TECHNICAL DESIGN PROPOSAL

BULLHEAD REVERSE SQUEEZE CEMENTING FOR MUD AND GAS KICK PROBLEM AT LAPINDO-PORONG, SIDOARJO EAST JAVA
Objectives:
The objective is to combat a well known never ending devastating Lapindo Mud and gas Kick problem and permanently stop the current mud flow as well as pumping back all existing puddle of mud trough the existing hole, at Porong – Sidoarjo, East Java – Indonesia.

Background:
As shown many times in TV and other media, Lapindo has drilled a well that created a crater resulted in a huge origin mud flow at Porong-Sidoarjo, and hot mud had gushing out of the company's gas exploration site, 2,284 houses in five villages have been inundated. In addition, 64 hectares of sugarcane plantations and almost 300 hectares of rice fields have been flooded. However, as currently there is no rig and well head available on location and considering such difficulties in rising a complete drilling rig, A special technique and tools are positively required. The required special technique and tools are the main back bone and discussed entirely in detailed in this proposal.

Coiled Tubing Unit and Coiled Tubing Logging
Coiled tubing operations have increased steadily over the past few years due to their pumping capability and their effectiveness in highly deviated wells. This effectiveness is further increased when electric line is installed in the coil. Service companies can offer more services and operators benefit from the increased utilization of the coiled tubing unit that is already on-site. The use of an acoustic source and an array of receivers located in the same borehole to image hole profile and structures is required prior to designing the cementing process inside the center of mud sources.

Most International Oilfield Companies offer the complete range of equipment for electric line operations ranging from the down hole cable head and adapters to a complete log acquisition system suitable for both open and cased hole operations. The tools are easy and fast to make-up and breakdown and they have been developed so that you can run a wide range of tools on the one system. All tools have been developed and improved over many years to be robust and reliable. The application of years of field experience, highly qualified and innovative engineers and rigorous testing has produced a suite of tools that will ensure you get the job done properly and on time. Coiled Tubing
Logging Head Features at a glance
Dual check valves
Stop reverse flow up the coiled tubing that are easily changed without having to disconnect the complete head and are pressure testable in situ
Simple robust design
Makes for an easy rig up/down. Too release options
Shear pin for precise over pull release and electrical when over pull cannot be properly controlled at surface
Fishing neck makes retrieval of the separated tool string easier.

Inflatable / Swell packers
Inflatable / Expandable / Swell Technology Solves Challenges in Difficult Well Completions. In an industry where methods are well established but seldom challenged, few people ever stop to consider if the technological starting points developed during the early days of the oilfield are still relevant a hundred years later. The new Technology has now enhanced more wells than expandable and surface controlled completions together. Though the technology is the youngest of the three and the least advertised, it has gained a tremendous momentum through recent years. Cementing alongside inflatable and expandable packers are techniques that have been used to isolate producing zones. A more effective approach is to affect a seal that continues to work long after installation by being adaptable to down-hole events. A rubber has elastic properties, and engineered compounds can expand and still provide a long term, reliable seal. Because certain rubbers can maintain the cross-links in their molecular structure, they are able to swell and effect an excellent seal. This unique Technology and property has been brought to industry is being applied in a wide range of down-hole applications. The use inflating / swelling rubber technology to offer operators a variety of completion sealing alternatives to cement, particularly when dealing with difficult environments such as irregularly shaped open hole, unstable formations and horizontal wells. This technology will be the main isolating tools for the existing Lapindo’s origin mud flows

LESSONS LEARNED
Wireline logs gather a large amount of information quickly and at reasonable cost. They measure formation properties in-situ and identify where other tests should be performed. However, they measure needed
parameters only indirectly, and logging data sometimes require involved interpretation techniques.

The New Coiled Tubing which reduces crane lifts to only below 40T on a typical operation in the North Sea, had inspire adopting this technology to be use on a pontoon / barge for permanently stopping Lapindo’s Mud and Gas Kick Problem at Porong – Sidoarjo.

**PROBLEM ADDRESSED**
The new, economic answer for offshore coiled tubing operations and certainly answer the operating need to permanently stop the mud flows in Lapindo problem. It is safer, efficient automated solutions reduce the amount of time and the number of people needed for this work. As far as I concerned, the new CT was developed within a flexible, fit-for-purpose concept that makes the unit readily adaptable for many offshore structures, including platforms, floaters and tension leg platforms. With this high degree of flexibility, the design still gives you the full capabilities of a conventional coiled tubing unit, which certainly meet the basic need of killing the mud flow at Lapindo, Porong-Sidoarjo.

A key philosophy driving the design architecture is the creation of safer, efficient and functional skid packages mounted on a pontoon barge should be designed to combat the existing Lapindo’s mud flow at Porong, Sidoarjo.

As there is no well head on the existing hole, a modified wellhead’s BOP components should be considered. However the Coiled Tubing Inflatable packer should have enough grip to hold down from working pressure uplift

Overall, This unit lay out should be designed as a highly flexible, fit-for-well-crater’s killing purpose at lapindo’s Mud and Gas Problem – Porong, Sidoarjo.

The whole process in this proposal consists of 3 phases i.e:
  1. HOLE CLEAN UP AND HOLE TRAJECTORY and PROFILE IMAGING
II. SYSTEM DESIGN AND TOOL MANUFACTURING

III. PUMPING AND CEMENTING PREPARATION AND PROCESS

PHASE I - HOLE CLEAN UP AND HOLE TRAJECTORY and PROFILE IMAGING
Help from previous team who insert the cement ball inside the existing hole is required:
1. Clear up AMAP all existing cement ball insertion available on the port of flow.
2. Run a Hole Trajectory and hole caliper log using CTL (Coiled Tubing Logging).

PHASE II - SYSTEM DESIGN AND TOOL MANUFACTURING
Help from Machine Shop and Oilfield Cementing Laboratory is required:
1. Design a cement slurry system at 15.8 ppg OR higher and lab test at BHCT.
2. On the laboratory, Do the cement- Mud compatibility test using (10:90, 20:80, 40:60 and 50:50)% ratio.
3. If CTU is not available, Design a Special High Pressure Cementing Head, and Manufacture it on a machine shop.
4. built 3 units of Pontoon / barges (2 units if CTU is not available) completed with 40 MT pedestal cranes each to be able to float on the mud area.
   a. 1 pontoon/barge for all cementing Equipments,
   b. 1 pontoon/barge for Cement, chemicals and Cement head + Control Crew
   c. 1 pontoon/barge for coiled Tubing Unit and accessories

PHASE III – PUMPING AND CEMENTING PROCESS
With the help from Construction Company and Oilfield Cementing Company:
- Alternative 1 : Bullhead Squeeze using CTU and Inflatable packer
- Alternative 2 : Bull head Squeeze using modified Cementing Head
III-1 Alternative 1: Bullhead Squeeze using CTU and Inflatable packer
Depending on the hole profile, we need to run the CTU to considerable good depth inside the crater, this is the best available alternative that we should do.

**Step by step procedures:**
1. Rig-up CTU on the pontoon barge.
2. Run CTU to desired TVD and establish circulation.
3. Set and inflate the packer to provide maximum seal in the annulus.
4. Pump the existing mud as maximum as allowable
5. Pump mud-slurry spacer
6. **Run bull head Squeeze** using the designed cement Slurry
7. Unset the Packer and ROOH CTU to 100 M above the above depth.
8. Run cement plug balance for 80 M height
9. ROOH CTU to 100 M above the above depth.
10. Re-set and inflate the packer to provide maximum seal in the annulus.
11. Run bull head Squeeze using the designed cement Slurry
12. Unset the Packer and ROOH CTU to 100 M above the above depth.
13. Back to point 6 – 9 until reach surface

III-2 Alternative 2: Bull head Squeeze using modified Cementing Head
This alternative to be done if **ONLY** for any reason, the CTU can not be run to expected depth inside the existing hole and this alternative consist of 2 stages:

- 1st Stage: Run Stove pipe cementing job to create maximum seal on the casing-OH annulus through macaroni pipes.
- B. 2nd Stage: Run Bullhead Squeeze with the designed cement slurry.
A. 1st Stage: Run Stove pipe cementing job to create maximum seal on the casing-OH annulus.

1. Bring all Tools and equipment to location and hold a pre job safety meeting for all personnel involved on the job.
2. Hook-up the Special Cementing head, Insert and slide a long modified cementing head to the existing open hole’s port. **Note**: The open hole and casing annulus should be sealed off to prevent any fluid flows. Ensure to keep down the cementing head as low as possible and make sure be able to hold from uplift pressure due to cementing working pressure
3. RIH macaroni pipe on the annulus
4. Run the stove pipe cementing to create maximum seal on the annulus.
5. WOC

B. 2nd Stage: Run Bullhead Squeeze with the designed cement slurry.

1. Bullhead Flow test at 1, 3, 5, 7, 10 to maximum bpm at allowable pressure. Record flow and pressure using Electronic Pressure Recorder.
2. Based on the fluid flow test, at maximum possible rate, pump all existing puddle of mud.
3. Based on the fluid flow test, at maximum possible rate pump cement spacer.
4. Start a Squeeze cementing process using **bullhead squeeze technique** below the maximum fracture pressure.
5. Upon all designed cement slurry mixed and pumped down hole, close the cementing head’s ball valve (2 x 2”) and WOC : wait for the cement slurry to harden (thickening time should be designed 30 mins + slurry pumping time).

Equipments needed:

- 3 ea Mud Pontoon / barges:
  - 1 Main Pontoon/barge with 2 set of 40 MT pedestal crane for barge for Coiled Tubing Unit and accessories.
  - 1 ea auxiliary pontoon/barge for all cementing Equipments, Silos, Cement and chemicals
- 11 ea auxiliary pontoon/barge for Modified Cement head and Control Crew
- 1 ea Coiled Tubing Unit
- 1 ea Special Cementing Head.
- 2 ea Cement Pumping Skid Unit
- 6 ea 2000 cft Pneumatic Cement Silo
- 1 ea 60 cft pneumatic surge tank
- 1 ea Cement Cutting Bottle.
- 1 ea LPHV Air Compressor
- 1 ea 6000 gals Tank for Fresh water
- 1 ea 2000 gals Tank for Mixing Fluid
- 1 lot of 2” high Pressure Treating Lines
- 1 lot of 2” HP Valves
- 1 HP 2”Coflexif hose completed with 2”WECO Unions in both end.
- 1 lot of Cement and cementing chemicals.

**Cement Slurry Tests to perform:**
- Thickening Time test
- Fluid Loss Control Test
- Compressive Strength development Test
- Free Water Test
- Cement – Mud Compatibility Test

**Materials requirement to build Special Cementing Head:**
- 1 ea pipe (casing) as big as Top hole diameter
- 1 ea Flat end steel
- 2 ea 2-7/8” HP short nipple pipe
- 2 ea 2” HP WECO unions

**Cement Slurry Test to be Performed**

<table>
<thead>
<tr>
<th>CEMENT SYSTEM (Cement with Gas prevention system)</th>
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<tbody>
<tr>
<td>Compositions:</td>
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<tr>
<td>Cement class G</td>
</tr>
<tr>
<td>+ ..........gps Cement Fluid Loss Control + Gas-Preventer Agent</td>
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<tr>
<td>+ ..........gps Cement Dispersant</td>
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</table>
BULLHEAD REVERSE SQUEEZE CEMENTING
FOR LAPINDO MUD and gas kick PROBLEM

+ ……..gps Cement Retarder
+ ……..gps Gas Stabilizer
+………etc (let the Cementing company design their own).

<table>
<thead>
<tr>
<th>Total Mixing Fluid</th>
<th>= ……gps</th>
<th>Slurry yield</th>
<th>= ……. cuft/sk</th>
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<tbody>
<tr>
<td>Slurry density</td>
<td>= 15.8 ppg</td>
<td>Porosity</td>
<td>= ……. %</td>
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### TEST RESULTS

1. **Thickening Time, hr : min**
   - Time to reach 50 Bc
   - Time to reach 100 Bc

2. **Rheology (R1B1, F=1)**
   - After Mixing
   - At BHCT
   
<table>
<thead>
<tr>
<th>RPM</th>
<th>6 rpm</th>
<th>3 rpm</th>
<th>10 sec Gel strength</th>
<th>10 min Gel strength</th>
<th>Plastic Viscosity (PV), cP</th>
<th>Yield Value (TY), lbf/100 sqft</th>
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3. **Operating Free water, ml/250 ml**
   - Traces

4. **Fluid loss at BHCT, ml/30 min**
   - Below 17
UNSCALED MODIFIED CEMENTING HEAD DRAWING

1. 2” nipple
2. 2” ball Valve
3. 2” WECO Union
4. Fat End

Can be more than 2 branches of 2” flow lines