Improving Oil Spill Risk Assessment

William Gala
Chevron Energy Technology Company
ITAC, Plymouth, UK
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Oil spill risk assessment guidance

What can happen?  | Identify Potential Release Scenarios  | IOGP guidance
Know your oil.  | Oil Characterization  | IOGP + CVX guidance
Where can it go?  | Fate and Trajectory Modeling  | CVX guidance, API CRA
What is in its way?  | Resources at Risk  | IOGP + CVX guidance
Potential consequences (without safeguards)  | Risk Evaluation  | IOGP guidance, API CRA

What should we plan for?  | Business Unit develops & implements response plans to increase preparedness
Identify potential release scenarios

• Recognized sources of likelihood data should be used
  – SINTEF Offshore Blowout database
    (mostly based on North Sea and GOM data)
  – BSEE eWell system (since 2010)
    (Well Activity Reports - WARs)
  – ITOPF Oil Tanker Spill Database

• May need to adjust likelihood based on historical trends or site-specific data

• Will historical data capture very rare events?
  – Extreme value analysis

• Select representative spill scenarios for consequence analysis
Oil characterization

- Laboratory data on fresh and weathered crude oil
  - Distillation curves
  - Viscosity
  - Density
  - Pour Point
  - Interfacial Tension
  - Flash Point
  - SARA
  - Waxes
  - Sulfur compounds (e.g., light mercaptans)
  - VOCs

- Dispersant efficacy tests

- Aquatic Toxicity tests
  - PETROTOX
Fate and trajectory modeling

- Stochastic modeling used to quantify extent and probability of oiling

- Conflicting guidance on how to select “representative” spill
  - Don’t blindly adopt P100 run for consequence analysis
  - Select moderately conservative (Run 78) run to represent “expected value”
  - Remember to adjust likelihood if utilizing rare worst-case deterministic runs (Run 36)

- Discriminate between “fresh oil” and “tar balls” (≤1% VOC/SVOC)
Resources at risk

• Resources at risk includes:
  – shoreline habitat and socio-economic resources (often found on ESI maps)
  – but also coastal, pelagic and deep-water resources (rarely included on ESI maps)

• Resources at risk may be highly seasonally dependent in temperate and arctic waters

• Predicted oiling less than thresholds equal low likelihood of unacceptable impacts

<table>
<thead>
<tr>
<th>VEC Type</th>
<th>Exposure Measure</th>
<th>Lower Threshold</th>
<th>Higher Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birds, Mammals, &amp; Reptiles,</td>
<td>Surface floating oil mass per unit</td>
<td>10 g/m² (10 μm)</td>
<td>100 g/m² (100 μm)</td>
</tr>
<tr>
<td>Sargassum</td>
<td>in water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plankton in Upper 20m</td>
<td>PAH concentration in water</td>
<td>1 μg/L (ppb)</td>
<td>10 μg/L (ppb)</td>
</tr>
<tr>
<td>Other Water Column</td>
<td>PAH concentration in water</td>
<td>10 μg/L (ppb)</td>
<td>100 μg/L (ppb)</td>
</tr>
<tr>
<td>Vegetation &amp; Habitats</td>
<td>Shoreline oil mass per unit area</td>
<td>100 g/m² (100 μm)</td>
<td>1 kg/m² (1 mm)</td>
</tr>
<tr>
<td>Intertidal Invertebrates</td>
<td>Shoreline oil mass per unit area</td>
<td>10 g/m² (10 μm)</td>
<td>100 g/m² (100 μm)</td>
</tr>
</tbody>
</table>

Source: API CRA (RPS ASA 2016)
• Severity of spill determined by:
  – Modeling fate & trajectory of spilled oil
  – Comparing exposure to environmental sensitives

• Evaluating risk
  – Compare risk level to tolerance criteria
  – Account for the conditional probability (from stochastic modeling)
  – Are safeguards needed?
  – Are risks as low as responsibly practical (ALARP)?
Oil spill contingency planning

- Select release scenarios for contingency planning
- Develop response strategies based on capabilities and regulations
- Use Spill Impact Mitigation Analysis (previously NEBA) to select preferred response strategies
- Develop tactical response plans for high priority locations
- Local (Tier 1) and Regional/National (Tier 2) response resources
  - Location
  - Type
  - Amount
- Plan for cascading of Tier 2 and Tier 3 resources and sustaining long responses
Aquatic Toxicity of the Global Dispersant Stockpile pre-planning to support approval

Approval to Use GDS

• GDS is essential to subsea response preparedness

• Dispersant pre-approval varies by country
  – Slickgone NS not listed on US NCP Product Schedule
  – Corexit 9500 “transitionally accepted” by AMSA (use national stockpiles only)

• Operator must demonstrate that non-approved dispersant is low in aquatic toxicity

• Two options:
  – Conduct testing consistent with regulatory requirements
  – Use existing toxicity data

<table>
<thead>
<tr>
<th>Type</th>
<th>Quantity (m3)*</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Slickgone NS</td>
<td>500</td>
<td>OSRL Base UK Southampton</td>
</tr>
<tr>
<td></td>
<td>350</td>
<td>OSRL Base Singapore</td>
</tr>
<tr>
<td>Finasol OSR S2</td>
<td>500</td>
<td>OSRL Base UK Southampton</td>
</tr>
<tr>
<td></td>
<td>350</td>
<td>OSRL Base Singapore</td>
</tr>
<tr>
<td></td>
<td>1500</td>
<td>France</td>
</tr>
<tr>
<td></td>
<td>800</td>
<td>OSRL Base South Africa</td>
</tr>
<tr>
<td>Corexit EC9500A</td>
<td>500</td>
<td>Florida USA</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>Brazil</td>
</tr>
</tbody>
</table>

*Quantities at each location are provisional figures only and may be subject to change.
Aquatic Toxicity of the Global Dispersant Stockpile
pre-planning to support approval

Study Objective
Compare the aquatic toxicity of dispersants in the GDS to support approval for use in response plan

Methods
• Generate species sensitivity distributions* using existing data (LC/EC50s)
• Data for marine crustaceans, fish, mollusks, cnidarians, and algae
• Compared distributions and calculate 5th percentile concentrations (HC5) of species potentially affected

Conclusion
GDS dispersants have similar across a range of taxonomic groups
– Overlapping SSDs
– HC5s within a factor of 2

*Based on Burr Type III (Burrlioz 2.0, v.1.1, CSIRO) distribution if data included eight or more taxonomic species

<table>
<thead>
<tr>
<th>Dispersant</th>
<th>HC5 (ppm)</th>
<th>95% CI</th>
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</thead>
<tbody>
<tr>
<td>Corexit 9500</td>
<td>3.4</td>
<td>1.3 – 7.8</td>
</tr>
<tr>
<td>Finasol OSR 52</td>
<td>3.0</td>
<td>0.33 – 11</td>
</tr>
<tr>
<td>Slickgone NS</td>
<td>4.0</td>
<td>0.99 – 11</td>
</tr>
<tr>
<td>Slickgone EW</td>
<td>6.3</td>
<td>3.2 – 39</td>
</tr>
<tr>
<td>Corexit 9527</td>
<td>4.8</td>
<td>2.1 – 14</td>
</tr>
</tbody>
</table>