Hydrogen Sulphide (H2S) is one of the main hazards involved with Oil and Gas operations, posing significant risks to people and assets. In the past years, due to the limited availability of deep water rigs, operators often found themselves with limited choices when procuring drilling rigs. This meant that sometimes the operator had to intervene to upgrade the rig to meet the specific company needs. This paper presents the activities carried out to prepare a conventional semi-submersible rig for an exploration drilling campaign on HP/HT wells with an estimated H2S concentration up to 6%.

The significance of the expected H2S concentrations, the intrinsic uncertainty of the exploration wells and the typical constraints of an offshore environment required a comprehensive approach that goes beyond the design envelope and the normal operating modes of conventional rigs. As a result, different measures were developed together with the rig contractor, targeting rig equipments, operating procedures, training and awareness of the personnel.

**H2S Properties Overview**

- **IDLH** \( H_2S \) * Immediately Dangerous for Life and Health
  - 100 ppm
  - Heavier than Air
  - Colourless
  - @ very LOW concentration
  - @ HIGH concentration
  - Paralysis of the Olfactory Nerve

**Process Methodology**

- **Plan**: H2S Risk Assessment and development of an *ad hoc* H2S Protection Plan
- **Do**: equipment upgrading, procedures development, training of personnel and supervision of the operations
- **Check**: H2S drills, equipment tests and audits
- **Act**: gathering and dissemination of lessons learned

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**Risk Assessment and Protection Plan**

- **Hazop Style Workshop**
  - exact evaluation of the emergency response provisions with respect to H2S hazards
  - definition of H2S Protection Plan main lines

**Living Quarter Upgrading**

- HVAC modifications
- Living Quarter integrity survey
- installation of double doors
- additional fixed \( H_2S \), \( SO_2 \) and flammable gas detection system rented by specialized company
- personal detectors
- complete breathing air cascade system composed of:
  - breathing air storages
  - compressors
  - airlines
  - SABAs and SCBAs to cover all critical areas, including muster points and TEMPS

**Detection System and Breathing Air System Upgrading**

- SV Living Quarter integrity survey
- SCBAs on bridge and deck + spare cylinders
- personal H2S detectors
- multi-gas detector available on the bridge
- SCBAs on the Fast Rescue Craft for its crew, plus SABAs with hood for potential casualties
- personal detectors for the Fast Rescue Craft crew
- spare equipment for Fast Rescue Craft

**Supply Vessel Protection**

- specific procedures development for drilling, coring, testing etc. in presence of \( H_2S \)
- theoretical and practical training as per API RP49-55-68

**Procedures Development**

- verify continuous alignment with \( H_2S \) Protection Plan

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**Test and Drills**

- equipment test and calibration
- weekly H2S alarm drills
- "restricted" H2S Drill scenarios
- continuous practice

**Training**

**Supervision**

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**Breathing Air Equipment List**

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCBA 30 minutes</td>
<td>35</td>
<td>Manifolds 6 connections</td>
<td>34</td>
</tr>
<tr>
<td>Spare 30 minutes cylinder</td>
<td>35</td>
<td>Airlines (20 m long)</td>
<td>289</td>
</tr>
<tr>
<td>SABA 15 minutes</td>
<td>210</td>
<td>6 Cylinders cascade rack</td>
<td>11</td>
</tr>
<tr>
<td>Manifolds 13 connections</td>
<td>10</td>
<td>1 Cylinders cascade rack</td>
<td>3</td>
</tr>
</tbody>
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**Figures**

1 & 2: Installation of breathing air manifolds inside a TEMPSC
3 & 4: Installation of breathing air manifolds at MUSTER POINT

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**Notes**

- *Immediately Dangerous for Life and Health*.
- \( H_2S \) 100 ppm.
- Colourless.
- @ very LOW concentration.
- @ HIGH concentration.
- Paralysis of the Olfactory Nerve.