

**THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.**

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 1097891 JIV report S/N: 0371

*(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: 1097891 2. Type of incident\* OIL SPILL  
 3. Name of Location SANTA BARBARA WELL 6T FLOWLINE  
 4. Name of nearest community IKEGIMAKIRI 5. State: BAYELSA 6. LGA NEMBE  
 7. Type of Production facility/Installation OIL FLOWLINE Asset owner/District SWAMP 2

**B. INCIDENT INFORMATION:**

9. Details of incident

- a. Date of incident: 3RD JANUARY, 2014  
 b. Start date/time of investigation: 8TH JANUARY, 2014 / 11:41 HOURS  
 c. Investigation End date: 8TH JANUARY 2014 Actual investigation duration, days: ONE (1) DAY  
 d. Description of spill point environment 2014

- |   |  |   |
|---|--|---|
| <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 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 checked="" 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 equipment impact                      | <input type="checkbox"/> Flare System/Bund wall failure | <input type="checkbox"/> Accidental 3 <sup>rd</sup> party   |
| <input type="checkbox"/> Valve Failure   | <input type="checkbox"/> com unit failure               | <input type="checkbox"/> Cold vent                          |
| <input type="checkbox"/> Relief valve failure                                  | <input type="checkbox"/> Others (specify) _____         |   |

f. Incident caused by:

- Third party interference (Sabotage; crude theft; Line theft; Accidental 3<sup>rd</sup> party damage)  
 Operational  Others (including Mystery spills) \_\_\_\_\_

g. Spill point coordinates

Measuring unit <u>METERS</u> <u>MINNA MID-BELT</u>	
Northing: <u>61287.97</u>	Easting: <u>450029.95</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: 1097891 JIV report S/N: 0371

**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). **MANGROVE VEGETATION** [ **10** ,m]

12. Containment measures put in place;

- Booms     Trench     Dyke     Natural depression     Pit

Others: **NONE OBSERVED AS AT TIME OF INVESTIGATION**

13. Any pictures or video coverage?

[  ] [ 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
<b>NONE WITHIN AREA OF IMPACT</b>					

16. Crops/Economic Trees

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 1097891 JIV report S/N: 0371

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

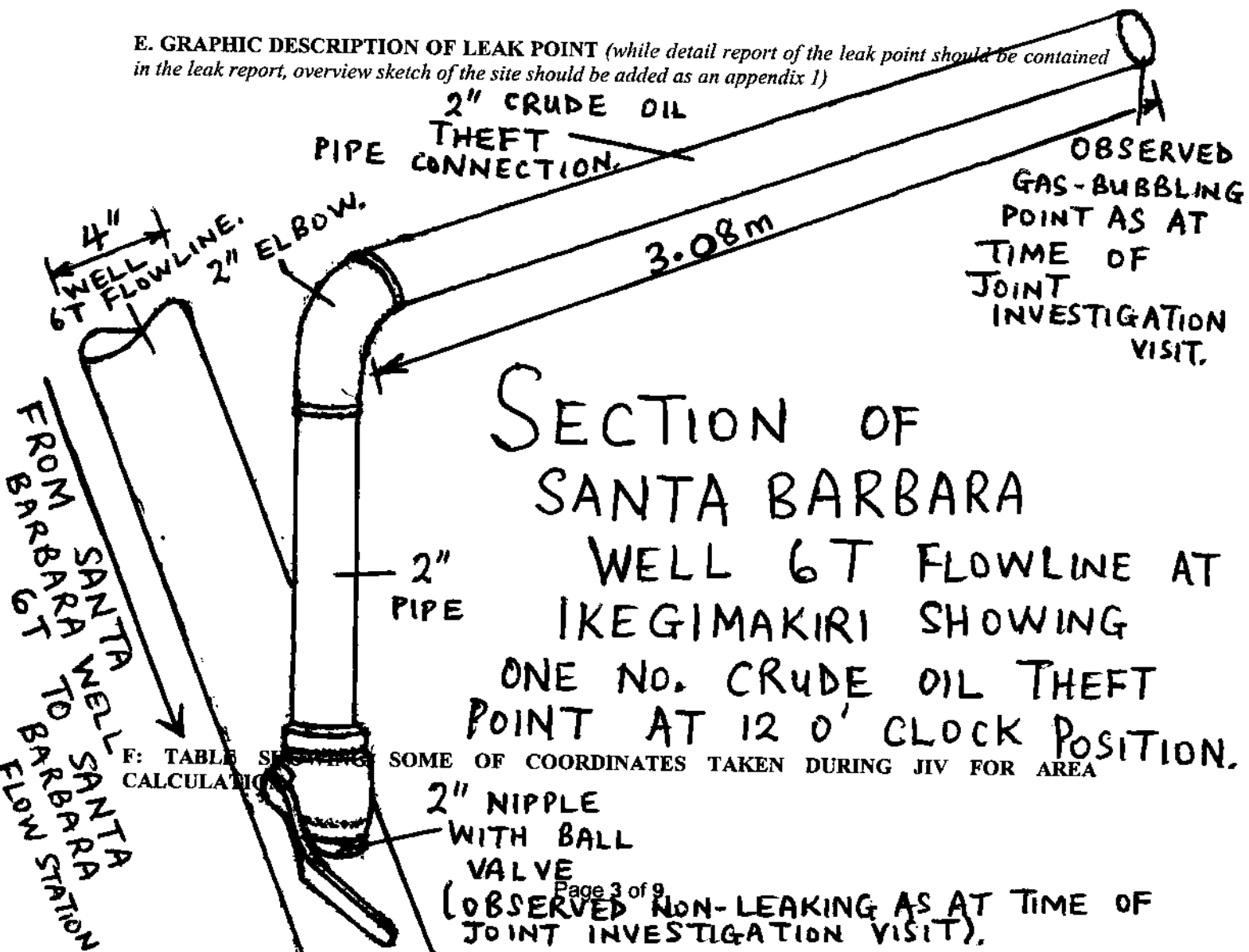
17. Fish/Nets/Ponds

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)



THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 1097891 JIV report S/N: 0371

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

MINNA MID-BELT

S/N	Northing METERS	Easting METERS
	61294.13	450026.88
	61287.37	450029.19
	61294.10	450036.13
	61287.96	450036.11
	61297.17	450036.14
	61291.16	449986.76
	61287.18	450036.77
	61286.34	449992.06
	61282.91	449989.29
	61287.96	450033.03

G. INCIDENT INFORMATION:

20. Impacted Area Details

- Total calculated area of impact 0.04 Ha
- Impact within SPDC R.O.W YES
- Impact outside SPDC R.O.W NO

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

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 1097891 JIV report S/N: 0371

Recovered oil $V_{rec}$ :	<b>NOT APPLICABLE</b>	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 **NOT APPLICABLE**
- ii. Average Depth (m) of pool of free phase oil **NOT APPLICABLE**
- iii. Emulsification factor: \_\_\_\_\_

iv.

Estimated Volume of pool of free phase oil.	<b>NOT APPLICABLE</b>	Barrels
$V_{pool}$ :		

b. Computation of estimated volume of infiltrated oil in the soil ( $V_{inf}$ ).

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

**CONSIDERING THE TIDAL NATURE OF THE SPILL SITE AND THE POSSIBILITY THAT THE EXTENT OF IMPACT OBSERVED AS AT TIME OF INVESTIGATION MAY NOT REPRESENT THE TRUE EXTENT OF SPILL, VOLUME COMPUTATION WAS DONE USING THE FORMULA SHOWN IN THE ATTACHED APPENDIX A.**

- i. Area\* ( $m^2$ ) of soil covered by the oil: \_\_\_\_\_
- ii. Average Depth (m) above leaking facility i.e. pipeline/flowline: **NOT APPLICABLE**
- iii. Soil type: \_\_\_\_\_
- iv.  $P_e$  (effective porosity of the soil): \_\_\_\_\_
- 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: \_\_\_\_\_
- ix. Estimated depth of infiltration around spill point: **NOT APPLICABLE**

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

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: \_\_\_\_\_
- 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. $V_{inf b}$	<b>NOT APPLICABLE</b>	Barrels
---	-----------------------	---------

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

- i. Area ( $m^2$ ) of soil covered by the oil: \_\_\_\_\_
- ii. Area ( $m^2$ ) of the pool of free phase oil in touch with oil: **NOT APPLICABLE**
- iii. Average Depth (m) below ground surface of infiltration of oil: \_\_\_\_\_
- iv. Soil type: \_\_\_\_\_
- v.  $P_e$  (effective porosity of the soil): \_\_\_\_\_

vi.

Estimated Volume of infiltrated oil. At $V_{inf c}$	<b>NOT APPLICABLE</b>	Barrels
---	-----------------------	---------

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

1. Total area of oil on open water: **NOT APPLICABLE**

# APPENDIX A (INCIDENT NO. - 1097891)

- COMPUTATION OF NET ESTIMATED SPILLED VOLUME USING THE LEAK VOLUME FORMULA:

$$V_s = A_o T C \sqrt{\frac{2 \Delta p}{\rho}} f$$

WHERE,  $V_s$  = NET VOLUME SPILLED (IN  $m^3$ ).

$T$  = DURATION OF LEAK (IN SECONDS).

$C$  = DISCHARGE COEFFICIENT (= 0.62).

$\Delta p$  = PRESSURE DIFFERENTIAL ACROSS THE POINT OF LEAK, (IN PASCALS OR NEWTONS/ $m^2$ ).

$\rho$  = OIL DENSITY (IN  $kg/m^3$ ).

$f$  = FRACTION OF OIL IN THE LEAKING FACILITY (FLOWLINE);

$A_o$  = CROSS-SECTIONAL AREA OF LEAK HOLE (IN  $m^2$ ).

CONSIDERING THE INTERNAL BORE DIAMETER OF  $1\frac{3}{4}$ " ( $\approx 0.044m$ ) FOR THE 2" BALL VALVE, THE LEAK CLEARANCE IS ESTIMATED TO BE APPROXIMATELY 0.02% OF THE  $\left[ \frac{(\text{BORE DIAMETER})^2}{2} \times \pi \right]$ , THAT IS, THE BORE AREA

THEREFORE,  $A_o = 0.02\% \times \pi \times \left( \frac{0.044}{2} \right)^2 \approx 3.04 \times 10^{-7} m^2$ .

$T$  = TIME INTERVAL FROM LEAK REPORT TO CONFIRMATION OF, AND CLOSE-IN OF AFFECTED WELL (6T) =  $14\frac{1}{2}$  HOURS =  $14\frac{1}{2} \times 3,600$  SECONDS = 52,200 SECONDS.

$\Delta p$  = FLOWLINE PRESSURE - ATMOSPHERIC PRESSURE = 33 BARS - 1 BAR = 32 BARS =  $32 \times 100,000 N/m^2 = 3,200,000 N/m^2$ .

$\rho$  = DENSITY FOR BONNY LIGHT OIL TYPE = 850  $kg/m^3$ .

CONSIDERING BSW (BASE SEDIMENT AND WATER) OF 22.29%, FRACTION OF OIL,  $f = 100\% - 22.29\% \approx 77.71\% = 0.7771$ .

$V_s = 3.04 \times 10^{-7} \times 52,200 \times 0.62 \times \sqrt{\frac{2 \times 3,200,000}{850}} \times 0.7771 \approx 0.6634 m^3 \approx (0.6634 \times 6.29) \text{ BARRELS} = 4.17 \approx \underline{5 \text{ BARRELS}}$ .

**THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.**

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 1097891 JIV report S/N: 0371

- ii. Table of average depth of oil on water based on coloration \*\*Spill Factors from USCG FOG (2000 Edition)

	Thickness (mm)	Percentage coverage	Volume (m3)
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		

**NOT APPLICABLE**

iii.	Percent Total 100%	Estimated Volume of oil on open water, $V_{wat}$ :	<b>NOT APPLICABLE</b>	Barrels
------	--------------------	--	-----------------------	---------

24. Calculation of evaporated volume:

- i. Estimated Volume available for evaporation with surface area: **NOT APPLICABLE**
- ii. E-Factor: **NOT APPLICABLE**

iii.	Estimated Volume of evaporated oil, $V_{evap}$ :	<b>NOT APPLICABLE</b>	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. <b>Net Estimated Spilled Volume</b> $V_{net}(bbls) = V_{evap}(bbls) + V_{wat}(bbls) + V_{inf}(bbls) + V_{pool}(bbls) + V_{rec}(bbls) =$	<b>4.17 (AS SHOWN IN ATTACHED APPENDIX A).</b>
<b>Estimated Reported Volume**</b> $V_{rep}(bbls) =$	<b>5 BARRELS.</b>

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  $m^3$  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"/>
--

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED.

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 1097891 JIV report S/N: 0371

B. Investigation of the incident site showed that there is residual impact on site requiring further works

27. REPRESENTATIVES

This report was filled, agreed and signed on the 08/01/2014 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]:  **NOMINATED NPF REPRESENTATIVE WAS UNABLE TO ATTEND JIV DUE TO NON-POSSESSION OF REQUIRED CERTIFICATE FOR FLIGHT OPERATIONS TO SPILL SITE.**
- Shell Petroleum Development Company [SPDC]:
- Signatories agree with reported findings:
- Separate DPR form has been filled out with same findings:

Tick as applicable

28. Appendix 1: Overview sketch of the site

Location: SANTA BARBARA WELL 6T FLOWLINE AT IKGIMAKIRI



