

To: Thorseth, Jay C
Cc: Bozeman, Walt
Subject: FW: Macondo TAM
Importance: Normal
Attachments: 0904_Macondo_Tam.xls

Jay,

CH1 of Macondo is finished and ready to upload. Ch2 and 3 should also be on their way to you this afternoon from Walt. Recommend we do not upload the drilling chapter till next month (we'll have the actual work done) and we probaly need a discussion around how to frame the economics, the FM, the AFE and then write the economics chapter around that.

The short answer: upload 1,2 and 3 this afternoon.

Regards,

Jasper Peijs
Exploration Manager
Eastern GOM Deepwater
email: peijsj@bp.com
Tel: 281-366 3267
Mobile: 832-668 6738

From: Bondurant, Charles H
Sent: Thursday, April 23, 2009 2:53 PM
To: Peijs, Jasper
Subject: Macondo TAM

Here is the final V1 of the Macondo TAM.

Chuck Bondurant
BP Geologist EGoMX
Westlake 4 02065B
Office # (281) 366-7848



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DocID	◀ BP-HZN-MBI00180472 ▶
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ParentID	BP-HZN-MBI00180471
Page Count	1
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Attachment Title	0904_Macondo_Tam.xls
Application	Microsoft Excel
File Path	\\DELI000016\BP_Peijs_Jasper_export\1\Jasper\2009.PST:/Archive Folders/GOM DW/TEAM/Ch Bondurant/0904_Macondo_Tam.xls
Doc Link	BP-HZN-MBI00180472.pdf ◀ ▶
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[-] Objective Coding

From	bondurch
Subject	TAM Chapter 1
Doc Date	00/00/0000
Date Created	04/09/2008
Date Last Modified	04/23/2009
Date Received	07/02/2010
File Size	4077568





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Technical Assurance Memorandum

Sections: 2 and 3

Region:	Deepwater Gulf of Mexico	
Prospect:	Macondo (Epidote)	
Operator	BP	
Date	Jan-2009	

Prepared by:	Name	Role
	Tanner Gansert	RE Challenger
	Randy Peters	Development Engineer
	Mark Hafle	Drilling Engineer
Endorsed by:	Walt Bozeman	GXR/Eng. Team Leader
Approved by:		

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Section: 2 Pre-Drill Appraisal Plan

2.1 Prospect Synopsis and Summary

Prospect Resources:	64	mmbob
Appraisal Cost:	0	\$mm
Pre-Drill Appraisal Summary		
Macondo is a low risk ILX prospect in which the exploration well will be saved for production and no appraisal wells are planned. Due to high quality, largely extra-salt seismic data, with amplitude anomalies with conformance to structural closure, and considering that the exploration well will confirm approximately 63% of the expected resource volume, appraisal of a potential discovery will be driven by data gathered in the discovery well only.		

2.2 Key Risks, Uncertainties and Opportunities

Appraise Stage (with consideration of risks not resolved with Exploration well):
Charge access is considered the critical risk at Macondo due to the possibility of intermediate carrier beds between source and the primary M56 reservoir. An exploration success would effectively eliminate charge access risk.
Residual risks for appraisal include reservoir continuity/compartimentalization, resource volume and aquifer strength.
A potential opportunity exists in the M54 and 55 horizons in which seismically invisible oil charged sands could be present within closure. The exploration well will penetrate these horizons to test the deep prospective Miocene section.

2.3 Appraisal Strategies

Appraisal Context - (Strategy To Address Uncertainties):
Although all Na Kika area fields had appraisal wellbores, either wells or sidetracks, no appraisal wells are planned. All data required for a project sanction decision will be collected from the exploration well. Charge access and reservoir deliverability risks are addressed in the exploration well through wireline logging, fluid sampling, and sidewall core acquisition. Additionally, the presence or absence of a hydrocarbon-water contact in the wellbore (expected 200' below penetration), along with the observed amplitude conformance to structural closure would establish, to a large degree, the lateral extent of the reservoir.
The remaining risks of compartmentalization and aquifer size/strength require dynamic data and/or production history to be evaluated.
Summary of Exploration Well Data Acquisition
LWD, acquire a full suite of wireline logs, formation pressures, fluid samples (oil and water), and sidewall cores in all potential reservoir intervals. As in the Isabela well, one 2.75 gallon and one six-pack of MPSRs and SPMCs is recommended to ensure adequate volume for fluid studies. In the event of multiple sands at the M56 level, at least one sample should be taken in each sand that could potentially be commercially developed to evaluate. These samples should be evaluated to determine the presence of an asphaltene gradient and variability in asphaltene precipitation between sands. No variable PVT properties have been observed in Na Kika analogue wells.
No whole core acquisition is planned for the exploration well. Core was not obtained in the Isabela well but cores were taken in the offset Santa Cruz well in both the M55 and M56 sands and could serve as analogues for the Macondo reservoir rock.
Summary of Appraisal Well Data Acquisition
There is no appraisal well planned.
Other Appraisal activities - studies, etc.
Fluid samples will undergo full PVT analysis, wax and asphaltene appearance testing, and completion brine compatibility testing.



Seismic Acquisition / Reprocessing:

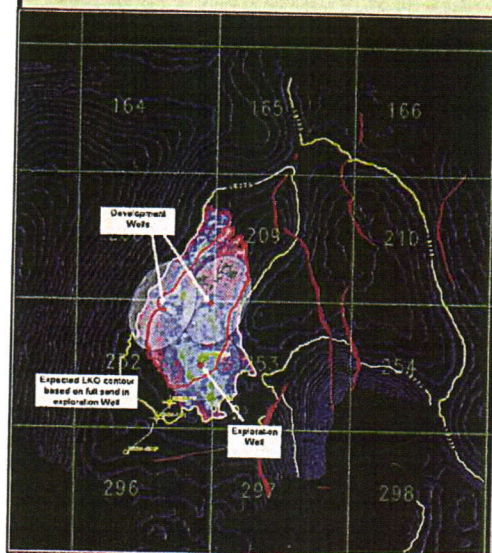
Full anisotropic reprocessing of the existing narrow-azimuth data has been completed to technical limit in 2009. Further reprocessing will be necessary in the event of the following:

1. If post drill actual depths are inconsistent with predicted depths a new model could be created using well information.
2. Na Kika/Kepler wide-azimuth acquisition is executed and footprint covers Macondo (as currently planned). New seismic would be delivered and paid for as part of the Kepler program.

2.3 Appraisal Strategies

Appraisal Well Location Map and Discussion:

No appraisal wells are planned. A successful exploration well that doesn't encounter an oil-water contact will confirm 63% of the predicted resource volume and the reservoir footprint as indicated by the map below. Accordingly, remaining risks that must be mitigated or accepted include reservoir compartmentalization and aquifer support, both of which require dynamic data to be evaluated. In the event of a compartmentalized reservoir, additional wells may be required to adequately drain the reservoir.



2.4 Engineering and Technology

Technology issues and opportunities to support Appraisal:

New technology is not required as expected STIP is 9,870 psi, including 1000 psi working pressure. Accordingly, a 10 ksi development is expected. If discovered pressures are significantly different than predictions, existing 15 ksi technology could be used. Technologies that may enhance development economics that need to be studied during the front end of the project include using buried flowline in lieu of pipe in pipe, utilizing a subsea pig launcher with a single flowline (as a low cost solution) and subsea separation combined with subsea pumping to enhance recovery.

As a subsea tie-back development, flow assurance studies will be critical. Fluid samples must be tested for wax and asphaltene deposition properties for live oil at flowline conditions and as a commingled dead oil stream at export pipeline conditions.

Project engineering study plans to support Appraisal activities

None

2.5 Discovery and Appraisal Capex – table:

Discovery and appraisal capex – events	Cost Item	\$mm, Gross	Comments
1	Exploration Well	137	109 days at 44 days/10k, assuming split for hurricane season
2			
3			
4			
5			
6			
7			





Section: 3 Pre-Drill Development Plan

3.1 Prospect Synopsis and Summary

Prospect Resources		
Developable Resources	64	mmboe
Timing From Discovery to First Oil	64	mmboe
Development Concept Base Type	4	years
Macondo will be a subsea development tied back to a BP operated host for oil and gas export. Potential tiebacks to Pompano (22 miles to the north), Horn Mountain (24 Miles to the northeast), and Na Kika (17 miles to the south) have been identified and evaluated. There will be no water injection for pressure support.		
Development Costs for Base		
F&D Costs / BOE (\$/boe (F&D – Finding and Developments Costs per NRI boe)	1,895	\$mm
Pre-Drill Development Summary	27	\$/boe
The Macondo prospect underlies three blocks in Mississippi Canyon: MC252, 253 and 208. The mapped prospect is predominantly in MC 252 which is owned 100% by BP but it extends north and east into blocks owned 100% by LLOG. A three well development of Macondo could recover 100% of the resources given Nakika like drainage radii and optimum well placements. The economics in Chapter 5 are modeled that way.		
Without access to the adjacent blocks, Macondo's development consists of three wells in MC252 with the intent of draining as much resource as possible from the remaining blocks. This case is shown in the field development below. Due to long drainage distances from well locations in MC 252, to the reservoir boundaries, it is likely that development of the entire resource volume on the northern block (MC208) will not be possible. It is estimated that 80% of the total prospect resource volume or 51 mmboe would be developed. Economics for this case have not been modeled at this time.		
The exploration well will be saved and completed for production. One additional development well will be predrilled for first oil in 4Q 2013. Drilling the final development well is delayed until 3Q 2014 due to ullage capacity limitations on the host facility (Pompano in the base case). This delay also serves to allow collection and analysis of dynamic reservoir data to assist in the design and placement of the third well.		

3.2 Development Thresholds

Development Threshold Volume (Standalone and/or Tieback)	28	mmboe
The threshold reflects the minimum resource volume for the exploration well to be completed and tied back to Pompano economically. Based on the most likely volumetric parameters, this resource base would reflect a single well draining a 1700 acre reservoir. The threshold volume is less than the expected P90 resource volume of 44 mmboe.		

3.3 Depletion Options Summaries Table:

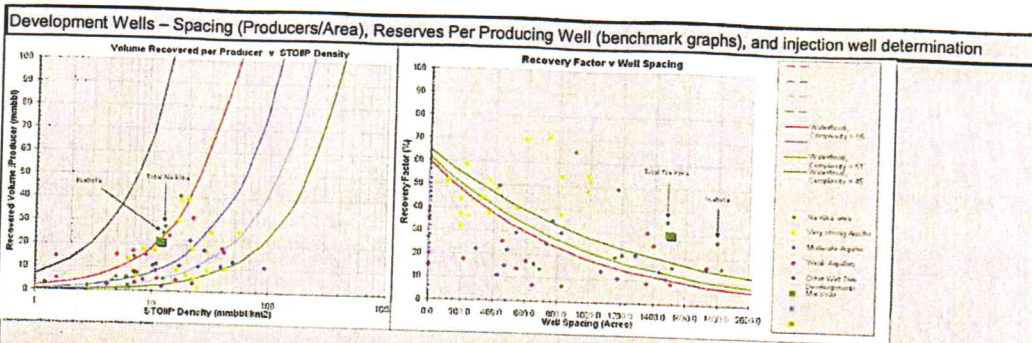
Depletion Option	1	2	3	4	5
Case title	Base (to Pompano)	Base (to Horn Mtn.)	Base (to Na Kika)	min to develop	
resource mmboe	64		64	28	
Total well count (Incl. injectors)	3	3	3	1	
Plateau Rate mmboed	36	36	36	18 (initial rate)	
Fac Cost \$mm	708	770	620	611	
D&C Cost \$mm	618	618	618	224	
Total Cost \$mm	1,326	1,388	1,238	835	

Comments (timing, concept type, etc)	
Case 1	3 well subsea development tied back 22 miles to Pompano. First oil in 4Q 2013.
Case 2	3 well subsea development tied back 24 miles to Horn Mountain. First oil in 4Q 2013.
Case 3	3 well subsea development tied back 17 miles to Na Kika. First oil in 4Q 2013.
Case 4	Single well tied back 22 miles to Pompano.

3.4 Discussion and Details on Depletion Options

Depletion Strategy:
The primary M56 target will be developed with a total of three wells. Two of the wells, the exploration well (which will be kept for production) and one development well, are predrilled. The final well will be drilled approximately six months after first oil, based on ullage capacity constraints at Pompano. This delay yields the opportunity for dynamic data acquisition and analysis to inform the necessity and location of the next development well(s). For developments tied back to Na Kika, which has greater ullage capacity than Horn Mountain, it would be possible to accelerate production by drilling the third well earlier.
Development Analogues:
The closest analogue is Isabela, which discovered oil and gas in M56 and M55, respectively. Conceptual development of the Isabela oil reservoir is based on 1800 acres/well with 25 mmbbl/well at an ultimate recovery factor of 27%.
Development Options - Fluids:
33 API oil with GOR of 800 scf/stb is expected. Production of 0.6 cp oil will not present problems due to viscosity. Flow assurance is the dominant concern for produced fluids due to the long tieback distance. Asphaltene precipitation, hydrate formation and scaling tendencies must be fully analyzed.
Development Options - Facilities and Export:
The most likely development scenario involves the three producing wells being tied into a single looped pipeline to the host via Pipeline End Manifolds (PLEMs). Due to large capital costs associated with long tieback distances (17-25 miles) a single (unlooped) flowline with a subsea pig launcher could be considered. The feasibility of this alternative scenario with respect to operability and reliability of the pig launcher must be evaluated. Alternatively, the existing oil flow line from Mica to Pompano could be utilized, either with dual lines from Macondo to Mica or with a single line from Pompano to Mica via Macondo. A final option, utilizing the existing Ariel-Na Kika pipeline was identified but it is not recommended due to technical challenges.
Development Wells – type of well and completion -issues
Exploration keeper and development wells are planned to be near vertical with frac pack completions. No completion issues are expected.





Well spacing is on the upper limit of GoM-wide benchmarked analogues but it is consistent with Na Kika area fields with comparable resource density (Kepler, Herschel, and Fourier) and Isabela models. The development plan would require reservoir drainage from up to 10,000 ft. from the wellbore. This is 50% farther than the largest drainage radius at Na Kika (6700' at Ariel A1 RC). Wells will be drilled on/near the crest of the structure to optimize recovery/well. If, based on dynamic production data, well drainage area and/or recovery is less than expected, additional wells may be required to effectively drain the reservoir. In the event of a continuous reservoir, it is possible that there may not be sufficient drawdown to mobilize oil from 10,000 ft away. In this case, a well in block 208 would likely be required to develop resource within that block.

Alternatively, if compartmentalization exists, it is possible that an additional well within MC252 would be required to access all recoverable resource.

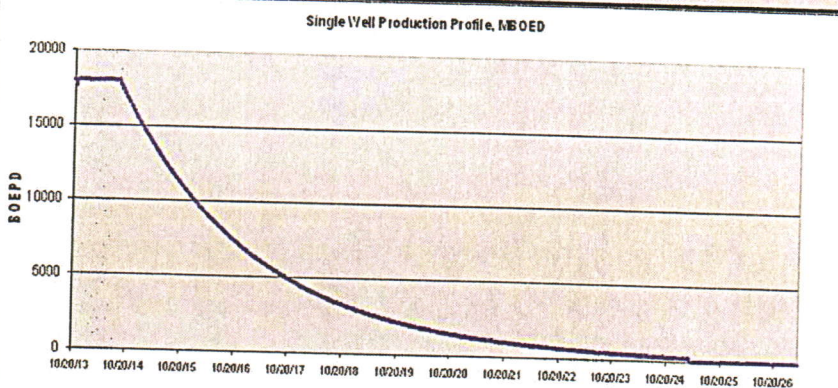
3.4 Discussion and Details on Depletion Options

Recovery Factor : 30%

Recovery Factor Discussion

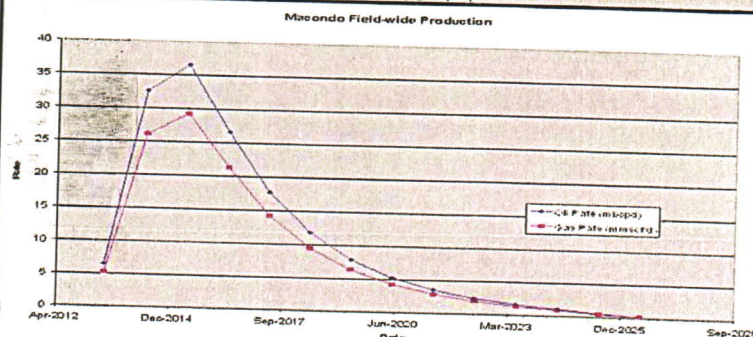
Recovery factor is based on Isabela analogue as determined by material balance modeling. Results of the model are consistent with Na Kika fields average and also worldwide subsea analogues with weak to moderated aquifer support. Benchmarking data indicates that 30% RF is conservative based on Na Kika fields with resource density similar to Macondo (Fourier, Herschel, and Kepler) and also benchmarked fields with strong water drive which have current average recovery of 42% and 45%, respectively. This conservatism can be justified based on expected lower compressibility in Macondo compared to the shallower Na Kika fields and also the large well spacing.

Production Rate – Individual Well Production Rate (graph):



IP is 18 mboepd, consistent with Middle Miocene performance and 2009 LTP assumption for ILX wells.

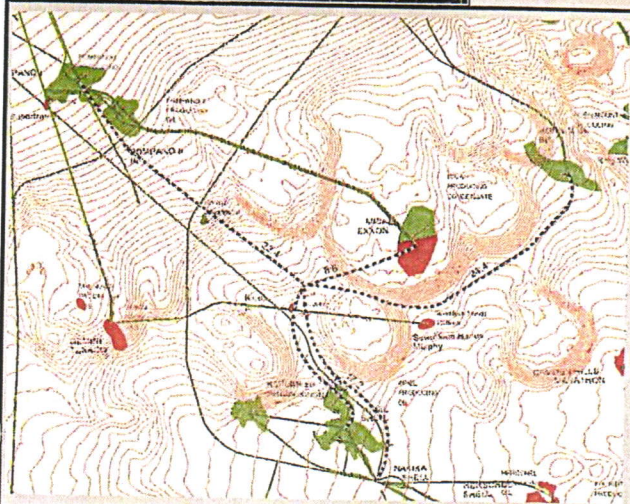
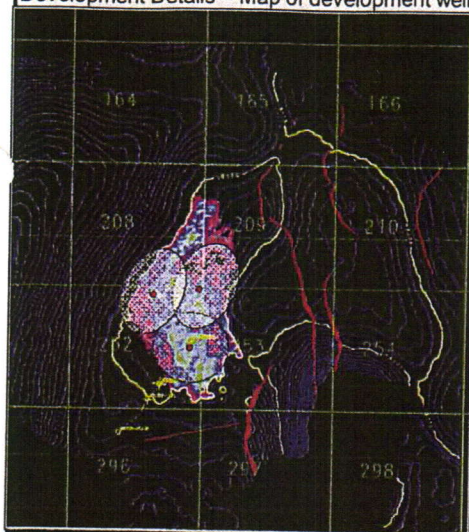
Production Profile – Field Production Rate (graph):



Two wells are predrilled, yielding an initial plateau rate of 32 mbb/d. The third well is then brought online and a peak rate of 36 mbb/d is achieved prior to decline.



Development Details – Map of development wells, timeline of activities, export pipeline map and etc.)



In the base case scenario, first oil occurs 4 years after discovery, based on the Isabela schedule. There is an opportunity to progress Macondo faster because no appraisal wells are planned.

3.4 Discussion and Details on Depletion Options

HSSE plans and issues

No H2S has been encountered in Na Kika fields, Isabela or Santa Cruz. None is expected at Macondo.

Development – Additional discussion on options

Several tieback hosts were identified and evaluated in an effort to determine the best location. Ensuring that any proposed tieback is technically feasible is of primary importance. All proposed hosts would require relatively long tieback distances (17-25 miles) and have the potential for significant flow assurance problems. With the current scoping evaluations completed, Pompano, Horn Mountain and Na Kika should all be considered as viable host candidates however a detailed flow assurance assessment should be conducted for confirmation.

The second major consideration in the evaluation of tieback locations is economics. The primary difference between potential hosts is the tieback distance and therefore subset facility capital cost as detailed above. Additionally, while it is not considered in a standalone evaluation of Macondo, the benefit to BP from PHA fees from any potential partner and at hosts with differing working interests must also be considered (i.e. 75% at Pompano, 50% at Na Kika and 100% at Horn Mountain). Finally, these economic considerations should be tempered by considerations of the presence of additional tieback opportunities to a host facility and of the possibility of Macondo bearing all of a facility's operating costs in the event that it produces longer than the existing production.

3.5 Engineering and Technology

Technology issues and opportunities with timing impacts.

There are no enabling technologies required for Macondo, but several technologies may enhance economics and recovery. Burial of uninsulated flowlines recently studied in Deepstar shows potential for improving flow assurance and decreasing cost and has been done by Shell. Single flowlines could decrease cost but would require a subsea pig launcher. Subsea booster pumping with separation could increase recovery by decreasing abandonment pressure. This would require improvement from our King subsea pump (which did not have separation).

Project engineering study plans to Sanction in addition to Appraise, Select, and Define Engineering studies:

None.



Section: 4 Pre-Drill Drilling and Wells Engineering Plan

Prospect Synopsis and Summary

Exploration Well Cost (Gross):	\$131MM based on planned operation with Marlonas, moored semi. (DHC = \$113M + \$20M for mooring system)	
Exploration Well - Days Per 10K:	55 days/10K LTP performance assumption (Gold benchmarking Pmean performance ranges from 56 - 89 days / 10K for this well, depending on final number of casing strings required.)	
Well TD, Target Depths (feet or meters):	20,200' Well TD.	
Water Depth (feet or meters):	4992'	
Drilling and Wells Engineering Summary	The Macendo well is very similar to the recently drilled Isabela prospect, and correlates closely to several other Mississippi Canyon Miocene prospects. It is an extra-salt well, that will require 7 strings of casing to reach objective depth. It has a somewhat narrow PPOB window expected, which drives the well planning. It will be drilled as a keener well, with rupture disks installed in the 10" casing for future APB mitigation purposes.	

Exploration - Time and Cost Summary

Exploration Well assumptions	Exploration well will be drilled with the Marlonas. It is a moored semi with somewhat limited drilling performance capabilities, and a poor recent track record during hurricane seasons in the OoM	
Best in Class Performance: (Well and day/10k)	Performance benchmarking for this class of well, (7 strings, 10,000 - 17,000 bbl) ranges from	
Spread Rate(\$/min):	All-in Spread rate = \$1,131/Min	
Drilling Days:	~ 100 days	

Appraisal Wells - Time and Cost Summary

Appraisal Wells assumptions:	No appraisal wells for this ILX prospect	
Time and Costs to Drill (Days and Gross Costs):		
Appraisal Well - Days per 10k:		
Sidetrack Time and Costs (Days, Gross Costs) :		
Coring Time and Costs (Days, Gross Costs):		
Testing Time and Costs (Days, Gross Costs):		

Development Wells - Time and Cost Summary

Development Wells assumptions:	Straight hole likely. Likely only 1 additional well for this development.	
Development Well - Drilling and Completion Costs:	~ \$87MM + \$72MM = \$159MM D&C	
Total Development Drilling Costs:	\$159MM	
Time to D&C Producers and Injectors:	133 days	
P10 - P90 Time and Cost Distributions-D&C w/plot:		
Development Wells - Days Per 10K:	Assumed 40 days/10k	
Completion Analogues & Diagrams & Tables:	Single zone - miocene frac pack type completion.	
Recompletion scope/issues/costs:		
Producer/Injector Well Risks:		
Drilling Learning Curve:	N/A with 2 well development.	

Assumptions and Risks

Project Scope Assumptions:		
Key Risk Assumptions:		

Offset Wells Information

Stick Diagrams:		
Offset Well Information:	Compiled in Macendo Hazards Folder	

Offset Well Information	Operator	Well Name	Water Depth (ft/m)	Total Depth (ft/m)	Days per 10K	Distance from proposed location (miles/km)	Comments
1	BP	Isabela - POC 102	4930'	19270'	21.5	2.1	Primary analog well design
2	BP	Isabela - POC 119	4930'	19110'	19	2.1	
3	BP	Isabela - POC 129	4930'	18950'	19	2.1	
4	BP	Isabela - POC 139	4930'	18790'	23	2.1	
5	BP	Isabela - POC 149	4930'	18630'	27	2.1	4 strings - shallow
6	BP	Isabela - POC 159	4930'	18470'	31	2.1	4 strings - shallow
7	BP	Isabela - POC 169	4930'	18310'	35	2.1	
8	BP	Isabela - POC 179	4930'	18150'	39	2.1	





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BP-HZN-2179MDL0290064C



Macondo TAM Chapter 5

Prospect Synopsis

Prospect Resources (MMBOE)	64
Exploration Well Cost (Gross/Net) (\$MM)	\$137/\$137
Ownership (BP WI%)	100%
Prospect Risk	67%
EMV (\$m)	266
Resources in Eco Model (MMBOE)	64
Water Depth (feet)	4800

Context & Assumptions

Strategic Fit	BP's strategy in the GoM is to create a high quality, sustainable business by focusing on material and high equity opportunities. Macondo is a material, low risk tie-back opportunity for 3 facilities including Nakika, Horn Mountain and Pompano.
Land/Co-owners	The Macondo prospect underlies 3 blocks in the Mississippi Canyon area, MC 252, MC 253 and MC 208. BP owns MC 252 at 100%, and the other two blocks are owned by LLOG at 100%. The expected case is based on a 3 well development scenario where all wells are on MC 252 and the development working interest is 100% with subsea tieback to Pompano.
Infrastructure	Macondo will be a subsea development tied back to a BP operated host Pompano for oil and gas export which is 22 miles north of Macondo and BP owns 75%.
Other	Other potential tiebacks considered were Horn Mountain (24 Miles to the northeast with 100% BP working interest), and Na Kika (17 miles to the south with 50% working interest).

Economic Metrics Table

Base Price	NRI Volume (MMBOE)	52
	NPV (\$m)	442
	IRR	19%
	F&D (\$/NRI boe)	27
Low Price	NPV (\$m)	-71.5
	IRR	5%
High Price	NPV (\$m)	946
	IRR	29%

Graphs

