eWCAT (ELECTRONIC WELL CONTROL ASSURANCE TOOL) AND PROCESS SAFETY

USEPA HF Technical Workshop, April 2013

Marco Op De Weegh
Well Control & Design Integrity Team Lead
DE F I N I T I O N S  A N D  C A U T I O N A R Y  N O T E

The companies in which Royal Dutch Shell plc directly and indirectly owns investments are separate entities. In this presentation “Shell”, “Shell group” and “Royal Dutch Shell” are sometimes used for convenience where references are made to Royal Dutch Shell plc and its subsidiaries in general. Likewise, the words “we”, “us” and “our” are also used to refer to subsidiaries in general or to those who work for them. These expressions are also used where no useful purpose is served by identifying the particular company or companies. “Subsidiaries”, “Shell subsidiaries” and “Shell companies” as used in this presentation refer to companies over which Royal Dutch Shell plc either directly or indirectly has control. Companies over which Shell has joint control are generally referred to “joint ventures” and companies over which Shell has significant influence but neither control nor joint control are referred to as “associates”. In this presentation, joint ventures and associates may also be referred to as “equity-accounted investments”. The term “Shell interest” is used for convenience to indicate the direct and/or indirect (for example, through our 23% shareholding in Woodside Petroleum Ltd.) ownership interest held by Shell in a venture, partnership or company, after exclusion of all third-party interest.

This presentation contains forward-looking statements concerning the financial condition, results of operations and businesses of Royal Dutch Shell. All statements other than statements of historical fact are, or may be deemed to be, forward-looking statements. Forward-looking statements are statements of future expectations that are based on management’s current expectations and assumptions and involve known and unknown risks and uncertainties that could cause actual results, performance or events to differ materially from those expressed or implied in these statements. Forward-looking statements include, among other things, statements concerning the potential exposure of Royal Dutch Shell to market risks and statements expressing management’s expectations, beliefs, estimates, forecasts, projections and assumptions. These forward-looking statements are identified by their use of terms and phrases such as “anticipate”, “believe”, “could”, “estimate”, “expect”, “goals”, “intend”, “may”, “objectives”, “outlook”, “plan”, “probably”, “project”, “risks”, “schedule”, “seek”, “should”, “target”, “will” and similar terms and phrases. There are a number of factors that could affect the future operations of Royal Dutch Shell and could cause those results to differ materially from those expressed in the forward-looking statements included in this presentation, including (without limitation): (a) price fluctuations in crude oil and natural gas; (b) changes in demand for Shell’s products; (c) currency fluctuations; (d) drilling and production results; (e) reserves estimates; (f) loss of market share and industry competition; (g) environmental and physical risks; (h) risks associated with the identification of suitable potential acquisition properties and targets, and successful negotiation and completion of such transactions; (i) the risk of doing business in developing countries and countries subject to international sanctions; (j) legislative, fiscal and regulatory developments including regulatory measures addressing climate change; (k) economic and financial market conditions in various countries and regions; (l) political risks, including the risks of expropriation and renegotiation of the terms of contracts with governmental entities, delays or advancements in the approval of projects and delays in the reimbursement for shared costs; and (m) changes in trading conditions. All forward-looking statements contained in this presentation are expressly qualified by the cautionary statements contained or referred to in this section. Readers should not place undue reliance on forward-looking statements. Additional risk factors that may affect future results are contained in Royal Dutch Shell’s 20-F for the year ended December 31, 2012 (available at www.shell.com/investor and www.sec.gov). These risk factors also expressly qualify all forward looking statements contained in this presentation and should be considered by the reader. Each forward-looking statement speaks only as of the date of this presentation, 16th & 17th of April, 2013. Neither Royal Dutch Shell plc nor any of its subsidiaries undertake any obligation to publicly update or revise any forward-looking statement as a result of new information, future events or other information. In light of these risks, results could differ materially from those stated, implied or inferred from the forward-looking statements contained in this presentation.

We may have used certain terms, such as resources, in this presentation that United States Securities and Exchange Commission (SEC) strictly prohibits us from including in our filings with the SEC. U.S. Investors are urged to consider closely the disclosure in our Form 20-F, File No 1-32575, available on the SEC website www.sec.gov. You can also obtain these forms from the SEC by calling 1-800-SEC-0330.
AGENDA

HSSE & SP CF, Process & Personal Safety ....................... 1 min
Process Safety, Wells Standards – Dem 1 & 2 ..................... 2 min
Well Delivery Process & Bow-tie methodology (well life cycle) 2 min
PCM – eWCAT .......................................................................... 2 min
P&ID’s .......................................................................................... 1 min
Equipment, Personnel & Barrier Verification Plans (BVP) ........ 2 min
COC & COS .................................................................................. 3 min
Compliance in eWCAT ................................................................. 2 min
Questions ..................................................................................... ?

Total: 15 min
HSSE & SP CONTROL FRAMEWORK, PROCESS SAFETY & PERSONAL SAFETY

Addressing Wellbore Integrity in Practice
**PROCESS SAFETY IN WELLS**

- Prevention of potential major industrial incidents caused by unintended release of energy or hazardous substances
- Potential hazards associated with well control, wellbore integrity & containment
- Potential incidents relating to well control & loss of well integrity
  - Loss of primary well control
  - Design load case exceeded
  - Single barrier failures
  - Unintended release of well effluents
  - Other relevant incidents
- Incidents shall be RAM-classified & followed-up accordingly

---

Well Process Safety Pyramid

<table>
<thead>
<tr>
<th>SEVERITY</th>
<th>People</th>
<th>Assets</th>
<th>Environment</th>
<th>Reputation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No injury or health effect</td>
<td>No damage</td>
<td>No effect</td>
<td>No impact</td>
</tr>
<tr>
<td>1</td>
<td>Skeletal injury or health effect</td>
<td>Slight damage</td>
<td>Slight effect</td>
<td>Slight impact</td>
</tr>
<tr>
<td>2</td>
<td>Minor injury or health effect</td>
<td>Minor damage</td>
<td>Minor effect</td>
<td>Minor impact</td>
</tr>
<tr>
<td>3</td>
<td>Major injury or health effect</td>
<td>Moderate damage</td>
<td>Moderate effect</td>
<td>Moderate impact</td>
</tr>
<tr>
<td>4</td>
<td>PTD or up to 3 fatalities</td>
<td>Major damage</td>
<td>Major effect</td>
<td>Major impact</td>
</tr>
<tr>
<td>5</td>
<td>More than 3 fatalities</td>
<td>Massive damage</td>
<td>Massive effect</td>
<td>Massive impact</td>
</tr>
</tbody>
</table>

**CONSEQUENCES**

**INCREASING LIKELIHOOD**

- A: Never heard of in the Industry
- B: Heard of in the Industry
- C: Has happened in the Organisation more than once per year
- D: Has happened at the Location more than once per year
- E: Has happened more than once per year at the Location
DEM 2: Process safety basic requirement to prevent re-occurrence of incident.

PSBRs (Process Safety Basic Requirements), “SHALL” statement [PS]

DEM 1 & WS’s: Wells Standards (WS), DEP’s (Shell Design and Engineering Practices),
- Example: PCM (Pressure Control Manual) & CTDM (Casing Tubing Design Manual), “shall”, mandatory

Process Safety Basic Requirements (PSBR)
Currently 11 PSBR’s:

PSBR 1 Safe sitting of occupied portable buildings
PSBR 2 ESD valves on platform risers
PSBR 3 Temporary refuges
PSBR 4 Permit To Work
PSBR 5 Management Of Change
PSBR 6 Avoid liquid release relief to atmosphere
PSBR 7 Avoid tank overfill followed by vapour cloud release
PSBR 8 Avoid brittle fracture of metallic materials
PSBR 9 Alarm management
PSBR 10 Sour Gas (H2S)
PSBR 11 Deepwater Well Design and Construction
Well Delivery Process:

Bowties:

**Bowtie Diagram**
CTDM (Casing Tubing Design Manual):

Process Safety requirements:

- Barrier Policy
- Design Process
  - Material, pipe body, connection (selection)
  - Design load scenario’s; conditions for casing & tubing.
  - Design Check equations (Casing / tubular limitations vs. conditions)
  - Design Factors (addressing uncertainty load vs. capacity) for:
    - Running-Tension
    - Running – Compression
    - Collapse
    - Tri-axial Burst
- Supplementary & Specific well design requirements
eW CAT (PROCESS SAFETY)

PCM (Pressure Control Manual):

- Process safety requirements:
  - Policy, Procedures & Practices for well control (well construction phase)

- eW CAT Implementation:
  - Upload template(s)
    - Equipment (“walk the line”)
    - Personnel (contractor & Shell personnel WC certification)
  - Barrier diagram(s) / Verification plan, (primary & secondary barriers)
  - Well Control Model (Min. equipment, tests frequency & scope)
eW CAT APPLIES TO ALL RESERVOIR HYDROCARBON WETTED PRESSURE CONTAINING SYSTEMS

PCM (Pressure Control Manual):

- Barrier Diagrams / Verification Plans
- Well Control Model

Non-Primary Flow Wetted Equipment

C&K manifold

Control Unit (s)

Note: These examples are for illustrative purposes only, and are not intended to cover all equipment, sites or situations.
Implementation:

P&ID Diagrams

Note: This example is for illustrative purposes only, and is not intended to cover all equipment, sites or situations.
**Implementation:**

Barrier diagram / verification plan(s), (primary & secondary barriers for operational scopes, Norsok D-010-rev.3)

Barrier verification test(s)

---

**Well Risk Parameters**

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max anticipated wellhead pressure</td>
<td>2060.0 psi</td>
</tr>
<tr>
<td>Max anticipated H₂S level</td>
<td>0 ppm</td>
</tr>
<tr>
<td>Risk of shallow gas</td>
<td>N/A</td>
</tr>
<tr>
<td>Maximum anticipated wellhead temperature</td>
<td>55</td>
</tr>
<tr>
<td>Well Is HPHT</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Barrier Elements**

<table>
<thead>
<tr>
<th>Name</th>
<th>Verifying Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wellhead</td>
<td>Pressure Test Casing</td>
</tr>
<tr>
<td>Casing Hanger</td>
<td>Pressure Test Casing</td>
</tr>
<tr>
<td>Production Casing</td>
<td>Production Casing Shoe Depth</td>
</tr>
<tr>
<td></td>
<td>Pressure Test Casing</td>
</tr>
<tr>
<td></td>
<td>Check Backflow Volume</td>
</tr>
<tr>
<td></td>
<td>Inflow test</td>
</tr>
<tr>
<td>Production Casing Cement</td>
<td>Pressure Test Casing</td>
</tr>
<tr>
<td></td>
<td>Inflow test</td>
</tr>
<tr>
<td></td>
<td>Cement</td>
</tr>
<tr>
<td></td>
<td>Formation Test</td>
</tr>
</tbody>
</table>
- Certificate of Compatibility
- Certificate of Compliance
- Certificate of Conformance (COC)
- Certificate of Service (COS)
COMPLIANCE IN EWCAST

- Well Control Equipment Inventory + Work Unit Equipment Configuration
  - Test reports
  - Equipment certification compliance

- Role assignments + Personnel training certification
  - Well Control Test compliance
  - Personnel certification compliance

- Barrier verification plans (well design / well control) + Barrier verification tests (cement, casing, leak-off etc)
  - Barrier Verification compliance

Compliance to Well Control Model
KEY MESSAGES

- Process Safety
- Well life cycle
- Well bore integrity, barriers & verification
- eW CAT (electronic Well Control Assurance Tool)
Back up slides
Certificate of Compatibility: Document in which a Manufacturer, Repairer, Remanufacturer, or recognized technical authority certifies that the part or system is compatible with the Original Product Definition, including design changes resulting from a malfunction or failure history of drill-through equipment manufactured, remanufactured and/ or repaired to the appropriate International Standard/ Specification and is fully compatible and/ or can be integrated into other systems guaranteeing the operations envelope as defined by the OEM.

Certificate of Compliance: Document in which the OEM or recognized technical authority certifies that the equipment and/ or system meets the required standards or rules as depicted in the relevant area of operations regulatory requirement.

Certificate of Conformance (COC): Document in which the OEM or OEM-licensed facility certifies that the assembly or part has been manufactured/ remanufactured in conformance to the mentioned standard(s), specifications and guidelines in accordance with the Original Product Definition, including design changes resulting from a malfunction or failure history of drill-through equipment manufactured, remanufactured and/ or repaired to the appropriate International Standard/ Specification.

Certificate of Service (COS): Document in which the equipment OEM, OEM-licensed facility, recognized technical authority/ Owner or Operator certifies that the equipment has been inspected, properly maintained and tested in accordance with Original Equipment Manufacturer (OEM) specifications.