THE SHELL PETROLEUM DEVELOPMENT COMPANY OF NIGERIA LIMITED
JOINT INVESTIGATION REPORT FOR INCIDENT NO: 636964

No. 01511

A. GENERAL INFORMATION:
1. Spill incident Number: 636964
2. Name of Location: OTUMARA W 445 RISER AT THE WELLHEAD
3. Name of nearest community: OTUMARA
4. State: DELTA LGA WARRL SOUTH WEST
5. Type of Production facility/Installation: WELLHEAD Asset owner/District: NWS1

B. INCIDENT INFORMATION:
6. Details of incident:
   a. Date of incident: 21st March 2011
   b. Date/Period of investigation: 28th March 2011 12:13 hrs
   c. Description of spill point environment:
      - Firmed soil [Y]
      - Loose soil [Y]
      - Previously excavated area [Y]
      - Under water [Y]
      - Swampy [N]
      - Exposed pipe surface [Y]
   d. Description of leak point (tick as applicable):
      - Drilled hole, [Y]
      - Hack saw cut, [Y]
      - Explosive tear, [Y]
      - Complete Rupture [Y]
      - Inward dent, [Y]
      - Well head tampering [Y]
      - Failed Weld-on illegal hot tap valve, [Y]
      - Missing pipeline (flowline) [Y]
      - Crude oil theft (illegal bunkering) point, [Y]
      - Third party tampering with Clamp Bolt/Nut, [Y]
      - Third party tampering with valve setting, [Y]
      - Third party tampering with flange Nuts/bolts, [N]
      - Corrosion, [Y]
      - Saver-pit over flow, [Y]
      - Surge vessel overflow, [Y]
      - Outward dent [Y]
      - Others (specify).

   e. Spill point coordinates:
      Longitude: 183708° N
      Easting: 302603 m E

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C. RISK/DAMAGE ASSESSMENT

7. Type of environment of spill site:
   □ Land
   □ Swamp (DREDGED SLOT)
   □ water

Type of environment of which oil has spread:
   □ Land
   □ Swamp
   □ water

8. Distance from the nearest sensitive habitat
   □ Government reserved and designated protected area [N/A, m] [N/A, m] [N/A, m] (NOT APPLICABLE)
   □ Drinking water source
   □ Built up area
   □ Farmlands
   □ Fish Farm/Pond
   □ Fishing net
   □ Others (specify).

9. Containment measures put in place;
   □ Booms [Y] [N]
   □ Trench [Y] [X]
   □ Dyke [Y] [X]
   □ Others: ____________________________

10. Any pictures or video coverage? [Y] [N]

11. Was there any disruption to the investigation? [Y] [X]

   If yes give brief description:
   [N/A (NOT APPLICABLE)]

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

A. Structures / Properties

<table>
<thead>
<tr>
<th>S/N</th>
<th>Type of Structures</th>
<th>Description</th>
<th>Size</th>
<th>Number</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N/A (NOT APPLICABLE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
B. Crops/Economic Trees

<table>
<thead>
<tr>
<th>S/N</th>
<th>Types of crops</th>
<th>Young</th>
<th>Medium</th>
<th>Matured</th>
<th>Quantity</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

C. Fish/Nets/Ponds

<table>
<thead>
<tr>
<th>S/N</th>
<th>Fish/Nets/Ponds</th>
<th>Description</th>
<th>Quantity/Size</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>S/N</th>
<th>Others</th>
<th>Description</th>
<th>Quantity/Size</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

E. GRAPHIC DESCRIPTION OF LEAK POINT (Details should be contained in leak repair report)

![Diagram showing containment boom, well heads, and close-up diagram with flow line and pin holes]
F: TABLE SHOWING SOME OF COORDINATES TAKEN DURING JIV FOR AREA CALCULATION

E. Coordinates

<table>
<thead>
<tr>
<th>S/N</th>
<th>Northing</th>
<th>Easting</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>183743</td>
<td>302632</td>
</tr>
<tr>
<td>02</td>
<td>183737</td>
<td>302641</td>
</tr>
<tr>
<td>03</td>
<td>183706</td>
<td>302674</td>
</tr>
<tr>
<td>04</td>
<td>183732</td>
<td>302667</td>
</tr>
</tbody>
</table>
G. INCIDENT INFORMATION:

17. Impacted Area Details
   a. Total calculated area of impact
      - Impact within SPDC R.O.W. \(376 \text{ m}^2\)
      - Impact outside R.O.W. \(N/A\) (NOT APPLICABLE)

18. Volume of oil recovered before completion of IJV (\(V_{\text{rec}}\)):
   - Recovered oil \(V_{\text{rec}}\): \(N/A\) barrels

19. Computation of the residual volume on site
   a. Computation of the volume of pooled free phase oil (on land or confined water body).
      i. Area (m\(^2\)) occupied by pool of free phase oil: \(N/A\) (NOT APPLICABLE)
      ii. Average Depth (m) of pool of free phase oil: \(N/A\) (NOT APPLICABLE)
      iii. Volume of pooled of free phase oil: \(V_{\text{pool}}\): \(N/A\) barrels

   b. Computation of volume of infiltrated oil in the soil (\(V_{\text{in}}\)).
      i. Area (m\(^2\)) covered by the oil: \(N/A\) (NOT APPLICABLE)
      ii. Average Depth (m) below ground surface of infiltration of oil: \(N/A\)
      iii. Soil type: \(N/A\) (NOT APPLICABLE)
      iv. \(\rho_s\) (effective porosity of the soil): \(N/A\) (NOT APPLICABLE)

   v. Volume of infiltrated oil, \(V_{\text{in}}\): \(N/A\) barrels

20. Computation of volume of oil on open water based on standard coloration.

<table>
<thead>
<tr>
<th>Thickness (mm)</th>
<th>Percentage coverage</th>
<th>Volume (m(^3))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barely Visible</td>
<td>0.00004</td>
<td>(376 \times \frac{1}{1000})</td>
</tr>
<tr>
<td>Silvery</td>
<td>0.00008</td>
<td>(0.376 \text{ m}^3)</td>
</tr>
<tr>
<td>Slight Colour</td>
<td>0.00015</td>
<td>(0.376 \times 6.29 = 2.365 \text{ bbl})</td>
</tr>
<tr>
<td>Bright Colour</td>
<td>0.0003</td>
<td></td>
</tr>
<tr>
<td>Dull</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Dark</td>
<td>0.002</td>
<td></td>
</tr>
<tr>
<td>Black oil</td>
<td>0.1</td>
<td>100% total volume</td>
</tr>
<tr>
<td>Emulsion (30% Oil)</td>
<td>1</td>
<td>(2.365 \text{ bbl})</td>
</tr>
</tbody>
</table>

21. Calculation of evaporated volume:

\[ V_{\text{spill}} = \frac{V_{\text{cal}}}{1 - E \cdot F} \]

\[ = \frac{2.365}{1 - 0.15} \]

\[ = 2.782 \text{ bbl} \]

\[ V_{\text{vap}} = E \cdot F \cdot V_{\text{spill}} = 0.15 \times 2.782 \]

\[ = 0.417 \text{ bbl} \]

\[ V_{\text{esp}} = 0.417 \text{ barrels} \]

<table>
<thead>
<tr>
<th>Oil Type</th>
<th>Bonny Light</th>
<th>Bonny Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period Since Oil Spill</td>
<td>E-Factor</td>
<td>E-Factor</td>
</tr>
<tr>
<td>&lt;1 day</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>1-7 days</td>
<td>25%</td>
<td>15%</td>
</tr>
<tr>
<td>&gt;7 days</td>
<td>40%</td>
<td>25%</td>
</tr>
</tbody>
</table>

9. Gross Total Estimated Spilled Volume

\[ V_{\text{esp}} = V_{\text{vap}} + V_{\text{wat}} + V_{\text{inf}} + V_{\text{pool}} + V_{\text{esp}} \]

\[ = 0.417 + 2.365 + 0 + 0 + 0 \]

\[ = 2.782 \text{ bbl} \]

10. Net Total Estimated Spilled Volume

\[ V_{\text{esp}} = V_{\text{vap}} + 0.6 \times V_{\text{wat}} + V_{\text{inf}} + V_{\text{pool}} + V_{\text{esp}} \]

\[ = 0.417 + 0.6 \times 2.365 + 0 + 0 + 0 \]

\[ = 1.846 \text{ bbl} \]

*Calculation of the respective estimated volume is done using the new spill estimation software on site

*Conversion of m3 to barrel is Total volume VT (m3) x 0.29

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

This report was filled and signed on the [28 / 03 / 2011] at incident site by joint investigation representative 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