Application of 3D-Scanning to BWMS Installation for Existing Vessel

21 September 2012

Nippon Kaiji Kyokai
ClassNK R&D Activities

Collaborated R&D Complying with Industries requests
- Collaborated R&D with Industries and Academic Partners.

R&D directly relating to Classification Society
- Independent R&D conducted by ClassNK Research Institute.
ClassNK’s Research and Development

Collaborated R&D Complying with Industries requests

Status of Joint R&D Projects

<table>
<thead>
<tr>
<th>Status</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed</td>
<td>62</td>
</tr>
<tr>
<td>Ongoing</td>
<td>97</td>
</tr>
<tr>
<td>Proposed</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>( Under Evaluation )</td>
</tr>
</tbody>
</table>

ClassNK is looking for Partners of Our R&D Projects from all over the world!

at the End of August 2012
Research and Development

Application of 3D-Scanning to

Ballast Water Management System (BWMS) Installation for Existing Vessel
1. Background of the R & D
The Ballast Water Management Convention applies to all sea going ships greater than 400gt which use ballast water.

According to MEPC some 40,000 vessels will need to be retrofitted with Ballast Water Management System (BWMS), including around 6,500 listed on the ClassNK register.

Vessels must install and operate an approved BWMS within several years once the treaty comes into effect.

ClassNK has made a priority of bringing the industry’s latest technology to commercial viability for retrofit installations.
1. Background of the R & D

Point of BWMS Selection

Main factors in BWMS Selection for owners

- Voyage Route
- Delivery date of BWMS
- Maintenance & Accessibility
- Ballasting Time & Method
- Docking Schedule
- After service network to avoid off-hire

Docking Schedule is one of the main factor
1. Background of the R & D

Where is the space to install BWMS?

- Many equipment and device are already installed to Engine Room.
- BWMS device is not so small.
1. Background of the R & D

Installation Works for BWMS

If all conversion works are carried out in dry dock;
⇒ Work period takes two(2) or three(3) weeks.

Example: (Each work is carried out in parallel.)
- Structural modification(5days)
- Equipment installation(7days)
- Piping(14days)
- Electric work(7days)
- Operation Test (2days)

- Advanced preparation and divided installation work at safe location may minimize installation schedule with safety first.
- System experts and/or experienced engineers give more smooth work.
Important factor in BWMS retrofit

Keep Docking Period on Schedule

◆ The advanced preparations are indispensable for smooth conversion work.

What is Advanced Preparations?

◆ Recognition of current situation in engine room.
◆ 3-D representation of engine room structures.

3-D modeling of the engine room and the design using a 3-D model are effective as advanced preparations.
1. Background of the R & D

3-D Scan by laser scanner

- A 360 degree 3-D scan of the engine room produces point group data.
- Collection of the necessary data is completed within several hours.

3D laser scanner is a measuring tool which can acquire three-dimensional coordinate data targeted for the topography or the structure by using a laser to instantly measure the target structure.
2. Outline of the R & D
2. Outline of the R & D

3D-Scanning Application to Actual Operations

**Target**
- Establishment of measurement technique, and scanned data collection of existing vessel.
- Development of software for point group data handling.
- Examination of method of utilizing other case.

**Period**
From April 2012 to June 2014
## 2. Outline of the R & D

### Participants

<table>
<thead>
<tr>
<th></th>
<th>University &amp; Institute</th>
<th>Shipping Company</th>
<th>Repair Yard</th>
<th>Engineering Company</th>
<th>Software Developer</th>
<th>Classification Society</th>
</tr>
</thead>
<tbody>
<tr>
<td>The University of Tokyo MTI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sasebo Heavy Industries</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanwa Dock</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NYK K Line</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEA Systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARMONICOS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ClassNK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. Outline of the R & D

Work flow for the design by using 3-D laser scanner

1. Actual Vessel Measurement

2. transform to 3-D Model from point group data
3. convert into 3-D CAD data
4. carry out a design for installation work of BWMS on 3-D CAD software

Expected to reduce man-hours
2. Outline of the R & D

Assessment of accuracy

Comparison actual value with measured value
Distance from 3-D laser scanner to the pipe: abt. 2m

- Inclination of the flange
  - Actual value: 2.5°
  - Measured value: 2.15°
  - Measurement error: -0.35°

- Interval of the bolts (Center)
  - Actual value: 100mm
  - Measured value: 100.1mm
  - Measurement error: 0.1mm

- Diameter of the flange
  - Actual value: 430mm
  - Measured value: 430.8mm
  - Measurement error: 0.8mm

- Length of the pipe
  - Actual value: 995mm
  - Measured value: 994.5mm
  - Measurement error: -0.5mm
2. Outline of the R & D

Transform Point Group Data to 3-D Model

1st Step

- It takes about 1 week by using general-purpose software for point handling.
- In order to apply 3-D scanning for retrofit of BWMS, operation hour reduction is required.

Specialized software for the maritime use is necessary.
2. Outline of the R & D

Transform Point Group Data to 3-D Model

- 3-D Models are converted to general-purpose data for commercially available 3-D CAD Software.
- Advanced design is feasible by using 3-D CAD Data.
2. Outline of the R & D

Software under development

Specialized for maritime use!

Point group data after automatic noise removal

Developed by Armonicos

Automatic recognition for pipe and plane
A number of tools are acceptable to support the retrofit of such installations but the 3-D scanner has greater potential for increasing efficiency during the retrofit process.

ClassNK believes the use of 3-D scanners in the design and installation of BWMS retrofits it commercially viable.

To further encourage the use of this new technology, ClassNK will continue collaborated R&D including specialized software development.
Thank you for your kind attention