# Petroleum and natural gas industries — Well integrity standard

## ISO 16530-1 Well integrity Lifecycle Governance

2015 BSEE Domestic and International Standards Workshop
Houston May 8 th 2015

Presenter Paul Hopmans Project Leader of ISO/DIS 16530-1

# Well Integrity Journey :

- Well Integrity as subject started drawing more attention in the 70 ties some failures had drastic impacts on the environment and overall business reputation. (Santa Barbara 1969)

- The journey of improving well integrity started with API 14 series for well safety systems, by introducing standards for subsurface safety systems, like storm chokes, subsurface safety valves, annular safety systems and surface safety systems.

- With the introduction of these systems wells became more complex and also had more failures as a consequence.

- Performance analysis and reliability testing in 80 & 90 ties resulted next generation subsurface safety valves and well integrity forums , work shops that did lead to the drafting procedures and more analytical tools or methods.

- In 2010 the initiative for an ISO standard for well integrity was raised throughOGP

# Intent of Well integrity  life cycle standard

An INDEPENDENT method of applying performance standards that assures well integrity over life cycle of the well.

These performance standards  can be existing or to be developed standards in industry or by Well Operator.

In principle :

The well integrity management system (WIMS) should assure that well integrity is maintained throughout the well life cycle by the application of a combination of technical, operational and organizational processes.

The Well Operator should include continuous improvement processes in the WIMS for each phase of the life cycle in which the improvement can be implemented.

# Well Integrity ISO standard

- Started in 2010 and developed operate phase ISO 16530-2 as technical specification under IOGP Standards solution. Published by ISO August 2014.

- Kicked off phase 2 ISO 16530-1 Well integrity Lifecycle Governance that incorporates operate phase. Working draft delivered by IOGP to ISO in Q4 2014

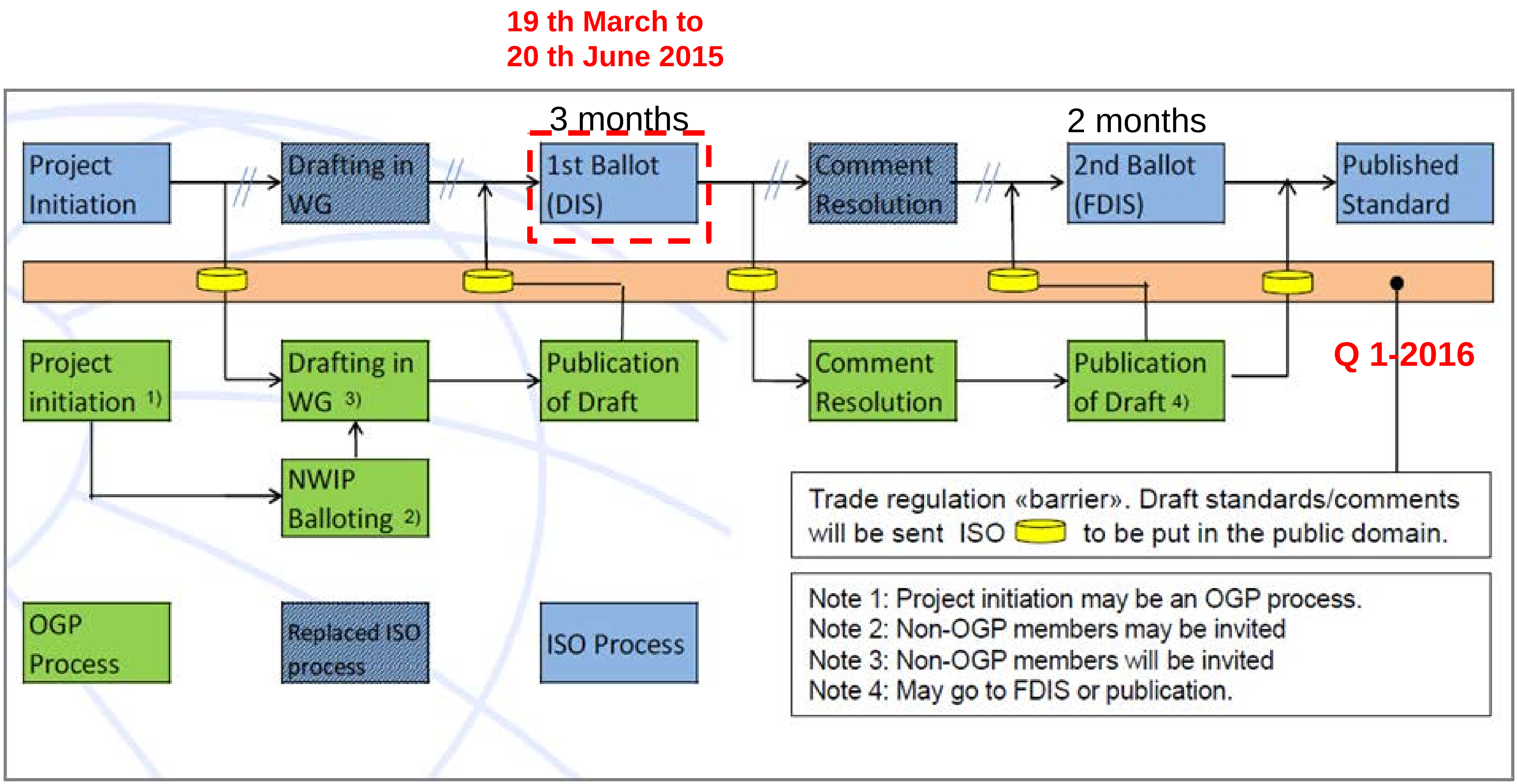
**Active participating companies**

| Company |
|---|
| Shell |
| Hess |
| Schlumberger |
| Total |
| ConocoPhillips |
| Woodside |
| Statoil |
| ExxonMobil |
| Maersk Oil |
| TullowOil |
| Petrobras |
| Chevron |
| General Electric |
| BP |

- Publication of standard 16530-1 by ISO is expected Q1 2016

- Operate phase ISO 16530-2 will be retired after ISO 16530-1 is published

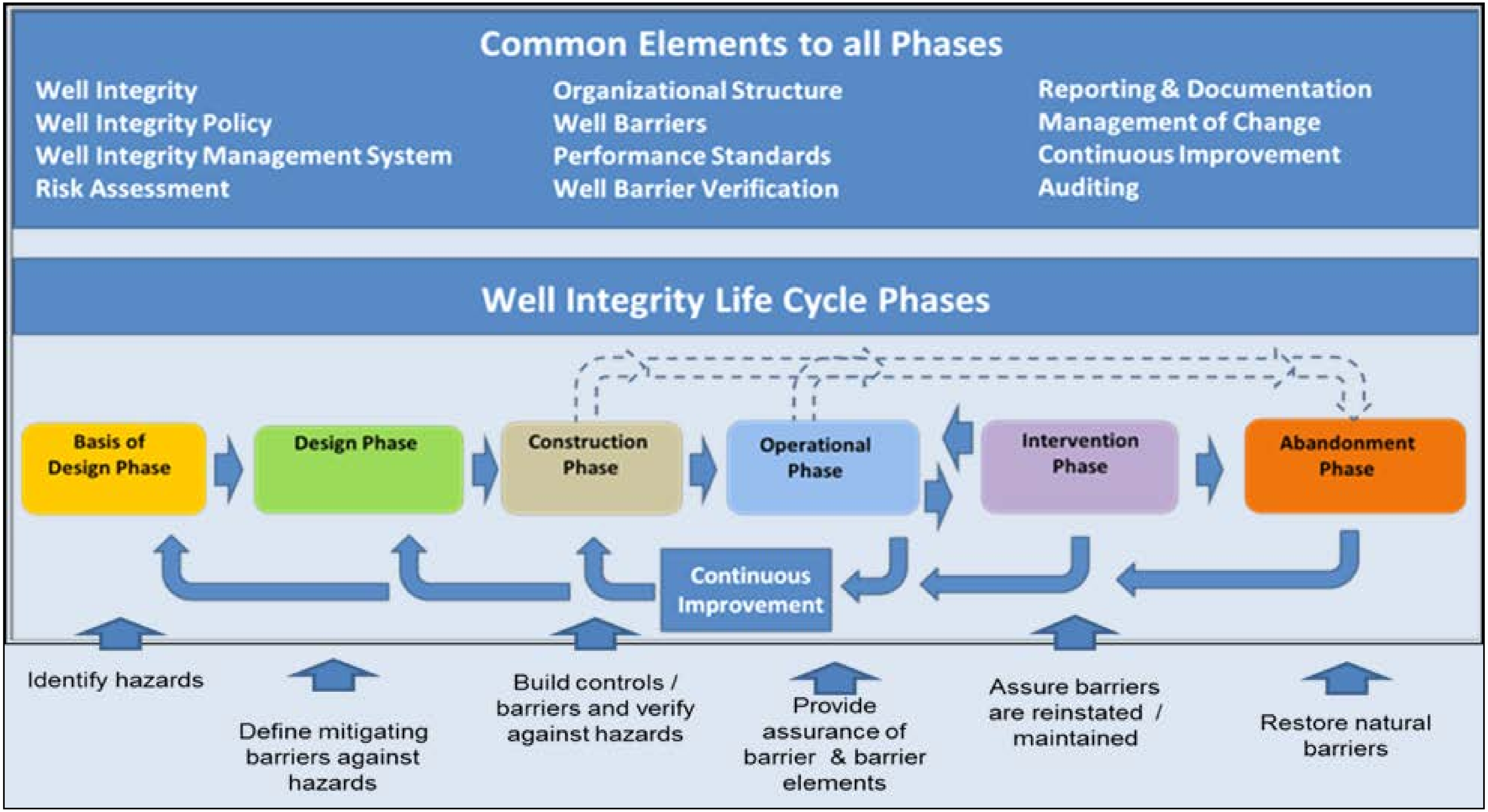
# Workflow process IOGP / ISO




Well integrity lifecycle standard ISO 16530-1 is at 1 st Ballot step closing 20 th June 2015

**Note: IOGP works as A-liaison, there is no specific agreement between IOGP and ISO**

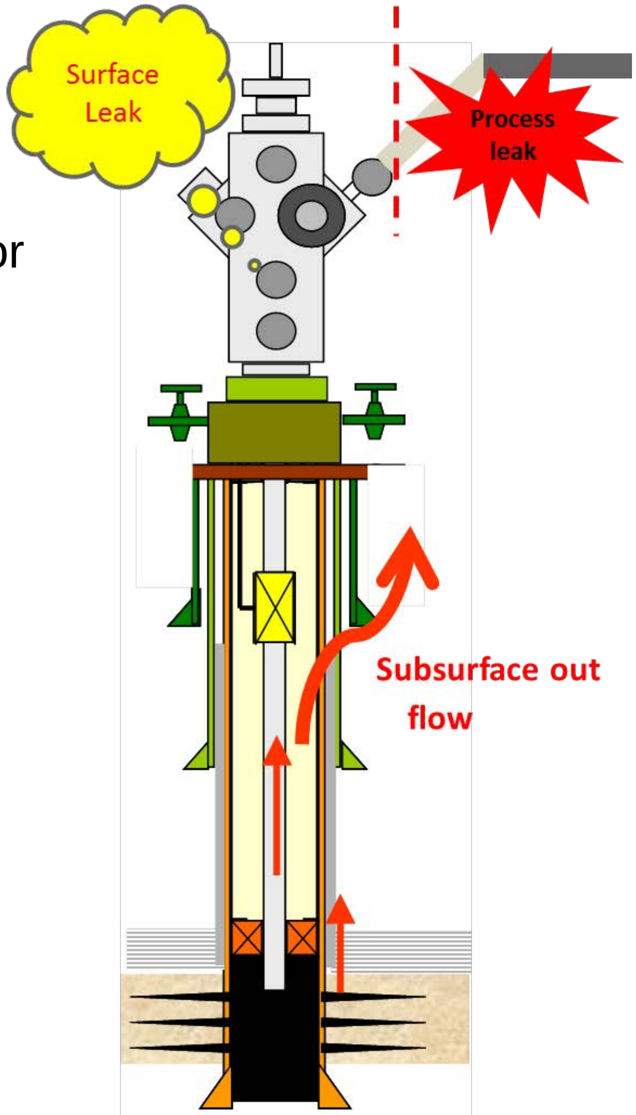
# Document structure



# Well Integrity process

**Assurance of Well Barriers over lifecycle:**

- Barriers for subsurface that prevent outflow or inflow from subsurface
- Barriers that control the effect off loss off containment to surface
- Barriers that control the effect off loss off containment to process
- Barriers for safe well bore access



# Continuous improvement

The continuous improvement process would detail how the information and knowledge gained through the process should be communicated to those responsible for the phase of the life cycle in which the improvement can be implemented.

Several methods can be employed to carry out such performance monitoring, including, but not limited to, the following:

- KPI monitoring;
- capture of lessons learned;
- compliance audit process.

These methods can be used to identify where aspects of the WIMS can be improved.

- Setting, tracking and regularly reviewing these metrics aids in
- determining the effectiveness of the WIMS as currently implemented,
- identifying general trends regarding the reliability of the well stock,
- identifying general trends regarding the well integrity risk posed by the well stock.

This allows monitoring of both the performance of well integrity activities and their effectiveness in maintaining and improving integrity.

# Examples of KPI's Lagging indicators

1. number of hydrocarbon releases,
2. number of well barrier elements failing verification test(s),
3. number of well anomalies (relative to total number of wells) versus time and/or versus cumulative production/injection (can be tracked for each anomaly type),
4. total number of wells completed, flowing, closed-in and suspended *vs*. total number of wells being managed in the WIMS,
5. well failures as a percentage of the total well stock,
6. number of wells operating under a dispensation,
7. percentage of wells of total well stock with annulus pressure anomalies,
8. percentage of wells in non-compliance with monitoring plans,
9. underlying causes of each failure mode as a percentage of all failure mode

# Examples of KPI's Leading indicators

1. mean time to failure (can be tracked for each anomaly type),
2. time taken to address well anomalies (can be tracked for each anomaly type and/or by level of risk),
3. mean time to repair/replace/abandon (can be tracked for each anomaly type and/or by level of risk),
4. number of non-conformances to the WIMS that have been identified (e.g. during compliance audits, well reviews and assurance processes),
5. percentage number of wells operating under a deviation *vs.* time,
6. percentage of wells of the total well stock in compliance with preventive corrective tasks, annular pressures MAASP and corrosion monitoring plans
7. measures of well integrity management performance against the plan (e.g. inspections and tests completed *vs.* planned)
8. repairs and workovers completed *vs.* planned
9. staffing of relevant key positions and competence levels.

# Verification testing

Function testing is a check as to whether or not a component or system is operating as intended. It should be realistic, objective, and the results recorded. It typically (but not exclusively) consists of empirical testing of

- valve functioning,
- valve closing/opening times,
- valve handle turns,
- actuator stem travel distances,
- hydraulic signature (analysis of control line response and hydraulic fluid actuation volumes).

In cases where it is neither practical nor possible to perform a leak test, such function testing may be accepted on its own as verification testing.

For example, function testing may be performed on valves, safety shutdown systems, alarms and gauges.

Function testing of ESD/SSV valves may be carried out as defined in API STD 6AV2 (this document should also be applied to onshore wellhead and tree ESDs).

# Reference Reliability ISO standards

ISO/TC 67/WG 4 - Reliability Engineering & Technology
ISO standards – Project groups

**Projects** (organized via OGP Interim Solution since July 2012 – from March 2014 through OGP Standards Solution)

- **PG1: ISO 14224** *"Collection and exchange of reliability and maintenance data for equipment"*
  - 2nd edition issued Dec 2006. New revision now being developed.

Issued DIS plan Ballot Q3

- PG2: ISO 20815 *"Production assurance and reliability management"*
  - 1st edition issued June 2008. Corrected version 2009.
- **PG3: ISO TR 12489** *"Reliability modelling and calculation of safety systems"*
  - 1st edition issued Nov 2013.
- PG4: ISO 15663-1/2/3 *"Life cycle costing"*
  - 1st editions issued 2000/2001.
- **PG5: ISO 19008** *"Standard Cost Coding System for oil and gas production and processing facilities"*
  - *New activity initiated in 2013, 1st edition planned in 2016*

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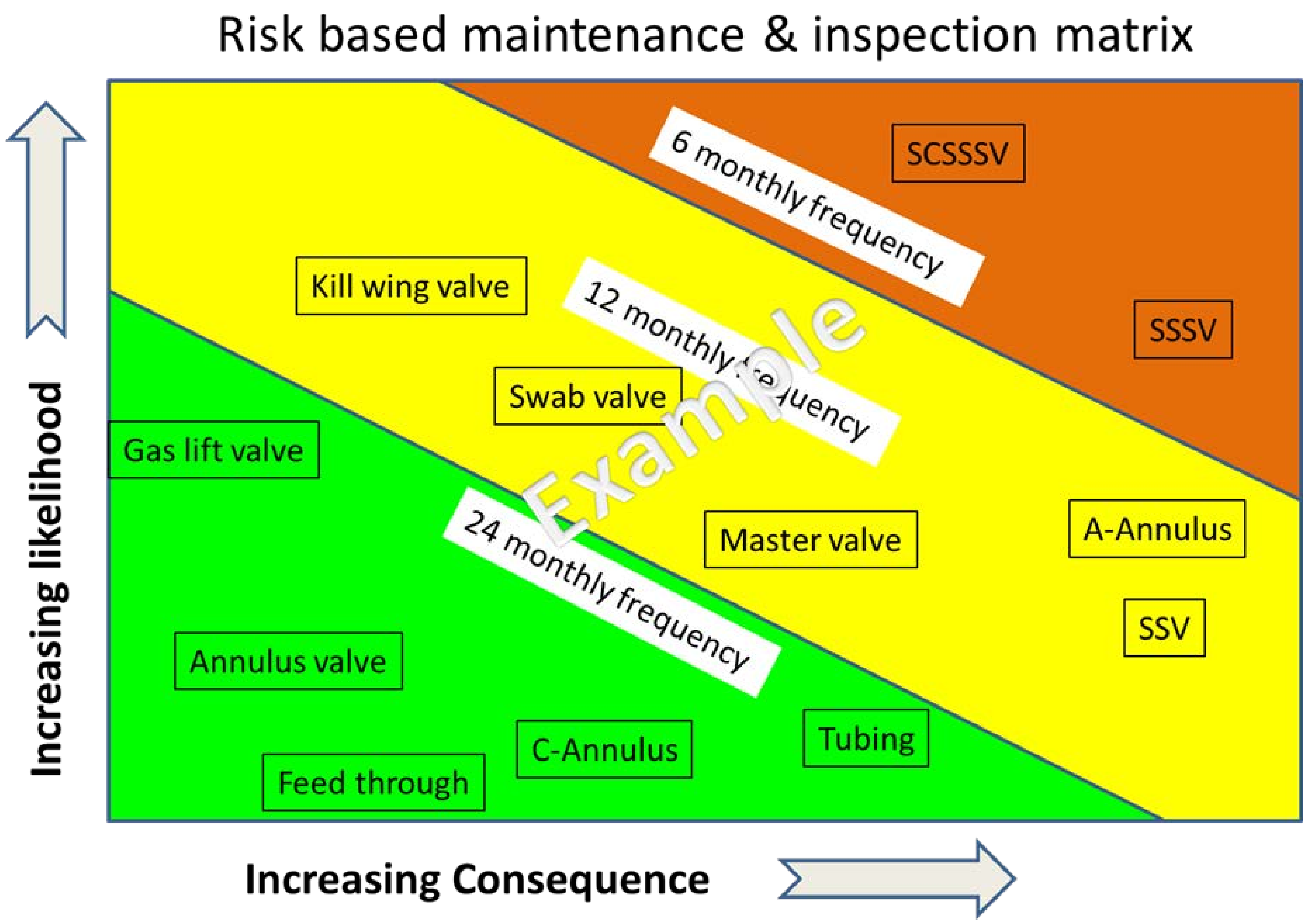
# Well related reliability systems

There are current commercial well integrity and completion reliability assessment systems available i.e.

- Woodgroup - Intetech – IQRA
- Exprosoft - Well-Master
- Oxand - Semio risk based assessment
- RIFTS -mainly artificial lift, structural under development (JIP)
- OREDA - Offshore and Onshore reliability data

- Are there others ?

# Example of risk based inspection



# W.I. lifecycle prescriptive approach

Each element of the lifecycle has common elements.

- The common elements (the what) are defined as prescriptive
- The requirements (the how) are defined as goal setting.

For example

- The Well Operator **shall** have a well integrity policy that defines its commitments and obligations to safeguard health, safety, environment, assets and reputation.
- The well integrity management system (WIMS) **should** assure that well integrity is maintained throughout the well life cycle by the application of a combination of technical, operational and organizational processes.
- The Well Operator **shall** identify the well integrity hazards over the life cycle of the well, and identify the risk associated with these hazards.
- Risk is defined by the likelihood of event occurrence and the consequences should the event occur. The Well Operator **should** determine the acceptable levels/definitions for likelihood and consequences of event occurrence.