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# Norwegian Oil and Gas training curriculum

## Course on underwater operational inspection with an ROV

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Version no: 2

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## FOREWORD

This training curriculum has been compiled for the course on underwater operational inspection.

The training is intended to provide competence on inspection of underwater structures with the aid of a remotely operated vehicle (ROV).

In this context, competence means *the ability to perform tasks and master complex challenges*.

Courses which build on this curriculum and which are conducted at different players are considered to be of equal standing.

The contact for this training curriculum in Norwegian Oil and Gas is the manager, expertise development.

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## 1 INTRODUCTION

### 1.1 Purpose

This training curriculum describes the content and execution of the course on underwater operational inspection with an ROV.

The training is designed to provide competence on

- underwater structures: various types of materials, properties and use
- degradation mechanisms and operating life assessments
- corrosion protection: methods and inspection
- welding and connection methods
- underwater structures
- marine fouling
- inspection
- reporting and documentation
- human factors
- in-depth training in inspection, reporting and documentation – level 2

### 1.2 Learning outcomes

After completing the training, the participant must be able to

- plan an underwater inspection together with the inspection supervisor
- conduct an underwater inspection with the ROV operator in accordance with the inspection plan
- comment on observations and findings in a clear and concise manner
- use the correct terminology
- make entries correctly in a video log and handle inspection data and database
- report inspections to the inspection supervisor in a satisfactory manner

After completing the training at level 2, the participant must be able to

- plan an underwater inspection in accordance with specification/contract
- approve an inspection report
- be responsible for final processing of inspection data
- be responsible for submitting the report with associated inspection data to the customer

### 1.3 Target group

The target group for the training is personnel conducting and reporting on underwater operational inspections with the aid of an ROV.

## 2 CONTENT

### 2.1 Parameters for conducting the course

#### Level 1

30 hours of teaching, including final test.

#### Level 2

12 hours of teaching, including final test.

### 2.2 Teaching materials

Teaching materials used during the course must be tailored to the competence objectives specified in this training curriculum.

### 2.3 Prior knowledge

#### Level 1 Inspector

Relevant technical education or similar.

#### Level 2 Inspection supervisor

Taken and passed level 1, able to document at least four different inspections with reporting and at least one year of relevant inspection experience.

### 2.4 CSWIP

Personnel with valid CSWIP 3.3U are considered equivalent to a level 1 inspector. Personnel with valid CSWIP 3.4U are considered equivalent to a level 2 inspection supervisor.

### 2.5 Medical requirements

The participant must have passed the Ishihara colour vision test.

### 2.6 Facilities and equipment

The training can be conducted through classroom teaching, e-learning and possible other appropriate facilities and equipment.

### 2.7 Training curriculum

Participants must be given an introduction before the course starts which reviews the purpose of the course, assessment requirements, the timetable and safety measures.

See the training curriculum set out in table 1 below.

*Table 1: Training curriculum*

<b>Topic</b>		<b>1.0 UNDERWATER STRUCTURES: VARIOUS TYPES OF MATERIALS, PROPERTIES AND USE – LEVEL 1</b>		
<b>Competence objectives</b> After completing the training, the participant will be able to:	<b>Specification of competence objectives</b>	<b>Method</b>	<b>Learning environment</b>	<b>References</b>
1.1 Introduction	The participant must be able to outline <ul style="list-style-type: none"> <li>material choices and terms such as specification, standards, data sheet and certificate.</li> </ul>	Theory lesson(s) E-learning	Classroom	
1.2 Outline use of the metallic materials most commonly used in underwater structures	The participant must be able to outline <ul style="list-style-type: none"> <li>the structure of metallic materials</li> <li>terminology (metals, alloys, steel)</li> <li>classification (unalloyed/low alloy steel versus stainless steel)</li> <li>general properties of metallic materials (unalloyed/low alloy steel versus stainless steel)</li> </ul> The participant must be able to describe <ul style="list-style-type: none"> <li>the use of steel/metallic materials under water, structures and piping systems, mooring, risers, valves and the like.</li> </ul>	Theory lesson(s) E-learning	Classroom	
1.3 Outline the use of concrete in underwater structures	The participant must be able to outline <ul style="list-style-type: none"> <li>structure of concrete in brief, terminology</li> <li>general properties of concrete</li> <li>use of concrete under water: structure, grouted connections.</li> </ul>	Theory lesson(s) E-learning	Classroom	
1.4 Outline the use of polymer materials	The participant must be able to outline <ul style="list-style-type: none"> <li>structure of polymers in brief, terminology</li> <li>general properties of polymers</li> <li>use of polymers under water: coating, sheathing, hoses, composites, flexible risers, etc.</li> </ul>	Theory lesson(s) E-learning	Classroom	

Topic	<b>2.0 DEGRADATION MECHANISMS AND OPERATING LIFE ASSESSMENTS – LEVEL 1</b>			
Competence objectives After completing the training, the participant will be able to:	Specification of competence objectives	Method	Learning environment	References
2.1 Introduction	The participant must be able to outline <ul style="list-style-type: none"> <li>• operating life in brief and factors affecting it</li> <li>• general classification of degradation/damage (chemical, mechanical, wear, production and fabrication faults).</li> </ul>	Theory lesson(s) E-learning	Classroom	
2.2 Outline degradation of metallic materials	The participant must be able to outline <ul style="list-style-type: none"> <li>• the corrosion processes</li> <li>• factors affecting corrosion: general</li> <li>• relevant forms of corrosion – local versus general, galvanic (see also principles for cathodic protection)</li> <li>• fatigue and factors affecting fatigue life, typical occurrence</li> <li>• other fracture types in brief – ductile and brittle, causes</li> <li>• wear – relevant wear mechanisms subsea (primarily abrasive: particle erosion which can be identified with ultrasonic testing), typical occurrence.</li> </ul>	Theory lesson(s) E-learning	Classroom	
2.3 Outline degradation of concrete structures	The participant must be able to outline <ul style="list-style-type: none"> <li>• factors influencing degradation of concrete</li> <li>• relevant defects and damage.</li> </ul>	Theory lesson(s) E-learning	Classroom	
2.4 Outline degradation of polymers	The participant must be able to outline <ul style="list-style-type: none"> <li>• factors influencing degradation of polymers</li> <li>• relevant defects and damage.</li> </ul>	Theory lesson(s) E-learning	Classroom	
2.5 Outline operating life assessments	The participant must be able to outline <ul style="list-style-type: none"> <li>• factors affecting operational life of components/ structures</li> <li>• input to operating life assessments.</li> </ul>	Theory lesson(s) E-learning	Classroom	

Topic		3.0 CORROSION PROTECTION: METHODS AND INSPECTION – LEVEL 1		
Competence objectives After completing the training, the participant will be able to:	Specification of competence objectives	Method	Learning environment	References
3.1 Outline corrosion protection methods	The participant must be able to outline <ul style="list-style-type: none"> <li>different methods for external corrosion protection: overview</li> <li>principles for cathodic protection (CP)</li> <li>coating inspection</li> <li>inspection/monitoring of CP systems.</li> </ul>	Theory lesson(s) E-learning	Classroom	

Topic		4.0 WELDING AND CONNECTION METHODS – LEVEL 1		
Competence objectives After completing the training, the participant will be able to:	Specification of competence objectives	Method	Learning environment	References
4.1 Outline welding	The participant must be able to outline <ul style="list-style-type: none"> <li>terminology (weld, cap, root, weld toe, HAZ, etc)</li> <li>various types of welded connections</li> <li>typical weld-related irregularities and faults (which can be detected by visual surface inspection).</li> </ul>	Theory lesson(s) E-learning	Classroom	
4.2 Outline other connection methods	The participant must be able to outline <ul style="list-style-type: none"> <li>other connection methods</li> <li>problems related to other connection methods.</li> </ul>	Theory lesson(s) E-learning	Classroom	

<b>Topic</b>		<b>5.0 UNDERWATER STRUCTURES – LEVEL 1</b>		
<b>Competence objectives</b> After completing the training, the participant will be able to:	<b>Specification of competence objectives</b>	<b>Method</b>	<b>Learning environment</b>	<b>References</b>
5.1 Outline underwater structures	The participant must be able to outline metallic, concrete and fibreglass structures <ul style="list-style-type: none"> <li>• construction</li> <li>• terminology</li> <li>• problem areas</li> <li>• grouted connections for concrete structures</li> </ul>	Theory lesson(s) E-learning	Classroom	
5.2 Outline piping systems	The participant must be able to outline <ul style="list-style-type: none"> <li>• piping types</li> <li>• material types in piping</li> <li>• connections</li> <li>• areas of application</li> <li>• problem areas</li> </ul>	Theory lesson(s) E-learning	Classroom	
5.3 Outline construction and terminology for underwater structures	The participant must be able to outline construction and terminology for <ul style="list-style-type: none"> <li>• templates</li> <li>• valve types</li> <li>• production and process equipment</li> <li>• risers – rigid and flexible</li> <li>• umbilicals</li> <li>• bundles</li> <li>• mooring lines</li> </ul>	Theory lesson(s) E-learning	Classroom	

Topic	6.0 MARINE FOULING – LEVEL 1			
Competence objectives After completing the training, the participant will be able to:	Specification of competence objectives	Method	Learning environment	References
6.1 Outline various forms of marine fouling	<p>The participant must be able to outline</p> <ul style="list-style-type: none"> <li>• types of fouling</li> <li>• consequences</li> <li>• prevention</li> <li>• removal methods.</li> </ul> <p>The participant must be able to describe the factors which affect fouling</p> <ul style="list-style-type: none"> <li>• temperature</li> <li>• depth</li> <li>• nutrient</li> <li>• currents</li> <li>• salinity</li> <li>• CP.</li> </ul>	Theory lesson(s) E-learning	Classroom	

Topic		7.0 INSPECTION – LEVEL 1		
Competence objectives After completing the training, the participant will be able to:	Specification of competence objectives	Method	Learning environment	References
7.1 Describe underwater inspections	The participant must be able to describe <ul style="list-style-type: none"> <li>• the goal of inspections</li> <li>• condition monitoring and status</li> <li>• inspection planning</li> <li>• access, methods and cleaning</li> <li>• ROVs – capacity and limitations</li> <li>• labelling/signs/ID</li> <li>• visual inspection</li> <li>• non-destructive testing (NDT)</li> <li>• leak testing</li> <li>• flooded member detection (FMD)</li> <li>• CP measurement, and calibration of CP equipment</li> <li>• equipment used for pipeline inspection.</li> </ul>	Theory lesson(s) E-learning	Classroom	
7.2 Outline the use of lights	The participant must be able to outline <ul style="list-style-type: none"> <li>• the significance of correct/incorrect lights</li> <li>• available light sources</li> <li>• lighting the inspection area.</li> </ul>	Theory lesson(s) E-learning	Classroom	
7.3 Describe the use of cameras	The participant must be able to describe <ul style="list-style-type: none"> <li>• available camera types and areas of application</li> <li>• choice of camera based on capacity and limitations.</li> </ul>	Theory lesson(s) E-learning	Classroom	
7.4 Describe the use of instruments	The participant must be able to describe <ul style="list-style-type: none"> <li>• available types of instruments and areas of application</li> <li>• choice of instruments based on capacities and limitations.</li> </ul>	Theory lesson(s) E-learning	Classroom	

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<p>7.5 Describe damage and findings in connection with underwater inspections</p>	<p>The participant must be able to describe relevant damage and its development</p> <ul style="list-style-type: none"><li>• damage from operational activities</li><li>• fatigue</li><li>• mechanical damage</li><li>• corrosion findings</li><li>• marine fouling</li><li>• damage to anodes</li><li>• damage to clamps</li><li>• deposition/undermining</li><li>• debris - including mines</li><li>• concrete damage</li><li>• welding faults</li><li>• free spans</li><li>• buckling and movement of products</li><li>• damage from trawling.</li></ul>	<p>Theory lesson(s) E-learning Visualisation</p>	<p>Classroom</p>	
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Topic		8.0 REPORTING AND DOCUMENTATION – LEVEL 1		
Competence objectives	Specification of competence objectives	Method	Learning environment	References
After completing the training, the participant will be able to:				
8.1 Outline inspection reports and data	<p>The participant must be able to outline</p> <ul style="list-style-type: none"> <li>• relevant inspection procedures.</li> </ul> <p>The participant must be able to describe</p> <ul style="list-style-type: none"> <li>• systemisation of reports and documentation</li> <li>• how to provide a clarifying explanation</li> <li>• use of drawings</li> <li>• use of photos/video/audio – editing methods</li> <li>• storage and systemisation of photos/videos in relation to the report</li> <li>• report standards</li> <li>• use of drawing symbols</li> <li>• available reporting tools (data tools).</li> </ul>	Theory lesson(s) E-learning	Classroom	
8.2 Conduct inspections	<p>The participant must be able to</p> <ul style="list-style-type: none"> <li>• prepare an inspection plan</li> <li>• conduct an inspection</li> <li>• write an inspection report.</li> </ul>	Practical exercises	Classroom	

Topic	<b>9.0 HUMAN FACTORS – LEVEL 1</b>			
Competence objectives After completing the training, the participant will be able to:	Specification of competence objectives	Method	Learning environment	References
9.1 Describe the human factors which influence the inspector and the inspection	The participant must be able to describe <ul style="list-style-type: none"> <li>• the inspector’s job and integrity</li> <li>• human factors which influence the result of the inspection</li> <li>• communication with specialist personnel and the client.</li> </ul>	Theory lesson(s) E-learning	Classroom	

Topic	<b>10.0 IN-DEPTH TRAINING IN INSPECTION, REPORTING AND DOCUMENTATION – LEVEL 2</b>			
Competence objectives After completing the training, the participant will be able to:	Specification of competence objectives	Method	Learning environment	References
10.1 Outline underwater inspections	The participant must be able to outline <ul style="list-style-type: none"> <li>• the goal of inspections</li> <li>• condition monitoring and status</li> <li>• inspection planning</li> <li>• access, methods and cleaning</li> <li>• ROVs – capacity and limitations</li> <li>• labelling/signs/ID</li> <li>• visual inspection</li> <li>• non-destructive testing (NDT)</li> <li>• leak testing</li> <li>• flooded member detection (FMD)</li> <li>• CP measurements, and calibration of CP equipment</li> <li>• equipment used for pipeline inspection</li> <li>• safety measures when using X-rays.</li> </ul>	Theory lesson(s) E-learning	Classroom	

<p>10.2 Outline damage and findings in connection with underwater inspections</p>	<p>The participant must be able to describe relevant damage and its development</p> <ul style="list-style-type: none"> <li>• transport and installation damage</li> <li>• damage from operational activities</li> <li>• fatigue</li> <li>• fabrication faults</li> <li>• mechanical damage</li> <li>• corrosion findings</li> <li>• marine fouling</li> <li>• damage to anodes</li> <li>• damage to clamps</li> <li>• deposition/undermining</li> <li>• debris – including mines</li> <li>• concrete damage</li> <li>• welding faults</li> <li>• free spans</li> <li>• buckling and movement of products</li> <li>• damage from trawling.</li> </ul>	<p>Theory lesson(s) E-learning Visualisation</p>	<p>Classroom</p>	
<p>10.3 Outline inspection reports and data</p>	<p>The participant must be able to describe</p> <ul style="list-style-type: none"> <li>• relevant inspection procedures</li> <li>• systemisation of reports and documentation</li> <li>• how to provide a clarifying explanation</li> <li>• use of drawings</li> <li>• use of photos/video/audio – editing methods</li> <li>• storage and systemisation of photos/videos in relation to the report</li> <li>• report standards</li> <li>• use of drawing symbols</li> <li>• available reporting tools (data tools).</li> </ul>	<p>Theory lesson(s) E-learning</p>	<p>Classroom</p>	
<p>10.4 Outline the human factors which can influence the inspector and the inspection</p>	<p>The participant must be able to describe</p> <ul style="list-style-type: none"> <li>• the inspector's job and integrity</li> <li>• human factors which influence the result of the inspection</li> <li>• communication with specialist personnel and the client.</li> </ul>	<p>Theory lesson(s) E-learning</p>	<p>Classroom</p>	
<p>10.5 Outline use of camera</p>	<p>The participant must be able to describe</p> <ul style="list-style-type: none"> <li>• available camera types and areas of application</li> <li>• choice of camera based on capacity and limitations.</li> </ul>	<p>Theory lesson(s) E-learning</p>	<p>Classroom</p>	

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10.6 Outline use of inspection instruments	The participant must be able to describe <ul style="list-style-type: none"><li>• available types of instruments and areas of application</li><li>• choice of instruments based on capacities and limitations.</li></ul>	Theory lesson(s) E-learning	Classroom	
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### 3 ASSESSMENT AND DOCUMENTATION OF TRAINING

#### 3.1 Assessment

The participant must be continuously assessed during the course and take a final test at levels 1 and 2.

To pass level 1, the final test will take three hours and 80 per cent of the answers must be correct.

To pass level 2, the final test will take two hours and 80 per cent of the answers must be correct.

#### 3.2 Documentation

A course certificate must be issued on passing the test. See appendix 1.

#### 3.3 Evaluation of the training

All course participants must complete a questionnaire after completing the course as a contribution to continuous improvement.

## 4 REVISIONS

The following revisions have been made to this document.

Revision:	Date:
<p>Version 2</p> <p>Chapter 1.1 Purpose</p> <p>Amended bullet points in accordance with the changes made to the topics in table 1.</p> <p>Table 1, training curriculum</p> <p>Changed the names of topics 1, 2 and 3.</p> <p>Former topic 3 moved to topic 4.</p> <p>Because of some overlapping, the competence objectives in topics 1, 3 and 5 have been reorganised.</p> <p>Topic 2, competence objectives from topic 7 have been moved here.</p> <p>Topic 7, competence objectives on human factors have been moved to a separate topic 9, and the former topic 9 has been renumbered as topic 10.</p>	<p>27 February 2018</p>

## Appendix 1

Documentation of training/course certificate

Example of information required in the course certificate:

Surname:	First name:	Date of birth:
Company/facility/department:		
<p>The person named above has taken and passed a course in accordance with the Norwegian Oil and Gas training curriculum</p> <p>Course name: Underwater operational inspection with ROV, level 1</p> <p>Date: .....</p> <p>Signature of course manager: .....</p>		

Surname:	First name:	Date of birth:
Company/facility/department:		
<p>The person named above has taken and passed a course in accordance with the Norwegian Oil and Gas training curriculum</p> <p>Course name: Underwater operational inspection with ROV, level 2</p> <p>Date: .....</p> <p>Signature of course manager: .....</p>		