Well Path Data Transfer Standard

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Presentation Outline

Introduction
Uses and Requirements for WellPath data
Coordinate reference systems
Prior Well Path data formats
Well Path data in WITSML 1.3
Conclusions
Glossary

- **WITSML** – the Wellsite Information Transfer Standard Mark-up Language
- **Well** – A well is a unique surface location from which wellbores are drilled into the Earth for the purpose of either (1) finding or producing underground resources; or (2) providing services related to the production of underground resources.
- **Wellbore** – A wellbore is a unique, oriented path from the bottom of a drilled borehole to the surface of the Earth. The path must not overlap or cross itself.
Glossary – 2

- **obj_trajectory**: the WITSML construct that contains contextual information about the trajectory and the trajectoryStation data objects
- **obj_trajectoryStation**: the WITSML construct that references the containing well, wellbore and trajectory objects AND the inclination/azimuth and location data plus much (optional) instrument, acquisition and processing data
Deviated Well Terminology

- **Zero Measured Depth**
  - e.g: Rotary table, kelly bushing

- **Well Reference Point**
  - e.g: Ground level, Mud line

- **Vertical Reference Datum**
  - e.g: Mean Sea Level, Lowest Astronomical Tide

- **Zero True Vertical Depth**
  - Typically at VRD or ZMD

- **Parent well**

- **Sidetrack wellbore**

- **Azimuth**

- **Inclination**

Acknowledgement: UKOOA P7/2000
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Life-Cycle Uses of WellPath Data

- Planning – can result in many well paths, some of which may be drilled
  - Define intersections with geological and reservoir targets
  - Ensure safety and collision avoidance
  - Support well engineering design in- or out-of-house
  - Regulatory permitting

- Drilling
  - Initial Drilling: Geosteering, MWD acquisition and near-real-time processing
  - Sharing and integration with specialist wellsite services
  - Lateral and infill drilling: Tie-in to existing wellbore
  - ...
Life-Cycle Uses of WellPath Data – 2

• E&P Operations
  - Provision and maintenance of Asset data resources for users and applications
  - Static and dynamic reservoir modelling, analysis and visualisation
  - Regulatory reporting

• Asset Disposal
  - Sale, relinquishment, or decommissioning
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Coordinate Reference Systems

“Having spent the greater part of the last three months trying to spatially coordinate several disparate data sets, I have no doubt whatever that adoption of an Industry standard for Coordinate Reference Systems is a thoroughly sound proposal”

- Matthew Kirkman, Portfolio Manager, Drilling and Well Services Applications, BP and Chairman, WITSML SIG following a presentation to the WITSML SIG recommending adoption of the European Petroleum Survey Group (EPSG) geodetic parameter set
Insert ~4-6 Roel Nicolai slides
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Prior Well Path data formats

- WITS EDI (1980 and subsequently)
- LAS version 3 (2000)
- WITSML Version 1.3 (early 2005 release)
  - Trajectory and Trajectory Station – updated
  - WellPath Composite Object – new capability
Well Path Data Categories

- Well, Wellbore identification and context
  - Name, Field, Lease/Licence, Basin, Country etc
- Survey information and context
  - Operator, acquisition and processing contractor(s)
  - Dates, depth ranges
  - Survey tools, algorithms, corrections, gravity and magnetic field models, …
- Coordinate Reference System data
  - Geographic and projected coordinates and transformations
  - Vertical datums: permanent and drilling related
- Well Path Trajectory and Trajectory Stations
  - Measured depth, inclination and azimuth
  - True vertical depth, geographical, projected and engineering coordinates
Strengths of UKOOA P7/2000

- Supports multiple contractors, roles and survey phases, including wireline and MWD/LWD
- Supports multiple Vertical Datums and relationships between them
- References EPSG geodetic and coordinate system standards
- Supports post-acquisition life-cycle usages
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Well Path data in WITSML

- Objectives in WITSML V1.3
  - Extend previous capabilities from WITSML V1.2 for reporting raw measurements to also support planned well paths and calculated well paths
  - Reuse WITSML specifications and objects as far as possible
Well Path data in WITSML

- well
- wellbore
- trajectory
- trajectoryStation
  - wellCRS
  - acqn. & proc. parameters (>45)
  - location
obj_well Example

<wells>
  <well uid="w1">
    <name>207/29-A6</name>
    <nameLegal>207/29-A6Z</nameLegal>
    <numGovt>207/29-A6Z</numGovt>
    <field>Saltire</field>
    <country>GBR</country>
    <block>207/29</block>
    <timeZone>0.00</timeZone>
    <operator>Highland Oil</operator>
    <waterDepth uom="ft" datum="VRD1">118.40</waterDepth>

    <!-- well location: the location of the well reference point -->
    <wellLocation>
      <nameWellCRS uidRef="proj1">ED50 / UTM Zone 31N</nameWellCRS>
      <easting uom="m">425353.84</easting>
      <northing uom="m">6623785.69</northing>
      <description>location of well reference point in proj system</description>
    </wellLocation>
    ...
  </well>
</wells>
wellCRS Example (geographic)

<wellCRS uid="geog1">
  <name>ED50</name>
  <geographic>
    <nameCRS namingSystem="epsg" code="4230">ED50</nameCRS>
    <geodeticDatumCode>ED50</geodeticDatumCode>
    <xTranslation uom="m">-89.5</xTranslation>
    <yTranslation uom="m">-93.8</yTranslation>
    <zTranslation uom="m">-123.1</zTranslation>
    <xRotation uom="seca">0</xRotation>
    <yRotation uom="seca">0</yRotation>
    <zRotation uom="seca">-0.156</zRotation>
    <scaleFactor>1.200</scaleFactor>
    <ellipsoidName namingSystem="epsg" code="7022">International 1924</ellipsoidName>
    <ellipsoidCode>INT24</ellipsoidCode>
    <ellipsoidSemiMajorAxis uom="m">6378388</ellipsoidSemiMajorAxis>
    <inverseFlattening>297.0</inverseFlattening>
  </geographic>
</wellCRS>
wellCRS Examples (projected, local)

```xml
<wellCRS uid="proj1">
  <name>UTM31N</name>
  <mapProjection>
    <name>UTM Zone 31N</name>
    <nameCRS namingSystem="epsg" code="23031">ED50 / UTM Zone 31N</nameCRS>
    <projectionCode>UniversalTransverseMercator</projectionCode>
    <zone>31N</zone>
  </mapProjection>
</wellCRS>

<wellCRS uid="localWell11">
  <name>WellOneWSP</name>
  <localCRS>
    <usesWellAsOrigin>true</usesWellAsOrigin>
    <northDirection>Grid north</northDirection>
    <yAxisAzimuth uom="dega">0</yAxisAzimuth>
    <xRotationClockwise>true</xRotationClockwise>
  </localCRS>
</wellCRS>
```
obj_trajectory Example

<trajectorys>
  <trajectory uid="trajacq1" uidWell="w1" uidWellbore="wb1">
    <nameWell>207/29-A6</nameWell>
    <nameWellbore>207/29-A6Z</nameWellbore>
    <name>Acquisition trajectory #1</name>
    <dTImTrajStart>1972-06-28T00:00:00</dTImTrajStart>
    <mdMn uom="ft">0.0</mdMn>
    <mdMx uom="ft">1824.0</mdMx>
    <serviceCompany>Tain Drilling</serviceCompany>
    <definitive>false</definitive>
  </trajectory>
  <trajectory uid="trajacq2" uidWell="w1" uidWellbore="wb1">
    <nameWell>207/29-A6</nameWell>
    <nameWellbore>207/29-A6Z</nameWellbore>
    <name>Acquisition trajectory #2</name>
    <dTImTrajStart>1972-07-09T00:00:00</dTImTrajStart>
    <serviceCompany>AC Surveys</serviceCompany>
    <mdMn uom="ft">1915</mdMn>
    <mdMx uom="ft">3584</mdMx>
  </trajectory>
</trajectorys>
obj_trajectory Example 2

<trajectory uid="trajgeometry" uidWell="w1" uidWellbore="wb1">
  <nameWell>207/29-A6</nameWell>
  <nameWellbore>207/29-A6Z</nameWellbore>
  <name>Wellbore Path Geometry</name>
  <dTimTrajStart>1994-04-15T00:00:00</dTimTrajStart>
  <mdMn uom="ft" datum="ZMD1">173.09</mdMn>
  <mdMx uom="ft" datum="ZMD1">4380.15</mdMx>
  <serviceCompany>Directional Services Inc.</serviceCompany>
  <magDeclUsed uom="dega">-1.42</magDeclUsed>
  <gridCorUsed uom="dega">-1.15</gridCorUsed>
  <definitive>true</definitive>
  <finalTraj>true</finalTraj>
  <aziRef>Grid north</aziRef>
  <trajectoryStation uid="row1">
    <typeTrajStation>O</typeTrajStation>
    ...
  </trajectoryStation>
</trajectory>
Conclusions

- WITSML V1.3 public comment period: mid-December through January. Feedback is currently being evaluated.
- WITSML V1.3 release is anticipated soon. The next feedback, evaluation, and enhancement cycle will follow.
- Use of V1.3 in pilot testing and commercial products anticipate during the first half of 2005.
- Well path uses cases to include: raw measurement reporting, planned well path transfer, and post-processing wellpath transfer.
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