

Leica Geosystems **TruStory** FPSO Vessel Conversion As-builts with Leica HDS3000 and Cyclone



Complete Capnor 3D As-Built Model

Background:

Marathon Petroleum Company (Norway) is converting the Multipurpose Shuttle Tanker (MST) Odin, renamed "Alvheim", to an FPSO (floating production, storage and offloading) vessel to serve the Norwegian Continental Shelf. The Alvheim development is operated by Marathon Petroleum Company (Norway) (65%), with working interest owners ConocoPhillips (20%) and Lundin Petroleum (15%). Built in 2001 by Izar (formerly Astilleros Espanoles), the vessel was received by Marathon from Statoil in January 2005. It has an overall length of 252m and 42m beam; after conversion, the vessel will have a storage capacity of 560,000 barrels of oil.

The Alvheim FPSO project has six main elements: drilling and completion of wells; installation of sub-sea infrastructure; construction of the Turret Mooring and Swivel

(TMS) system; hull upgrade; topsides and integration; and Operations readiness. This hull upgrade is being performed at Keppel Shipyard in Singapore. Topsides and Integration is undertaken by Vetco Aibel, with the work mainly being performed in Norway.

To address the many design issues and reduce the risk of construction interferences, the engineering team selected Aveva's VANTAGE PDMS 3D design system. However, before design could begin, two significant obstacles had to be overcome—the lack of accurate as-built drawings and the desire for a 3D as-built model for use in PDMS. To address these needs, Capnor Laser Scanning Services (formerly Hi-CAD Norway), headquartered in Stavanger, Norway with offices in Krakow, Poland, and Houston, Texas, USA, was awarded a

■ Scope

Create a complete and accurate as-built 3D model of the MST Odin to be used for FPSO retrofit design in AVEVA PDMS

■ Customer

Marathon Petroleum Company, Norway/
Capnor Laser Scanning Services, Stavanger, Norway

■ Date

September 2004 (Data collection); Early 2007: FPSO Alvheim scheduled to enter service

■ Project Summary

Field

11.5 days; 2-person crew; 110 full-dome high-resolution Leica HDS3000 scans

Registration

40 hours

3D Modeling

4-person team, 9 weeks; 35,000 modeled objects

Deliverable

3D As-built AVEVA PDMS model

■ Benefits:

- Early identification of clashes with existing congested areas
- Traditional as-built methods could not have delivered a similar 3D model to the level or accuracy demanded
- Smooth integration of as-built model with design tools for optimized engineering and better overall design
- Common model available to all contractors reduced interface issues
- Improved safety by reducing site visits and exposure to job site hazards

"I don't think it's even possible to do a project like this using traditional methods, but if it could be done I believe it would take 30 to 40 times longer to create a 3D model with similar coverage and accuracy as the laser scanned model we created."

Gunnar Dirdal, M Sc, General Manager
Capnor AS Laser Scanning Services

contract to use laser scanning to acquire as-built data and create an accurate 3D surface model from the scans. Key factors for Capnor's selection included their extensive laser scanning and 3D modeling experience, and their industry experience. Capnor has executed over 100 such projects since 2002. As of July 2006, Capnor owned two Leica HDS3000 and two HDS4500 scanners and more than a dozen licenses of Cyclone software.

Project Workflow

Leica HDS3000 Data Collection:

To meet the engineering schedule, Capnor needed to deliver a complete, accurate as-built 3D model long before the vessel was to arrive at the Keppel Shipyard for retrofit. To make the schedule, a 2-person Capnor laser scanning team, led by Haarvard Sande (Capnor Laser Scanning Services Manager), worked for 11.5 days, collecting over 110 high-resolution, full-dome scans with a Leica HDS3000 scanner. In addition, Ole Martin Dahle, a representative from the engineering design team, was present during scanning for guidance and technical assistance. The initial scope was to only scan the topside deck; however, based on the immediate success and value recognized by Marathon engineers, the scope was expanded to include numerous internal areas where modifications were to occur. Scanning was completed ahead of schedule.

Cyclone Registration:

Immediately after completing data collection, Capnor began registering and geo-referencing scans to their on-board survey control network. Control points were carefully surveyed to ensure tight dimensional control with scan targets used for scan registration. In addition, Leica's Cloud-to-Cloud registration technology was used to accurately align overlapping scans that did not include targets. Registration was completed and verified in one week.

Cyclone 3D Modeling:

Capnor's 3D modeling technicians used Cyclone MODEL to create the 3D surface model in a sequence based on priorities set by Marathon engineers. Modeled regions were then delivered area-by-area according to these priorities. In 9 weeks, a 4-person team accurately modeled over 35,000 objects. NewTek LightWave 3D software was separately used to model the hull with data obtained from photos and existing 2D drawings.

PDMS Deliverable: As each defined modeling area was completed, it was imported into PDMS, using AVEVA ImPLANT via Microstation. Advanced PDMS design, visualization, data management, and documentation tools were used for engineering design and clash detection.

Project Benefits Realized:

By using Leica High-Definition Surveying (HDS), as opposed to traditional as-built methods:

- 1. Higher Accuracy** - Data within 6mm average dimensional accuracy.
- 2. More Complete** - All visible objects were captured, including distortions and deviations
- 3. Convenient 3D Design Database** - As-built models for convenient design use directly in PDMS.
- 4. Reduced Site Visits** - Considerably fewer trips by design personnel to collect dimensions.
- 5. Faster** - High-speed scanning avoided possible weather delays associated with prolonged traditional measuring.
- 6. Safer** - Fewer personnel exposed to site hazards for shorter periods of time.
- 7. 3D Design and Automated Clash Detection** - HDS allowed the design team to take full advantage of automated 3D PDMS clash detection capabilities.
- 8. Better Design Reduces Project Risk** - Visualizing a new design in context with the real world allowed project engineers to better understand constraints, constructability issues, fabrication requirements, and design opportunities.
- 9. Reduced Rework** - Minimizing design interferences and fit-up problems reduced potential rework costs and the risk of associated construction delays.



Aerial photo of the MST Odin