From: Hill, Trevor
Sent: Mon May 31 19:01:08 2010
To: Tieszen, Sheldon R
Cc: Wells, Kent; Tooms, Paul J
Subject: Phone call, slide pack, further information
Importance: Normal
Attachments: Secretary Salazar May 31 2010_Final.ZIP

Sheldon
Thanks for the discussions just now. I appreciate the invitation to attend the phone call with Secretary Chu and his scientific advisors at 2pm, but I will not attend on this occasion. However, I will be very happy to answer any questions arising, whether by conversation with yourself or with Tom Hunter.

Please see attached slide pack for forwarding to Tom and Secretary Chu.

<<...>>

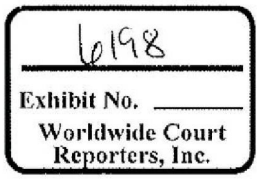
Talk to you later.

Regards

Trevor

Trevor Hill
E&P Engineering Technical Authority - Flow Assurance
[redacted]
BP Exploration Operating Co Ltd
Registered office: Chertsey Road, Sunbury on Thames, Middlesex, TW16 7BP, United Kingdom
Registered in England and Wales, number 305943

Flow Assurance BP Intranet Site Flow Assurance in BP Connect



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BPD153-006249

TREX-06198

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Deepwater Horizon Review

Monday May 31, 2010

Agenda

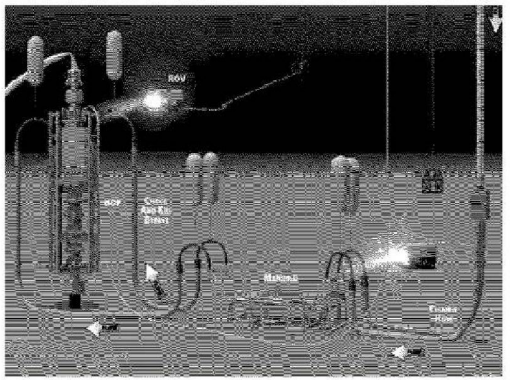
- Top Kill
  - Diagnostics & Analysis
- Containment
  - LMRP Cap Containment
  - LMRP Cap/Near Term BOP Containment
  - Long Term BOP Containment
  - Relief Wells

Summary of Execution

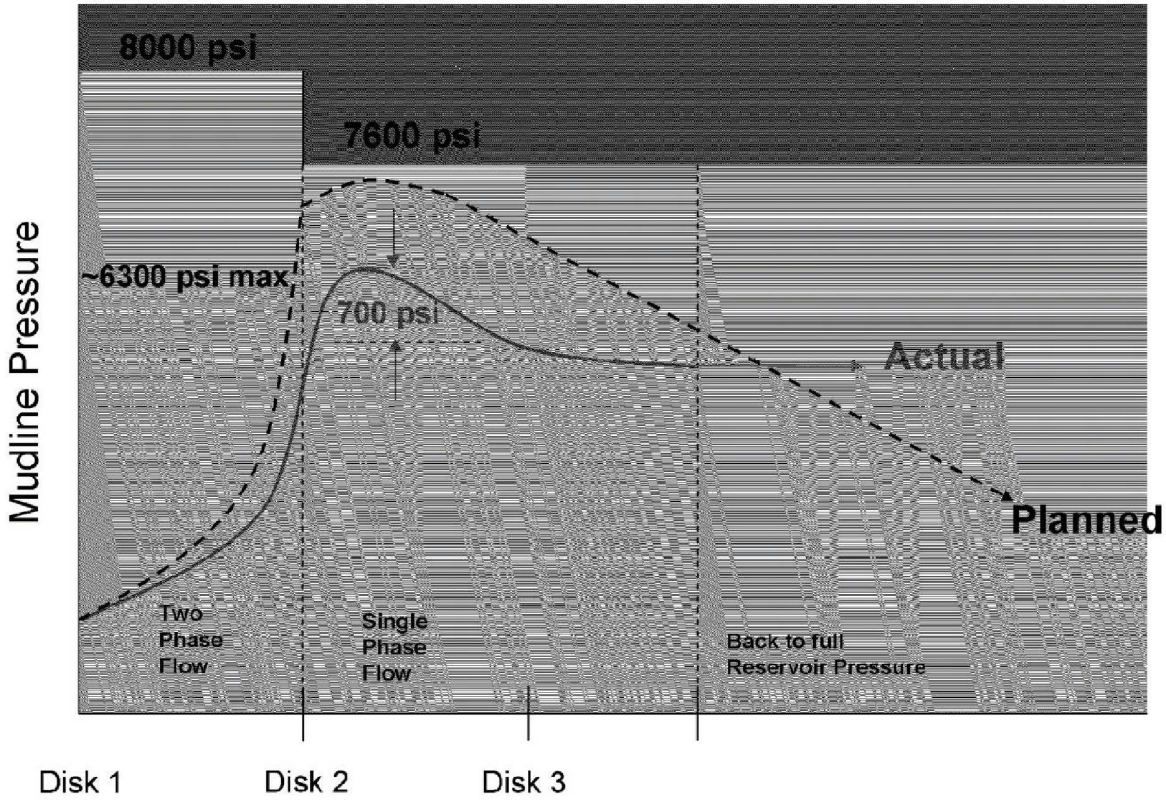
- Top Kill Statistics:
  - 3 separate attempts over 3 days.

    Pumped total 30,000 barrels of heavy mud at rates up to 80 bpm, 11,000 psi surface pressure, 6,000 psi wellhead.
  - Fired 17 different bridging material shots (varying sized balls, cubes and misc objects).
  - 29 vessels in the area, including 10 ROVs.

- Top Kill #1 May 26th
  - Pumped 13,100 bbls, 16.4 ppg, 53 bpm
- Top Kill #2 May 27th
  - Pumped 6,800 bbls, 16.4 ppg, 25 bpm with 15 shots of bridging materials
- Top Kill #3 May 28th
  - Pumped 9,800 bbls, 16.4 ppg, >70 bpm, with 2 shots of bridging materials



Top Kill Pump Actual Performance



Key Messages

- The operation was limited by available rate, not pressure.
- Back pressure required to kill well not generated.
- Pressures flat lined once a ca. 700 psi pressure drop was reached.

Scenarios to Explain Top Kill Results:

Defining Observations

1. Immediately after pumping ceased, hydrocarbons were seen venting at the kink (plume color at the kinks quickly reverted to brown as previously observed for oil/gas).

2. During the kills, always appeared to have gas entrained at the vents in the kink (similar energy/velocity as oil/gas only, but with a grey color due to mud).

3. During Kills, pressures reduced for a while by a maximum of ca.700 psi (for a fixed rate) independent of the rate though "Flat-Lined".

4. Pressure below BOP recovered back to near starting pressure very rapidly as pumping ceased.

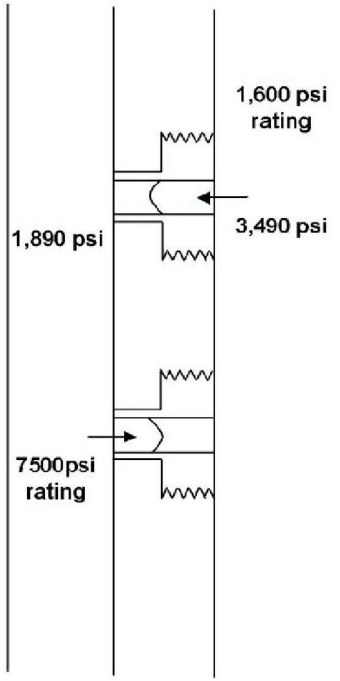
5. Pressure drops across rams in BOP have remained, although they have reduced somewhat.

Implications

- Hydrocarbon (HC) not displaced very far from wellhead
- HC must have alternate path to mud going in, probably via drill pipe.
- Indicates level is controlling the pressure reduction in well. Coincident w/ rupture disc height.
- HC not displaced/limited mud column built in main flow path.
- Drill pipe (including 3.1/2") is still present. Limited flow path by rams causing minor erosion.

Rupture and Burst Disk

- **Outward rupture of a burst disk**
  - No likely scenario
- **Inward rupture of a collapse disk**
  - Need 1,600 psi external pressure differential
  - Reasonable high external pressure is due to 11.1 ppg mud, 3,490 psi
  - Therefore, need internal pressure less than 3,490 – 1,600 = 1,890 psi
    - Gas (.15 psi/ft) from surface = 907 psi
    - Oil (.25 psi/ft) from surface – 1,512 psi
- **Conclusion** – An event- related rupture of a collapse disk can be conjectured.



Conclusions & Path Forward

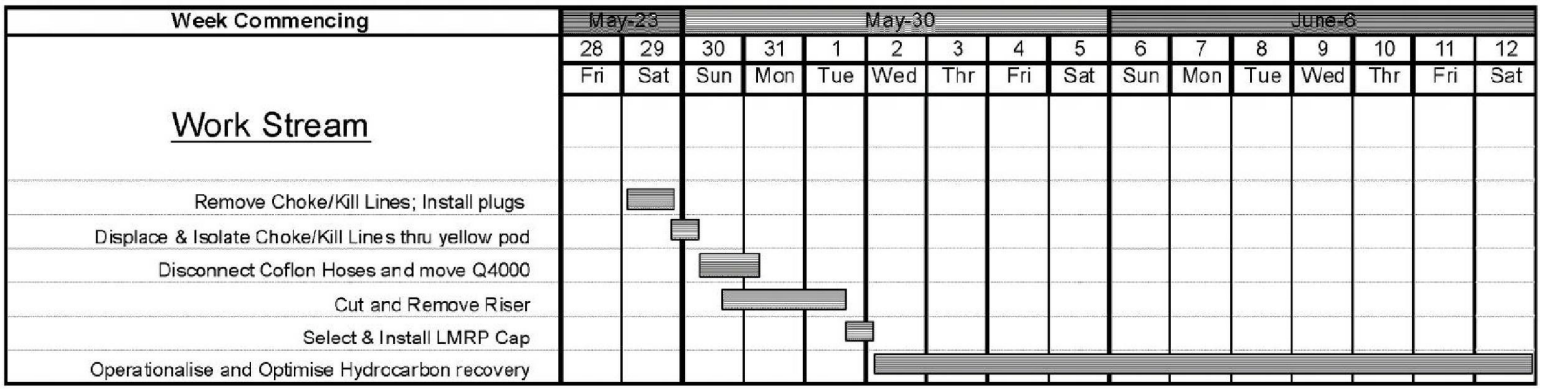
- There is little chance of success repeating the top kill. While options might be available to change the method, these are unlikely to work and carry additional risk.
- If there is a path open to formation then containment is the preferred option.
- Shutting the well in (via BOP on BOP) is no longer a viable option.
  - Need to maintain BOP pressure below 4,221 psi
- Relief wells are most likely solution to kill the well completely.

Containment

- **Objectives**
  - Systematically Minimize Pollution
  - Maintain Base BOP Pressure < 4,221 psi
  - Minimize Hurricane Affects

- **Approach**
  - LMRP Cap Containment
  - LMRP Cap Containment/Near Term BOP Containment
  - Long Term BOP Containment
  - Relief Wells

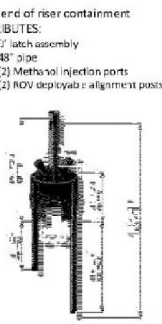
LMRP Cap Containment - Schedule



LMRP Cap Containment
Top Hat – Seafloor Inventory

Top Hat #2 – 'Riser Containment Hat'

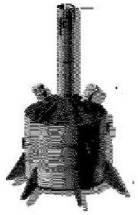
- USE: end of riser containment
- ATTRIBUTES:
  - 'J' latch assembly
  - 48" pipe
  - (2) Methanol injection ports
  - (2) ROV deployable alignment posts



Status: Wet Stored – Not In Storage Area

Top Hat #3 – 'General Purpose Hat'

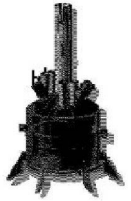
- USE: General Purpose
- ATTRIBUTES:
  - 'J' latch assembly
  - 48" pipe
  - (2) Methanol injection ports

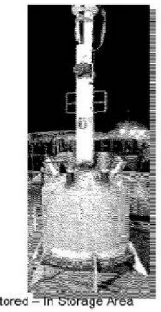


Status: Wet Stored – In Storage Area

Top Hat #4 – 'LMRP Top Hat'

- USE: Upper Flex Joint Flange 'overshot'
- ATTRIBUTES:
  - 'J' latch assembly
  - 48" pipe
  - (2) Methanol injection ports
  - (4) ROV operable 4" diverter valves
  - Internal Rubber Seal Ring – 41" ID

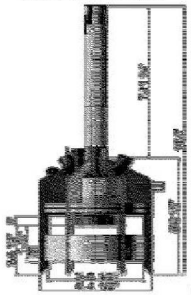


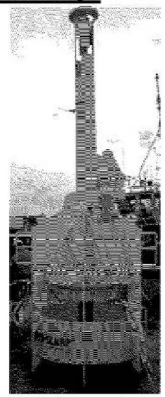


Status: Wet Stored – In Storage Area

Top Hat #5 – 'LMRP Cap'

- USE: Riser 'sealing' for upper LMRP
- ATTRIBUTES:
  - 'J' latch assembly
  - 28" pipe w/ internal elastomeric (26" OD, 22.5" ID, 15.5" length)
  - 45" outer support ring
  - (2) Methanol injection ports
  - (2) ROV operable 4" diverter valves

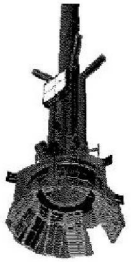




Status: Wet Stored – In Storage Area

Top Hat #6 – 'BOP Top Hat'

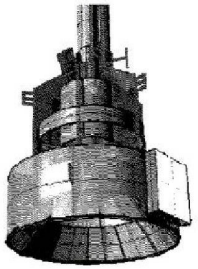
- USE: HC Connector 'overshot'
- ATTRIBUTES:
  - 14" casing
  - 'J' latch assembly
  - 40" pipe
  - (2) Methanol injection ports
  - (4) ROV operable 4" diverter valves
  - Internal Rubber Seal Ring – 25" ID
  - Teflon Landing Pads

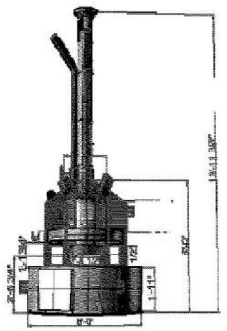


Status: In Production

Top Hat #7 – 'Lead LMRP Cap'

- USE: Weighted Riser 'sealing' for upper LMRP
- ATTRIBUTES:
  - 'J' latch assembly on 9-5/8" casing
  - 48" pipe
  - (2) Methanol injection ports
  - (2) ROV operable 4" diverter valves
  - Internal Rubber Seal Ring: 22" ID / 25" OD
  - Total Weight – 15000 lbs, 72" OD





Status: In Production

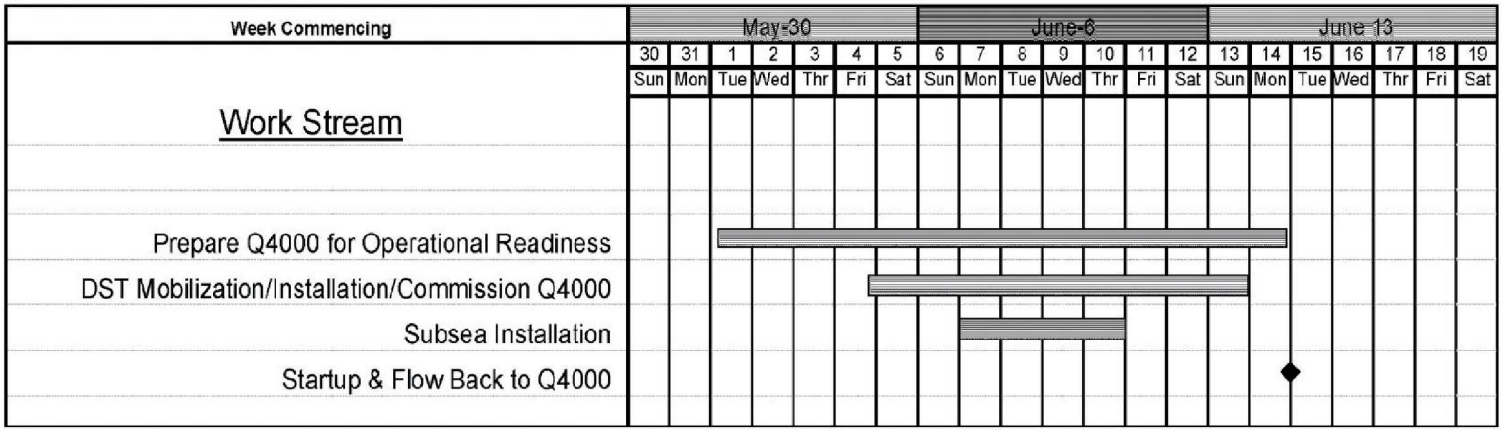
LMRP Cap Containment

11

LMRP Cap Containment

- **Risks**
  - Hydrate Formation
  - Cap "Chatter"
  - Visibility
  - Exceeding Enterprise Capacity
  - Hurricane
  - SIMOPS
- **Mitigations**
  - Methanol Injection
  - "Bypass" Flow Control
  - Subsea Dispersant

LMRP Cap/Near Term BOP Containment - Schedule



LMRP Cap/Near Term BOP Containment
bp
14
Q-4000
Enterprise Drillship
LMRP Cap
Top Kill Manifold

LMRP Cap/Near Term BOP Containment

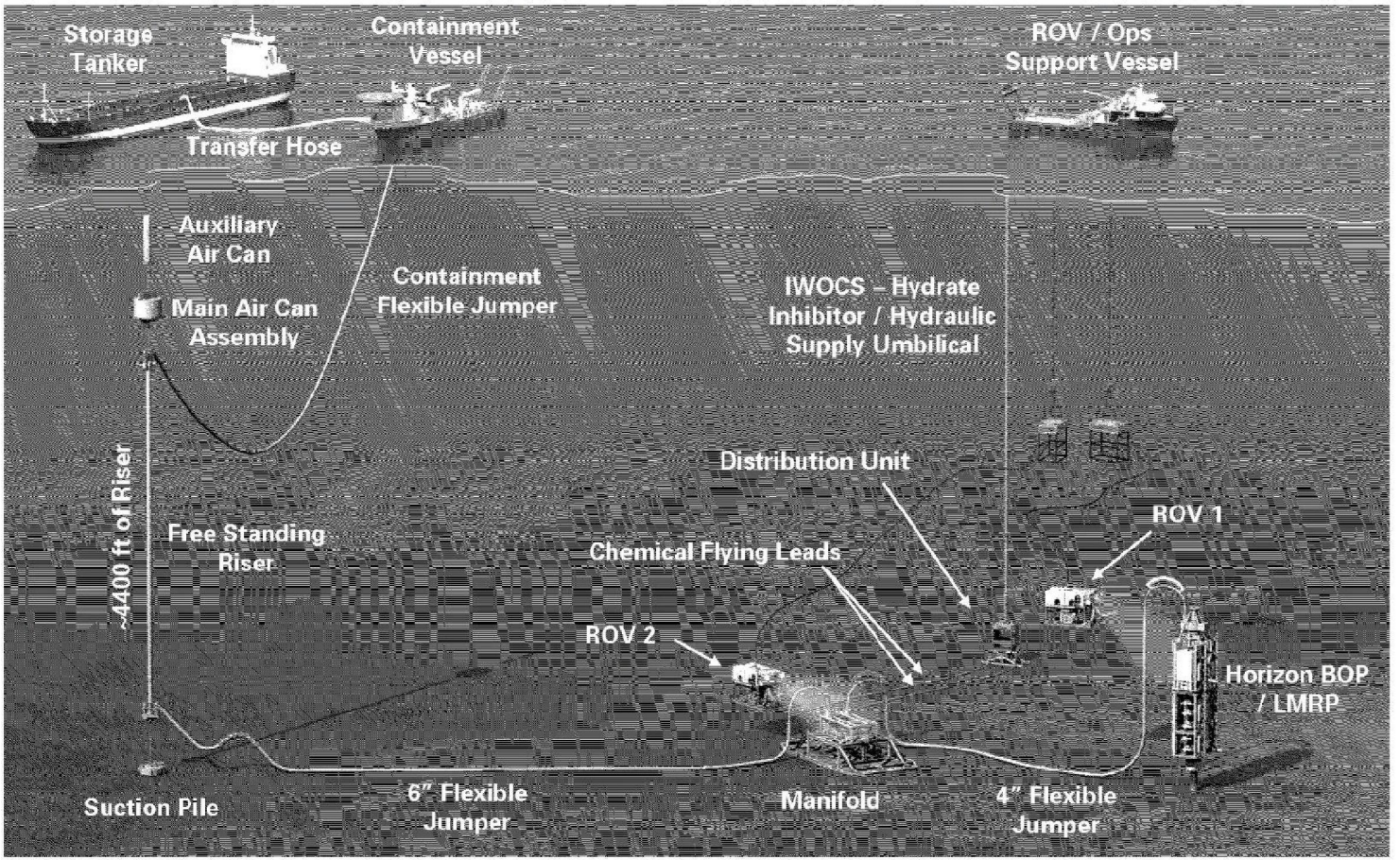
Risks

- **LMRP Cap**
  - Hydrate Formation
  - Cap "Chatter"
- **Near Term BOP Containment**
  - Subsea System Integrity
  - Operability
  - Flow Assurance
- **Both**
  - SIMOPS
  - Hurricanes

Mitigations

- Methanol Injection
- "Bypass" Flow Control
- Balance Production Between Enterprise and Q4000
- Constant Subsea Monitoring
- Subsea Dispersant

Long Term BOP Containment



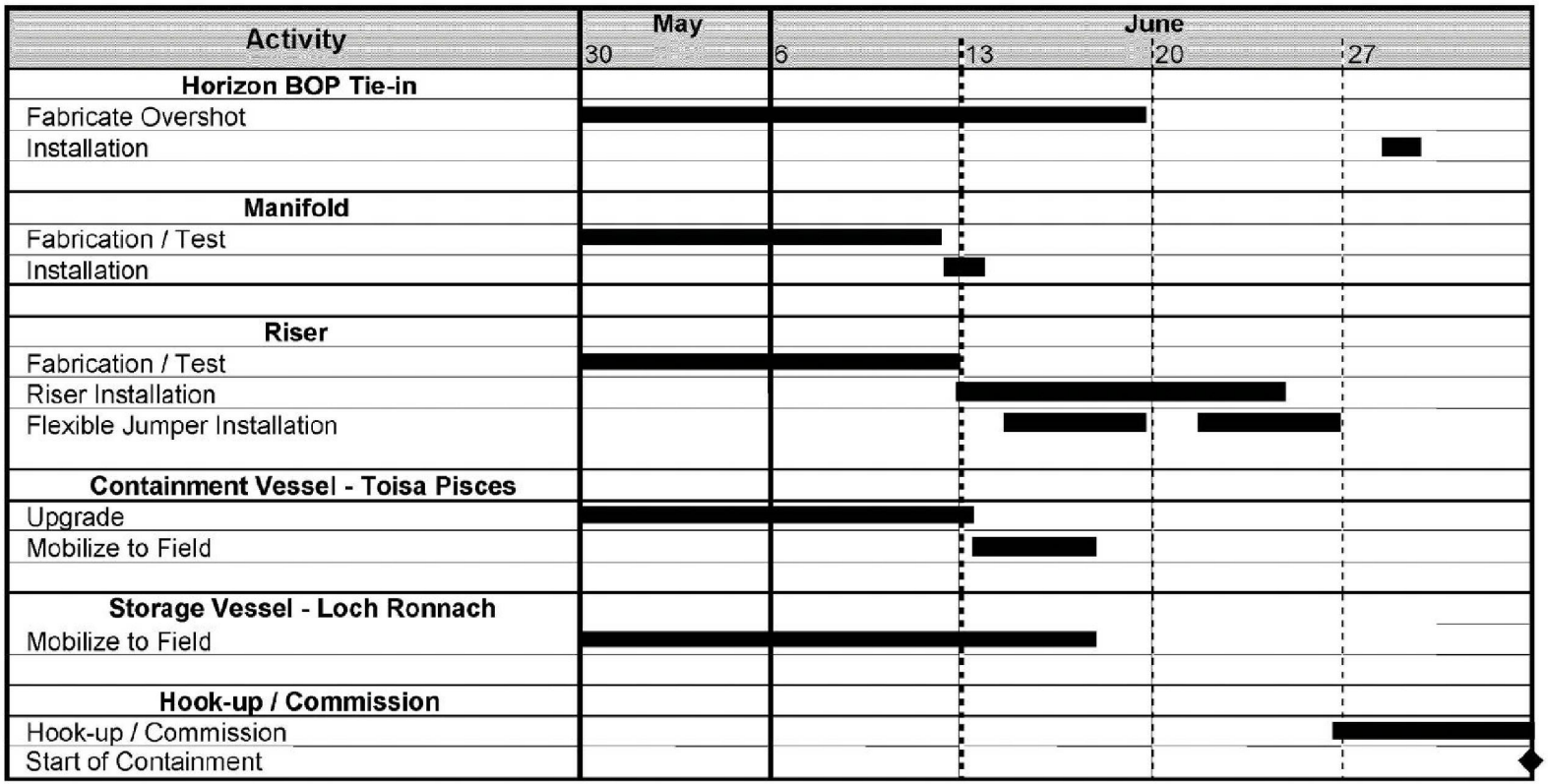
Not to scale, for illustrative purposes only

MC252, ~5,000 ft water depth

Long Term BOP Containment
bp
Storage Tanker
BUOY
Free Standing Riser
Flare
Containment Vessel
Subsea Dispersant Option
PSV 1
Hurricane Choke Vent
PSV 2
ROV/Ops Support Vessel
Hydrate Inhibitor
Manifold
Horizon LMRP
Horizon BOP
17

Long Term BOP Containment - Schedule

MC 252 - Containment and Disposal Project
May 30, 2010



Long Term BOP Containment
Toisa Pisces

Long Term BOP Containment

Buoyancy Can

Long Term BOP Containment

Subsea Manifold

- Subsea Manifold - Cameron
  - 10ksi rated
  - 35 tonnes
  - ~36' L x 24' W x 12' H

BP-HZN-2179MDL00943295

BPD153-006270

TREX 006198.0022

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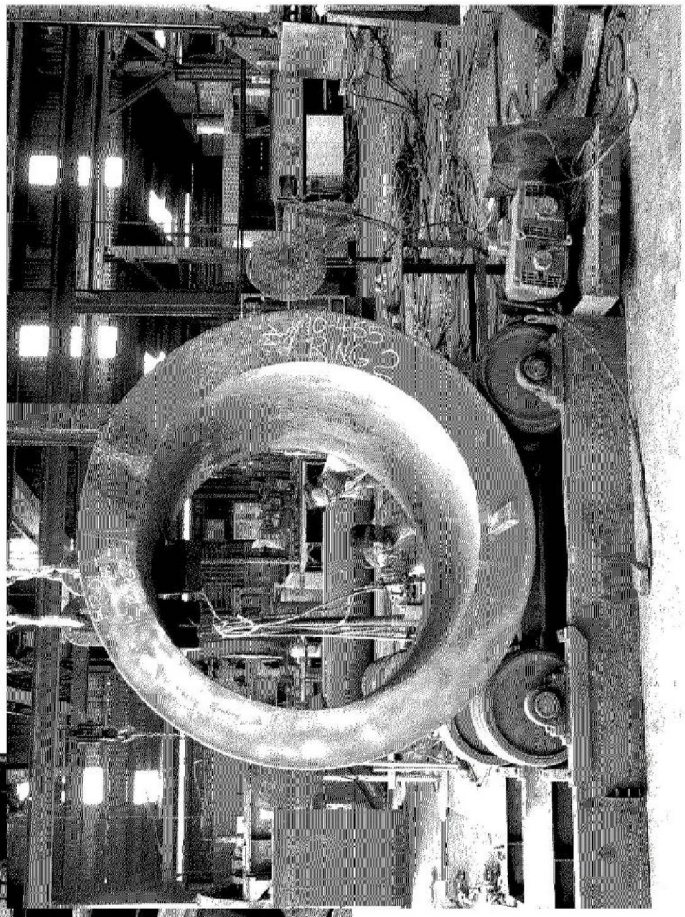
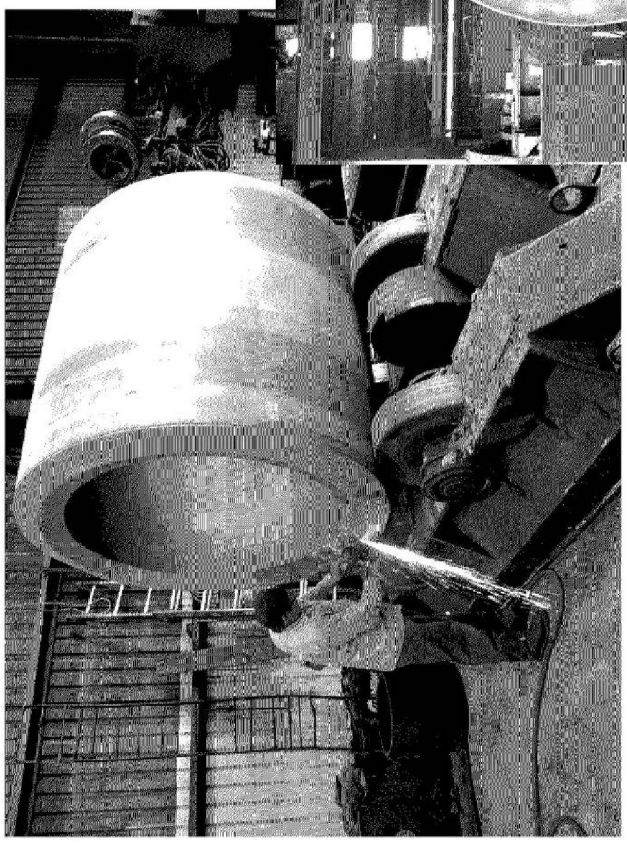
Long Term BOP Containment

Overshot Fabrication





LMRP Cap/Near Term BOP Containment

- **Risks**
  - Schedule Delivery of multiple components
  - BOP Connection with Overshot – installation engineering
  - SIMOPS – installation activities and hand-off from Enterprise
  - Hurricanes
- **Mitigations**
  - Dedicated project team
  - Expediting multiple critical paths
  - Onshore testing (sealing system)
  - Contingency option (Flanged connection)
  - Fully integrated with IMT planning and execution
  - Subsea Dispersant

Relief Wells