RECOMMENDED GUIDELINES FOR DEPLOYMENT OF RFID ON THE NORWEGIAN CONTINENTAL SHELF

- Fixed Equipment -

THE NORWEGIAN OIL INDUSTRY ASSOCIATION (OLF)
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1 Introduction

This guideline for deployment of Radio Frequency Identification (RFID) on the Norwegian Continental Shelf (NCS) addresses the main needs and requirements of the offshore industry for operational information in the area of locating and tracking fixed equipments.

2 Domain

2.1 Fixed equipment

Fixed equipment is defined as equipment that is placed on the facility to provide a function for the facility on a permanent basis. Equipment on a facility that is subject to maintenance and operational routines are tagged according to engineering numbering systems by the operator. This guideline is describing how normal tagging should be combined with RFID technology.

There are basically two types of application:
- The ability to automatically capture an asset’s/equipment’s ID
- The ability to track an asset’s/equipment’s movements

Temporary equipment (hired), containers and baskets are not covered here. But if the fixed equipment is relocated, the RFID systems in this deployment area may be used to identify and locate items efficiently to avoid delays in production or even total work stoppages. The general requirements for this part of the RFID systems are:
- Unambiguously identify the equipment.
- Locate a particular equipment when is required.
- Track the movement of the equipments within a platform offshore or on a base onshore and at entry and exit points.
- Automatically transmit the movements of the equipments to the enterprise system and to a repository for record.
- Record the equipment has been issued to or is in the custody of a particular operator/company employee.
- Capture electronic proof that an asset has been physically visited – e.g. to provide audits of safety inspections

The requirements presented in these guideline will be applied to different implementation solutions and different approaches to fulfilling these requirements are considered. The guidelines consider that there will be different right solutions and implementations to fulfil the requirements.

3 Business objectives

Application of RFID combined with PDAs PDAs (with attached or build in RFID readers) or/and Ultra Mobile PCs (UMPCs) for use in the field, is generally increasing quality and reducing potential personal failures in daily operations. The concept of inputting information by scanning the item rather than writing down the information by hand has significant benefits because it speeds up the transaction and substantially reduces human error.
Every action on equipments will be tracked, linking the work order and the equipment with time stamps. The operator can then document what has been done at which time, and ensure that everything is covered that is supposed to be.

### 3.1 Safety
A significant part of the work performed on an installation is related to testing of safety critical functions or components. Administration of this work is of vital importance in order to ensure the integrity of these safety critical functions. Application of RFID in this process will automate parts of the work process, reducing the options for personal failures.

RFID will thus increase the quality of this safety critical work and reduce the likelihood of tags falling between chairs.

### 3.2 Quality
Work on the ‘wrong equipment’ is a root cause of several production loss incidents, classified as human error. This is typically work on ESD/PSD- equipment that is expected to be in bypass mode. RFID and PDAs are tools that will help the operator to get a confirmation that he or she is at the right equipment before action is taken.

### 3.3 Efficiency
To increase efficiency, good quality planning and estimates is the key. Application of RFID and PDAs will significantly improve the quality of future estimates on recurring work like planned preventive maintenance actions, in particular the ones with high frequency or with relative large volumes of similar tags with the same maintenance actions. Better planning will increase resource utilisation and performance for an installation.

Real-time reporting of progress will have a positive effect in turnaround situations, revealing opportunities as the turnaround is in progress. The automation of this reporting is also saving time for the individual operator.
Time writing against work orders is today generally a separate activity that can be done more automated “on the fly” without spending time in the office performing this. This will have a significant impact on non value added time for some installations.

4 Cost and benefits

Hardware costs are marginal compared to the value of production saved. RFID-Tags, PDAs and WLAN Network are at relatively low cost in the petroleum industry. Software costs should be considered together with costs of ERP systems and software for specific applications.

Benefits:
- Improved quality of safety critical systems integrity.
- Reduced likelihood of human error related unplanned shut downs of production systems. Assuming 20% reduction of these failures.
- Improved planning and resource utilisation. 5-10 % potential
- Paper less process
- Resource planning

It is recurred that the deployment RFID projects justify on direct benefits and consider the following:

- For “automatically capturing as asset’s/equipment’s ID” – RFID solutions will be compared with industrial barcode solutions. The cost of the RFID tags is negligible, but the time taken to retrofit them could be significant.
- WLAN is not initially critical for most RFID applications and so often tends to be deprioritised. If possible, it is recommended that WLAN should be regarded as a critical and necessary “infrastructure” cost rather than a project cost (because it enables so many other beneficial applications) in some cases this may make cost justification easier.

As part of determining the benefits, it’s important to perform time studies before and after implementing the system.

5 Antenna, tags and sensors

RFID Tags:
On fixed equipment placed offshore, RFID passive tags (no battery included) are recommended, with the exception of equipment that needs to be tracked from long distances (10-50m).

The RFID tag is recommended to be integrated in a conventional tag number plate, known and used in the industry for decades. This is done to avoid mixing up the tag plate and the RFID tag in the field. The tag number plate will serve as a backup for the system and it will be readable by the user on site, as is done today. Integrating the RFID tag in a conventional tag number plate is not sufficient for all cases. In these cases it is required to develop some conventions for knowing where RFID tags are when integration with tag plates is not possible.

For practical reasons tag numbering plates can be placed relatively close to each other, depending on the extent of tagging on the plant. This can introduce challenges in the process of reading. Therefore short reading distance is preferred, in the range of 10cm.

- Frequency: (LF, HF or UHF)
- EX/ATX: (Zone 1)
- Environment: Wet, salt water, outdoors/indoors, -40 to +55 °C
- ID numbering: To be combined with standard tag numbering system.
  - Standard tag number printed in text on the tag or
RFID tag integrated in standard tag number plate.

5.1 Frequency
The frequency for the passive RFID-tag should be decided depending on the application. A number of factors that should be taken into account when choosing the frequency are listed below:

- Reading distance should be fairly short (10 cm or less).
- Availability in the market.
- Availability of hand held devices with reader in EX/ATEX -version.
- Price per tag.

A solution where either frequency (LF, HF) can be used is desired and the requirements have to be adapted to the specific application.

Interference:

- Active WLAN networks (802.11.x) must be expected in the area. 2.4GHz
- Wireless transmitters networks, (frequency ranges from 450 MHz to 2,4 GHz)
- Several other frequencies and magnetic fields can also be expected.

5.2 EX/ATEX
Ignition protection in explosive atmosphere is required. When a tag is being activated by a reader it is regarded as part of the system. Thus, even passive tags are subject to certification. For use of electronic equipment in the fixed equipment area, including the well centre, the following requirements are applicable for tags: Hazardous area Zone 1, Gas group IIC, and temperature class T4/T6.

5.3 Environment
This equipment will be placed in a harsh environment with:

- Strong winds.
- Temperatures varying from -40 °C to +55 °C.
- Salt.
- Wet.
- Metal nearby, (steel, aluminium).

5.4 ID numbering
RFID Tags for this purpose should have the same standard as all other tags used in the Oil industry on the Norwegian Continental Shelf.

5.5 Security
The system is not to be designed to be business critical, but an improved work process. Falling back to a paper based process is an option.

6 Antenna and readers
Readers:

- Frequency to be aligned with the tags.
  - LF, HF or UHF.
- EX/ATX (Zone 1).
- Environment: Wet, salt water, outdoors/indoors, -40 to +55 °C.
- Portable (hand held PDA or/and Ultra Mobile PCs (UMPCs).
- Interface with CMMS ((SAP) (Interface is a separate activity)).
• Wi-Fi module wanted to allow for future online communication.
• Battery life to fit normal work schedule as a minimum. Docking and charging during breaks.
  o Power saving function, sleep mode is recommended.
• Should be user-friendly like normal PDAs or/and Ultra Mobile PCs (UMPCs).
  o Able to operate with gloves?
  o Readable in good and poor light conditions.
  o Lay out (key pad, screen) to be discussed in more detail.

**Antenna/Access point for WLAN:**
• Frequency: 2,4 GHz
• EX/ATX: (Zone 1)
• Environment: Wet, salt water, outdoors/indoors, -20 to +40 °C
• ID numbering: Standard tag numbering system
• Material: Need Reference to NORSOK. -316 S or better.
• Interface/synergies: LAN/ synergies with Visiwear.
• Security: WLAN security standards.

### 6.1 Frequency
See section 5.1.

### 6.2 EX/ATEX
Ignition protection in explosive atmosphere is required. For use of electronic equipment in the fixed equipment area, including the well centre, the following requirements are applicable for handheld readers: Hazardous area Zone 1, Gas group IIB, and temperature class T4/T6. The requirements applicable for portal readers are mainly the same as for handheld readers, but depend on the localization of the portal. Onshore readers may not need this kind of certification.

### 7 Application integration

When considering application integration there are three modes of operation that have to be considered:
• Offline Mode (characterised by standalone access and capture of data – synchronised, typically by docking a PDA or UMPC)
• Permanently Connected Mode (the system depends on a wireless connection, in real time to work)
• Occasionally Disconnected Mode (which recognises that even with WLAN deployed on a facility there are some places where the signal will be lost).

The third mode of operation is critical and requires applications to be built in dedicated mobile environments such as Syclo.

The data capturing is defined by the business processes, but a list of possible inputs/outputs are given below:

**Data downloaded** to the PDA/UMPC-device before work starts (Offline version without WLAN):
• Work orders with tasks, including tag-list.
• Hours estimated.
• Materials needed.
- Permits.
- Documentation, procedure, check list etc.
- Previous history on the equipment, like maintenance activities, failures etc.

**Data uploaded** to the ERP or CMMS system from the field device:
- Confirmation of completion of task or order. Changing status from *to be inspected* to *inspected*.
- Readings from measurement points (e.g. operator rounds).
- New notifications, reporting findings or deviations from normal condition.
  - Including symptom codes if applicable in CMMS.
- Time spent in performing a task.
- Material used during repair.
- Cause code for the failure. Cause often not evident until work is completed.
  - In alignment with ISO 14224.

In case there is a WLAN available access to more data on demand basis is a lot easier.
- The CMMS (SAP) contains the data; the RFID is only for identification. The interface with the CMMS needs to be defined by the operator according to business needs and work processes in place. The cross reference register is located in the CMMS.
- The PDA is displaying the data in the field. Data can be loaded up/down before the job starts and after completion (Docking).
- Wireless interface and real time access to data as needed and available infrastructure on the facility.

All data transfer is behind firewalls, and of internal nature. No need to exchange data with external parties outside already established communication lines.

The following business processes must be integrated:
- Maintenance process.
- Operational rounds.
- Interface with ERP like SAP for handling of work orders, readings, time writing and confirmation of work.
- Planning and scheduling process.

The Computerized Maintenance Management System is the driver for the maintenance applications. SAP is currently used by most of the operators.

A PDA version of SAP already exists, covering a wide range of work processes in SAP, but some customizations might be needed. Other planning and scheduling systems might apply as well.

In general very flexible, since the data is stored and maintained in the database, not the RFID tag.

The industry has common interest in standardization of RFID tags and readers, to ensure availability of hardware with required functions and features. The hardware (PDA/UMPC device) needs to be EX-proof and able to communicate with wireless infrastructure (WiFi/WLAN networks) that is a backbone for Integrated Operations.
8 Appendices
<table>
<thead>
<tr>
<th>Topics</th>
<th>Tags</th>
<th>Readers</th>
<th>Additional information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deployment area: Fixed equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Passive</td>
<td>Semi-passive</td>
<td>Active</td>
</tr>
<tr>
<td>Infrastructure and integration:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall infrastructure</td>
<td>See Additional information.</td>
<td>See Additional information.</td>
<td>Semantic web; “Internet of Things”; ISO/W3C standards; XML schemas/WITSML standard; Oil and Gas ontology; SOIL network (optional).</td>
</tr>
<tr>
<td>Data integration</td>
<td>See Readers.</td>
<td>Seamless integration with the ERP system.</td>
<td>ERP (e.g. SAP).</td>
</tr>
<tr>
<td>ID-numbering:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory/ buffer</td>
<td>User definable (9-4kbytes, e.g. EEPROM).</td>
<td>Up to 400 tags, extension 2000 tags (EEPROM).</td>
<td></td>
</tr>
<tr>
<td>Programmable</td>
<td>Wireless activation/reprogrammable by proximity device (max. 5cm).</td>
<td>Program updates via host computer interface.</td>
<td></td>
</tr>
<tr>
<td>Air interface and related properties:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General annotations</td>
<td>Recommended: Passive tags integrated in a conventional tag number plate; xxHz.</td>
<td>Handheld readers are required. Portals are only of interest when moving/transportation occur.</td>
<td></td>
</tr>
<tr>
<td>Standard/Protocol/Frequency</td>
<td>Global standard/ISM frequency band, (&lt;135kHz, 13.56MHz, 433MHz, 860-960MHz or 2.45GHz).</td>
<td>Tag compatible.</td>
<td>&lt;135kHz (ISO 11784/5, 14223, ISO/IEC 18000-2, RuBee/IEEE P1902.1); 13.56MHz (ISO 14443, 15693, ISO/IEC18000-3); 433MHz (ISO/IEC 18000-7); 860-960MHz (ISO/IEC 18000-6, EPC Class1/Gen2); 2.45GHz (ISO/IEC 18000-4).</td>
</tr>
<tr>
<td>Transmission Power</td>
<td>Depending on energy from reader.</td>
<td>Depending on frequency band and application.</td>
<td>Depending on frequency band, application and human exposure limits (passive tag applications).</td>
</tr>
<tr>
<td>Read range</td>
<td>See Readers.</td>
<td>Max. 10cm.</td>
<td>Depending on application.</td>
</tr>
<tr>
<td>Detection accuracy</td>
<td>See Readers.</td>
<td>100%.</td>
<td>Dependent on application.</td>
</tr>
<tr>
<td>Power:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power source</td>
<td>No battery, induced by the reader.</td>
<td>Non-replaceable/built-in battery, Min. 4 years @ 2sec intervals.</td>
<td>Rechargeable battery.</td>
</tr>
<tr>
<td>Battery indicator and backup.</td>
<td>-</td>
<td>Low battery indication.</td>
<td>Low battery indication.</td>
</tr>
<tr>
<td>Environmental properties, incl. ignition protection in explosive atmosphere:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EX/ATEX.</td>
<td>EX Zone 1.</td>
<td>See Tags.</td>
<td>EX Zone 0, 1 or 2 (depending on the localization of the portal).</td>
</tr>
<tr>
<td>Gas certification/ detector</td>
<td>Certification group IIC.</td>
<td>See Tags.</td>
<td>Certification group IIC. Gas detector, trip level 60% LEL (only EX Zone 2).</td>
</tr>
<tr>
<td>Operating temperature.</td>
<td>From -40°C up to +85°C.</td>
<td>See Tags.</td>
<td>-40°C/+85°C or -40°C/+135°C (depending on the localization).</td>
</tr>
<tr>
<td>Humidity</td>
<td>100% RH and be non-condensing.</td>
<td>See Tags.</td>
<td></td>
</tr>
<tr>
<td>Material.</td>
<td>Corrosion and fire resistant, low smoke, halogen free, withstands aggressive gases/ liquids and physical strain.</td>
<td>See Tags.</td>
<td></td>
</tr>
<tr>
<td>Storage/ washing</td>
<td>Temperatures up to 100°C and sound hygienic.</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: All prevailing regulations given by the authoritative body within the application must be followed, (Petroleum Safety Authority Norway, Norwegian Post and Telecommunication Authority, The Data Inspectorate in Norway, and Norwegian Radiation Protection Authority etc.).