edu> and Dr Samantha Joye et al). We need to acquire the data – heard that yet from anybody in Government?
- E. You know what happens to the drill/casing pipe when a huge drilling rig explodes and sinks. It pulls up so hard (maybe with over a million pounds of force) on the pipe string that the pipe breaks (shear failures) like you see in the BP video. It could dislocate the BOP by pulling it up and damage/break the internal mechanical mechanisms inside the BOP that is supposed to shear/close the pipe. It could pull a BOP off the

wellhead connector if the rig fails to maintain dynamic positioning (on board explosion). We have no way of currently addressing these types of catastrophic failures in deepwater wells.

- F. NASA in traveling to the moon, tried to achieve 0.999999 reliability in its systems (everything has to have a back-up). In the deepwater oil industry, there is no back-up BOP, there are no secondary wells already drilled, there was no acoustic sensor (to sense an wellhead explosion and automatically shut-in the well because a human could never respond fast enough), there was no barge in-place for a wellhead blow-out, etc, etc. It was busy as usual for drilling in the Gulf of Mexico.

III. Stop the Wellhead Blowout

- A. Any way you can – let’s see a Government prioritized list (not BP) of what coming down the pipe for the next top five technical approaches from the consultants to stop the wellhead flow. Why wasn’t the pipe cutoff at the BOP at the outset and an LMRP tried? Why wasn’t the original containment boom rigged to pump warm water/methanol to try and prevent hydrate formations – why didn’t you pull it back up and rig it for methanol/warm water injection if it was forming hydrates? Why wasn’t a number of smaller skimmers with tried above the wellhead off of ships with oily water separators (still have not done this) – could have been 500 ft to 1000 ft above the wellhead. This is the reason that the Government should take immediate charge of an environmental disaster – it’s called Federal Waters. Who was in charge from the Government on Day Ten who could override BP - nobody?
- B. Can you imagine someone saying we are going to let this oil continue to flow out this well until August (or Christmas?) until relief wells are drilled (statement by Carolyn Browner – Energy Consultant to President Obama)? We are suppose to wait until it hits our beaches and make some kind of response with a large manpower response (mobilize the National Guard) and/or deploy an orange oil boom and hope for the best!? Not acceptable!

- C. BP's senior management is up to their ears in alligators trying to address a response so the Government is now sending Eric Holder (Justice Dept) to investigate/file "criminal charges" against BP – what a PR disaster for everyone and just impeccable timing. If Eric Holder (Justice Dept) is not going to put on a HazMat suit what good is this going to accomplish right now? Try investigating how much lobby money from Big Oil went into everybody's campaign in the past thirty years (at all levels of Government) if you want to open a "can of worms".
- D. We need to stop this wellhead blowout soon – if this flow goes around the Southern tip of Florida into the Atlantic Loop Current we have just bought a potential global climate change problem – it can become that ugly fast with oil being carried all over all the oceans. If BP/consultants cannot stop this well in next 45 days, we need to seriously consider placing conventional charges (C4 or thermite) under the seabed/down the well bore of the relief well and closing this pipe by explosive charges. Alternatively, a possible option is to design a small "residual cavity" nuclear device (only 1 kilotons to 3 kilotons) detonated at a depth of say 7,000 feet (or whatever the computer codes give for optimum placement and standoff distances to crush rock against the down hole drill string (will produce a cavity of 11,000 cubic meters for residual oil to flow into to remove the pressure). There will be no escaping radiation and no fracturing of the oil reservoir at the surface if detonated in the Miocene rock or way down into sandstone. This is a very small explosion designed to produce more of a uniform spherical wave front to crush the pipe closed. The Soviets have extensive data (on land) with this approach. It gives the Government a "final resort option" if we want to stand around for months and hand-wring about it while the oceans become polluted while everything else has failed. This is why the guys in Government get paid the big bucks to make these kinds of decisions.

Suggested Action Items:

A. Let BP senior management alone to try and stop the wellhead blow-out “one more time” with LMRP cut and stab. If this fails, BP should be out of here and replaced by Government/Military Tiger Response Team asap. I think you can hire the same ROV operators and contract the same ships – just a management change. We need the equivalent of a General Honore (from Katrina days) to lead the troops and reinvent American ingenuity – anybody who has a candidate in mind send your suggestions to your Congressman/White House. Possibly General Powell could head up a military response as special White House appointee. Do something even if it’s wrong because so far it’s grading out at a D minus. Hopefully we can get this off the front page soon but decades of coming damage.

B. Activate at least three super tankers with oily water separators to track down large underwater plumes identified by US Navy and/or University marine Research Teams. Start measuring the oil wellhead flows and what’s in the water in terms of concentrations (easily done by a Harbor Branch Team out of Florida). Why hasn’t the US Navy been activated in this response? Many of our Navy people trained on the Gulf Coast and have family or relatives living along the Gulf Coast and would be glad to do something for their country. I bet I could get one hundred proposals from the US Navy/Air Force Contractors to address this oil clean-up within ten days or less (everything from air-sparged oily separators to concentrated microbes to specialized high speed skimmer craft to start sucking up oil – where is the Government’s request for proposals with rapid evaluation and awards)? Submarines can track underwater plumes and ships can be modified to skim oil and there is a ton of manpower already available. There is no innovative thinking from our Government.

C. Initiate major National Labs efforts (Sandia , INEL (DOE), Air Force Research (Wright Patterson Labs), Army Labs (Harry Diamond), ONR (Naval Research), etc) to concentrate on innovative solutions to stopping the wellhead flow (do I hear injecting wellhead mud with liquid nitrogen?) as well as start running super computer models for simulations of any/all solutions as well as fate and transport of underwater plumes and trajectories and ways to quickly locate plumes as well as concentrating microbes to attack the spills at sea on accelerated basis (go talk to a company called In-Pipe about how they concentrate microbes by a factor of 10,000 for treating

grease/oily wastes). Where are the finite element (stress runs) computer runs from Cameron (maker of the BOP) which show what can happen if a transient 1,000,000 axial load is placed on the drill string at the BOP and jerks it upward off its base. What is the damage internally and what happens at the wellhead connector – did we break or crack the collar and can we crack cement seals down the wellhead bore?

D. Start emergency Purchase Orders and funding by Congress for ordering hundreds of additional boom/microbes/organic oil cleanup compounds for deploying along the Florida (and possibly) Atlantic coastline. We need to be ready to mobilize the National Guard on one weeks notice for oil cleanup and we need Hazmat suits at the ready (and there are tens of thousands of high school students looking for work this summer – can you think of a job for them?).

E. According to data from the University of South Florida, oil plumes (slight?) maybe going around South Florida and into the Atlantic Loop Current (starting to make its turn around the Southern tip of Florida and towards Miami). It could head-up the East Coast. We need to be actively tracking this and sending marine research vessels to acquire the data. This is a major reason why oil drilling should be permanently banned off the coast of Florida – you can screw up the global ocean thermocline with a massive deepwater wellhead blow-out by changing the salinity if the water is transported by the Atlantic Loop Current.

F. Declare a National Emergency now – we are still facing decades of impact already and 70% of the problem is still underwater. We are going to be dealing with this fiasco for decades in some states/shorelines.

G. The President has too many issues on his platter to address with major bank debt sovereign crisis, Turkey's conflicts with Israel, and coming debt defaults with Greece and possibly Spain and Portugal, China selling US Treasuries and coming US Dollar devaluation, and two wars to deal with the day to day BP fiasco. He needs to get this delegated to a high level “mucky muck” (with a Big Checkbook from Congress or this is not worth addressing at all) and get on with his own world wide agenda. Mr President please delegate asap and provide the funding – Tiger Team is not yet in place!

