Horizontal Wellbore Schematic

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The Horizontal Schematic is a visual representation of the wellbore in the ground. The schematic shows the direction of the wellbore as well as the details of the wellbore itself. The schematic is created based on live data in Wellcore and dynamically changes as the data changes. Wellcore leverages the schematic rendering technology from INT Technologies in order to create the diagram within Wellcore.

The purpose of this document is to provide a guide on how to use the Wellbore Schematic functionality. This guide will also provide information about the data used to create the schematic.

Configuration
License Key

The Horizontal Schematic is a separate licensed feature in Wellcore. This functionality is not part of the Wellcore Enterprise standard install. Once the license has been installed, the schematic functionality must be enabled in the OneCoreConfiguration.xml file.

Insert the company’s license key into the OneCoreConfiguration file in the schematic section similar to the following example:

```
<schematic>
  <add name="company" value="MyCompany"/>
  <add name="key" value="1234567ABC78DE9012345AA67BC8901D"/>
</schematic>
```

Replace “MyCompany” with your company name. Replace “###” with the number of licensed users as per the contract agreement. Replace the “key” value with the license provided by P2 Energy Solutions.

If the number of users licensed exceeds the number of contractual licenses (numberofusers), then an event log error will indicate that the number of licensed users has been exceeded with the following message:

“Cannot assign Schematic permissions for user %USERNAME% - maximum number of licensed users has been reached.”

  %USERNAME% will be replaced with the name of the user that the last license assignment was attempted for.

Bottom Hole Assembly Library

Bottom hole assembly (BHA) items must be mapped to an image in order for the component to be displayed on the schematic diagram.

- This is done in the Administration workbook > Drilling > Bottom Hole Assembly Library document.
- A new column has been added to accommodate mapping the component to the appropriate symbol.

The schematic symbol is a pick list that lists all the component images that are available in Wellcore. The Administrator must assign a symbol or image to the BHA item for Drilling event types. This image is associated to the BHA item and will appear in the schematic whenever the BHA item is in the schematic dataset. Only schematic symbols set for Drilling event types will affect the schematic. If symbols are set for other event types, i.e. Completions, these are ignored.

Note: Changes to the pick list must be made by P2 Energy Solutions. This list displays all available symbols not just BHA related components. It is up to the user to set the appropriate symbol to the BHA item. Refer to the Components and Images for a complete list of the available schematic symbols.

Pipe Setup

Pipe components must be mapped to a horizontal schematic symbol. This is done in the Administration workbook > Completions > Pipe Setup document. A new column has been added in that will allow the Administrator to map a schematic image to a pipe component. This mapping will apply for all users in the company. The Image column is used to map the pipe components to an image that will be mapped for the Downhole Schematic (Completions > Completion Reports > Schematics folder). This functionality is the same as in previous versions of Wellcore.

The new Schematic Symbol column will only apply to clients who have licensed the new Horizontal Schematic functionality.
Note: The drop-down list data is administered by P2 Energy Solutions. Changes to the pick list must be made by P2 Energy Solutions. This list displays all available symbols not just pipe related components. It is up to the user to set the appropriate symbol for the pipe.

Schematic Data Summary

The schematic order must be set in order for the report on Page 2 to display data. The ordering of the Section Name corresponds to the report sections on Page 2.
**Wellbore Schematic Details**

The new Horizontal Schematics document is found in Completions > Completion Reports > Horizontal Schematics.

The schematics document consists of 3 pages, with each page containing the same header information. As in other Wellcore documents, select on the tabs at the bottom of the document to navigate between the document pages. Horizontal Downhole Schematic is page 1, Horizontal Downhole Schematic Page 2 is page 2 and Directional Plots is page 3.

**Header**

The header displays basic well information for the particular wellbore. This displays the same information as the header in the Data Downhole Schematic document.

**Horizontal Downhole Schematic - Page 1**

The schematic displays how the wellbore looks downhole with all the components that make up the wellbore and the depth of the wellbore. The schematic components are also labeled accordingly with tubing outside diameter (OD) and inside diameter (ID) values. The left-hand side displays the depth axis for the wellbore. The axis changes dynamically depending on the depth values of the different data sources included in the schematic; i.e. directional survey, casing, cementing, etc.

**Display Options**

Display options are available at the top of the schematic diagram. Select Checkboxes for the following display items:
The schematic that is drawn is date driven. Therefore, different dates will display a different schematic image. For example, if the casing was set on Oct 3, the tubing set on Oct 5, and the drill pipe set on Oct 6, each of these days will display a different schematic picture. If the date is set to Oct 3, only the casing will be displayed on the schematic. If the date is set to Oct 6, the schematic will display all components: casing, tubing, and drill pipe.

This is the schematic filter date and corresponds to the date when a component is set. This will display the well as it appears on the selected date. The date is set on several different documents that are identified below. This can be entered manually following the format MM/DD/YYYY, or clicking on the down arrow will allow you to select from a calendar.

If no date is set, all components will be drawn on the schematic.

If no date is set, all components will be drawn on the schematic.

Horizontal Downhole Schematic - Page 1

The schematic displays how the wellbore looks downhole with all the components that make up the wellbore as well as the depth of the wellbore. The components displayed on the schematic varies by the date selection.
Each schematic component is labeled accordingly with the measured depth and the date the component was added in.

The left-hand side displays the depth axis for the wellbore. Only True Vertical Depths (TVD) are represented in the axis. The axis changes dynamically depending on the depth values of the different data sources included in the schematic; i.e. directional survey, casing, cementing, etc. All depths are referenced against the drilling rig’s kelly bushing (KB). The kelly bushing height is set on the Rig List document in the Administration module.

**Data Sources**

The components that are rendered in the schematic depend on the data setup in several documents. The component name in the document must match the component name in the XML component mapping file. The XML mapping file is used to create the symbol list used in the BHA Library and Pipe Setup. Refer to the Appendix in this document for a listing of the component and its’ corresponding image. The data from the following documents are used to draw the schematic.

**Drilling Reports**

**Daily Drilling Reports**

This report is located in the Daily Drilling Report folder.
The Report Date on Page 1 is important to identify the date when a drilling component is used. The schematic date filter checks against the Report Date to determine when the drilling component will display on the schematic. The component will only display on this particular day on the schematic, the next day the component will not appear unless it is set on a new daily report. In the example below, any drilling component set on 11/29/2011 will only display on the schematic if the schematic filter date is set to 11/29/2011 or if the filter date is blank.

The MD at Report Time field in the Progress grid on Page 1 is also required for the schematic.

The drilling component is set on Page 2 of the DDR in the BHA Data grid. The BHA Data is associated with the BHA Inventory report. You can go directly to this report by selecting on the BHA Inventory button.

Bit information is also on Page 2 in the Bit Data section. If there are multiple bits in the Bit & Pump Report, you can select which of the bits from this report to include in the Bit Data section. The Depth Out field that matches the ‘MD at Report Time’ field on Page 1 is the depth that will display on the schematic. If there are multiple bits, the bit with the largest Depth Out field will be displayed.

BHA Inventory

This report is located in the Drilling Reports folder.

Fill in the Bottom Hole Assembly and BHA Details grid. The pick list from the BHA Details grid comes from the administered list in the BHA Library that was previously set.

Because this information is important for the DDR, selecting on the Go to DDR button will automatically open the DDR.
Directional Surveys

This report is located in the Drilling Reports folder. On this report, the Survey Section Details and the Details grids are important for the schematic. In the Details grid, the data in the Inclination column determines the degree that the horizontal well will be drawn. The Depth column identifies the location where the well curve occurs and will correlate with the depth axis on the left hand side of the schematic diagram. If no directional survey data is entered, the schematic will draw a vertical well.

In order to get the curve for the horizontal schematic, the survey section must be set to “Main” in the Survey Section Details grid.

Cementing Details

The Cementing Details report is located in the Drilling Reports folder. The data in the Hole and Cement grids are important for the schematic. In the Hole grid, the Hole Size and Casing Size is required for the schematic. In the Cement grid, the Top and Bottom depths, and the Set Date fields are used for the schematic rendering. The Top and Bottom data determines the depth where the cement component is drawn on the schematic. The Set Date column determines when the component will appear on the schematic depending on the filter date that is set on the schematic. If the Set Date field is left blank, the cement will appear on all days regardless of the schematic filter date.

The depth fields (Top and Bottom) also determines the way the depth axis on the left hand side will appear.
Casing Report

The Casing Report is located in the Drilling Reports folder. The data in the Hole and Casing grid and the Casing Summary grid are important for the schematic.

The components in the Description column pick-list must be setup first in the Pipe Setup document in the Administration workbook for Drilling Tally Type. Corresponding OD and ID pick-list values are also pre-set in the Pipe Setup document.

The Date Set column determines the day when the casing will show up on the schematic for the first time. After this point, the casing will always be displayed on the schematic. The Hole Size and Casing Size are important as it correlates to the Hole and Casing size from the Cementing Details document.

The Casing Set At column will display the total sum of the Length column from the Casing Summary grid. This value must be set for the schematic to render.
In the Casing Summary grid, the Description column identifies the component. This pick list is an administered list that is maintained from the Pipe Setup document for the Drilling Tally Type. If there are multiple casing runs, the schematic only displays one label for the same casing run instead of multiple labels.

The OD and ID pick lists are also an administered list maintained from the Pipe Setup document. The inside diameter must be smaller than the outside diameter in order for the schematic to draw. If the inside diameter is set to a value greater than the outside diameter, the schematic will display as a red x.

The Length column determines how long the casing should be drawn. The Top and Bottom fields determine the depth where the casing will be drawn and will correlate with the depth axis. The depth axis is dynamically drawn by the values in the top and bottom depth values.

Completion Reports

There are a couple of completion reports that must contain the appropriate data in order to render the schematic. These reports are located in the Completions > Completion Reports folder. A completion event is required before these reports can be filled in.

Perforation Report

The Stage Information and Intervals grids are important for the schematic.

The Run Date in the Stage Information section determines the date when the perforations appear on the schematic. The perforations will remain on the schematic from this date on.

The Top and Bottom fields determine the depth of the perforation. The perforations and the number of shots are drawn at the specified depths on the schematic. The number of shots, the top and bottom depths, and the perforation date are displayed in the label.
String Summary Report

The String Type and String Summary sections are important for the schematic.

In the String Type section, the Install Date is the date that the schematic date filter will compare against in order to determine when the component will be drawn on the schematic. If a Pulled Date is entered, the schematic also takes this into consideration when generating the components to display on a given day. The Set At MD field must total the sum of the Length column in the String Summary section.

In the String Summary section, the Component column identifies the schematic component that will be drawn on the schematic. The component must be mapped to a symbol in the Pipe Setup document in order for the component to be drawn on the schematic. The pick list is based on the Completions Tally Type in the Pipe Setup document. If any one of the selected components is not mapped, the entire schematic will not draw and the user will see a red x instead. Like the Casing Report, the ID must be a smaller value than the OD value; otherwise the schematic will not be rendered. The Top and Bottom depths determine the placement of the component on the schematic based on the depth axis.
Page 2 contains the data details for the schematic on Page 1. Each section of the report corresponds to the component data. For example, the Casing Details section shows the casing data used to render the casing component in the schematic.

<table>
<thead>
<tr>
<th>Report Section</th>
<th>Data retrieved from</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casing Details</td>
<td>Drilling &gt; Casing Report</td>
</tr>
<tr>
<td>Casing Summary</td>
<td>Drilling &gt; Casing Report</td>
</tr>
<tr>
<td>Directional Plots</td>
<td>Drilling &gt; Casing Report</td>
</tr>
<tr>
<td>Cement Details</td>
<td>Drilling &gt; Casing Report</td>
</tr>
<tr>
<td>Perforations</td>
<td>Drilling &gt; Cementing Details</td>
</tr>
<tr>
<td>String Summary Details</td>
<td>Completions &gt; Perforation Report</td>
</tr>
</tbody>
</table>

The display order of the sections is set on the Schematic Data Summary document in Administration. Refer to section 2.4 for more detail.

**Directional Plots - Page 3**

The directional plots on the third page are exactly the same as the Directional Plots document found in the Drilling Reports folder.
Data to create the Directional Plots are from the Drilling > Drilling Reports > Directional Surveys document. Create directional surveys, then in the Directional Plots document, add the survey section(s) to the Directional Plots document by selecting on the Add Section To Plot button at the top of the document.

The survey sections are then plotted in the diagrams displayed below. The identical information is then displayed on Page 3 of the Horizontal Schematic.

Validate Data

A Validate Data button is available at the top of the Horizontal Schematic document that allows users to check to ensure that all required data for the schematic has been properly entered.

If the schematic is not appearing, you will see an ‘X’ where the schematic should be.

Selecting on the Validate Data button will display all the data errors and warnings.
Validation Messages
In the following warning messages, ‘N’ identifies the run order number and ‘X’ identifies the component name.

Casing Description Warning
Message: “Warning: Casing description is empty for section: [X], run order: N”
Resolution: In the Casing Report, set the description in the Casing Summary grid for the specified run number.

Casing OD Warning
Message: “Warning: Casing OD is empty for section: [X], run order: N”
Resolution: In the Casing Report, set the OD in the Casing Summary grid for the specified run number.

Casing ID Warning
Message: “Warning: Casing ID is empty for section: [X], run order: N”
Resolution: In the Casing Report, set the ID in the Casing Summary grid for the specified run number.

Cement Top Warning
Message: “Warning: Cement top is empty for section: [X]”
Resolution: In the Cementing Details document, set the formation top depth in the Cement grid.

Cement Bottom Warning
Message: “Warning: Cement bottom is empty for section: [X]”
Resolution: In the Cementing Details document, set the formation bottom depth in the Cement grid.

BHA Component Not Mapped to Schematic Symbol
Message: “Error: Schematic symbol is empty for item: [X]”
Resolution: In the Bottom Hole Assembly Library (Administration Workbook), the component identified does not have an associated schematic symbol. In the Bottom Hole Assembly Details grid, assign a schematic symbol to the component identified in the error.

BHA Component OD Error
Message: “Error: OD is empty for item: [X]”
Resolution: In the BHA Inventory, set up the OD in the BHA Details grid.

Completion Component Not Mapped to Schematic Symbol
Message: “Error: Schematic symbol is empty for item: [X]”
Resolution: In the Pipe Setup document (Administration Workbook), assign a schematic symbol to the component identified in the error message.

Hole Size Null Error
Message: “Error: Hole size is empty for section: [X]”
Resolution: Enter the hole size value in the Cementing Details document in the Hole grid.

Hole Size Zero Error
Message: “Error: Hole size is zero for section: [X]”
Resolution: The cementing hole size must be greater than 0. Enter a valid hole size value in the Hole grid on the Cementing Details document.

Hole Size or Casing Size Error
Message: “Error: Hole size is less than casing size for section: [X]”
Resolution: In the Cementing Details document, enter a Hole Size value that is greater than the Casing Size value.

Print Schematic
Users have the ability to print the schematic using the Print Schematic button at the top of the document.

When users choose to print, they will be prompted to open or save the pdf file.
If the user chooses to Open the file, a pdf viewer will display the schematic on the first page, and the Schematic Page 2 and Directional Plots in the subsequent pages of the same pdf file. The user can then send the file to the printer from the pdf viewer if they so choose to. Opening the file gives the user the opportunity to view the file contents before sending to the printer, similar to Print Preview.

**Note:** This button is only available from the Horizontal Downhole Schematic first page.

Save