bp

May 24, 2010

BY ELECTRONIC DELIVERY

The Honorable Edward J. Markey
Chairman
Subcommittee on Energy and Environment
Committee on Energy and Commerce
U.S. House of Representatives
2125 Rayburn House Office Building
Washington, DC 20515-6115

Re: Response to Chairman Markey's Correspondence, Dated May 14, 2010, to Mr. Lamar McKay, President and CEO of BP America, Inc.

Dear Chairman Markey:

I am writing on behalf of BP America, Inc. ("BPA") in response to your May 14, 2010 letter to Mr. Lamar McKay. We very much appreciate the importance of providing reliable and timely information regarding the flow of oil from the damaged wellhead in the Gulf of Mexico. With that objective in mind and in the spirit of cooperation and transparency that has informed all of our efforts to date, BPA is providing the responses below to your questions and the accompanying documents, identified by the Bates-range BP-HZN-CEC 020095 – 020107.

As you know, the estimate of 5,000 barrels per day is a Unified Command estimate, not a BP estimate. The primary methods which Unified Command has used to estimate the amount of oil flowing from the well are summarized below and in the attached materials, identified as BP-HZN-CEC 020103 - BP-HZN-CEC 020106. The range varies from about 1,000 barrels per day to roughly 15,000 barrels per day, with a best scientific guess of roughly 5,000 barrels per day – the number that Unified Command has used repeatedly and has made clear is only a rough estimate.

1. Prior to the incident, did BP already have an estimate of the maximum amount of oil that could be expected to flow from this well under normal conditions?

Prior to drilling, BP had prepared a production estimate for this well based on expected overall oil volume in place, expected reservoir properties, and the anticipated development concept. This concept included three (3) wells processed through a neighboring oil production facility. The rate associated with this initial well was 15,000 barrels per day.

2. What was the basis for this estimate?

Prior to the drilling of the Macondo well, the estimate of the maximum amount of oil that could be expected to flow from the well under normal conditions was based on interpretation and modeling from: (1) production information from other wells in the Mississippi Canyon; (2) geological information from other wells in the Mississippi Canyon; and (3) seismic data.

3. Please provide all documents that relate to the amount of oil that could be expected to flow from this well, including any estimates of profits that this well was projected to generate.

We have enclosed a production profile estimate for three development wells, one of which is the Mississippi Canyon 252 #1 exploration well. [BP-HZN-CEC 020107.] If you require additional information, please let us know.

4. What is the BP method and scientific basis for the estimate of 5,000 barrels per day? Was this estimate based solely on surface monitoring of the size of the spill?

The estimate of 5,000 barrels per day is a Unified Command estimate, not a BP estimate. The initial work leading to this estimate was carried out by the National Oceanic and Atmospheric Administration ("NOAA"). Two approaches were used – estimation of oil volumes on surface and estimates of velocity of the plume exiting the riser. The documentation provided by NOAA is shown at BP-HZN-CEC 020102.

- It is our understanding that NOAA estimated, through visual observation, that the volume of oil on the water on April 26 was 10,000 barrels. Using this information, a daily flow rate can be estimated as follows.
  - For this oil type, 50% of the volume is expected to evaporate or disperse naturally within hours of release.
  - Thus, 10,000 barrels on the water implies 20,000 barrels were released. (At this point in the response, negligible oil had been skimmed or dispersed, and none had been burned.)
  - The spill began when the Deepwater Horizon sank on April 22. Thus, 20,000 barrels represents four days of flow.
  - 20,000 barrels divided by four days equals 5,000 barrels per day.

- It is our understanding that, by observing the velocity of the plume exiting the end of the riser, NOAA scientists made an estimate of the flow rate at the seabed as follows.
  - Oil leaking from a hole approximately 40 cm in diameter (the Deepwater Horizon riser is 19.5"/49.5 cm ID, and is somewhat crimped at the release point).
  - By visual inspection the velocity of the material in the plume is between 7 and 30 cm per second.
  - The plume contains roughly 50% oil droplets (together with gas bubbles and entrained seawater).
  - Assuming a mid-range velocity of 15 cm per second, NOAA estimated a flow rate of 5,000 barrels per day. The associated range would be from 2,500 to 10,000 barrels per day.

Subsequent estimates of flow rate have been carried out within Unified Command and have yielded consistent results.

5. Were all or any of the latest methods that are available today for estimating the amount of such a spill employed?

To the best of our knowledge, Unified Command has employed, and is continuing to employ, all viable methods to estimate the volume of oil flowing. We have recently learned that the U.S. Geologic Survey ("USGS") has an aircraft-mounted system known as AVIRIS (Airborne Visible/Infrared Imaging Spectrometer), which can measure the thickness of oil on water. The system has been deployed, and the data are currently being processed.

6. Please provide all documents created since the incident occurred that bear on, or relate to, in any way, estimates of the amount of oil being released.

We are producing documents, which can be found at BP-HZN-CEC 020095 - BP-HZN-CEC 020106, that relate to estimates of the amount of oil being released. If you require additional information, please let us know.

In addition, the federal government created a Flow Rate Technical Group ("FRTG"), comprised of members of the scientific community and government agencies, to provide further specificity on the flow rate. Consistent with its stated commitment to transparency and cooperation, BP has provided the FRTG with data showing release points and amounts of oil and gas currently being collected on the Discoverer Enterprise, as well as subsea video of the oil release to assist with FRTG's efforts.

7. What is the basis, if any, for the worst case estimate of approximately 60,000 barrels per day provided to the Energy and Commerce Committee during a May 4th briefing?

Prior to drilling the Mississippi Canyon 252 exploration well, an estimate of the maximum discharge from the well in the worst case scenario of an uncontrolled flow was provided as part of the permitting process. Predictions of reservoir thickness, quality and pressure were considered, in light of the well design, to develop this scenario. After the sinking of the Deepwater Horizon, that earlier estimate was reviewed in light of new data points and assumptions relating to the then-current situation, which yielded the estimated flow rate, in the worst case, of approximately 60,000 barrels per day.

8. Was BP, as has been reported in the press, offered an opportunity to use the latest technology for estimating the volume of oil flowing from the pipe?

Please see answer to Question 5.

9. Did BP accept or refuse any such offers and has BP used the latest technology to estimate the volume of oil flowing from the well?

As noted above, the Unified Command has developed the estimates regarding the rate of oil flowing from the well. It is our understanding that Unified Command has employed, and is

continuing to employ, all viable technologies to estimate the volume of oil flow. We are also assisting FRTG with its efforts to provide further specificity on the flow rate.

10. Has BP used any subsurface technology to estimate the amounts of oil flowing from the well? If so, please provide the results of any such efforts.

BP is not aware of any technology that reliably estimates the amount of oil flowing from the well, either subsea or subsurface.

11. Is it accurate to suggest as BP Vice President Kent Wells did recently that "There's just no way to measure it?" If so, then does BP stand behind the current estimates of the amount of oil flowing or not?

Under the current circumstances, it is indeed challenging to determine the rate of oil flow with precision. No direct measurement of the flow rate at the well is feasible. That said, one can make scientifically informed estimates regarding the likely flow by observing a range of factors at sea level as well as the limited available subsea information. BP believes the Unified Command made a reasonable judgment based on the available information. In addition, BP is currently assisting FRTG with its efforts to provide further specificity on the flow rate.

12. Could an increased flow from the riser pipe affect proposed or attempted efforts to stop the flow of oil, such as the failed containment dome strategy, the so called "junk shot" strategy, attempts to place an additional pipe into the riser, and the drilling of relief wells for plugging the well bore?

Yes. Flow rates have been considered in connection with all efforts to stop the flow of oil.

13. Please indicate for the record BP's current estimate of the amount of oil flowing from the well and provide the basis and methodology for that estimate, along with any uncertainty or error ranges for the estimate.

The primary methods which Unified Command, and in particular NOAA, has used to estimate the amount of oil flowing from the well are summarized above in response to Question 4. The resulting calculation ranges from about 1,000 barrels per day to roughly 15,000 barrels per day, with the most scientifically-informed judgment suggesting a best guess of roughly 5,000 barrels per day. Please note that, as the Unified Command has made clear, these are only estimates.

14. BP has suggested in press reports that it is focused on closing the leak, rather than in measuring it. Are efforts to close the leak inconsistent with efforts to measure its volume? Why wouldn't such efforts actually be complementary?

BP is committed to stopping the leak, containing the oil offshore as much as possible and taking proactive mitigation to protect the shoreline. Although no direct measurement of the flow

rate at the well is feasible, the methodologies and results for inferred estimation are described in the answer to Question 4 above.

15. **Using estimates of 5,000 barrels per day, 40,000 barrels per day and 70,000 barrels per day, and further assuming that the leak continues for another 60 days, what is the projected extent of the spill in square miles and the amount of Gulf coastline in miles that would potentially be affected by such a spill?**

As the Committee undoubtedly appreciates, the situation in the Gulf of Mexico continues to be highly dynamic, and any estimate regarding the potential geographic reach of the spill or the amount of impacted coastline will depend on a range of factors that are not static, including meteorological forecasts which cannot be predicted with any degree of confidence beyond NOAA's three-day forecast.

* * * * * * * *

Please note that the documents that we are providing in connection with these responses contain confidential business information. BP respectfully requests that these documents be maintained confidentially and that, if the Committee or Subcommittee is considering releasing any of these documents, BP be given an opportunity to be heard on that question.

Again, thank you for the opportunity to respond to your concerns. If you have any questions, please feel free to contact me or to have your staff contact Liz Reicherts at (202) 457-6585.

Sincerely,

R. Kevin Bailey

Enclosures

cc (w/o encl.):

Chairman Henry Waxman
Ranking Member Joe Barton
Ranking Member Fred Upton

Using "Standard Guide for Visually Estimating Oil Spill Thickness on Water, ASTM F 2534 - 06."

ATTACHMENT 1

Oil on Water Estimate - Low

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	1500	0.5	50	37500	893
Dull oil	250	0.2	666	33300	793
Dark oil	9	0.15	3330	4495.5	107
Total oil on water				75296	1793
x 2 to compensate for evap and disp					3586
recovered					200
chemically dispersed					1000
Total emitted					4786
Barrels emitted per day					**1063**

Oil on Water Estimate - Best Guess

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	1500	0.66	333	329670	7849
Dull oil	250	0.35	1332	116550	2775
Dark oil	9	0.25	6660	14985	357
Total oil on water				461205	10981
x 2 to compensate for evap and disp					21962
recovered					450
chemically dispersed					3500
Total emitted					25912
Barrels emitted per day					**5758**

Oil on Water Estimate - High

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	1500	0.75	666	749250	17839
Dull oil	250	0.5	3330	416250	9911
Dark oil	9	0.35	13320	41958	999
Total oil on water				1E+06	28749
x 2 to compensate for evap and disp					57498
recovered					700
chemically dispersed					6000
Total emitted					64198
Barrels emitted per day					**14266**

Attachment 2

Using "Standard Guide for Visually Estimating Oil Spill Thickness on Water ASTM F 2534 - 06"

Oil on Water Estimate - Low

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	1641	0.5	50	41025	977
Dull oil	235	0.2	666	31302	745
Dark oil	21	0.15	3330	10490	250
Total oil on water				82817	1972
x 2 to compensate for evap and disp					3944
recovered					200
chemically dispersed					1000
Total emitted					5144
Barrels emitted per day					**935**

Oil on Water Estimate - Best Guess

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	1641	0.66	333	360659	8587
Dull oil	235	0.35	1332	109557	2609
Dark oil	21	0.25	6660	34965	833
Total oil on water				505181	12028
x 2 to compensate for evap and disp					24056
recovered					450
chemically dispersed					3500
Total emitted					28006
Barrels emitted per day					**5092**

Oil on Water Estimate - High

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	1641	0.75	666	819680	19516
Dull oil	235	0.5	3330	391275	9316
Dark oil	21	0.35	13320	97902	2331
Total oil on water				1308857	31163
x 2 to compensate for evap and disp					62327
recovered					700
chemically dispersed					6000
Total emitted					69027
Barrels emitted per day					**12550**

Using "Standard Guide for Visually Estimating Oil Spill Thickness on Water, ASTM F 2534 - 06."

Attachment 3

Oil on Water Estimate - Low

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	1929	0.5	50	48225	1148
Dull oil	238	0.2	666	31702	755
Dark oil	91	0.15	3330	45455	1082
Total oil on water				125381	2985
x 2 to compensate for evap and disp					5971
recovered					400
chemically dispersed					1400
Total emitted					7771
Barrels emitted per day					**1195**

Oil on Water Estimate - Best Guess

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	1929	0.66	333	423956	10094
Dull oil	238	0.35	1332	110956	2642
Dark oil	91	0.25	6660	151515	3608
Total oil on water				686426	16343
x 2 to compensate for evap and disp					32687
recovered					1500
chemically dispersed					4200
Total emitted					38387
Barrels emitted per day					**5905**

Oil on Water Estimate - High

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	1929	0.75	666	963536	22941
Dull oil	238	0.5	3330	396270	9435
Dark oil	91	0.35	13320	424242	10101
Total oil on water				1784048	42477
x 2 to compensate for evap and disp					84955
recovered					3000
chemically dispersed					6000
Total emitted					93955
Barrels emitted per day					**14455**

ATTACHMENT 4

Using "Standard Guide for Visually Estimating Oil Spill Thickness on Water: ASTM F 2534 - 06"

Oil on Water Estimate - Low

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	2481	0.5	50	62025	1477
Dull oil	160	0.2	666	21312	507
Dark oil	35	0.15	3330	17483	416
Total oil on water				100820	2400
x 2 to compensate for evap and disp					4801
recovered					500
chemically dispersed					1800
Total emitted					6901
Barrels emitted per day					**920**

Oil on Water Estimate - Best Guess

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	2481	0.66	333	545274	12983
Dull oil	160	0.35	1332	74592	1776
Dark oil	35	0.25	5660	58275	1388
Total oil on water				678141	16146
x 2 to compensate for evap and disp					32292
recovered					2000
chemically dispersed					4900
Total emitted					39192
Barrels emitted per day					**5226**

Oil on Water Estimate - High

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	2481	0.75	666	1239260	29506
Dull oil	160	0.5	3330	266400	6343
Dark oil	35	0.35	13320	163170	3885
Total oil on water				1668830	39734
x 2 to compensate for evap and disp					79468
recovered					4000
chemically dispersed					7200
Total emitted					90668
Barrels emitted per day					**12089**

Attachment 5

Using "Standard Guide for Visually Estimating Oil Spill Thickness on Water, ASTM F 2534 - 06."

Oil on Water Estimate - Low

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	5256	0.5	50	131400	3129
Dull oil	597	0.2	666	79520.4	1893
Dark oil	120	0.15	3330	59940	1427
Total oil on water				270860.4	6449
x 2 to compensate for evap and disp					12898
recovered					15838
chemically dispersed					16600
burned					5821
Total emitted					51057
Barrels emitted per day					**1891**

Oil on Water Estimate - Best Guess

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	5256	0.66	333	1155164	27504
Dull oil	597	0.35	1332	278321.4	6627
Dark oil	120	0.25	6660	199800	4757
Total oil on water				1633285	38888
x 2 to compensate for evap and disp					77775
recovered					31676
chemically dispersed					33000
burned					11642
Total emitted					154093
Barrels emitted per day					**5707**

Oil on Water Estimate - High

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	5256	0.75	666	2625372	62509
Dull oil	597	0.5	3330	994005	23667
Dark oil	120	0.35	13320	559440	13320
Total oil on water				4178817	99496
x 2 to compensate for evap and disp					198991
recovered					63352
chemically dispersed					66000
burned					23284
Total emitted					351627
Barrels emitted per day					**13023**

ATTACHMENT 6

Seafloor Exit
7" x 9-7/8" Casing Annulus Flow Path

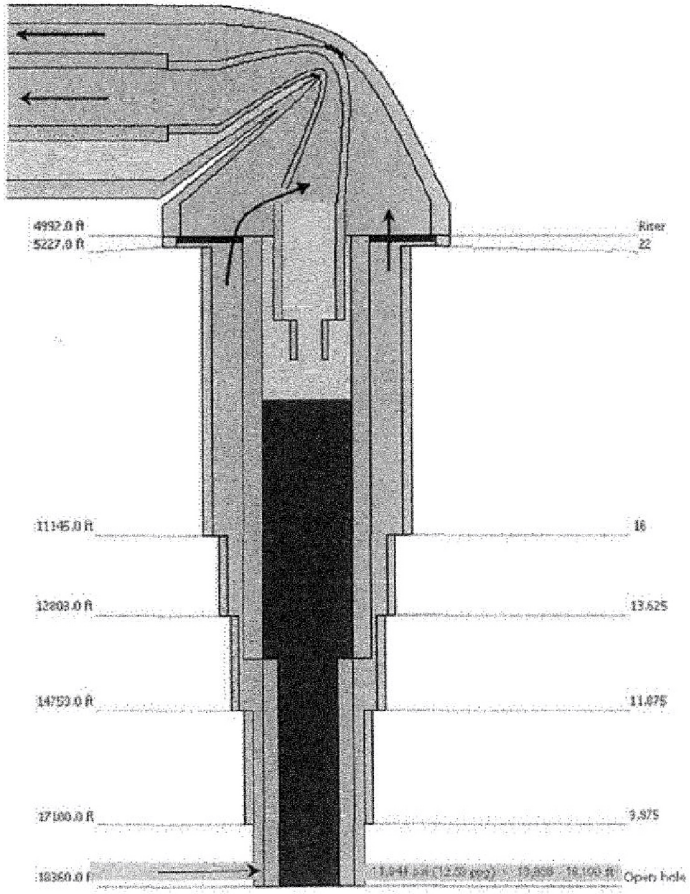
Worst case theoretical flow assumes:

- Split 5-1/2" drill pipe at subsea BOP and flow out 6-5/8" drill pipe
- Maximum theoretical flow rate is 60,000 BOPD

Items that reduce worst case theoretical flow:

- Crushed and bent riser and drill pipe
- Cement sheath in open hole by casing annulus
- Casing hanger and pack-off restriction
- Sand production (unconsolidated formation)
- Shale collapse
- Water production
- BOP functions activated
- Expected range of possible flow rates is 5,000 to 40,000 BOPD

NOTE: Removal of all restrictions (riser, BOP, and drill pipe) adds ~10,000 BOPD to rates above



ATTACHMENT 7

Key Messages

Expected Case:
In the current state a wellhead pressure decrease from 3800 psi to 2270 psi (pressure seafloor) results in a flow rate increase ranging from 15% to 30%

Alternate Case:
If fluid flow is only through the drill pipe – and then the drill pipe is unintentionally removed and flows into the sea (2270 psi):

- For flow up the annulus the rate doubles
- For flow inside production casing the rate triples

Note:
If BOP and wellhead are removed and if we have incorrectly modeled the restrictions – the rate could be as high as ~ 100,000 barrels per day up the casing or 55,000 barrels per day up the annulus (low probability worst cases)

09-0-200210.
ATTACHMENT 8

Estimation of the Oil Released from Deepwater Horizon Incident (26 April 2010, 1200hrs PDT)

1) Surface Oil volume Estimation

Estimating oil volume by the visual appearance of the slick is a highly unreliable process. At best, one can calculate an answer to only an order of magnitude. Other estimation methods, if available, are likely to give more accurate answers

Oil spills separate into thick portions that can be as thick as an inch or more and thin sheen that are only as thick as a few visible light wavelengths. Most of the oil volume in a typical crude oil spill is in the thick part (but most of the area is sheen

Much of the oil from the light crude that is being released will evaporate or disperse in the water column. We would expect at least half of the oil released to be accounted for by these mechanisms

The oil that makes it to the surface is showing signs of emulsification. Emulsified oil can contain up to 90% water.

Weathered oil that has formed tar balls are not detectable by satellites or overflights.

Based upon past experiments, published standards, and actual spills, NOAA/ERD defines the range of thickness of slicks as

Sheen thickness – $(10^{-8}m \leftrightarrow 10^{-5}m)$
Dark oil thickness- $(10^{-5}m \leftrightarrow 10^{-2}m)$

Area coverage of slick (4/26/10), based upon satellite images $(1500km^2 \leftrightarrow 3000km^2)$

→ Sheen volume, using average thickness of 0.1 micron, area of 2000 sq. km and 100% coverage yields oil volume of 200 cu. m = 1200 bbl= 50,000 gal

→ Thick oil volume, using average thickness of 100 microns, 1% average coverage and 50% water content yields an oil volume of 1000 cu. m = 6000 bbl. = 0.25 million gal

→ To an order of magnitude, we estimate that there are around 10,000 bbl of oil on the water surface, or around a half million gallons

2) Estimated Present Volume Release Rate

The following assumptions are used to make a release rate calculation. If any of them are changed, the answer could be significantly different.

The oil is leaking, in a vertical plume from a hole approximately 40 cm. in diameter.

The velocity of the material in the plume is estimated by visual observation to be between 7 cm/sec and 30 cm/sec.

The plume itself contains gas bubbles, oil droplets, and entrained seawater.

Assuming that 50% of the plume volume is oil and a rise velocity of 15 cm/sec, the oil released from this source would be roughly 5000 bbl/day. (approximately 200,000 gal/day) Other sources would contribute additional oil. This answer will be refined as additional information becomes available.

Mississippi Canyon 252 #1
Flow Rate Calculations

Context
A 30 second video clip of hydrocarbons leaking from the broken end of the Deepwater Horizon drilling riser has been released to the public. Various "experts" are challenging Unified Command's best guess estimate of flow rate at the seabed based on this video clip. This note summarizes the various estimates that have been made within Unified Command.

Mass Balance
The mass balance calculation involves estimating, through visual inspection, the volume of oil on the surface of the water. Allowances are then made for natural dispersion and evaporation. Estimates of volumes skimmed, burned, and chemically dispersed then allow an estimate of the oil released at the seabed over the duration of the spill. The calculation is repeated each day weather permitting.

In the early days of the spill, the surface expression of the spill was relatively small. Overflights were able to provide fidelity with respect to the character of the oil on the surface. Three descriptors were used

- Sheen
- Dull
- Dark oil

There are two Standards for estimating the thickness of oil on water using visual descriptors.

- US-based ASTM Standard
- European-based Bonn Agreement

The visual descriptors are different in the two standards and the relationships to thickness are also different.

From April 27 through April 30 daily estimates of flow rate were made on the basis of visual description of the oil on the surface. Three estimates were made each day – low, best guess, and high – to allow for differences between the two standards, and uncertainties around the input parameters.

- Low end was always around 1,000 barrels per day
- Best guess was between 5,000 and 6,000 barrels per day
- High end varied from 12,000 to 14,000 barrels per day

The tables associated with these estimates are attached (Attachments 1-4). These estimates played an important part in Unified Command's decision to raise the estimate of flow rate from 1,000 to 5,000 barrels per day.

During the storm which began on May 1, and for several days after, no visual description of the spill was obtained. From May 8, daily outlines of the spill have been available based on a combination of satellite and aerial overflights. However, because of the size of the spill area, overflights have been unable to provide fidelity on the visual appearance of the oil within the spill area. During the five days in April for which fidelity was available, the ratios of dark oil to dull oil to sheen remained relatively constant at 2/10/88. These ratios have been applied to the total area of spill on May 17. Current estimates of volumes of oil skimmed, burned, and chemically dispersed were then applied to provide an updated range of possible flow rates as follows: 2,000 – 6,000 – 13,000 barrels per day (Attachment 5).

Note that all serious scientists recognize that there are huge uncertainties in estimating oil volumes from visual inspection. Oil thickness is by far the greatest uncertainty, with both sheen and darker oil thicknesses varying by orders of magnitude.

Maximum Discharge Calculation

Prior to drilling the MC 252 exploration well a maximum discharge estimate was provided as part of the permitting process. Predictions of reservoir thickness, quality, and pressure were convolved with the well design to develop a worse case scenario as follows.

- Optimistic assumptions for reservoir thickness, quality, pressure, and fluid properties.
- Total loss of control of well after drilling through reservoir in largest hole size allowed by the well design – 12 ¼".
- Totally uncontrolled flow from drilling riser at surface.

Using these assumptions, a maximum case discharge of 162,000 barrels per day was estimated.

After the sinking of the Deepwater Horizon, this estimate was reviewed in the light of the actual situation as it was understood at that time.

- Formation evaluation of the reservoir interval.
- 9 7/8" hole size in the reservoir
- 7" production tubing across the reservoir
- Flow to seabed through casing annulus
- Split 5 ½" drill pipe at BOP and flow out 6 5/8" drill pipe
- No restrictions in BOP, riser, or drill pipe (ie well head open to seabed – requires BOP to fall off well head)

An absolute worst case flow rate of 60,000 barrels per day was calculated. A more reasonable worst case scenario of 40,000 barrels per day recognizes the following.

- BOP is in place and may be partially activated.
- The riser and drill pipe is crushed and kinked.

- Restrictions provided by cement in the casing annulus, formation collapse, casing hangers, etc., are likely.

This analysis is summarized on Attachment 6.

A more sophisticated version of this calculation has been carried out as more has been learned about pressures at the top and bottom of the well head. This review calculates unconstrained flow rate through the casing as well as up the annulus. Absolute worst cases with wellhead and BOP removed, and no downhole restrictions, are as follows (Attachment 7).

- Annular flow – 55,000 barrels per day
- Casing flow – 100, 000 barrels per day

Fluid Velocity At Seabed

On April 26, NOAA scientists made an estimate of volume release rate at the seabed as follows.

- Oil leaking from a hole approximately 40 cm in diameter (Deepwater Horizon riser is 19.5"/49.5 cm ID, and is somewhat crimped at release point).
- By visual inspection the velocity of the material in the plume is between 7 and 30 cm per second.
- The plume contains roughly 50% oil droplets (together with gas bubbles and entrained seawater).

The NOAA estimate using these assumptions was roughly 5,000 barrels per day (Attachment 8).

Evidence Against Extreme Flow Rates At Seabed

A Professor from Purdue University has calculated a current flow rate at the seabed of 70,000 +/- 14,000 barrels per day. He bases his estimate on the velocity of fluid exiting the drilling riser on the seabed. His estimate is unlikely to allow for the following additional factors required to estimate the flow of oil.

- Drill pipe in riser reducing flow area
- Partial crimping of riser end reducing flow area
- Proportion of gas and entrained water exiting riser with the oil
- Volume reduction of oil as gas escapes en route from seabed to surface
- Flow rate not constant

Finally, there is absolutely no evidence of any floating material being entrained in the plume exiting the broken riser. In a report to the MMS on Oil Spill Containment, Remote Sensing and Tracking For Deepwater Blowouts, PCCI Marine and Environmental Engineering made the following statement.

> *"The blowout plume will make it difficult to approach the well with anything but very massive equipment pieces or ROVs. The operation of ROVs will be difficult around the blowout point. The jet zone will cause vast amounts*

of water to flow towards the well. The danger of having lighter equipment sucked into the flow is large. Many ROVs have been rendered useless by relatively minor blowout plumes"

ROV video shows neutrally buoyant material passing within inches of the plume without being sucked in. From this observation alone, the flow must be relatively minor.

PetroVR Well Production

Macondo-FM_80% vMocando TAM

4-way

Wells 7/27/2009 7:49:09 PM 7.101

Well	Reservoir	Well Type	Unit	Fluid	365 1009	365 2010	365 2011	365 2012	365 2013	365 2014	365 2015	365 2016	365 2017	365 2018	365 2019	366 2020	366 2021	365 2022	365 2023	365 2024	366 2025	365 2026	365 2027	365 2028	366 2029	365 2030	365 2031	366 2032	366 2033	365 2034	365 2035	365 2036	366 2037	365 2038	365 2039	366 2040	366 2041	365 2042	365 2043	365 2044	366 2045	366 2046	365 2047	366 2048	365 2049	365 2050	365 2051	366 2052	366 2053	365 2054	365 2055	365 2056	365 2057	365 2058	Cum
Development Well Completion 1	Primary Target	Oil	bpd	Oil	0	2	0	0	968	1898	1035	629	378	228	137	83	50	30	18	11	7	4	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
Development Well Completion 1	Primary Target	Oil	bpd	Water	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Development Well Completion 1	Primary Target	Oil	Mfd scfc	Gas	0	2	0	0	1	12	8	5	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
Exploration Well Completion	Primary Target	Oil	bpd	Oil	0	2	0	0	563	1454	1324	838	538	305	196	126	81	52	33	21	13	8	5	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
Exploration Well Completion	Primary Target	Oil	bpd	Water	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
Exploration Well Completion	Primary Target	Oil	Mfd scfc	Gas	0	2	0	0	0	12	8	5	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
Development Well Completion 2	Primary Target	Oil	bpd	Oil	0	2	0	0	0	4034	1421	9226	5556	3350	2020	1217	733	442	266	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
Development Well Completion 2	Primary Target	Oil	bpd	Water	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
Development Well Completion 2	Primary Target	Oil	Mfd scfc	Gas	0	2	0	0	0	5	11	7	4	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12