

THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED

JOINT INVESTIGATION REPORT FOR INCIDENT NO: 0354 864034

(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: 864034 2. Type of incident * OIL SPILL
3. Name of Location BONNY WELL 2S FLOWLINE
4. Name of nearest community BONNY 5. State: RIVERS 6. LGA BONNY
7. Type of Production facility/Installation OIL FLOWLINE 8. Asset owner/ District NESI/ CAWTHORNE CHANNEL

B. INCIDENT INFORMATION:

9. Details of incident

- a. Date of incident: 6TH SEPTEMBER 2012.
b. Start date/time of investigation: 5TH NOVEMBER 2012. AND
c. Investigation End date: 13TH NOVEMBER 2012
d. Description of spill point environment
 Firmed soil Loose soil Previously excavated area
 Under water Swampy Exposed pipe surface
 Well Platform (on Water) Rig
e. Description of leak point (tick as applicable);
 Drilled hole Hack saw cut Explosive tear,
 Complete Rupture Inward dent, Well head tampering
 Failed Weld-on illegal hot tap valve, 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
 Outward dent Flare System/Bund wall failure
 Valve Failure com unit failure Cold vent
 Relief valve failure Others (specify) _____
f. Incident caused by:
 Third party interference Operational Mystery _____

g. Spill point coordinates

| | |
|--|----------------------------|
| Measuring unit | |
| MINNA MID BELT | |
| Northing: <u>55103</u> <u>55102.65m</u> | Easting: <u>529480.76m</u> |

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C. RISK ASSESSMENT

10. Type of environment:

- Land Swamp Water Seasonal swamp

i. Type of environment to which oil has spread: **NO RESIDUAL IMPACT WAS OBSERVED AS AT TIME OF JOINT INVESTIGATION.**

- Land Swamp Water River (identify) _____

ii. Weather condition

- Raining Sunny

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

Others: NONE

13. Any pictures or video coverage? [] [N]

14. Was there any disruption to the investigation? [] [N]

If yes give brief description:

JOINT INVESTIGATION VISIT (JIV) OF 5TH NOVEMBER 2012 WAS INCONCLUSIVE DUE TO THE INABILITY OF THE JOINT INVESTIGATION TEAM TO ASCERTAIN THE CAUSE OF LEAK AS THE SPILL POINT ON THE AFFECTED FLOWLINE WAS SUBMERGED AT A RIVER CROSSING. THE AFFECTED FLOWLINE SECTION UNDER WATER WAS DETACHED ON 13TH NOVEMBER 2012 TO CONFIRM LEAK CAUSE.

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 FOUND TO BE IMPACTED. | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

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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

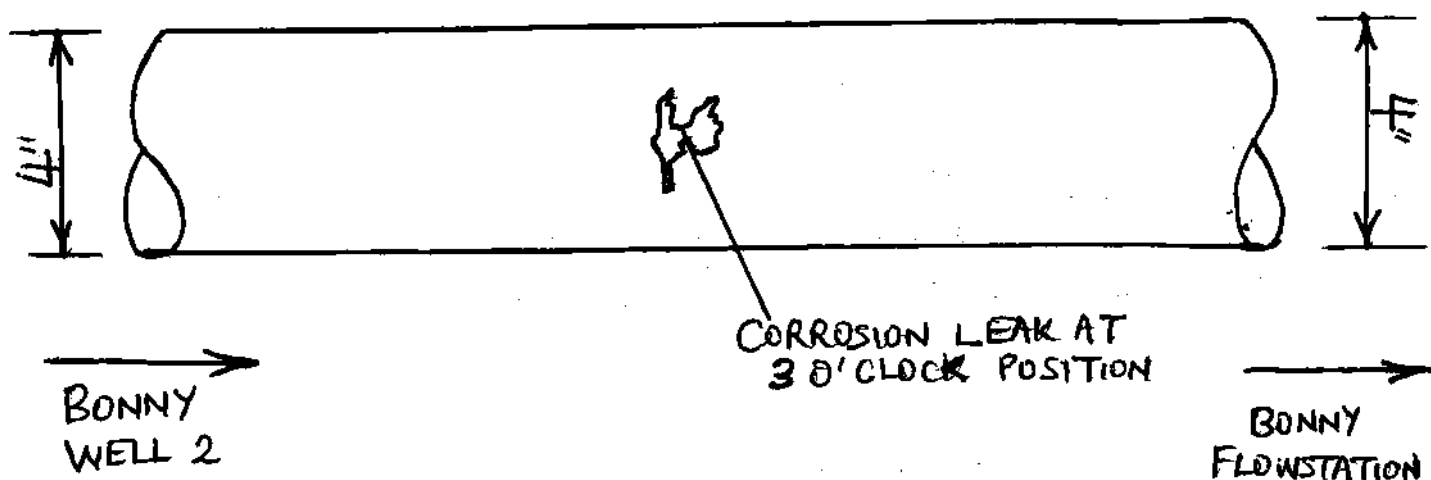
| S/N | Fish/Nets/Ponds | Description | Quantity/Size | Comments |
|----------------------------|-----------------|-------------|---------------|----------|
| NONE FOUND TO BE IMPACTED. | | | | |

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 BONNY SHOWING POSITION
OF CORROSION LEAK.



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iii. Emulsification factor: NIL **IT SHOULD BE NOTED THAT LEAK WAS OBSERVED DURING WELL OPEN-UP, WELL WAS CLOSED IMMEDIATELY.**

iv. Volume of pool of free phase oil: NIL barrels

- b. Computation of volume of infiltrated oil in the soil (V_{inf}).
- i. Area *(m²) covered by the oil: NOT APPLICABLE
 - ii. Area of the pool of free phase oil in touch with soil: 10 MINUTES (1/6 HOUR)
 - iii. Average Depth (m) below ground surface of infiltration of oil: ALSO LEAK POINT IS ABOUT A STONE THROW FROM WELL HEAD, THUS LEAK WAS OBSERVED IMMEDIATELY.
 - iv. Soil type: NOT APPLICABLE
 - v. P_e (effective porosity of the soil): NOT APPLICABLE
 - iv. Volume of infiltrated oil: NIL barrels

21. Computation of volume of oil on open water based on standard coloration. $C_o =$ DISCHARGE COEFFICIENT WITH A VALUE OF 0.62, $\Delta P =$ PRESSURE ACROSS THE HOLE, COMPUTED AS FOLLOWS:

- i. Total area of oil on open water: NIL
- ii. Table of average depth of oil on water based on coloration**

| | Thickness (mm) | Percentage coverage |
|--------------------|----------------|---------------------|
| Barely Visible | 0.00004 | |
| Silvery | 0.00008 | <u>NOT</u> |
| Slight Color | 0.00015 | |
| Bright Color | 0.0003 | |
| Dull | 0.001 | <u>APPLICABLE</u> |
| Dark | 0.002 | |
| Black oil | 0.1 | |
| Emulsion (30% Oil) | 1 | |
| | Percent Total | 100% |
| | Total Volume | bbbl (ATMOSPHERE) |

$P_{in} =$ PRESSURE INSIDE PIPE AT THE HOLE = PUMPING PRESSURE = 1,015 PSI = 1015 X 6894.75729 (1 PSI [POUND PER SQUARE INCH] = 6894.75729 Pa) = 6,998,178.65 Pa

$P_{atm} =$ IN THIS CASE, PRESSURE OUTSIDE THE HOLE, AT AN ESTIMATED 10M DEPTH BELOW RIVER SURFACE, AMOUNT OF PRESSURE (IN ATMOSPHERE) IS GIVEN BY THE EQUATION:

iii. Volume of oil on open water: NIL barrels

22. Calculation of evaporated volume:

- i. Oil type: BONNY LIGHT
- ii. E-Factor: EVAPORATION FACTOR INCLUDED IN ESTIMATED SPILL VOLUME
- iii. Volume of evaporated oil: NIL barrels

$Y = 1 + 1/33 X$ WHERE X IS THE DEPTH (IN FEET) BELOW WATER SURFACE.
 DEPTH = 10M = 10 X 3.2808399 FEET = 32.808399 FEET.

| Oil Type | Days on site | Bonny Light | Bonny Medium |
|------------------------|--------------|-------------|--------------|
| Period Since Oil Spill | < 1 day | 10% | 5% |
| | 1-7 days | 25% | 15% |
| | > 7 days | 40% | 25% |

THEREFORE $Y = 1 + 1/33 (32.808399) = 1.994193909 \approx 2 \text{ ATM}$
 $= 2 \times 101325 \text{ PASCALS}$
 (1 ATM = 101325 PA) = 202650 PA.

$\Delta P = P_{in} - P_{atm} = 6,998,178.65 \text{ Pa} - 202,650 \text{ Pa} = 6,795,529 \text{ Pa}$

$P = \rho \times g \times h$ DENSITY. (VALUE OF SPECIFIC GRAVITY FOR BONNY LIGHT OIL TYPE TAKEN AS 0.85, THEREFORE OIL DENSITY = SPECIFIC GRAVITY X 1000 KG/M³ = 0.85 X 1000 = 850 KG/M³. F = GAS OIL RATIO, GIVEN AS 462 MCF/BARREL = 462000 SCF/BARREL = 462000/5.6146 = 82,285.47 SM³/SM³ (STANDARD CUBIC METRE/STANDARD CUBIC METRE).

$V_s = A_o T C_o \sqrt{\frac{\Delta P}{P}} f = 0.00022 \times \frac{1}{6} \times 0.62 \sqrt{\frac{6795529}{850}} \times 82285.47 = 0.00022 \times \frac{1}{6} \times 0.62 \times 25648.605 = 0.583 \text{ m}^3 \approx 0.583 \times 6.29 = 3.67 \text{ BARRELS} = 4 \text{ BARRELS}$

*If area is not same as the total area of impact, please indicate in the overview sketch
 ** Spill Factor from USCG FOG (2000 Edition)

ESTIMATED SPILL VOLUME = 4 BARRELS.

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23. Gross Total Estimated Spilled Volume

$$V_{Est}(bbls) = V_{evap}(bbls) + V_{wat}(bbls) + V_{inf}(bbls) + V_{pool}(bbls) + V_{recj}(bbls)$$

$V_{Est}(bbls) =$ 4 BARRELS

24. Net Total Estimated Spilled Volume

$$V_{Est}(bbls) = V_{evap}(bbls) + 0.6 * V_{wat}(bbls) + V_{inf}(bbls) + V_{pool}(bbls) + V_{recj}(bbls)$$

$V_{Est}(bbls) =$ 4 BARRELS

*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 Total volume VT (m3) x 6.29

*Emulsification factor for spill on water to consider is 60% of volume of oil.

25. 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
- B. Investigation of the incident site showed that there is residual impact on site requiring further works

26 REPRESENTATIVES

This report was filled and signed on the 13 / 11 / 2012 at incident site 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]:

Tick as applicable

27. Appendix 1: Overview sketch of the site

