

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 933258 JIV report S/N: 0020

(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: 933258 2. Type of incident* OIL SPILL
 3. Name of Location NEMBE 2 WELL 17S FLOWLINE
 4. Name of nearest community NEMBE 5. State: BAYELSA 6. LGA NEMBE
 7. Type of Production facility/Installation OIL FLOWLINE 8. Asset owner/District NES2/NEMBE

B. INCIDENT INFORMATION:

9. Details of incident

- a. Date of incident: 22ND FEBRUARY 2013
 b. Start date/time of investigation: 27TH FEBRUARY 2013
 c. Investigation End date: 27TH FEBRUARY Actual investigation duration, days: ONE (1) DAY
 d. Description of spill point environment 2013

- | | | |
|---|--|---|
| <input type="checkbox"/> Firmed soil | <input checked="" type="checkbox"/> Loose soil | <input checked="" type="checkbox"/> Recently excavated area |
| <input 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 checked="" 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 checked="" 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 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"/> Valve Failure | <input type="checkbox"/> com unit failure |
| <input type="checkbox"/> Relief valve failure | <input type="checkbox"/> Others (specify) _____ | <input type="checkbox"/> Cold vent |

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>NETERS</u> <u>MINNA (MUD-BELT)</u>	
Northing: <div style="font-size: 2em; text-align: center;">48875.04</div>	Easting: <div style="font-size: 2em; text-align: center;">428762.42</div>

*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: 933258 JIV report S/N: 0020

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). **NOT APPLICABLE**

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
	NONE WITHIN AREA OF IMPACT				

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 933258 JIV report S/N: 0020

--	--	--	--	--	--

16. Crops/Economic Trees

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

17. Fish/Nets/Ponds

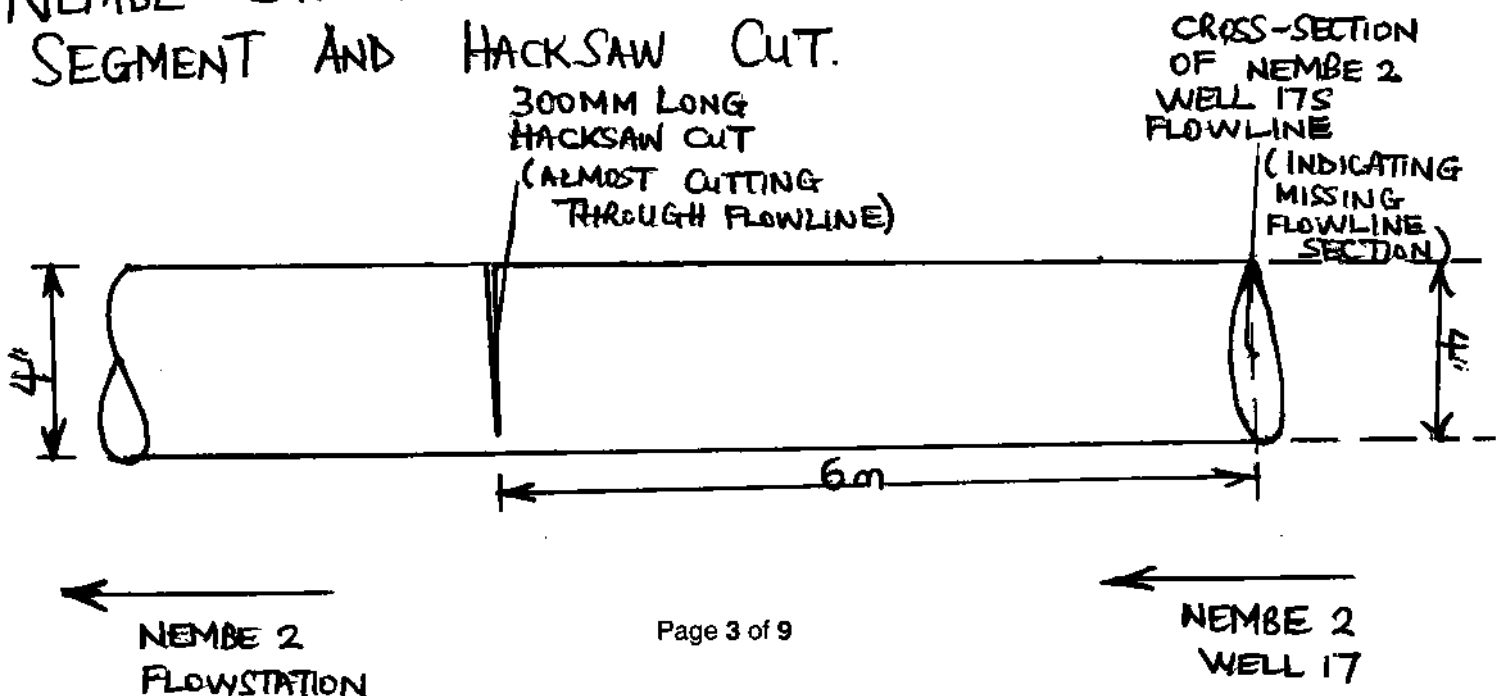
S/N	Fish/Nets/Ponds	Description	Quantity/Size	Comments
NONE WITHIN AREA OF IMPACT				

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)

SECTION OF NEMBE 2 WELL 17S FLOWLINE AT NEMBE SHOWING MISSING FLOWLINE SEGMENT AND HACKSAW CUT.



THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 933258 JIV report S/N:

G. INCIDENT INFORMATION:

0020

20. Impacted Area Details

- Total calculated area of impact 0.87Ha
- Impact within SPDC R.O.W. _____
- Impact outside SPDC R.O.W. _____

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

Recovered oil V_{rec} :	<u>NIL</u>	Barrels
---------------------------	------------	---------

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 NOT APPLICABLE
- iii. Emulsification factor: _____

iv. Estimated Volume of pool of free phase oil. V_{pool} :	<u>NOT APPLICABLE</u>	barrels
--	-----------------------	---------

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: NOT APPLICABLE
- ii. Average Depth (m) above leaking facility i.e. pipeline/flowline: APPLICABLE
- iii. Soil type: CLAY iv. P_e (effective porosity of the soil): 8%
- v. Cause of spill: THIRD PARTY INTERFERENCE vi. Oil type: BONNY LIGHT
- vii. Oil Residence time on site, day: 5 DAYS
- viii. Average depth of infiltration below leaking facility i.e. pipeline/flowline: NOT APPLICABLE
- ix. Estimated depth of infiltration around spill point: NOT APPLICABLE

x. Estimated Volume of infiltrated oil at spill point. $V_{inf a}$:	<u>NOT APPLICABLE</u>	barrels
--	-----------------------	---------

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

Estimated Volume of infiltrated oil at spill point. $V_{inf b}$:	<u>NOT APPLICABLE</u>	barrels
---	-----------------------	---------

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

COMPUTATION OF ESTIMATED SPILLED VOLUME IS BASED ON THE FORMULA:
 V_s (VOLUME SPILLED) = $Q(T_2 - T_1) + f A_p L$
 (SEE ATTACHED APPENDIX A).

APPENDIX A

COMPUTATION OF ESTIMATED SPILLED VOLUME BASED ON THE EQUATION: $V_s = Q(T_2 - T_1) + fA_p L$ WHERE

V_s = VOLUME OF OIL SPILLED, (IN M^3)

Q = OIL FLOWRATE IN THE FLOWLINE (IN M^3 /HOUR).

NET FLOWRATE FOR NEMBE 2 WELL 17S = 430 BARRELS/DAY

$$\text{NET FLOWRATE/HOUR (IN BARRELS)} \equiv \left(\frac{430}{24}\right) \frac{\text{BARRELS}}{\text{HOUR}} \approx 17.92 \text{ BARRELS/HOUR}$$

$$\text{NET FLOWRATE (IN } M^3/\text{HOUR)} \equiv \left(\frac{17.92}{6.29}\right) M^3/\text{HOUR} \approx 2.85 M^3/\text{HOUR}$$

THUS, $Q = 2.85 M^3/\text{HOUR}$.

$T_2 - T_1$ = DURATION OF LEAK [BASED ON ONGOING PRODUCTION FLOW INTERVAL BETWEEN DETECTION OF PRESSURE DROP DUE TO LEAK AND AUTOMATIC SHUT DOWN SYSTEM (WELLHEAD-EQUIPPED)]
 $\approx 3 \text{ MINUTES} \approx \left(\frac{3}{60}\right) \text{ HOUR} = 0.05 \text{ HOUR}$.

THE PRODUCT, $fA_p L$ REPRESENTS THE OIL VOLUME AFTER SHUT-DOWN WHERE f = FRACTION OF OIL IN FLOWLINE, ESTIMATED AS 0.104 (BASED ON FLOWLINE PRESSURE OF 10 BARS).

A_p = CROSS-SECTIONAL AREA OF FLOWLINE (4" DIAMETER, EQUIVALENT TO 10CM) = πR^2 WITH RADIUS OF 5CM (0.05M) = $\pi \times 0.05^2 \approx 0.0079 M^2$.

L = LENGTH OF FLOWLINE FROM THE CUT-THROUGH POINT TO THE POINTS OF CLOSURE (UPSTREAM AND DOWNSTREAM) = 6.2 KM (6,200M).

$$\begin{aligned} \text{ESTIMATED SPILLED VOLUME, } V_s &= Q(T_2 - T_1) + fA_p L = \\ &= (2.85 \times 0.05) + (0.104 \times 0.0079 \times 6,200) \\ &= 0.1425 + 5.0939 = 5.2364 M^3 = (5.2364 \times 6.29) \text{ BARRELS} \\ &\approx 32.94 \text{ BARRELS} \approx \underline{\underline{33 \text{ BARRELS}}} \end{aligned}$$

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 933258 JIV report S/N: 0020

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

Estimated Volume of infiltrated oil. At V_{inf} :	<u>NOT APPLICABLE</u>	barrels
---	-----------------------	---------

23. Computation of estimated volume of oil on open water based on standard coloration.

- i. Total area of oil on open water: NOT APPLICABLE
- 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	<u>NOT</u>	
Silvery	0.00008		
Slight Color	0.00015		
Bright Color	0.0003	<u>APPLICABLE</u>	
Dull	0.001		
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>NOT APPLICABLE</u>

Barrels

24. Calculation of evaporated volume:

- i. Estimated Volume available for evaporation within surface area: NOT APPLICABLE
- ii. E-Factor: 25%
- iii.

Estimated Volume of evaporated oil. V_{evap} :	<u>NOT APPLICABLE</u>
--	-----------------------

Barrels

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_{recf} (bbls) =	32.94 BARRELS
Estimated Reported Volume** V_{rep} (bbls) =	33 BARRELS

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 933258 JIV report S/N: 0020

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 <u>27/02/2013</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: 933258 JIV report S/N: 0020

28. Appendix 1: Overview sketch of the site

