

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.

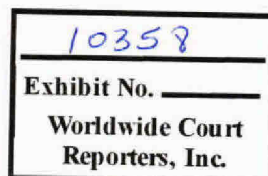
As you know, the estimate of 5,000 barrels per day is a Unified Command estimate, not a BP estimate. The primary methods which Unified Command has used to estimate the amount of oil flowing from the well are summarized below and in the attached materials, identified as BP-HZN-CEC 020103 - BP-HZN-CEC 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.



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- 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

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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?**

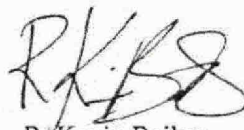
As the Committee undoubtedly appreciates, the situation in the Gulf of Mexico continues to be highly dynamic, and any estimate regarding the potential geographic reach of the spill or the amount of impacted coastline will depend on a range of factors that are not static, including meteorological forecasts 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	bbbs
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	bbbs
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	bbbs
Sheen	1500	0.75	666	749250	17839
Dull oil	250	0.5	3330	416250	9911
Dark oil	9	0.35	13320	41968	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

4/27/10
5/17/2010

Attachment 2

Using Standard Guide for Visually Estimating Oil Spill Thickness on Water ASTM F 2534 - 05

Oil on Water Estimate - Low

	sq mi	Cover Factor	gal/sq m	gals	bbls
Sheen	1641	0.5	50	41025	677
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 m	gals	bbls
Sheen	1641	0.66	333	360659	8587
Dull oil	235	0.35	1332	109557	2609
Dark oil	21	0.25	6660	34955	833

Total oil on water 505181 12028
 x 2 to compensate for evap and disp 24056
 recovered 450
 chemically dispersed 3500
Total emitted 28005
Barrels emitted per day 5092

Oil on Water Estimate - High

	sq mi	Cover Factor	gal/sq m	gals	bbls
Sheen	1641	0.75	666	819580	19516
Dull oil	235	0.5	3330	591275	9316
Dark oil	21	0.35	13320	57902	2331

Total oil on water 1508957 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."

Oil on Water Estimate - Low

	sq mi	Cover Factor	gal/sq m	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 m	gals	bbls
Sheen	1929	0.66	333	423956	10094
Dull oil	238	0.35	332	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 1920
 chemically dispersed 4200
Total emitted 38387
Barrels emitted per day 5906

Oil on Water Estimate - High

	sq mi	Cover Factor	gal/sq m	gals	bbls
Sheen	1929	0.75	666	953536	22941
Dull oil	238	0.5	3300	996270	9425
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

Attach to report 3

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 m	gals	bbbls
Sheen	2481	0.5	50	62025	1477
Dull oil	160	0.2	866	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 1500
Total emitted 6801
Barrels emitted per day 920

Oil on Water Estimate - Best Guess

	sq mi	Cover Factor	gal/sq m	gals	bbbls
Sheen	2481	0.66	333	545274	12983
Dull oil	160	0.35	1332	74592	1776
Dark oil	35	0.25	6860	58275	1388
Total oil on water				678141	16146

x 2 to compensate for evap and disp 32282
 recovered 2000
 chemically dispersed 4900
Total emitted 39192
Barrels emitted per day 5226

Oil on Water Estimate - High

	sq mi	Cover Factor	gal/sq m	gals	bbbls
Sheen	2481	0.75	666	1239260	29506
Dull oil	160	0.5	3330	266400	6343
Dark oil	35	0.35	13320	183170	3885
Total oil on water				1668850	39734

x 2 to compensate for evap and disp 79468
 recovered 4000
 chemically dispersed 7200
Total emitted 90668
Barrels emitted per day 12089

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	75520.4	1853
Dark oil	120	0.15	3300	59940	1427
Total oil on water			270850.4		6449

x 2 to compensate for evap and disp 12898
 recovered 15838
 chemically dispersed 16500
 burned 5421
Total emitted 51057
Barrels emitted per day 1881

Oil on Water Estimate - Best Guess

	sq mi	Cover Factor	gal/sq mi	gals	bbls
Sheen	5256	0.66	383	1195164	27504
Dull oil	597	0.35	1332	278321.4	6627
Dark oil	120	0.25	6660	199800	4751
Total oil on water			1632285		38883

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 m	gals	bbls
Sheen	5256	0.75	666	2625372	62509
Dull oil	597	0.5	3336	994065	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 83342
 chemically dispersed 66000
 burned 23284
Total emitted 351627
Barrels emitted per day 13023

Accepted

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

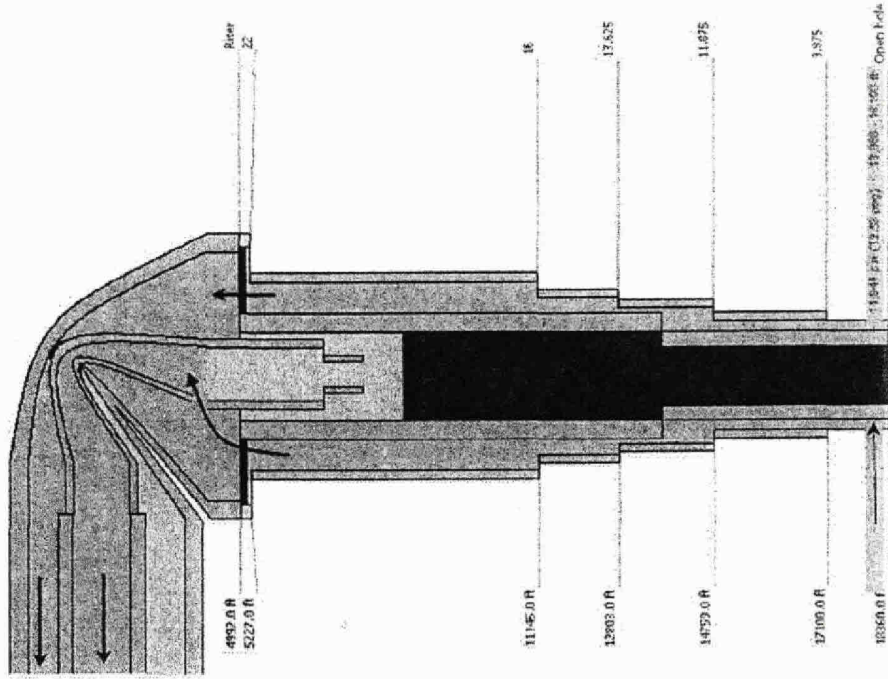
Worst case theoretical flow assumes:

- 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 6

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)

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 ($1500 km^2 \leftrightarrow 3000 km^2$)

- 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.

9 [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 1/4".
- 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 1/2" 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.

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