

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 955320 JIV report S/N: 0160

(Note: As practicable as possible the JIT report is to be signed in the field by all the participating parties)

A. GENERAL INFORMATION:

1. Spill incident Number: 955320 2. Type of incident* OIL SPILL
 3. Name of Location BONNY Well 2S FLOWLINE
 4. Name of nearest community OLOKIYA 5. State: RIVERS 6. LGA BONNY
 7. Type of Production facility/Installation OIL FLOWLINE 8. Asset owner/District SWAMP 1

B. INCIDENT INFORMATION:

9. Details of incident

a. Date of incident: 2ND APRIL, 2013
 b. Start date/time of investigation: 1TH APRIL, 2013
 c. Investigation End date: 15TH JULY, 2013 Actual investigation duration, days: 3 DAYS

d. Description of spill point environment

- | | | |
|---|--|--|
| <input type="checkbox"/> Firmed soil | <input type="checkbox"/> Loose soil | <input type="checkbox"/> Recently excavated area |
| <input checked="" type="checkbox"/> Under water | <input checked="" type="checkbox"/> Swampy | <input type="checkbox"/> Exposed pipe surface |
| <input type="checkbox"/> Well Platform (on Water) | | <input type="checkbox"/> Drill Rig |
- e. Description of leak point (tick as applicable);
- | | | |
|---|---|--|
| <input type="checkbox"/> Drilled hole | <input type="checkbox"/> Hack saw cut | <input type="checkbox"/> Tear (_____), |
| <input type="checkbox"/> Complete Rupture | <input type="checkbox"/> Inward dent, | <input type="checkbox"/> Well head tampering |
| <input type="checkbox"/> Failed Weld-on illegal hot tap valve, | <input type="checkbox"/> Failed Clamp | <input type="checkbox"/> Missing Pipeline/Flowline |
| <input type="checkbox"/> Crude oil theft (illegal bunkering) point, | | <input type="checkbox"/> Third party tampering with Clamp |
| <input type="checkbox"/> Third party tampering with valve setting, | | <input type="checkbox"/> Third party tampering with flange, |
| <input checked="" type="checkbox"/> Corrosion | <input type="checkbox"/> Saver-pit over flow, | <input type="checkbox"/> Surge vessel overflow, |
| <input type="checkbox"/> Bulging Outward | <input type="checkbox"/> Flare System/Bund wall failure | <input type="checkbox"/> Accidental 3 rd party equipment impact |
| <input type="checkbox"/> Relief valve failure | <input type="checkbox"/> Valve Failure | <input type="checkbox"/> com unit failure |
| | <input type="checkbox"/> Cold vent | <input type="checkbox"/> Others (specify) _____ |

f. Incident caused by:

- Third party interference (Sabotage; crude theft; Line theft; Accidental 3rd party damage)
 Operational Others (including Mystery spills) _____

g. Spill point coordinates

Measuring unit		<u>Minna Mid Belt</u>	
Northing:		Easting:	
<u>54594.02 m</u>		<u>528755.42 m</u>	

*This can be: a) Oil Spill b) Drilling fluid/Chemical c) Siltation d) construction e) Encroachment f) Fire,

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 955320 JIV report S/N: 0160

C. RISK ASSESSMENT

10. Type of environment:

- Land Swamp Water Seasonal swamp Shoreline/Waterfront

i. Type of environment to which oil has spread:

- Land Swamp Water River (identify) _____
- NO RESIDUAL IMPACT WAS OBSERVED AS AT TIME OF JOINT INVESTIGATION.*

ii. Weather condition

- Rain Sunny Dry Wet Windy Hot Cool

11. Distance from the nearest sensitive habitat

- Government reserved and designated protected area [,m]
 Drinking water source [,m]
 Built up area [,m]
 Farmlands [,m]
 Fish Farm/Pond [,m]
 Fishing net [,m]
 Others (specify) [,m]
- NONE SEEN WITHIN VICINITY*

12. Containment measures put in place;

- Booms Trench Dyke Natural depression Pit
 Others: _____

13. Any pictures or video coverage?

[N]

14. Was there any disruption to the investigation?

[Y]

If yes give brief description:

JOINT INVESTIGATION VISIT (JIV) OF 17TH AND 25TH APRIL, 2013 WAS

INCONCLUSIVE DUE TO THE INABILITY OF JIV TEAM TO ASSESS THE SPILL POINT

AFFECTED FLOWLINE WAS PULLED OUT OF WATER ON THE 15TH JULY 2013 TO
CONFIRM THE CAUSE OF LEAK BY THE JIV TEAM.

D. TYPE/NUMBERS OF PROPERTIES, IF ANY, FOUND WITHIN THE AREA OF SPREAD OF OIL

15. Structures / Properties

S/N	Type of Structures	Description	Size	Number	Comments
<i>NONE FOUND TO BE IMPACTED.</i>					

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 955320 JIV report S/N: 0160

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16. Crops/Economic Trees

S/N	Type of crops	Young	Medium	Matured	Quantity	Comments
	NONE FOUND TO BE IMPACTED					

17. Fish/Nets/Ponds

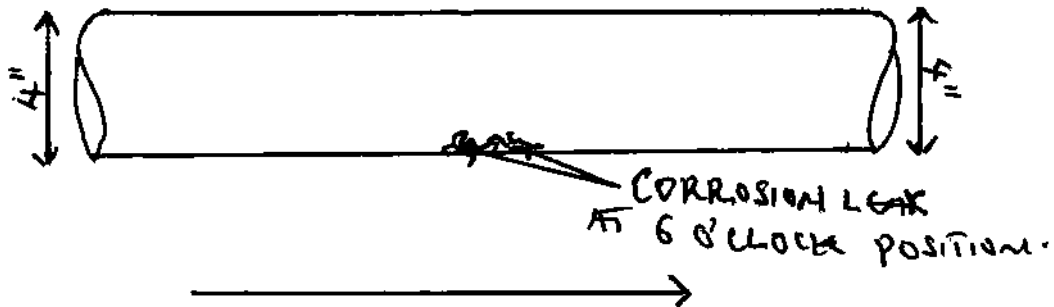
S/N	Fish/Nets/Ponds	Description	Quantity/Size	Comments
	NONE FOUND TO BE IMPACTED			

18. Others (Specify) i.e. Animal Traps

S/N	Others	Description	Quantity/Size	Comments
	NONE FOUND TO BE IMPACTED.			

E. GRAPHIC DESCRIPTION OF LEAK POINT (while detail report of the leak point should be contained in the leak report, overview sketch of the site should be added as an appendix 1)

SECTION OF BONNY WELL 2S FLOWLINE (UNDER WATER) AT
~~OLOMA~~ SHOWING POSITION OF CORROSION LEAK AT 6 O'CLOCK POSITION



FROM BONNY WELL 2 TO BONNY FLOWSTATION.

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 955320 JIV report S/N: 0160

G. INCIDENT INFORMATION:

20. Impacted Area Details

- Total calculated area of impact NILL
- Impact within SPDC R.O.W NILL
- Impact outside SPDC R.O.W NILL

21. Volume of oil recovered before completion of JIV (V_{rec}):

Recovered oil V_{rec} :	<u>30</u>	Barrels
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22. Computation of estimated residual volume on site

a. Computation of estimated volume of pool of free phase oil (on land or confined water body).

- i. Area (m^2) occupied by pool of free phase oil NOT APPLICABLE
- ii. Average Depth (m) of pool of free phase oil NOT APPLICABLE
- iii. Emulsification factor NOT APPLICABLE

iv.

Estimated Volume of pool of free phase oil. V_{pool} :	<u>NIL</u>	barrels
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b. Computation of estimated volume of infiltrated oil in the soil (V_{inf}).

1. Estimated Volume of infiltrated oil at spill point ($V_{inf a}$)

- i. Area* (m^2) of soil covered by the oil: _____
- ii. Average Depth (m) above leaking facility i.e. pipeline/flowline: _____
- iii. Soil type: NO iv. P_e (effective porosity of the soil): _____
- v. Cause of spill: NO vi. Oil type: _____
- vii. Oil Residence time on site, day: _____
- viii. Average depth of infiltration below leaking facility i.e. pipeline/flowline: _____
- ix. Estimated depth of infiltration around spill point: _____

x.

Estimated Volume of infiltrated oil at spill point. $V_{inf a}$:	<u>NIL</u>	barrels
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2. Estimated Volume of infiltrated oil at second spill point [if applicable] ($V_{inf b}$)

- i. Area* (m^2) of soil covered by the oil: _____
- ii. Average Depth (m) above leaking facility i.e. pipeline/flowline: _____
- iii. Soil type: NOT APPLICABLE iv. P_e (effective porosity of the soil): _____
- v. Cause of spill: NOT APPLICABLE vi. Oil type: _____
- vii. Oil Residence time on site, day: _____
- viii. Average depth of infiltration below leaking facility i.e. pipeline/flowline: _____
- ix. Estimated depth of infiltration around spill point: _____

Estimated Volume of infiltrated oil at spill point. $V_{inf b}$:	<u>NIL</u>	barrels
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3. Estimated Volume of infiltrated oil outside immediate spill point(s) region ($V_{inf c}$)

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 955320 JIV report S/N: 0160

- i. Area (m²) of soil covered by the oil: _____
- ii. Area (m²) of the pool of free phase oil in touch with soil: _____
- iii. Average Depth (m) below ground surface of infiltration of oil: _____
- iv. Soil type: NOT APPLICABLE
- v. P_e (effective porosity of the soil): _____

vi.

Estimated Volume of infiltrated oil. At V_{inf} :	<u>NIL</u>	barrels
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23. Computation of estimated volume of oil on open water based on standard coloration.

- i. Total area of oil on open water: NIL
- ii. Table of average depth of oil on water based on coloration (**Spill Factors from USCG FOG (2000 Edition))

	Thickness (mm)	Percentage coverage	Volume (m ³)
Barely Visible	0.00004		
Silvery	0.00008		
Slight Color	0.00015		
Bright Color	0.0003	<u>NOT</u>	
Dull	0.001	<u>APPLICABLE</u>	
Dark	0.002		
Black oil	0.1		
Emulsion (30% Oil)	1		

iii.

Percent Total	100%
Estimated Volume of oil on open water. V_{wat} :	<u>NIL</u>

 Barrels

24. Calculation of evaporated volume:

- i. Estimated Volume available for evaporation within surface area: _____
- ii. E-Factor: BONNY LIGHT EVAPORATION FACTOR INCLUDED IN ESTIMATED SPILL VOLUME.

iii.

Estimated Volume of evaporated oil. V_{evap} :	<u>NIL</u>	Barrels
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Evaporation Factors (E-Factor) for SPDC Crude oil			
Oil Type	Days on site	Bonny Light	Bonny Medium
Oil Residence time	< 1 day	10%	5%
	1-7 days	25%	15%
	> 7 days	40%	25%

25. Net Estimated Spilled Volume $V_{Est}(bbls) = V_{evap}(bbls) + V_{wat}(bbls) + V_{inf}(bbls) + V_{pool}(bbls) + V_{rej}(bbls) =$ SEE ATTACHED.

Estimated Reported Volume $V_{rep}(bbls) =$**

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 955320 JIV report S/N: 0160

Calculation of the respective estimated volume is to be done on site as far as practicable using the new spill volume estimation software on site; Conversion of m³ to barrels is Volume (m³) x 6.29; ****Round up estimated volume to next whole number using the following rules:**

- Any spill volume in excess of 1 bbl is rounded up to the next whole number.
- Any spill volume in less than 1 bbl is rounded up to the next 0.1 bbl.

Examples: Calculated volume = 15.3 bbl ----- Reported volume = 16 bbl
 Calculated volume = 0.35 bbl ----- Reported volume = 0.4 bbl
 Calculated volume = 0.01 bbl ----- Reported volume = 0.1 bbl.

Wherever this estimation tool is not applicable please refer to paragraph 6c (Deviations) of the JIV procedure to use appropriate steps for column estimation; record the calculation in a plain sheet of paper and attach to the JIV report.

26. GENERAL STATUS OF THE SITE

A. Joint investigation of the incident site found that there is no residual impact after the initial response and therefore recommend that the site be closed out <input checked="" type="checkbox"/>
B. Investigation of the incident site showed that there is residual impact on site requiring further works <input type="checkbox"/>

27. REPRESENTATIVES

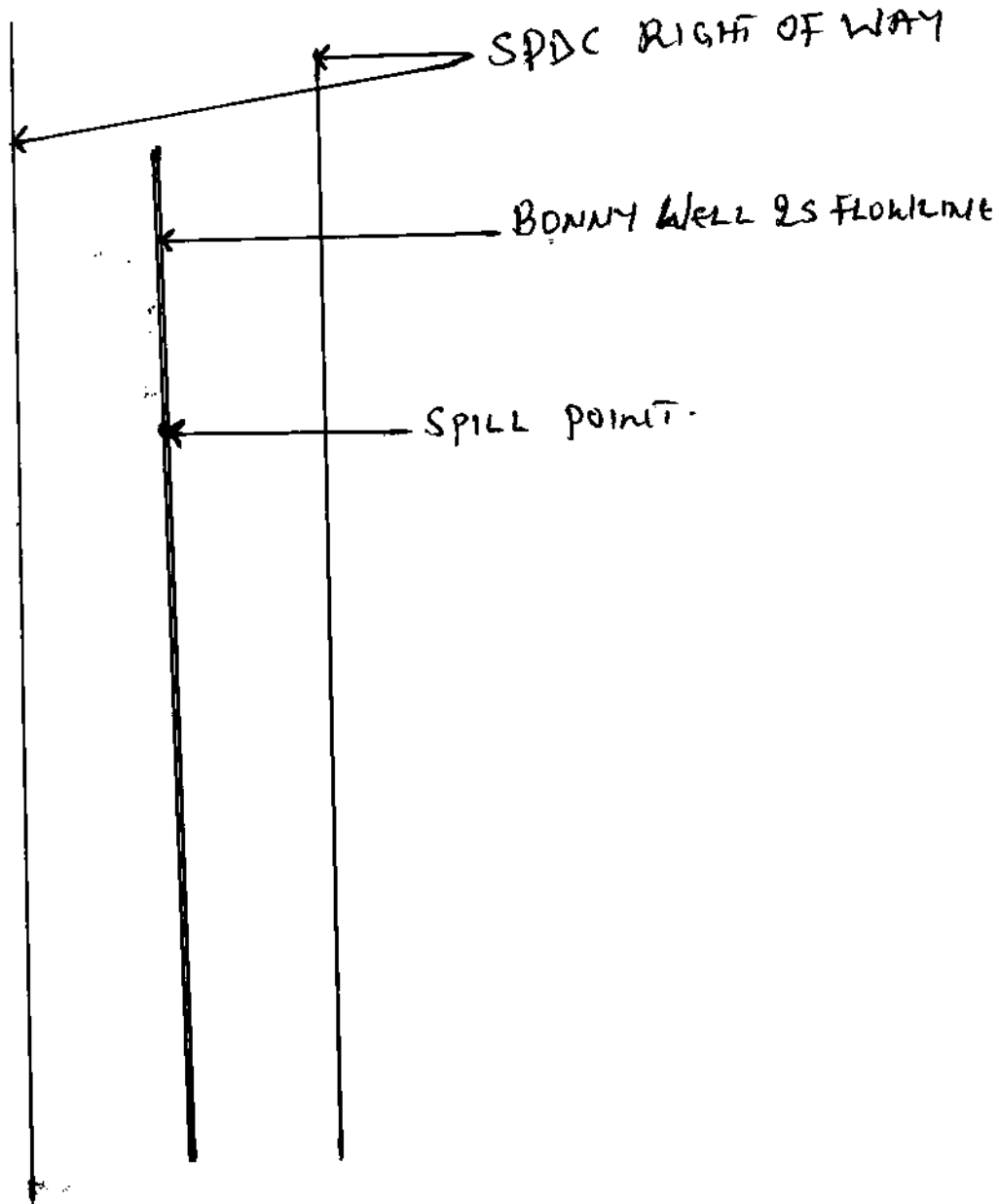
This report was filled, agreed and signed on the <u>15/07/2013</u> by joint investigation representatives from
• Host Community: <input checked="" type="checkbox"/>
• Department of Petroleum Resources [DPR]: <input type="checkbox"/>
• National Oil Spill Detection and Response Agency [NOSDRA]: <input checked="" type="checkbox"/>
• State Ministry of Environment [SME]: <input checked="" type="checkbox"/>
• Nigeria Police Force [NPF]: <input type="checkbox"/>
• Shell Petroleum Development Company [SPDC]: <input checked="" type="checkbox"/>
• Signatories agree with reported findings: <input checked="" type="checkbox"/>
• Separate DPR form has been filled out with same findings <input type="checkbox"/>
<i>Tick as applicable</i>

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 955320 JIV report S/N: **0160**

28. Appendix 1: Overview sketch of the site

Location: BONNY WELL 2S FLOWLINE AT ~~Bonny~~ OLOMA.



Notes from the JIV to Bonny Well 2s Flow line at Oloma

Duration of the JIV	
17 th April 2013	JIV team mobilized to the spill point but unable to assess the spill point.
25 th April 2013	For the second time, JIV team mobilized to the spill point but unable see the spill point due to the terrain and asset team planned for re-visit.
15 th July 2013	Finally, JIV team mobilized to the spill point and JIV was successfully conducted. The JIV team agreed that the incident was caused by corroded pipe (corrosion). JIV form is yet to be signed by the regulators and community rep.
Cause of spill	
<ul style="list-style-type: none"> The incident was agreed to have been caused due to operational (corrosion). 	
Area of impact	
<ul style="list-style-type: none"> On the day (15th July 2013) of investigation no residual impact was observed on site. The team assumed that the impact could have been washed away by the tidal influence because spill point was submerged under water which was linked to the Bonny river. Volume recovered from the incident was 30 barrels. 	
Volume spilled	
<p>No residual impact was observed on site at time of investigation, as most of the oil spilled could not be seen in the environment; hence direct assessment method as contained in our standard JIV report could not be used. Assumptions for the calculation of spilled volume was done based on the equation:</p> <ul style="list-style-type: none"> The pressure differential $\Delta p (p - p_a)$ at spill point is up to 10197.162kg force per m² as at the time that the ESD got activated and pressure dropping to 1bar. Bonny light is the crude in the line and the density (ρ_{liq}) is 850 kg per m³ Time (T) from the start to the end of the oil leakage was 5sec. Surface area of the holes (A_o) on the line is taken to be 0.0018m² (as was measured on site). Standard discharge coefficient (C_o) is taken as 0.62 The fraction (f) of oil in the pipe during the incident is taken as 77% Using the spill volume formula: $AoTC_o \sqrt{\frac{2(p - p_a)}{\rho_{liq}}} f$ <p>Taking into consideration the % of oil in the line, the time that the ESD got activated and the duration of the spill, total volume spilled is estimated to be 0.132 barrels.</p> <p>The point of leak is about 0.7Km from the well head. The flow line pressure (FLP) setting is such that the lower set point is set at 80% of the FLP. The speed of response of the flow line safety valve is a function of the nature of source of leak. A pin hole leak will take a longer time for the actuator to respond as the pressure will decline slowly to 80% of FLP. However, larger hole will cause a sudden drop in pressure. Based on distance of well head from point of leak and size of hole, it will take less than 5 sec for the FLSV to shut- in the well.</p> <p>NOTE: The length of the line from the spill point to the well is 700m and beyond it is another 300 m of the flowline before a bend and lowered gradient towards the Flow station. Based on the location of the spill points at 6'O' CLOCK position, it is assumed that the content of the line within the 1000m stretch will have drained out to the environment. The radius of the line is 0.051m and using the formula $\pi r^2 L$ and fraction (f) of oil in the line. The available oil within the section to drain out it.</p> <p>Total available volume of oil in the pipe at any moment is given as $\pi r^2 L f$.</p> <p>Radius of the pipe is 0.051m Length of the pipe from Well head to flow station is 1000m The fraction (f) of oil in the pipe during the incident is 0.77 Total available volume is estimated to be 39.246 barrels.</p> <p>Therefore estimated spilled volume is 40 barrels</p>	