Noise and vibration control in Cat-D offshore platform construction

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ABSTRACT

Multiconsult Acoustics were contacted late 2012 by the platform owner Songa Offshore, to assist with noise and vibration control for four near-identical drilling, intervention and completion platforms being built in South Korea. Multiconsult participated in the Korean site team for three years, helping to bring the project to a successful conclusion, with swift approval by the Norwegian Petroleum Safety Authority (PSA). Advantage to the Owner: assurance of effective communication and follow-up of Yard activities and documentation. Advantage to Yard: a qualified cooperation and discussion partner. Multiconsult engineers have benefited in gaining experience through an interesting project. Early cooperation assured documentation according to PSA expectations. Challenges were detected early and largely rectified, prior to rig handover. PSA on-site and post-delivery audits were supported. Verification activities included FAT, commissioning and Sea Trial noise tests and sound insulation measurements.

Keywords: Sound, Insulation, Transmission, Project team follow-up

I-INCE Classification of Subjects Number(s): 54.2

1. INTRODUCTION

Installations used on the Norwegian Continental Shelf (NCS) are subject to audits by the Norwegian Petroleum Safety Authority (PSA). The document governing the noise control requirements and various other Working Environment (WE) issues is NORSOK standard S-002. This standard contains specific (area) noise criteria, but also, in a normative annex, a procedure to be followed in the noise control work. Dealing with this, along with a set of qualitative criteria, can be perceived as difficult by some construction yards and can in some cases lead to contract disputes.

Effective use of the NORSOK S-002 noise regulations is best achieved with competent acoustical engineering personnel on both Owner and Yard sides of the table. It is preferred that noise control reports are available as “live documents”, and noise predictions are to be presented and updated throughout the engineering, construction and commissioning process.

This process is sometimes regarded as expensive and cumbersome. The Yard may prefer to do its work in peace and present test results of the finished product at the end. The Owner may choose to trust the Yard expertise and hesitates to hire in its own experts. Even with experts on hand, effective cooperation can require some deft diplomacy to overcome Yard skepticism.

Judging by Multiconsult experience, an open process leads to a better product through better quality control, as well as to a better learning process for all parties concerned.

This paper presents a project where the collaboration was taken seriously, and which can stand as an example of how following the NORSOK “process” can benefit all parties.

2. SHORT DESCRIPTION OF THE PROJECT

2.1 Platform Design

The four platforms are of the semi-submersible type, based on the GVA-7000 design. They stand
with four columns on pontoons and are held in position by a dynamic positioning (DP) system using six thrusters. This can be assisted by a mooring system for longer operations in one location. The rigs are self-propelled, with a central drilling derrick. Besides normal drilling and cementing operations, they can also assist in completion, where a well is made ready for production. They are also suited for well intervention. All in all this translates to a complicated system with greater than normal complexity of cabling and piping. The platforms are designed for a large degree of automatic operation, in part to reduce occupancy time in noisy and otherwise hostile areas. A picture illustrating the platform design is shown in Figure 1.

Figure 1 - Cat-D rigs under construction in Okpo, South Korea. Photo: DSME

Power is supplied by six diesel generators located aft. The noise sensitive areas are isolated as far as possible from the noisy equipment. Parts of the accommodation had to be integrated into the lower decks of the hull. Here, floating accommodation systems were used.

The main noise generating equipment was vibration isolated. This included hydraulic power units (HPU), compressors and chillers, which were relatively close to the accommodation, besides the main generators at relatively large distance. Mud pumps and cementing units were mounted on harder pads, but were relatively far away from the noise sensitive areas. Control cabins for drilling, cranes, anchor winches, etc. were mounted on vibration isolation elements. In some cases curtain systems were used for local noise control.

The extensive follow-up process assured that there were few surprises when commissioning tests were finally performed. The noise levels were in the end acceptable. The entire complex of Working Environment issues were followed up in a similar manner, and PSA approval was obtained in record time.

3. Follow-Up Process

The NORSOK S-002 follow-up procedure requires activities in all phases of a project. Basic evaluations are performed already during the concept phase, and a relatively complete analysis follows during the preliminary design phase. This can take the form of modification of a previous, proven design.

At the start of detail design and construction, the contractor/yard takes over responsibility and has to prepare the documentation, which follows the rig until PSA acceptance and into operation.

3.1 Multiconsult Involvement

Multiconsult entered the project some months after the work had started in Korea. Orders had already been placed for long lead items, construction was under way. A few major pieces of machinery had been delivered.
3.1.1 Establishing a Cooperative Environment

The first task was to establish a working spirit of trust and cooperation between DSME R&D experts and Owner. A framework for the Noise Prediction Report was established, and early revisions prepared with the material provided by GVA and the predictions made by DSME specialists. This report was updated and revised six times during the course of the project and formed the basis for weekly follow-up meetings. Procedures for testing during the different project phases were developed and issued by the Yard, as agreed between both teams.

All known issues were regularly discussed and noise reducing solutions developed and actively followed up. The Yard acousticians showed interest and willingness to accept the advice, and they worked hard on their part to implement the necessary actions. Sometimes the solutions required accommodation from both Owner and Yard to settle the contractual implications.

3.1.2 Practical tasks

Much of the follow-up activity consisted of “political” work: meeting, communicating, presenting and defending arguments. In some cases Multiconsult engineers also conducted special studies and wrote reports to address known areas of PSA concern.

Multiconsult engineers also participated in Fabrication Acceptance Tests (FAT) for major equipment, sometimes with Yard representatives present, and at other times to witness tests performed by experts hired by the supplier. With their own measurement equipment Multiconsult engineers could supplement with quality checks and special measurements not required in the FAT procedures, e.g., to identify main noise sources, check structure borne sound levels and vibration isolator performance on foundations.

During the commissioning and Sea Trial periods, regular inspections were made on board and Yard testing witnessed. The Yard engineers showed remarkable efficiency and conscientiousness in performing and reporting on their tests. The cooperative environment between the two expert teams may have helped this.

Accommodation systems were inspected in the mock-up cabins (the tests had been completed), and own tests made in the finished cabins to corroborate the Yard test results. Also in this case, Yard test program and follow-up can be assumed to have been helped through the active participation of the Owner’s experts.

3.1.3 Reporting

Multiconsult contributed in the preparation of the Yard’s Noise Prediction Report, which is required by NORSOK S-002. In addition Multiconsult prepared an enhanced Noise Exposure Report to include the effect of the special features of the rigs, and a Noise Survey Report forming the basis for future follow-up work in operation. Additional reports were also produced, showing measurement results, as well as giving a summary of all Multiconsult involvement in the project.

3.1.4 Benefit of Having Four Similar Rigs

The noise issues on the four rigs were similar, and the lessons learned with the first rig were helpful in addressing those on the following three. There were issues that needed to be handled in transit with the first rigs, but which could be rectified in the Yard with those following.

There are still differences from one rig to the other, related to small design changes, equipment or workmanship. The rigs are also very complex systems, and not all issues were detected on the first one. Access to spaces and processes is not always possible due to timing, painting or restrictions in when specific equipment could be operated. In the course of following up all the rigs, most issues occurring in Operation could be identified and described.

4. Did this Follow-up Eliminate all Problems?

The intensive follow-up certainly resulted in early detection of numerous noise control issues. Most noise sources could be checked in FAT and effectively predicted. Axial fans were an exception, since they were tested without ducting. However, the excessive noise levels resulting in some areas due to these fans, could all be mitigated by silencers and lagging/mantling installed after Sea Trial. Another issue concerning structure borne noise from combustion air intake ducts could also be solved before the rigs left the Yard.

In a few cases, PSA audits resulted in concerns that could be resolved through special studies with associated reports.

In the end, all noise and vibration issues could be resolved before sail-away or during transit. There were no after-work related to noise control, which certainly was a factor in securing a swift approval
for operation of the rigs on the Norwegian Continental Shelf.

5. Did it pay off for the Owner?
   If time can be saved before going into service, money spent in prevention is well spent. With day rates of several hundred thousand dollars, the fees for an acoustics specialist, even over three years, is quickly saved if after-work is prevented.
   There have indeed been projects where problems related to noise have been among the reasons for extended yard stays in Norway after delivery.
   For the Owner it was a priority to assure that Working Environment issues should not delay the transition into Operation. For this reason, the WE team in Korea was given priority, and the result has certainly been positive.

REFERENCES
1. NORSOK standard S-002, Revision 4, August 2004: Working Environment