The Fundamentals of Successful Well Collision Avoidance Management

CONTENTS:

1.0 Summary

This document was written by the Collision Avoidance Work Group of the ISCWSA. Recommendations are based on consensus within the Work Group; no greater authority is claimed.

The ISCWSA document *Current Common Practice in Collision Avoidance Calculations*, states: "*The adoption of a particular minimum allowable separation rule, no matter how conservative, does not ensure acceptably low probability of collision. Many other factors contribute, including the level of compliance by office and rig personnel with collision avoidance procedures, and the completeness and correctness of the directional database*." This document describes a process, which, if properly executed, will help assure well placement integrity and thereby avoid well collisions.

Eight requirements for successful collision avoidance management have been identified. Failure to meet any one of them can result in unintentional collision with a well or other hazard.

These requirements are equally important to the successful achievement of all other well positioning objectives such as target intersection and relief well intersection.

2.0 Overview

2.1 Data Structure and Integrity
The directional database is a 3D digital map. Processes should be in place to ensure that it is free from errors and remains free from errors as new data are added over the life of the field.

2.2 Position Uncertainty
Measurement uncertainties are often significant with respect to well construction position tolerances. All positions, planned and actual, should be assigned valid position uncertainty estimates.

2.3 Surface Location
Well surface location surveys should be referenced to the same datums used for the field set-up in the directional database. The uncertainty associated with the survey method should be reported and entered into the directional database.

2.4 Survey Program Design
As part of the well planning phase, a surveying program should be defined that demonstrably provides sufficient accuracy and reliability to meet the well's directional objectives.

2.5 Wellbore Survey Operations
The Survey program defined in the planning phase should be followed exactly during the drilling phase, or exceptions managed appropriately, to ensure that the directional objectives are achieved.

2.6 Collision Avoidance Procedures
Database integrity and adherence to survey programs are prerequisites for successful anti-collision. In addition, suitably conservative minimum allowable separation distance rules and monitoring procedures should be established, disseminated, and adhered to by all involved.

2.7 Quality Assurance
Procedures such as managed access, periodic audit and competency assessments are necessary to ensure the integrity of the software and database, and the competency of personnel, over the life of the field.

2.8 Communication
The preceding 7 elements fail in the absence of effective communication between those involved, at all stages of the planning, execution and archiving processes.

3.0 Detailed Recommendations

3.1 Data Structure and Integrity

Optimally there should be only one Master Database, containing all wellbores, accompanied by a written plan for use, maintenance and disaster recovery for the life of field.

This plan should specify:

a. Where the data are stored
b. Who has responsibility for maintaining the technical content
c. Who has responsibility for the physical management of the database(s)
d. Ensure safety critical software standards are honored e.g. during updates

The plan should specify the coordinate reference systems, both global and local, and define how to translate between the two. The plan defines all reporting needed to monitor any well or structure that has been added, edited or deleted.

The master database set-up should:

a. Manage offset well data integrity
b. Describe all wellpaths that represent potential collisions in a common coordinate system.
c. Define a single Well Reference Point for each wellpath. This is the deepest point in the well for which coordinates are known without the use of downhole wellbore surveying.
d. Utilize only approved survey Instrument Performance Models (IPMs).
e. Manage wellpath plan and actual revisions ensuring that a single planned and single actual trajectory are clearly labeled and/or defined.

3.2 Position Uncertainty

All wellpaths, planned and actual, should be associated with a valid position uncertainty estimate. The error models used to generate such estimates should include all significant error sources and/or err on the side of conservatism. Similarly the selection of the most appropriate model from those available should err on the side of conservatism.

The directional software should include position uncertainty in a well to well clearance scan, applying the calculation methods defined in the relevant collision avoidance policy. Manual calculations should be avoided.

3.3 Surface Location

The well location should be defined in the appropriate mapping system and converted to local drilling coordinates using the appropriate translation method (see 3.1). Locations should be surveyed to an approved accuracy standard and managed to allow updates as better position information becomes available during the well life cycle. The uncertainty associated with the location should be recorded as part of the well record. If the well reference point is on the seabed, the additional uncertainty between surface and seabed should be included. Revised surface locations should be distributed to all appropriate personnel and data archives.

3.4 Survey Program Design

Survey programs are designed to meet clearly defined quantitative positioning objectives such as:

a. Satisfy local governmental regulations
b. Ensure avoidance of collision with nearby wellbores, structures or hazards
c. Satisfy well control contingency requirements e.g. facilitate drilling of relief wells
d. Intersect targets

all with the desired level of confidence

To ensure that the above objectives are met, survey programs should:

a. Be based on the use of survey tools with valid error models (IPMs)
b. Specify running procedures and QC tests necessary to comply with error model assumptions
c. Include survey redundancy to limit the presence of unobserved gross error

3.5 Collision Avoidance Procedures

Collision Avoidance procedures should define how safe separation is managed during planning and execution of the drilling program. They should include categorization of risk and the separation rules applied to each classification.

Since HSE risk is associated with collision, the procedures should be jointly agreed between the Operating Company and the relevant contractors, Most contractors' internal policies require them to be active in managing HSE risk.

Anti-Collision (AC) scans should be run against the Master Database.

The planning phase should result in a collision monitoring program to be followed by office and rig personnel during the execution phase.

Clearance data should be presented to users in a usable, meaningful, format, numerical format, and/or graphical.. These should encourage correct interpretation and actions on the part of office and rig site personnel.

All personnel involved in wellbore construction activities should be trained in the collision management process and the detailed procedures appropriate to their role.

Survey programs should be executed in accordance with their design (see section 3.4). Any changes should have proper management of change processes applied.

The directional software, survey tool models and running procedures should be assessed and agreed with the Operator prior to their use.

All software used should be auditable against appropriate safety critical software standards. Software outputs produced should contain references for safety critical calculations and appropriate versions e.g. software, engine, build etc.

Collision Avoidance Management may also include;

- Classification of offset wells in terms of cost of intersection
- Minimum separation criteria per well classification
- Requirement for anti-collision scan
- Design approval prior to drilling
- Presentation of safe separation tolerances for planning & execution
- Verification of position relative to tolerances (timeliness while drilling)
- Action in the event of failure to maintain safe separation
- Identification of abandon radioactive sources

3.6 Wellbore Survey Operations

The survey program is designed to meet the well's directional objectives. Failure to execute the program means that the objectives may not be met. Good practice requires:

a. Inclusion of the Survey Program in the Drilling Program
b. Compliance with Survey Program
c. Compliance with recommended running procedures
d. Application of QC tests designed to validate surveys against error model specification (strongest validation being QC via overlapping independent surveys)
e. Exclusion of failed surveys from the survey log
f. Management of deviations from program to ensure directional objectives are satisfied

3.7 Quality Assurance

The quality assurance plan should define periodic assessment and audit of drilling & surveying tools and procedures:

a. software used to prepare directional plans, collision scans and final survey calculations specifically:
    a. Safety Critical Software standards compliance
    b. Consistency of algorithms and clear definition of limitations
    c. Availability of redundant data e.g. sub-surface (even though there is only one definitive database)
b. Instrument Performance Models (IPM's)
c. calculation methods
d. operations personnel training and frequency
e. Training systems that comply with tasks outlined in this document

3.8 Communication

Personnel involved in the well planning, execution and archive process should be defined and engaged in a timely manner. Candidates include, but are not limited to:

a. Sub-surface personnel
b. Drilling/Rig, Directional & Surveying contractors
c. Engineering personnel
d. Operations personnel
e. Environmental, Permitting and Regulatory compliance personnel