6th Pipeline Technology Conference 2011

Pipe Tracking Systems
Logistical challenges of large-scale projects like Nord Stream
Nord Stream project overview

- MES as the Pipe Tracking System for Nord Stream AG
  - Project goals
  - Infrastructure, information flow and IT architecture
  - PTS solution screen shots
  - Solution focus areas for an advanced pipe tracking system based on the iTAC.MES.Suite

- Why deploy a Manufacturing Execution System in a construction project?
- The recipe for success – and how to effectively replicate the results
Nord Stream

- Two parallel offshore pipelines of 1,224 km (transport capacity 55 bcm per year)
- A direct and fixed link between Russia’s vast proven gas reserves and the European Union
- An additional route complementing existing network and other planned pipelines
- Infrastructure project ‘of European interest’ within the framework of the EU’s TEN-E guidelines
- Gas transported by Nord Stream can provide 26 million European households with electricity and heating fuel
- Make a substantial contribution to EU climate protection goals
- Reach consumers already in late 2011
A project on track….

In comparison to Nord Stream, there is currently no other pipeline project that …

- has a similar high capacity
- will already deliver first gas in 2011
- boasts such a comprehensive environmental impact assessment
- can claim to have secured financing
- has completed permitting
- approx. 88% of the first line (1.075 KM) are built
- construction of the second line starts spring 2011

MES (Pipe Tracking System) implementation
Content

- Nord Stream project overview

**MES as the Pipe Tracking System for Nord Stream AG**

- Project goals
- Infrastructure, information flow and IT architecture
- PTS solution screen shots
- Solution focus areas for an advanced pipe tracking system based on the iTAC.MES.Suite

- Why deploy a Manufacturing Execution System in a construction project?
- The recipe for success – and how to effectively replicate the results
Accurate tracking of material is important for controlling such a complex project

- For a project the size of Nord Stream, several suppliers have to be used in parallel
- Vital to trace the serialized components
- Data needs to be consolidated
- Information is required for further processing in the next production step
- Enables Nord Stream to monitor and enforce high material and quality standards
- Helps to manage the complex logistic process during production and design
- Helps to avoid cost intensive downtimes
- Provides reports for internal and external use (e.g. public authorities)
The logistical challenge is initially a question of quality....

**Pipe segments**

- Approx. 12 metres long
- High-tensile steel, type X70
- Coated with
  - Interior epoxy coating of 0.09 mm for enhanced flow properties
  - Exterior anti-corrosive polyethylene coating of 4.2 mm
  - Concrete weight coating of 60-110 mm
- Quality control system covering the entire process from material selection and pipe production to welding on the vessel
- Approx. 100 parameters to be stored for each segment

© iTAC Software AG
The system tracks all production steps and movements from heat to pipe lay.
Nord Stream deploys a comprehensive system across all construction phases.
Infrastructure and communication

- **ERP (as required)**
  - ERP goods receipt
  - ... if requested

- **Reporting**
  - pipes by heat
  - fabrication overview
  - certificate report
  - violations
  - ...

**Pipe Tracking System based on the iTAC.MES.Suite**

- **Pipe Tracking System Interface (PTS)**
  - pipe information (heat, test data, etc.)
  - pipe coating information
  - yard bookings
  - in transport information

- **SMTP (Email)**
  - Information of component (pipe, anode, etc.) state
  - Logistic information (quarantined pipes)

- **FTP**

- **Contractors / Nord Stream QA**

- **Interface to GIS**

- **exchange of GPS data for visualization of the whole pipeline**

- **graphical depiction of problem areas**
Information flow structure

- standardized communication
  (XML based on IPC* Supply Chain standard)

* Institute for interconnecting and Packaging
Transparent Material Analysis

![Pipeline component list](image)

- Selection of the period and the lines
- Selection of the work order, part and/or the serial numbers
- Pipeline component list
- Trend of measured values

**Line:** 001 P1 - Pipe production

**From:** 2008-07-10 14:50:46
**To:** 2008-09-10 15:50:46

**State:** All
**Tests:** All
**Repairs:** All

**Trend of measured values**

- ROUGHNESS_SURFACE_MAX

© iTAC Software AG
Automated communication accelerates and simplifies failure notification / management

- Identify incomplete pipe data sets
- Limit violation
- Automatically blocked pipes
- Direct feedback to suppliers
The automatic test against "recipes" compares approx. 100 measured values for each of the 250,000 components and generates quality management information for the approval process.

### Table: Automatic Data Analysis

<table>
<thead>
<tr>
<th>Pipe-SN</th>
<th>HEAT-SN</th>
<th>Status</th>
<th>Concrete Core Test</th>
<th>Concrete Cube Test</th>
<th>CWC Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>E216157</td>
<td>D2200080300323609</td>
<td>quarantined</td>
<td>no data found</td>
<td>limit violation</td>
<td></td>
</tr>
<tr>
<td>E216166</td>
<td>D2200080300326122</td>
<td>quarantined</td>
<td>limit violation</td>
<td>limit violation</td>
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<tr>
<td>E216256</td>
<td>D220008070326267</td>
<td>quarantined</td>
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<tr>
<td>E216261</td>
<td>D22000805290323455</td>
<td>quarantined</td>
<td>limit violation</td>
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<tr>
<td>E216266</td>
<td>D22000805290323455</td>
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<td></td>
</tr>
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<tr>
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<tr>
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<tr>
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<td>quarantined</td>
<td>limit violation</td>
<td>limit violation</td>
<td></td>
</tr>
</tbody>
</table>

### Table: Limit Violations and Affected SN - Details

<table>
<thead>
<tr>
<th>Affected SN</th>
<th>Measurement Value Name</th>
<th>Measured Value</th>
<th>Min</th>
<th>Max</th>
<th>Work Step</th>
<th>Testlot</th>
<th>Tested SN</th>
<th>Analyze Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>E212896</td>
<td>AS_APPLIED_CWC_DENSITY</td>
<td>2830.0</td>
<td>2888</td>
<td>3192</td>
<td>CWC</td>
<td>25.06.2009 12:44</td>
<td></td>
<td></td>
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<tr>
<td>E212912</td>
<td>AS_APPLIED_CWC_DENSITY</td>
<td>2850.0</td>
<td>2888</td>
<td>3192</td>
<td>CWC</td>
<td>25.06.2009 14:57</td>
<td></td>
<td></td>
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<tr>
<td>E214955</td>
<td>AS_APPLIED_CWC_DENSITY</td>
<td>2886.0</td>
<td>2888</td>
<td>3192</td>
<td>CWC</td>
<td>25.06.2009 13:21</td>
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<td>E215592</td>
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<td>3192</td>
<td>CWC</td>
<td>25.06.2009 12:59</td>
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<td>2888</td>
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<td>CWC</td>
<td>25.06.2009 11:20</td>
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<td>AS_APPLIED_CWC_DENSITY</td>
<td>2821.0</td>
<td>2888</td>
<td>3192</td>
<td>CWC</td>
<td>25.06.2009 10:35</td>
<td></td>
<td></td>
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</tbody>
</table>

### Table: Release Suggestions

<table>
<thead>
<tr>
<th>Pipe-SN</th>
<th>HEAT-SN</th>
<th>CWC Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>E200175</td>
<td>D220008030903230348</td>
<td>T80_D3040</td>
</tr>
<tr>
<td>E200187</td>
<td>D220008031500320606</td>
<td>T80_D3040</td>
</tr>
<tr>
<td>E200204</td>
<td>D220008031500320608</td>
<td>T80_D3040</td>
</tr>
<tr>
<td>E200265</td>
<td>D2200080900320343</td>
<td>T80_D3040</td>
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<tr>
<td>E200301</td>
<td>D22000803170320680</td>
<td>T80_D3040</td>
</tr>
<tr>
<td>E200331</td>
<td>D220008031200320484</td>
<td>T80_D3040</td>
</tr>
<tr>
<td>E200595</td>
<td>D220008031200320478</td>
<td>T80_D3040</td>
</tr>
<tr>
<td>E200901</td>
<td>D2200829005319922</td>
<td>T80_D3040</td>
</tr>
</tbody>
</table>
Focused logistics management

- Nord Stream can compare planning and actual production data.
- This enables focused logistics management.

CWC DASHBOARD
PRODUCTION TILL WEEK 15
MUKNAN
LOGISTIC AND COATING DEPARTMENT

Reminder: Station VI: production before curing, Station VII production after curing.

Here below table shows production per week Station VI, all coated minus rejected, shows schedule planning per week and difference between the production and planned quantities. (per week and cumulative). Same for station VII.

<table>
<thead>
<tr>
<th>Week</th>
<th>Station VI Coated minus rejected</th>
<th>CWC Planning per week</th>
<th>Station VI against planning</th>
<th>Cumulated difference Station VI</th>
<th>Station VII Coated minus rejected</th>
<th>CWC Planning per week</th>
<th>Station VII against planning</th>
<th>Cumulated difference Station VII</th>
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</thead>
<tbody>
<tr>
<td>Week 2009-49</td>
<td>1'200</td>
<td>1'040</td>
<td>160</td>
<td>-172</td>
<td>1'157</td>
<td>1'040</td>
<td>117</td>
<td>-457</td>
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<tr>
<td>Week 2009-50</td>
<td>986</td>
<td>1'040</td>
<td>-54</td>
<td>-226</td>
<td>1'070</td>
<td>1'040</td>
<td>30</td>
<td>-427</td>
</tr>
<tr>
<td>Week 2009-51</td>
<td>1'074</td>
<td>1'040</td>
<td>34</td>
<td>-192</td>
<td>1'022</td>
<td>1'040</td>
<td>-18</td>
<td>-445</td>
</tr>
<tr>
<td>Week 2009-52</td>
<td>377</td>
<td>400</td>
<td>-23</td>
<td>-215</td>
<td>507</td>
<td>400</td>
<td>107</td>
<td>-336</td>
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<tr>
<td>Week 2010-02</td>
<td>1'029</td>
<td></td>
<td>814</td>
<td></td>
<td>917</td>
<td></td>
<td>917</td>
<td>579</td>
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<tr>
<td>Week 2010-03</td>
<td>1'003</td>
<td>950</td>
<td>53</td>
<td>867</td>
<td>1'009</td>
<td>950</td>
<td>59</td>
<td>638</td>
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<tr>
<td>Week 2010-04</td>
<td>950</td>
<td>950</td>
<td>867</td>
<td>908</td>
<td>850</td>
<td>950</td>
<td>-42</td>
<td>506</td>
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<tr>
<td>Week 2010-05</td>
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<td>950</td>
<td>-154</td>
<td>713</td>
<td>844</td>
<td>950</td>
<td>-106</td>
<td>490</td>
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<tr>
<td>Week 2010-06</td>
<td>943</td>
<td>950</td>
<td>-7</td>
<td>708</td>
<td>914</td>
<td>950</td>
<td>-36</td>
<td>454</td>
</tr>
<tr>
<td>Week 2010-07</td>
<td>911</td>
<td>950</td>
<td>-39</td>
<td>667</td>
<td>919</td>
<td>950</td>
<td>-31</td>
<td>423</td>
</tr>
<tr>
<td>Week 2010-08</td>
<td>919</td>
<td>950</td>
<td>-31</td>
<td>636</td>
<td>1'003</td>
<td>950</td>
<td>53</td>
<td>476</td>
</tr>
<tr>
<td>Week 2010-09</td>
<td>958</td>
<td>950</td>
<td>8</td>
<td>644</td>
<td>829</td>
<td>950</td>
<td>-121</td>
<td>355</td>
</tr>
<tr>
<td>Week 2010-10</td>
<td>1'021</td>
<td>950</td>
<td>71</td>
<td>715</td>
<td>1'005</td>
<td>950</td>
<td>118</td>
<td>473</td>
</tr>
</tbody>
</table>
„The logistics department can access the current status of all material movements in real time.“

<table>
<thead>
<tr>
<th>Movement Type / Movement Code</th>
<th>Location / Location code</th>
<th>Product</th>
<th>CWC Type</th>
<th>Anode Type</th>
<th>Quantity [pieces]</th>
<th>Total Length</th>
<th>Weight bare Pipe</th>
<th>Weight incl. ACC</th>
<th>Weight incl. CWC</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Production State IPS</td>
<td>Q pre CWC 2/3/1</td>
<td>PIPE_268 Pipe 26,8 mm</td>
<td>T100_D3040</td>
<td></td>
<td>1</td>
<td>0 m</td>
<td>0 t</td>
<td>0 t</td>
<td>0 t</td>
</tr>
<tr>
<td>In Production State IPS</td>
<td>Q pre CWC 2/3/1</td>
<td>PIPE_268 Pipe 26,8 mm</td>
<td>T110_D3040</td>
<td></td>
<td>4</td>
<td>12,11 m</td>
<td>9,38 t</td>
<td>9,63 t</td>
<td>9,63 t</td>
</tr>
<tr>
<td>In Production State IPS</td>
<td>Q pre CWC 2/3/1</td>
<td>PIPE_268 Pipe 26,8 mm</td>
<td></td>
<td></td>
<td>4</td>
<td>48,64 m</td>
<td>37,83 t</td>
<td>38,83 t</td>
<td>38,83 t</td>
</tr>
<tr>
<td>In Production State IPS</td>
<td>Q pre CWC 2/3/1</td>
<td>PIPE_309 Pipe 30,9 mm</td>
<td></td>
<td></td>
<td>3</td>
<td>36,48 m</td>
<td>32,73 t</td>
<td>33,49 t</td>
<td>33,49 t</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td>97,23 m</td>
<td>79,94 t</td>
<td>81,94 t</td>
<td>81,94 t</td>
</tr>
</tbody>
</table>
The history of each and every process step and all measured values is easily accessible.
After pipe lay on-shore or off-shore, the exact position of the welding seams is documented.
Interface to GIS

- All data (Pipe data, survey data etc.) is stored in the central PTS database.

The GIS System triggers real time request for data from the PTS.
Interface to GIS

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The GIS System triggers real time request for data from the PTS.
Solution Areas PTS

- **Collecting contractor information**
  - line pipe contractor information (pipes, heat information, coating information, weight information, test results etc.)
  - transfer required information to ERP
  - automatic import into PTS with verification of the data including alert management by email

- **Automatic block for non-conforming pipes or components**
  - block pipes and components if they are fail conformity tests
  - direct feedback about situation to suppliers by system generated email

- **Logistical monitoring for pipes**
  - inventory monitoring for several yards and each pipe or other component type based on serial numbers
  - monitoring of transport status
Solution Areas PTS

- **Traceability analysis for all collected data**
  - which components are effected (pipes, buckle arrestors etc. are assembled in which segment)
  - which certificates, test information, GPS data, orders are related to a dedicated segment or a pipe

- **Pipe laying process**
  - offshore laying contractors (laying data with assembly information, references and laying direction for each pipeline segment. A segment (always serialized) can include pipes, buckle arrestors, valves, anodes, pig traps, fittings etc.)
  - offshore as build contractor (as built information including GPS data for each segment)

- **Graphical visualization of the pipeline – GIS Interface**
  - open interface for GIS Visualization of the pipeline with crossings, frontiers and environmental information

- **Pipeline operation**
  - periodic collection of pig data (inspection data) for each segment
  - condition of each pipeline segment will be monitored regarding changes
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- Why deploy a Manufacturing Execution System in a construction project?
  - The recipe for success – and how to effectively replicate the results
A standard MES system for serialized environments delivers advantages for all phases of the project

- Standard requirements can be realized directly (e.g. serialized traceability analysis, test plans with specification of limits, logistics...)
- Consistent requirements regarding data and data format can be enforced for all suppliers
- Common advantages compared with individual solutions
  - Reduction of lead time
  - Stability, consistency, safety
  - Releases and Compatibility
  - Protection of investment
  - Protection of investment
  - Protection of investment
  - Protection of investment
  - Protection of investment
- Manual examination of approx. 250,000 components is simply not doable
- Minimal man power for administration of the system
  - Approx. 1-2 people in IT, logistics and quality
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Successful implementations of IT portals in international environments...

...can be reproduced with strict interface management:

- Definition of standards across the entire supply chain
  - QA processes (approvals etc.)
  - Data provision (interfaces)
- Facilitate easy access to the system
  - for data suppliers (contractors)
  - for internal and external parties who share a need for information
- Use of “Proven Technology”
- Use of Standard Software
- End-to-end documentation (in particular for contractors)
- Automated failure observation (technical and content)
- Correction of failures where they originate
Pipe | Tracking | System
Transparency is the basis for successful pipeline management.

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