

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 994463 JIV report S/N: 0143

(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: 994463 2. Type of incident* OIL SPILL/FIRE
 3. Name of Location 28" BOMU - BONNY TRANS NIGER PIPELINE.
 4. Name of nearest community BODO WEST 5. State: RIVERS 6. LGA GOKANA.
 7. Type of Production facility/Installation OIL PIPELINE 8. Asset owner/District PIPELINE/SWAMP.

B. INCIDENT INFORMATION:

9. Details of incident

- a. Date of incident: 19TH JUNE, 2013
 b. Start date/time of investigation: 20TH JUNE 2013
 c. Investigation End date: 26TH JUNE 2013 Actual investigation duration, days: 7 (SEVEN) DAYS
 d. Description of spill point environment
 Firmed soil Loose soil Recently excavated area
 Under water Swampy Exposed pipe surface
 Well Platform (on Water) Drill Rig
 e. Description of leak point (tick as applicable);
 Drilled hole Hack saw cut Tear (_____),
 Complete Rupture Inward dent, Well head tampering
 Failed Weld-on illegal hot tap valve, Failed Clamp Missing Pipeline/Flowline
 Crude oil theft (illegal bunkering) point, Third party tampering with Clamp
 Third party tampering with valve setting, Third party tampering with flange,
 Corrosion Saver-pit over flow, Surge vessel overflow,
 Bulging Outward Flare System/Bund wall failure Accidental 3rd party equipment
 impact Valve Failure com unit failure Cold vent
 Relief valve failure 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>METER</u> (MINNA MID-BEIT.)	
Northing: <p align="center"><u>63581.53</u></p>	Easting: <p align="center"><u>532399.34</u></p>

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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) _____

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).

12. Containment measures put in place;

- Booms Trench Dyke Natural depression Pit
 Others: _____

13. Any pictures or video coverage?

[Y] [N]

14. Was there any disruption to the investigation?

[Y] [N]

If yes give brief description:

NOT APPLICABLE

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
	<u>NONE WITHIN AREA OF IMPACT</u>				

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16. Crops/Economic Trees

S/N	Type of crops	Young	Medium	Matured	Quantity	Comments
NONE WITHIN AREA OF IMPACT.						

17. Fish/Nets/Ponds

S/N	Fish/Nets/Ponds	Description	Quantity/Size	Comments
NONE WITHIN AREA OF IMPACT.				

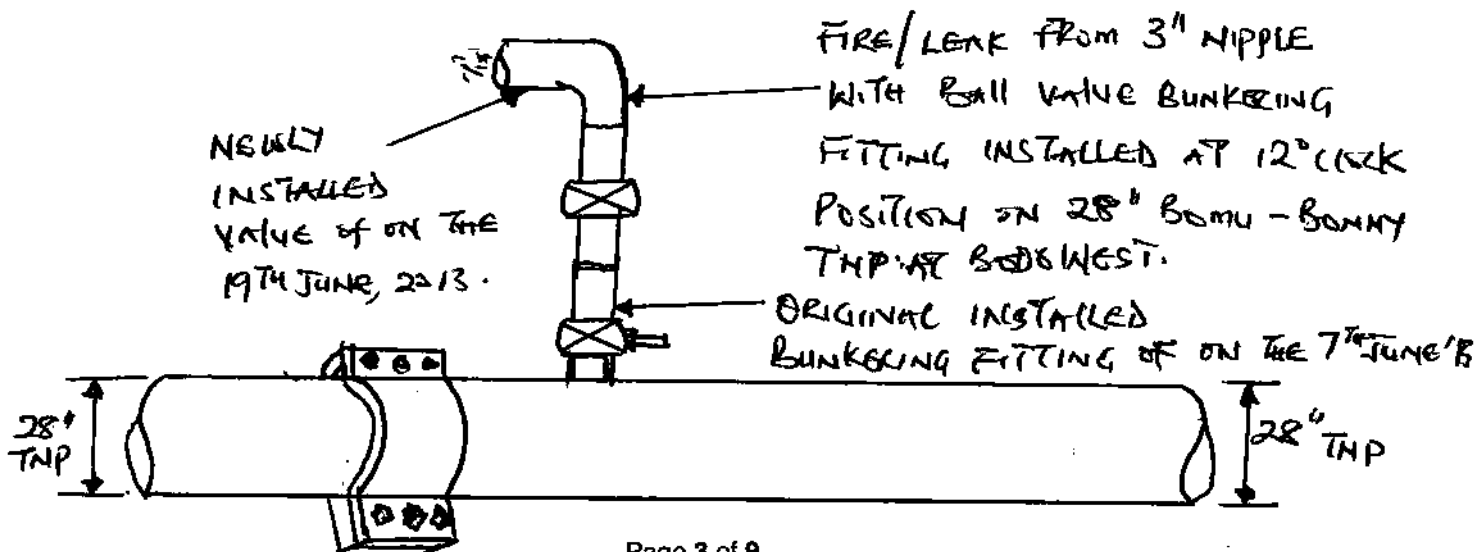
18. Others (Specify) i.e. Animal Traps

S/N	Others	Description	Quantity/Size	Comments
NONE WITHIN AREA OF IMPACT.				

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)

SECTIONAL VIEW OF 28" BOMU - BONNY TRANS NIGER PIPELINE

SHOWING 3" BALL VALVE NIPPLE BUNKERING FITTING



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F: TABLE SHOWING SOME OF COORDINATES TAKEN DURING JIV FOR AREA CALCULATION

19. Impacted area boundary Coordinates (If more, Print and attach as an appendix)

(MINNA MID - SET)

S/N	Northing (M)	Easting (M)
	63520.07	532411.57
	63544.61	532433.18
	63602.94	532451.78
	63624.44	532454.90
	63534.49	532340.14
	63560.30	532245.19
	63701.49	532304.00
	63661.42	532380.99
	63247.40	532007.30
	63090.84	531951.54
	62928.04	531957.42
	62765.04	532071.18
	63473.26	532169.96
	63793.72	532108.84
	62858.44	532042.32
	62910.57	532017.16
	63108.32	532031.54
	63194.61	532074.68
	63295.29	532160.97
	63399.55	532250.86
	63489.44	532311.98
	63658.43	532396.48
	63020.23	531948.84
	62851.25	531999.18

63645.84 532286.81
 63363.60 532085.47
 63013.04 532015.36
 62500.20 527200.51.

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G. INCIDENT INFORMATION:

20. Impacted Area Details

- Total calculated area of impact 9.37 Ha
- Impact within SPDC R.O.W YES
- Impact outside SPDC R.O.W YES

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

Recovered oil V_{recf} :	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 _____
- ii. Average Depth (m) of pool of free phase oil _____
- iii. Emulsification factor: _____

iv.

Estimated Volume of pool of free phase oil. V_{pool} :	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: CLAY iv. P_e (effective porosity of the soil): 8%
- v. Cause of spill: _____ Oil type: BUNNY MEDIUM
- 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. $V_{inf a}$:	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: NIL
- ii. Average Depth (m) above leaking facility i.e. pipeline/flowline: NIL
- iii. Soil type: NIL iv. P_e (effective porosity of the soil): NIL
- v. Cause of spill: NIL vi. Oil type: NIL
- vii. Oil Residence time on site, day: NIL
- viii. Average depth of infiltration below leaking facility i.e. pipeline/flowline: NIL
- ix. Estimated depth of infiltration around spill point: NIL

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

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- 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: CLAY
- v. P_e (effective porosity of the soil): 8%

vi. Estimated Volume of infiltrated oil. At V _{inf} :	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: _____
- 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		
Dull	0.001		
Dark	0.002		
Black oil	0.1		
Emulsion (30% Oil)	1		

iii. Estimated Volume of oil on open water. V _{wat} :	Barrels
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24. Calculation of evaporated volume:

- i. Estimated Volume available for evaporation within surface area: _____
- ii. E-Factor: 15%

iii. Estimated Volume of evaporated oil. V _{evap} :	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%

<p>25. Net Estimated Spilled Volume V_{Est}(bbls) = V_{evap}(bbls) + V_{wat}(bbls) + V_{inf}(bbls) + V_{pool}(bbls) + V_{recf}(bbls) =</p>
<p>Estimated Reported Volume** V_{rep}(bbls) = <u>2699 Barrels</u></p>

Notes from the JIV to 28" Bomu – Bonny Pipeline, Bodo west (Oil spill/fire incident site)

Duration of the JIV	
14 th June 2013	First JIV conducted on the line and found two illegally attached crude oil theft point
15 th June 2013	One of the point was repaired but due to noticeable pressure on the line, the second line could not be repaired.
16 th June 2013	Environmental barge was mobilized to the site to help in depressurizing the line
17 th June 2013	Removal of trapped content from the line to the barge via direct connection of hose from the theft point to the barge. No repair works done
18 th June 2013	Removal of trapped content from the line to the barge via direct connection of hose from the theft point to the barge. No repair works done
19 th June 2013	Report received of fire on site at about 02.30Hrs Regulators were informed and JIT visited site at about 10.20Hrs Incident site was reclassified as oil spill/fire incident site and JIT advised to stay off site until site is made safe for further investigation
22 nd June 2013	OSRT/Fire team visited site and confirm that fire is off and site no longer on fire JIV was scheduled for 24 th June 2013 Team was informed some NGOs staff will attend the JIV as observers
24 th June 2013	JIT mobilized to staging at Abuloma and Patrick waterside At about 12 noon, team was advised to reschedule as the NGO team are not able to join the team for JIV
25 th June 2013	JIT visited site with members NGO (National Coalition on Gas Flaring and Oil Spill in the Niger Delta (NACGOND)) with the team at about 12.30Hrs Remains of Equipment (Environmental barge, Flat bottom work boat, Self propelled heliskimmer, work-barge, clamps, booms) impacted by fire was inspected by the team The spill point was pumped to reveal part of the newly attached theft point. Team demobilized from site at about 16.00Hrs
26 th June 2013	The JIT with NGO team arrived site at about 11.30Hrs Oil was pumped out of the bunded area around the spill point at about 14:46Hrs 3" valve with an elbow was observed attached to old theft point on the line Team left site at about 16:00Hrs
Cause of spill	
<ul style="list-style-type: none"> Incident was reported by government security forces around 02.30Hrs when SPDC repair/response team was not on site On investigation, a new valve with a 3" elbow was found attached to previously identified theft point on the line The incident was agreed to have been caused due to third party interference 	
Area of impact	
<ul style="list-style-type: none"> The spilled was found to have impacted soil and the nearby river The area is prone to tidal influence, hence the impact on the river Total area measured by the surveyor is 9.37Ha 	
Volume spilled	
<p>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.</p> <p>Assumptions for the calculation.</p> <ul style="list-style-type: none"> The valve on the theft point was open and feeding the fire since 0230Hrs, 19th June 2013 The spill point is at low point of Bomu – Bonny pipeline The pressure differential $A_p (p - p_a)$ at spill point is up to 10197kg force per m^2 due to head from Bomu manifold (higher point) to the spill point. Bonny light is the crude in the line and the density (ρ_{liq}) is 850 kg per m^3 Maximum duration of the fire: 3 days (259200 s) Area (A_h) of the drilled hole on the line is taken to be $0.001m^2$ (range of hole diameter found on bunkering points range from 0.5" to 1.5" depending on drill bit size) Percentage of oil in 28" Bomu – Bonny pipeline in the last 4 months as recorded in our Bonny terminal is between 60 to 	

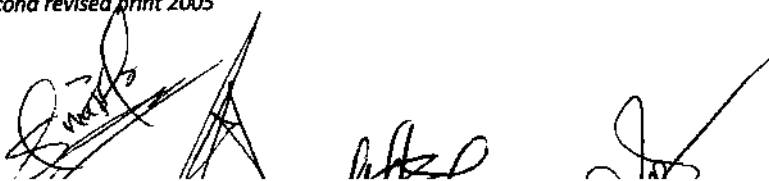
80%; Value of the percentage in the line during the incident is taken as 75% as the line was isolated and only hydrostatic pressure during the incident.

- Using leak rate formula:

$$Q = C_d \times A_h \sqrt{\frac{2(p - p_a)}{\rho_{liq}}}$$

- C_d is a standard discharge coefficient is taken at 0.62
- Leak rate for the spill point during the fire when the differential pressure is assumed to highest in the isolated is calculated to be $0.002\text{m}^3/\text{s}$
- Taking into consideration the % of oil in the line and the duration of the fire in seconds, Total volume burnt off during the fire is estimated to be **1881** barrels
- During the JIV of 26th June, physical measurement of the leak rate was done using a container of known capacity (10 L) and available wrist watches to time the filling up of the container, leak rate was measured to be 10L/min.
- The flow of oil from point was on from 22nd of June when the fire went off till 26th June (15.30Hrs) when the valve was locked.
- Taking into consideration, that the pressure on the line may have been higher on the 22nd when the fire went off than the 26th when the physical measurement of leak rate was done. The leak rate therefore has been taken to be an average of 20L/min for the 3 days
- Taking into consideration the % oil content of 75%, the estimated spilled volume after the fire is therefore **618** barrels
- Total volume discharged into the environmental barge that got burnt is **200** barrels
- Estimated total volume spilled due to the incident is **2699** barrels

¹ *Methods for the Calculation of physical effects - due to releases of hazardous materials (liquids and gases) – 'Yellow Book', CPR 14E, Third edition, Second revised print 2005*



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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 type="checkbox"/>
B. Investigation of the incident site showed that there is residual impact on site requiring further works <input checked="" type="checkbox"/>

27. REPRESENTATIVES

This report was filled, agreed and signed on the 28/06/2013 by joint investigation representatives from

- Host Community:
- Department of Petroleum Resources [DPR]:
- National Oil Spill Detection and Response Agency [NOSDRA]:
- State Ministry of Environment [SME]:
- Nigeria Police Force [NPF]:
- Shell Petroleum Development Company [SPDC]:
- Signatories agree with reported findings:
- Separate DPR form has been filled out with same findings

Tick as applicable

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28. Appendix 1: Overview sketch of the site

Location: 28' BOMU - BONNY TRANS NIGER PIPELINE AT BODO WEST.

