***Development and demonstration of an automated, modular and environmentally friendly multi-functional platform for open sea farm installations of the Blue Growth Industry***

# D7.6 – Training needs, including evaluation of End Users Usability report

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| **2.0** | 19/07/2022 | Gloria Testa<br>Fabrizio Lagasco | RINA-C | Specific reference to BOSIET certificate (already mentioned in § 2.2 Entry level requirements for trainees) in §3.1 BGF Safety Course, with additional details included in Annex B. Upgrade of § 4.0 Conclusions. | Update following further clarifications provided by EC Reviewers on 15/07/2022 |

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# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AR | Augmented Reality |
| BOSIET | Basic Offshore Safety Induction and Emergency Training |
| EC | European Commission |
| GA | Grant Agreement |
| GUI | Graphical User Interface |
| HMI | Human Machine Interface |
| O&M | Operation and Maintenance |
| R&D | Research and Development |
| VR | Virtual Reality |
| WP | Work Packages |

# APPLICABLE DOCUMENTS

[AD1] European Commission, Directorate-General for Research & Innovation, Grant Agreement Number 774426 The Blue Growth Farm (GA-2018-774426), 2018.

[AD2] Technical Annex I to the Grant Agreement Number 774426: “Description of Work”, April 2018, Part A and Part B.

# 1. INTRODUCTION

The present report has been produced in the framework of Task 7.6 (WP7) activities of the Blue Growth Farm contract [AD1], [AD2].

Within the scope of WP7, is to produce design of the Blue Growth Farm multi-purpose platform, taking advantage of return of experience from the experimental campaign carried out on the outdoor prototype, , technical input and indications coming from the environmental assessment as well as suggestions and recommendation resulted from workshops with marine users and interested stakeholders, identification of training needs for end users' operators to set the basis for future new skills and specialisations is the object of the present document to report about. The D7.6 goal is then to outline the training needs of BGF offshore platform's operators and suggest advanced training tools for the development of competencies. BGF future training, to be developed on the basis of the training needs identified in the project, will have the scope to form skills and knowledge to operate and maintain the BGF offshore platform, also by using the advanced technologies available for the build-up and retention of competencies.

Given that from the conclusions of the WP10 workshops activity, no aquaculture operators have been identified as feeling themselves pretty much attracted to the prospective management of a Multifunction Offshore Installation in the near future, this document does not include for now any End Users Usability report. This also testifies to the fact that the concept of Multi-Functional Platform is not yet sufficiently mature for commercial development in the short term. Additional reasons belonging to the nature and size of the majority of aquaculture farmers as well as the lack of regulatory framework and administrative burden have been also reported through the WP8 deliverables. Nevertheless, the BGF Consortium is willing to take advantage of the period for exploitation phase after the project end to continue this investigation by extending to other than aquaculture offshore operators, with the hope that offshore aquaculture farmers (or food operators) could in the meantime raise the level of their commercial profile taking advantage of the increasing interests and financial efforts mobilised by the Blue Economy.

## 1.1 Identification of the document and its structure

The present document is identified as D7.6 "Training needs, including evaluation of End Users Usability report" of the Blue Growth Farm Contract [AD1], [AD2].

The contents of the document are organized according to the following sections:

- Section 1 contains the introduction to the present document;
- Section 2 describes the training profiles, as derived from the BGF Operation and Maintenance (O&M) Manual, and identifies the training needs and applicable training methodologies
- Section 3 outlines the training program structure and contents;
- Section 4 reports the conclusions to the document
- Section 5 lists the quoted references.

## 1.2 Interfaces of the Blue Growth Farm System

The main composition of the BGF full scale configuration infrastructure is reported in Figure 1.

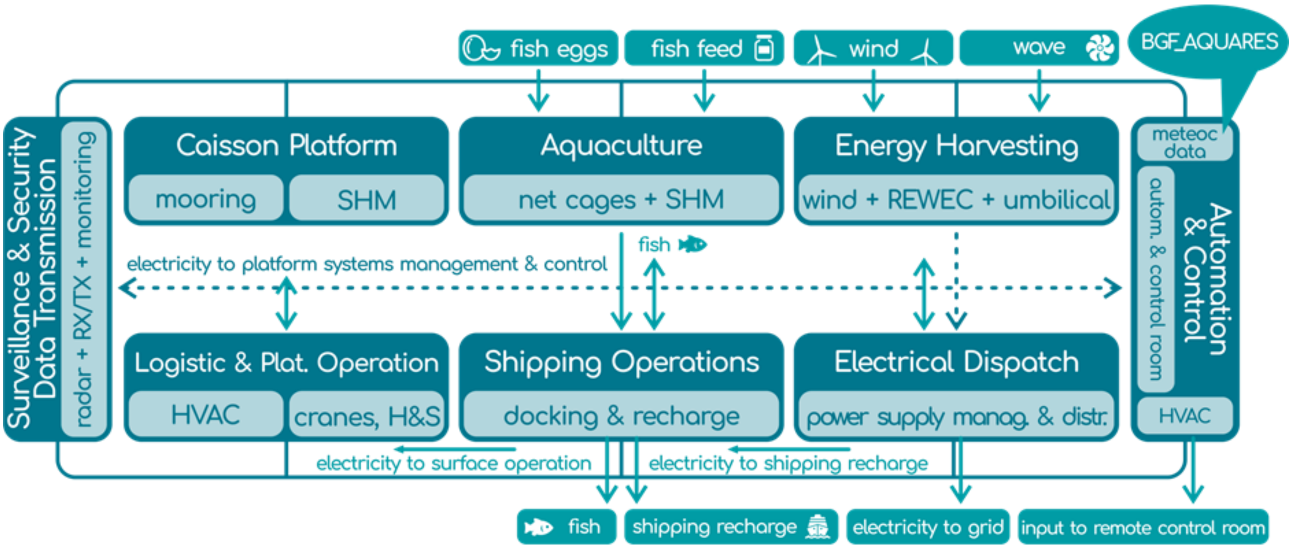


Figure 1. The BGF full scale configuration architecture

In particular, the infrastructure is composed of:

- A semi-submersible type floating platform based on industrialized modular concrete caissons' technology suitably joined to form a monolith assembly. This floating platform is 210 m long by 162 m wide. The platform is kept in position in typical water depth of 100 m (max 200 m) by multiple sea-bed anchors, occupying approximately 0.9 x 0.9 km (≈ 80 ha). A Structural Health Monitoring (SHM) system installed at critical areas of the platform enables a continuous monitoring of structural deformation leading to a better knowledge of environmental loading history experienced through the entire life.
- An industrial aquaculture system, based on 6 net cages (50 x 50 m), which are protected over three edges of the concrete caisson platform, being the fourth more transparent to waves to enable an appropriate internal re-circulation and dispersion of waste from the pool. The 6 cages guarantee a fish production of 2.000 tonnes/year of salmon, sea-bass or sea-bream (depending on environment). The net cages, which are hung on the structure, are kept in position and open by weights at their bottom. Net cages extend to 35 m below sea-level, being the first 20 m protected by the monolithic infrastructure. The presence of the protective service platform opens opportunities for system automation and management not normally available to offshore fish farms. As well, all activities that are carried out manually on current systems by operators staying on workboats aside the aquaculture plant are sited on the BGF platform with the support of service cranes. Other routine operations, such as net cleaning and repair, fish grading and vaccination, and the fish harvesting, processing, packing and storing, are greatly simplified by automation.
- A complex set of offshore energy production system is equipping the BGF platform. It is composed of a DTU 10 MW wind turbine technology, different WEC technology devices (evolution of REWEC patented solution) and PV panels located on the roof of the infrastructure operations building located in the aft side of the platform. As the BGF platform is conceived to be oriented along a predominant wave streaming, both wind tower and WEC are installed on the front side of the platform. Additional WECs can be also considered for installation over the two longitudinal sides of the floating platform, depending on the wave characteristics of the installation site, as well as on economic considerations. The WECs are embodied in the reinforced concrete caissons, so they are integral part of the monolithic structure. Whilst protecting the internal pool of the structure from the incoming waves by absorbing part of their energy and transforming it into electric energy, WECs also protect the water sheet into the platform (for fish cages) from green water and overtopping. The produced electric energy makes the

infrastructure energetically independent. Electric energy services for battery recharge of service vessels are also provided. The excess of energy left from the BGF operations is transferred to the land grid via the umbilical cable.

- An Automation & Control system interfaces the different systems of the multipurpose platform. The system provides real time interaction with the instrumentation for monitoring water and environmental parameters, electrical energy production systems, fiber-optic sensors for monitoring structures, the complete automation of fish feeding system, the surveillance and navigation safety system. With specific reference to the aquaculture automation and control, modern aquaculture automation technology is asked to enable real time estimation of total number of fish and size distribution, biomass control, selective breeding in parallel to environmental monitoring and biological indicators. In particular, the aquaculture automation enables a) a better feed management, including performance monitoring, including benchmark cage / population data; b) continuous automated monitoring to optimize farming operations & fish welfare, based on continuous automatic environmental monitoring (i.e. oxygen, chlorophyll, algae, etc.) in order to assess fish reaction to different farming operations and environmental influences; c) data measurement to quantify juvenile quality (morphology, physiology, health, stress); d) monitoring of anomalies and deviations from desired standard; e) data measurement to improve disease diagnosis. All information coming from sensors and cameras are directed to the Local Control Room, placed on BGF infrastructure operations building. The Control Room System is composed of servers and terminals to enable local supervision and control when the platform is manned. The Remote-Control Room, which hosts a copy of information available onboard, allows a real time monitoring of all functions running onboard when the platform is not man-operated (e.g., when access to platform is not safe due to exceptional weather conditions). Overall subsystems control by means of machine learning techniques (BGF_AQUARES) enables early alerting on anomalous trends of specific parameters under monitoring.
- An offshore electric substation provides with all the power conversion equipment to collect wind turbine, wave devices and PV panels produced energy and suitably transform it in order to distribute and adequately supply all electric loads installed onboard and to dispatch to onshore the electricity excess.
- A set of capabilities to enable shipping operations required to accomplish the following tasks: a) daily operations carried out by a regular staff assisting the onboard production; b) periodic controls and maintenance activities to all systems onboard; c) fish feed stock loading; d) fish production and harvesting; e) other functions like waste recovery to land, transport of produced microalgae to Clients, hosting specialised activities by suppliers' (e.g., assisted diving operations of inspection to the mooring and anchors on seabed, etc.). An assisted docking / undocking facility is placed along the aft side of the platform, thus benefitting from the calmer sea conditions. This platform is equipped with a charging system to serve full electric or hybrid propulsion-based vessels / boats providing services to the platform.
- A logistic sub-infrastructure to enable all platform operations, represented by the two-levels aft side building, sized 110 m length x 12 m width x 6m height, to allocate three distinct functional zones: a) living (manned area); b) functional area; c) electric substation area. The living (manned area) hosts all human operations, including the supervision and control activity deployed at the Local Control Room located in the Control Tower. The functional area accommodates a composition of specific volumes and related devices to support the BGF infrastructure fish production and management, in terms of Fish feeding, Fish feed storage (silos), Fish health monitoring, including a clinical diagnostic laboratory, Oxygen production and distribution, and micro-algae production. Operations support functions are deployed in terms of: potable and sanitary water production, Fire-fighting pumping, Ballasting pumping,

HVAC conditioning, workshops (including a divers store, equipment store, net store, spares parts store, and electro-mechanical laboratory for maintenance and repairing tasks). The platform deck operations are mainly limited to the fish farming tasks (net maintenance, fish harvesting, etc.) by means of deck cranes, maintenances of energy harvesting devices, off platform operations based on ROVs (BGF installation environmental monitoring, inspection and survey to the submerged structures, maintenance to the navigation safety devices, etc.) and on small boats lifted by vertical landing structure placed on the right side of the platform (for instance to enable small operations by staff within the pool).

- An integrated set of Surveillance and Security system (SSS) in charge of ensuring the physical integrity of the platform and of the people involved in its operations / maintenance. In particular, a) the External Surveillance and Security System (ESSS), combining surveillance Radars, AIS and long-distance cameras to produce a real time picture of navigation traffic far from the BGF installation and in particular vessels approaching the platform to monitor eventual unexpected events (accidental or deliberate actions) and to provide prompt or early alert; and b) the Internal Surveillance and Security System (ISSS) integrating a smart security network of cameras to implement access control of operators and surveillance of accuracy in carrying out tasks in safe conditions, thus promoting adequate behaviour during platforms operations. Navigation safety devices, according to applicable normative and to conform to the National Maritime Authority competent for the installation area are implemented in the BGF infrastructure design. Data managed at Local Control Room level are transmitted to the Remote Local Control (onshore) by redundant means: a) Fiber optic line (through the umbilical cable); b) Data transmission system (radio link). In particular, the Local Control Room monitoring videos are predominantly transmitted "through the umbilical" connection and only some information is replicated on the radio link, via satellite, thus enabling an overall traffic of 500 Mbit / s.

A map of the overall sub-systems interface is described in Table 1.

**Table 1. Sub-systems interface matrix**

| | STEEL CAISSONS PLATFORM | AQUACULTURE | ENERGY HARVESTING | AUTOMATION AND CONTROL | ELECTRIC DISPATCH | SHIPPING OPERATIONS | LOGISTICS AND PLATFORMS OPERATIONS | SURVEILLANCE AND SECURITY DATA TRANSMISSION |
|---|---|---|---|---|---|---|---|---|
| **STEEL CAISSONS PLATFORM** | | X | X | | X | X | X | X |
| **AQUACULTURE** | X | | | | | | X | |
| **ENERGY HARVESTING** | X | | | X | X | | X | X |
| **AUTOMATION AND CONTROL** | | | X | | X | | | X |
| **ELECTRIC DISPATCH** | X | | X | X | | | X | X |
| **SHIPPING OPERATIONS** | X | | | | | | | |
| **LOGISTICS AND PLATFORMS OPERATIONS** | X | | | | | X | | |
| **SURVEILLANCE AND SECURITY DATA TRANSMISSION** | X | | | X | X | | X | |

# 2. TRAINING NEEDS ANALYSIS

## 2.1 Personnel to be trained

In the Operation and Maintenance Manual [R1], a complete set of operation and maintenance specifications, for each subsystem, manufacturer and technology providers, has been identified and organized in a comprehensive way, such to enable end users / stakeholders, interested in the Blue Growth Farm multipurpose platform, a correct understanding of reliability of envisaged tasks and therefore derive the most realistic perception of risks associated to the investment.

Maintenance shall be carried out by the BGF personnel at least at a level of preventive and first degrees of corrective maintenance, leaving to the supplier technical assistance to intervene on specific maintenance / replacement tasks.

The Operation and Maintenance Manual consequently identifies the BGF manning, listing the complete set of job positions in charge for the operation and maintenance tasks on the BGF platform.

The list of such roles, grades and required number of personnel is here reported in Table 2.

Table 2. BGF O&M staff to be trained

| N° | Job Position | Role brief description | Professional grade | N° |
|---|---|---|---|---|
| 1 | Control Room Operator | Whole infrastructure management by supervising a dashboard of signals and commands available at console and displays level. | Engineer | 3 |
| 2 | Fish Production manager | Fish welfare through a lot of data recorded from sensors in real time and duly processed to produce continuous fish state awareness and then to drive relevant actions, based on both manned and automatic means. | Biologist | 2 |
| 3 | Energy Systems Manager | Planning of electric energy consumption to maximise consumption energy efficiency on site and stabilising the output release to the grid. | Engineer | 1 |
| 4 | Deck operations responsible | Operations carried out in floating conditions (crane movement, O&M of combined wind, wave and PV electric energy stations, etc.), follow up procedural protocols and safety practices. | Expert Technician | 1 |
| 4 | Automated ship docking & recharge control manager | Automated operations of service vessels dedicated to the BGF infrastructure logistic process | Expert Technician | 1 |
| 6 | Aquaculture biologist | Fish welfare and curing. Microalgae efficiency monitoring | Biologist | 2 |
| 7 | Husbandry staff | Aquaculture activities | Skilled Worker | 10 |
| 8 | Mechanical staff | Contribute to mechanical O&M activities | Skilled Worker | 2 |
| 9 | Electrical staff | Contribute to electrical O&M activities | Skilled Worker | 2 |
| 10 | Divers | Carry out underwater inspections | Skilled Worker | 5 |
| 11 | Remote Control Room Operator | Whole infrastructure management by supervising a dashboard of signals and commands available at console and displays level at remote control room | Engineer | 1 |

## 2.2 Entry level requirements for trainees

The present document defines the BGF personnel training needs, starting from the assumption that personnel employed are to be:

- Qualified
- Certificated

- Medically fit
- Competent to carry out their duties

according to international and local regulations.

Specifically, all personnel shall possess the Certificate of BASIC Offshore Safety Induction & Emergency Training (BOSIET) or equivalent.

Personnel of the following disciplines shall satisfy the following minimum prerequisites:

- Operations and Maintenance Engineers shall be skilled in their discipline and be qualified to a Bachelor of Science level and / or Professional Engineer certification or equivalent degree;
- Expert technicians shall have a minimum of 5 years' experience in the role on similar facilities;
- Skilled workers /Biologists shall have a minimum of 2 years' experience in the role on similar facilities.

## 2.3 Identification of training needs per profile category

The Tasks Matrix, assigning activities to each job position and for each subsystem, is shown in Table 2. Percentage of time spent on the different task is defined.

From the tasks matrix the complete and detailed training program for each job position is derived. Results are summarized in the training matrix (Table 4) and in Chapter 2, where the detailed contents of each course are detailed.

**Table 3. BGF O&M staff Tasks Matrix**

| AREA | MAIN SYSTEM | SUBSYSTEMS | TASK AREA | Control Room Operator | Fish Production Manager | Energy Systems Manager | Deck operations responsible | Automated ship docking & recharge control Manager | Aquaculture biologist | Husbandry staff | Mechanical staff | Electrical staff | Divers | Remote CR Operator |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRODUCTION | Microalgae | Microalgae System | Oper | | | | | | | | | | | |
| | Aquaculture | Fish Net System<br>Fish Net Cleaning System<br>Fish Feeding<br>Dead Fish Collect and Treat | Oper | | 80% | | | | 80% | 80 % | | | 45 % | |
| | Energy | Wind Turbine System<br>WEC System<br>PV System | Oper | 70% | | 60% | 10% | | | | 20 % | 20 % | | 40% |
| | Oxygen | Oxygen System | Oper | | | | | | | | | | | |
| | Sea water desalination | Reverse Osmosis System | Oper | | | | | | | | | | | |
| | Microalgae | Microalgae System | Mainten | | | | | | | | | | | |
| | Aquaculture | Fish Net System<br>Fish Net Cleaning System<br>Fish Feeding<br>Dead Fish Collect and Treat | Mainten | | 20% | | | | 20% | 20 % | | | 45 % | |
| | Energy | Wind Turbine System<br>WEC System<br>PV System | Mainten | 5% | | 10% | 10% | | | | 20 % | 20 % | | 10% |
| | Oxygen | Oxygen System | Mainten | | | | | | | | | | | |
| | Sea water desalination | Reverse Osmosis System | Mainten | | | | | | | | | | | |
| SERVICES | Mooring System | Mooring System | Oper | | | | | | | | | | 5% | |
| | HVAC | HVAC System | Oper | | | | 70% | | | | | | | |
| | Electric Offshore Substation | Dry Type Transformers<br>Medium Voltage Switchgear<br>Medium Voltage AC Cables | Oper | 20% | | 10% | | 70% | | | 30 % | 30 % | | 40% |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Shipping Operations | Automated Docking System<br>Electric Recharge System | Oper | | | | | | | | | | | |
| | Surveillance and Security | Surveillance Radar<br>Long Distance cameras<br>Automatic Identification Sys<br>Security Systems<br>Access Control System | Oper | | | | | | | | | | | |
| | Structural Health monitoring | Structural Health Monitoring System | Oper | | | | | | | | | | | |
| | Mooring System | Mooring System | Mainten | | | | | | | | | | 5% | |
| | HVAC | HVAC System | Mainten | | | | | | | | 30 % | | | |
| | Electric Offshore Substation | Dry Type Transformers<br>Medium Voltage Switchgear<br>Medium Voltage AC Cables | Mainten | | | 20% | | | | | | | | |
| | Shipping Operations | Automated Docking System<br>Electric Recharge System | Mainten | | | | 10% | | | | | | | |
| | Surveillance and Security | Surveillance Radar<br>Long Distance cameras<br>Automatic Identification Sys<br>Security Systems<br>Access Control System | Mainten | 5% | | | | 30% | | | | 30 % | | 10% |
| | Structural Health monitoring | Structural Health Monitoring System | Mainten | | | | | | | | | | | |

**Table 4. BGF O&M staff Training Matrix**

| COURSE | TYPOLOGY | METHODOLOGY | Control Room Operator (3) | Fish Production Manager (2) | Energy Systems Manager | Deck operations responsible | Autom ship dock & rech cont mng | Aquaculture biologist (2) | Husbandry staff (10) | Mechanical staff (2) | Electrical staff (2) | Divers (5) | Remote CR Operator (1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BGF Safety | THEOR | T, VM, VR | X | X | X | X | X | X | X | X | X | X | X |
| BGF Familiarization | THEOR | T, VM | X | X | X | X | X | X | X | X | X | X | X |
| BGF Operations | THEOR & PRACT | T, VR | X | X | X | X | X | | | | | | X |
| Detailed Divers Course | THEOR & PRACT | T, VR | | | | | | | | | | X | |
| Electr and Autom Maint | THEOR & PRACT | T, SH | X | | X | X | X | | | | X | | X |
| Mechanical Maintenance | THEOR & PRACT | T, SH | | | | X | X | | | X | | | |
| TRAINING BY VENDORS | | | | | | | | | | | | | |
| Microalgae | THEOR & PRACT | T, SH | X | | | X | | X | | X | X | | X |
| Fish net cleaning | THEOR & PRACT | T, SH | X | X | | X | | X | X | X | X | X | X |
| Fish feeding | THEOR & PRACT | T, SH | X | X | | X | | X | X | X | X | X | X |
| Wind turbine system | THEOR & PRACT | T, SH | X | | X | X | | | | X | X | | X |
| WEC system | THEOR & PRACT | T, SH | X | | X | X | | | | X | X | | X |
| Dry Type Transformers | THEOR & PRACT | T, SH | X | | | X | X | | | X | X | | X |
| Medium Voltage Switchg | THEOR & PRACT | T, SH | X | | | X | X | | | X | X | | X |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Automated Docking Sys | THEOR & PRACT | T, SH | X | | | X | X | | | X | X | | X |
| Electric Recharge System | THEOR & PRACT | T, SH | X | | | X | X | | | X | X | | X |
| Surveillance Radar | THEOR & PRACT | T, SH | X | | | X | X | | | X | X | | X |
| Automatic Identification Sys | THEOR & PRACT | T, SH | X | | | X | X | | | X | X | | X |
| Long Distance cameras | THEOR & PRACT | T, SH | X | | | X | X | | | X | X | | X |
| Struct Health Monit Sys | THEOR & PRACT | T, SH | X | | | X | X | | | X | X | | X |

Legend:

T = Traditional (Power Point, demonstrations at site/Vendor HQ)
VR = Virtual Reality simulation
SH = Smart Helmet
Vm = 360 Virtual Model

## 2.4 Classroom training methodology

The training shall be delivered using appropriate teaching methods for adult learning; the personal involvement of trainees shall be strengthened through active participation and an appropriate mix of teaching methods: direct instruction and inquiry-based learning.

Training lectures shall be held with the help of the training booklets and dedicated presentations, but also referring to case studies, demonstrations and testing techniques.

The information available from Project Documentation (mainly the HSE and Operating and Maintenance Manual) shall be skillfully synthesized to avoid useless repetitions and shall be visualized through the development of tables, flowcharts and block diagrams, whenever feasible. When necessary or appropriate, for specific topics the trainer shall go in more details by directly analyzing the Project Documents, which shall be referenced from the classroom presentations.

The learning objectives shall be clearly defined for each Course, while the knowledge of participants will be checked during classroom training, trainees will receive theoretical information and methodology for examining, studying and use the significant documentation produced for the Project.

The achievement of each learning objective shall be verified by specific questions after its subject shall be fully thought.

## 2.5 Practical training methodology

The practical training usually starts after the completion of the classroom phase, during the platform pre-commissioning activities.  This ensures that attendances possess the required level of the theoretical background to learn from experts performing the tasks and then on turn acquire the knowledge to perform the task by themselves.

The practical training is normally performed on site, under supervision of Coaches, according to the following steps:

- First Step – Observation: the Tasks are carried out by the Coach, competent in performing the Tasks, that shows the trainee how to perform them; the trainee at this stage is not performing the Tasks yet.
- Second Step – Coaching: the trainee starts performing the Tasks under supervision of the Coach;
- Third Step - Mentoring: the trainee performs the Tasks without anybody's supervision and demonstrates the acquired competencies; the Coach verifies the Tasks performed by trainee on a periodical base.  A

Competence assessment is executed by CONTRACTOR at the end of this step to prove that the trainee can, in full autonomy, perform what he has learned according to the defined standard.

During this important training phase, the trainee shall be requested to fill their own training card, listing the skills observed/learned/practiced and the activities performed.

The following training tools are proposed, enhancing training effectiveness and avoiding or optimizing site activities. For each tool the possible training applications are detailed.

### 2.5.1 Smart Helmet

A Smart Helmet is a wearable device that, combined with the Smart Helmet web Communication Platform, connects field persons with remote specialized experts.

The Smart Helmets can be used during the BGF crew classroom training, practical training and for remote support of the operation and maintenance activities, limiting or optimizing the effectiveness of the presence offshore.

The Smart Helmet web communication platform connects the person with the remote experts.

The remote expert is connected through a web app, accessible from a browser, while the field person can share content with the helmet camera, but also with the hand camera, and a smartphone.

The data stream is managed through a dedicated server according to the following scheme (Figure 2).

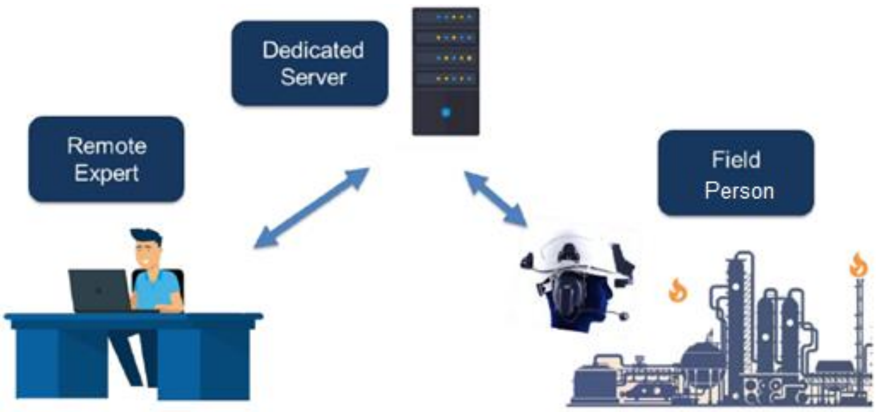


**Figure 2. Smart Helmet System Architecture**

Figure 3 shows the data streams that are available during a typical remote activity.

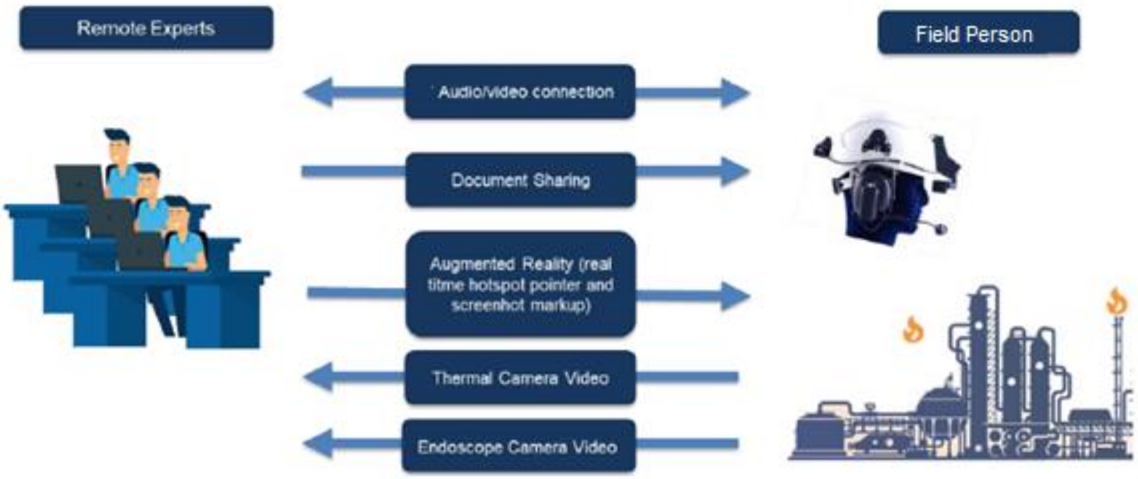


Figure 3. Smart Helmet Data Stream

The typical capabilities of a Smart Helmet are:

- It allows the remote team (expert/trainer/trainees) to see what the person on site, wearing the helmet, is seeing in real time;
- It enables high-resolution image capture and real-time mark-up of images (this allows effective communication between the remote person and the person on site);
- It supports easy document share;
- It permits multiple people support sessions, with video recording and playback.

Advantages of a Smart Helmet are:

- reduction of travel time and related costs;
- one single point of collection for photos, video and documents;
- fewer miscommunications;
- possibility to involve the right capability also remotely;
- possibility to stream site visits to remote teams (trainer and trainees, experts).

Below possible applications of the Smart Helmet during the BGF training are detailed.

#### 2.5.1.1 Classroom training support

During classroom training the Smart Helmet can support the instructor explanations by the following methods:

- The Helmet can be worn on site (or on similar plant/facilities), by a person supporting the Instructor explanations with live site views: the Instructor/Trainees can interact in real time with the site person through the Smart Helmet Web Communication Platform (for example it is possible to: talk and listen to the site person, zoom in&out on his site view, take and annotate screenshots from his site view, sketching indications on them to guide the site person;
- The Helmet can be used to record videos/photos from site, to be used as training material by the Instructor during the classroom lesson.

#### 2.5.1.2 *Practical training support*

The practical training can be performed by a combination of the following, to extend and enhance the classroom training:

- Traditional practical training, with the Instructor and Trainees on site;
- With the Instructor and Trainees in a classroom and one expert wearing the Helmet at site (or on similar plant/facilities);
- With the Instructor and Trainees in a classroom and one Trainee wearing the Helmet at site (or on similar plant/facilities);
- One to one supervised learning: with the Instructor connected to the Smart Helmet Web Communication Platform and one Trainee wearing the Helmet at site.

A proposed structure of a practical training, supported by the Smart Helmet with the aim of limiting the offshore presence is described below:

- **First Step - Observation:** the expert, wearing the Helmet at site, who knows how to do the requested task, shows the Trainees how to perform it, by using the camera mounted on the helmet and/or the hand camera, to provide an additional point of view or for details. The Trainees at this stage are not performing the job yet. During this step the team and the Instructor can interact with the site expert connected to the Smart Helmet Web Communication platform, in the same way as the classroom phase; the Instructor can integrate the live demonstration with additional explanation and important information about the task (such as steps, various scenarios or situations that may arise, successful performance criteria).
- **Second Step - Coaching:** the Trainee, wearing the Helmet at site, starts performing the tasks under direct supervision of an expert/Instructor at site. Other Trainees can observe the activities remotely, through the Smart Helmet Web Communication Platform.
- **Third Step - Mentoring:** the Trainee performs his job without anybody's supervision and demonstrates the competencies acquired during the training path. The remote Instructor, through the Smart Helmet Web Communication Platform, verifies the tasks performed by the Trainee; the Instructor can interact with the Trainee by showing to his Binocular Visor the site documentation and the step-by-step instructions, if needed.

#### 2.5.1.3 *Offshore operations and maintenance continuous support*

At the end of the Project, the Smart Helmet can be autonomously used for BGF lifecycle purposes to:

- train new employees;
- assess employees performing safety critical tasks, as part of a Competency Assurance Program;
- remotely support and guide in field operations on trouble shooting, maintenance, inspection and technical assistance: on-site workers receive support while staying focused on their job with a "hands-free" solution.

### 2.5.2 Web Based 360° Virtual Model

The Virtual Model tool is proposed for BGF project in order to improve training effectiveness and trainees' engagement during the classroom training sessions.

The Virtual Model consists in the production of a web based 360° Virtual photogrammetric model of a plant and made available on a secure web application.

The typical capabilities of a Web Based 360° Virtual Model are:

- navigation throughout the plant is very smooth and easy since it simulates walking through the plant;
- the model can be also navigated using different tools such as map navigation or menu navigation;
- the possibility to see/download the contents attached to a number of defined tags/hot points;
- the possibility to monitor plant parameters online;
- the possibility to use it for safety procedures;
- the possibility to build trainings modules related to specific areas or components;
- the possibility to build a full documental repository, linked to the areas or components.

### 2.5.3 Interactive Virtual Reality scenarios

A modern Virtual Reality software platform allows to re-create an existing or a prospect facility, such as industrial plants and infrastructures, in an immersive, photo-realistic environment, able to provide the most immersive training experience exploitable by modern technology.

This training tool is highly interactive: in the virtual environment the user can perform all the actions that can be done in a real plant and see the results in real-time. Virtual visits, technical procedures and best practices on safety, quality and environment issues can be also executed.

This power tool, able to simulate any hands-on experience, is highly recommended for the training of operative personnel to train on virtual model of the equipment, based on the minimum number of key (important) operations to take care of. To this concern, a very simple example has been built and contextualized in the BGF maintenance area and synthetic results are given in Annex A.

Generally speaking, the Virtual Reality solution provides risk-free environments to practice, test and develop competences by simulating situations that cannot always be reproduced (dangerous situations, accidents, emergency shutdowns, etc.). Operators can practice on procedures, improve skills in safety-critical tasks rarely performed in real conditions and finally learn how to react effectively in high-stress situations.

Some of the benefits coming from the implementation of a Virtual Reality training are:

- risk-free environments to practice test and develop competences;
- enhancement of the effectiveness of training and knowledge transfer through learning by doing, interaction and participation and knowledge retention overtime;
- resources saving;
- operational readiness improvement;
- safety improvement (human errors are the first source of incidents in plant operations).

Some of the activities that can be reproduced on a Virtual Environment are:

- Virtual visits for familiarization;
- Routine operations;
- Technical procedures;
- HSE best practices;
- Emergency procedures (including handling fire, flares, smoke, gas leaks, liquid leaks and man down);
- Practicing evacuations.

Training typologies in which the interactive Virtual Reality can be used are:

- **Self-eLearning:** the learning material is composed of Virtual Reality Scenarios, (i.e., Familiarization Scenario, to let the trainee explore and discover the different items, followed by a number of Scenarios, with variable degree of freedom/feedback, consisting in procedures to learn and repeat and short Q&A series with assessment).
- **Team eLearning**: trainees can be trained in team, acceding simultaneously to the virtual environment and performing the same scenario;
- **Classroom Training:** 40% of the time in the classroom is spent with an instructor using traditional training tools (e.g., power point presentations), while the 60% of the time the instructor utilizes the Virtual Reality Scenarios and trainees practice on them;
- **3D Operator Training Simulator:** Virtual Reality Scenarios are driven by the Instructor, who monitors how trainees behave and react to simulated situations.

# 3 TRAINING PROGRAM STRUCTURE AND CONTENTS

The proposed training program considers the different specializations of the professional profiles to be trained; in the following paragraphs main contents and attendants as well as the suggested training methodology for each course are detailed.

## 3.1 BGF Safety Course

| BGF HSE COURSE | |
|---|---|
| **Course objective** | The objective of the Safety Course is to stimulate proactive HSE awareness through knowledge of safety procedures and regulations applicable to the project.<br>All personnel prior to undertaking their duties are to be familiarized with BGF's safety equipment and arrangements, with the Company's HSE Management Systems' requirements, the safe working practices and the special circumstances regarding their position.<br>Note that Personnel working offshore must receive Basic Offshore Safety Induction & Emergency Training (BOSIET) (see § 2.2), including EBS (Emergency Breathing System), Extinguishers Use and Elementary first aid. Some details are provided in Annex B. |
| **Course typology** | Theoretical (classroom) |
| **Training methodology** | Traditional, Virtual Reality, 360 Virtual Model |
| **Attendances** | All BGF job profiles (Table 2) |
| **Main Topics** | • Platform Safety and Security rules and requirements<br>• Emergency evacuation plan and assembly points<br>• Emergency contacts<br>• Signage on site<br>• Medical First Aid and First aid kit locations (this module has to be repeated on the physical installation)<br>• Chemical hygiene plan<br>• Dangerous chemicals on site<br>• Food Safety principals<br>• Fishery policy<br>• Fisheries health and sanitation<br>• Food Hygiene HACCP<br>• PPE requirements on site<br>• Chemical storage areas<br>• Site Fire & Gas & Firefighting<br>• Marine protected areas<br>• Site waste disposal strategy<br>• Site waste storage area(s)<br>• Manual Handling |

## 3.2 BGF Familiarization Course

| BGF FAMILIARIZATION COURSE | |
|---|---|
| **Course objective** | To introduce to the BGF facilities, covering Production and Services subsystems, description, functionalities, operation and maintenance principles, in order to let attendees familiarize with everything that will represent their job environment. |
| **Course typology** | Theoretical (classroom) |
| **Training methodology** | Traditional, Virtual Reality, 360 Virtual Model |

| | |
|---|---|
| **Attendances** | All BRG job profiles (Table 2) |
| **Main Topics** | • BGF Platform overview (background to the project)<br>• Aquaculture technology and policy<br>• Systems and Sub-systems<br>• Basis of Design, functionalities, operation and normal parameters<br>• Operating philosophy<br>• Overview of maintenance policy and philosophy<br>• Control system description<br>• Aquaculture basics<br>• Electrical Network |

## 3.3 BGF Operations Course

| BGF OPERATIONS COURSE | |
|---|---|
| **Course objective** | To introduce to the BGF facilities, covering Production and Services subsystems, description, functionalities, operation and maintenance principles |
| **Course typology** | Theoretical (classroom) and practical |
| **Training methodology** | Traditional, Virtual Reality |
| **Attendances** | Control Room Operator<br>Remote Control Room Operator<br>Fish Production Manager<br>Energy System Manager<br>Deck operations responsible<br>Automated ship docking & recharge control manager |
| **Main Topics** | • Detailed description of the equipment: description, location, operations<br>• Equipment's specifications<br>• Normal operating conditions<br>• Platform control system<br>• Routine operations<br>• Troubleshooting, interpretation of unusual conditions that might affect plant operations<br>• Operations to be performed during unit/equipment start up and shutdown.<br>• Lockout/tagout procedures. |

## 3.4 Detailed Divers Course

| DETAILED DIVERS COURSE | |
|---|---|
| **Course objective** | To introduce to the Diving activities and practices |
| **Course typology** | Theoretical (classroom) and practical |
| **Training methodology** | Traditional, Virtual Reality |
| **Attendances** | Divers |
| **Main Topics** | • Emergency procedures<br>• Accident management/prevention<br>• Communications, both under-water and on the surface<br>• Diver assistance (self/buddy)<br>• Recommended diving practices (e.g., separation procedures, safety stops)<br>• Procedures for diving from boats |

| | |
|---|---|
| | • Proper use of personal diving log<br>• Planning and preparation, with emphasis on the prevention of out-of-breathing-gas situations and emergencies<br>• Routine Inspections (visual)<br>• Use of robots/drones<br>• Inspection report and checklists compilation (mooring and subsea equipment)<br>• Reporting |

## 3.5 Electrical and Instrumentation Maintenance Course

| ELECTRICAL AND AUTOMATION MAINTENANCE COURSE | |
|---|---|
| **Course objective** | To provide detailed technical information for electric and automation Maintenance management and execution on the electric, instrumentation and CCTV and surveillance equipment installed |
| **Course typology** | Theoretical, Classroom |
| **Training methodology** | Traditional, Smart Helmet |
| **Attendances** | Control Room Operator<br>Remote Control Room Operator<br>Energy System Manager<br>Electrical Staff<br>Automated ship docking & recharge control manager<br>Deck Operations Responsible |
| **Main Topics** | Maintenance of equipment within area of responsibility including:<br>a. Health and safety requirements (e.g., PPE, lockout / tagout, confined space requirements, dead/live working, isolation procedures, working in hazardous areas (fire or explosion risk, etc.).<br>b. Preventative maintenance tasks (e.g., inspections, lubrication, etc.).<br>c. Unscheduled maintenance diagnosis and performance (e.g., replacement of seals or other spare parts).<br>d. Integration of Computerized Maintenance Management System (CMMS) into maintenance activities and availability of spare parts.<br>e. Use of specialized tools<br>f. Understanding when vendor / subcontractor support is required and the means to secure these services.<br>Additional health and safety considerations specific to equipment operation and maintenance, including:<br>a. Specific safety awareness considerations for each equipment / system.<br>b. Engineering controls integrated into equipment / systems.<br>c. Procedures for de-energizing equipment, conducting hot works, confined space entry, etc. specific to the equipment / system.<br>d. Hazards of specific chemicals including detailed review of Safety Data Sheets (SDSs) as part of Hazard Communication awareness.<br>e. Requirements for personal protective equipment (PPE). |

## 3.6 Mechanical Maintenance Course

| MECHANICAL MAINTENANCE COURSE | |
|---|---|
| **Course objective** | To provide detailed technical information for mechanical maintenance management |

| | |
|---|---|
| | and execution on the mechanical equipment installed |
| **Course typology** | Theoretical, Classroom |
| **Training methodology** | Traditional, Smart Helmet |
| **Attendances** | Mechanical Staff<br>Deck Operations Responsible<br>Automated ship docking & recharge control manager |
| **Main Topics** | Maintenance of equipment within area of responsibility including:<br>a. Health and safety requirements (e.g., PPE, lockout / tagout, confined space requirements, etc.).<br>b. Preventative maintenance tasks (e.g., inspections, lubrication, etc.).<br>c. Unscheduled maintenance diagnosis and performance (e.g., replacement of seals or other spare parts).<br>d. Integration of Computerized Maintenance Management System (CMMS) into maintenance activities and availability of spare parts.<br>e. Use of specialized tools<br>f. Understanding when vendor / subcontractor support is required and the means to secure these services.<br>Additional health and safety considerations specific to equipment operation and maintenance, including but not limited to:<br>a. Specific safety awareness considerations for each equipment / system.<br>b. Engineering controls integrated into equipment / systems.<br>c. Procedures for de-energizing equipment, conducting hot works, confined space entry, etc. specific to the equipment / system.<br>d. Hazards of specific chemicals including detailed review of Safety Data Sheets (SDSs) as part of Hazard Communication awareness.<br>e. Requirements for personal protective equipment (PPE). |

## 3.7 VENDOR TRAINING

Vendors' representatives shall be involved in the training sessions concerning the operational and maintenance tasks. The list of Vendors O&M Courses and relevant attendees is detailed in Table 4.

# 4 CONCLUSIONS

The present document has been identified as Deliverable D7.6 "*Training needs, including evaluation of End Users Usability report*" of the Blue Growth Farm Contract [AD1], [AD2].

This document has presented the training and development needs of BGF O&M personnel so that they will be qualified to safely supervise, operate, maintain and technically support the BGF platform during its operative Lifecyle. Available practices established in the Oil&Gas offshore platform domain have been considered as a base for the present BGF offshore application.

A specific focus has been placed on modern training technologies and their use in the BGF training program, as interactive virtual environments (VR), 360° virtual modelling and smart helmets (AR). These powerful tools, used in a blended training format, are able to simulate advanced hands-on experience, and are highly recommended for the training of operative personnel in a condition where staff is to be minimized thanks to the level of automation and monitoring capacities made available on BGF infrastructure, whilst maintaining high safety levels typical of offshore installations.

Concerning the contribution by End User about the usability of the proposed BGF infrastructure, difficulties have been encountered in identifying interested End Users attracted to the initiative and willing to release their opinion on the effective usability of the BGF infrastructure, as conceived. Nevertheless, the BGF Consortium is willing to take advantage of the period for exploitation phase after the project end to continue this investigation by extending to other than aquaculture offshore operators, with the hope that offshore aquaculture farmers (or food operators) could in the meantime raise the level of their commercial profile taking advantage of the increasing interests and financial efforts currently mobilised by the Blue Economy.

# 5 REFERENCES

[R1] BGF Deliverable, 2021, “D7.5 – Operation and Maintenance Manual”, Rev. 0.0, 28th February.

## Annex A. Virtual Reality Test Case for BGF

**Forewords on Augmented and virtual reality for industrial applications**

Technical advancement has led to the availability of powerful and reasonably low priced augmented (AR) and virtual reality (VR) devices for the consumer market. Moreover, AR and VR devices also have great potential for industrial applications. For instance, efforts are being made to implement AR based support systems for employee training, remote maintenance or inspection and assembly processes. AR and VR both are part of a wider field of technology called mixed reality (MR). MR describes different technologies blending the physical world with the digital world and exists between the extrema of completely real and virtual environments. In addition, MR visualization produces visual stimuli with a higher level of similarity to real-world stimuli compared to standard displays. This allows the user to make use of the abilities learned in the real world, e.g., detection of meaningful patterns, or qualitative judgement. A variety of devices exist in the field of MR, such as AR tablets, Cave Automatic Virtual Environments (CAVE), head mounted displays (HMD), or AR projectors. These devices usually provide MR visualization as well as other basic functionalities especially for user interaction. In addition, tracked controllers, object recognition and tracking (e.g., hands) or haptic feedback can be integrated to support intuitive usability. By combining improved control and visualization, MR leads to optimized human-computer interaction. To estimate the potential of MR systems for inspection and maintenance processes, it is practice classifying involved components into three groups: **object**, **model** and **human**. Objects are all non-human real-world assets (e.g., workpieces, tools, and environment). The model contains all virtual assets (e.g., process model, documentation, and design drawings). The human is the human worker to be supported by the support system. As described, MR provides an enhanced interface between digital data and human, due to improved visualization and controls. Therefore, time and effort for the interaction between model and human can be used as a measure of the MR potential. Time and effort for these interactions are separated into three levels: little, medium and high. Little interaction takes place when there is no or just a rudimentary model. In this case, interacting with this model takes little to no time. Consequently, standard tools can be used instead. The medium level interaction consists of a bidirectional flow of model data, which is not directly apparent on the real-world object. Still, the data is in direct relation to the process and of relatively low complexity so that an experienced worker could assess it without a support system. Therefore, it is also important to take interaction into account that does not occur immediately during the process but has happened before (e.g., training or continuous learning of a work sequence). The highest level of interaction with the model is assigned to processes in which the model contains essential information that cannot be substituted with experience or additional training. Since different MR technologies are classified according to the degree of reality they allow and the degree of virtuality they can display, the suitability of different MR technologies can be determined by means of analyzing the interaction between human and object. Analogously to the model interaction the distinction of three levels is identified: **little**, **medium** and **high**. Little interaction means there is no change in the physical status of the object itself and only observations take place (unidirectional data flow). The medium level contains processes in which the physical status of the object is altered between predefined states. Consequently, modifying the object in previously undefined states means a high level of interaction between human and object. The potential of a technology characterized by a high degree of reality (AR) increases with higher effort for the interaction with the object. With little to no interaction between human and object, AR potential basically does not exist. Simultaneously, the potential of a technology characterized by a high degree of virtuality (VR) decreases with higher effort needed for the interaction with the object. If a lot of interaction with non-human real-world assets is needed, VR technology is not suitable. In this case, effort describes not only the time complexity or the quantity of the interaction but also the quality of the representation required for the execution of the process. For example, a video sees through display, which does limit the view of the object, is not suitable for a task for which all real-world stimuli are needed. In some cases, the potential for the use of MR can be further increased by enriching the model with additional data e.g., from additional sensors. This may be the case when the extension of the model allows the implementation of support functions, which replace or considerably accelerate an existing interaction with the object.

**Test Case developed for the Blue Growth Farm**

The use case for BGF demonstration has been selected in the frame of **maintenance tasks**. This piloting exercise wants to show the potential of Virtual Reality with a low interaction between the human and the objects and a high interaction between the human and the model.

As described in the previous paragraph, Virtual reality (VR) is an advanced computer technology that can give users multiple intuitive sensations while simulating mechanisms in a physical or imaginary world. VR applications can provide users not only immersive sight beyond reality but also the ability to interact with virtual objects. Maintainability is a feature of a product given during the design and manufacturing phase and is the relative ease and economy of time and resources when a product needs to be maintained or restored. It is defined as "the measure of the ability of an item to be retained in or restored to specific conditions when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources at each prescribed level of maintenance and repair". Early maintainability design works rely mainly on full-scale solid models of products with which designers can produce animations of maintenance processes and conduct design analyses and evaluations based on simulations. Thus, in the early stages, VR can be used to expose problems in maintenance design and help a designer make changes in time. In addition, VR can be applied to maintenance training and on-the-spot operation and maintenance.

The virtual reality implemented in the present BGF Test Case wants to support the training of the BGF operators by means of a VR interface which is expected to facilitate a better understanding of the equipment use, prior to on-the-job training on the physical equipment.

Description of the BGF Test Case

The object of maintenance is a component of the SM6 switchgear for the medium voltage of Schneider Electric (Figure A1). It is a switch unit with the code DM1A. The DM1A device, in addition to having the circuit breaker, also has a disconnector upstream of the circuit-breaker, an earthing switch for the disconnector itself (always upstream of the circuit-breaker) and an earthing switch to earth downstream of the circuit-breaker (see scheme below). The block has a voltage presence indicator. There are 2 commands: switch command and disconnector command. There are 3 key locks:

- key lock on the line disconnector in the closed position (feeder disconnector);
- key lock on the earthing switch in the closed position;
- key lock on the switch in the open position.

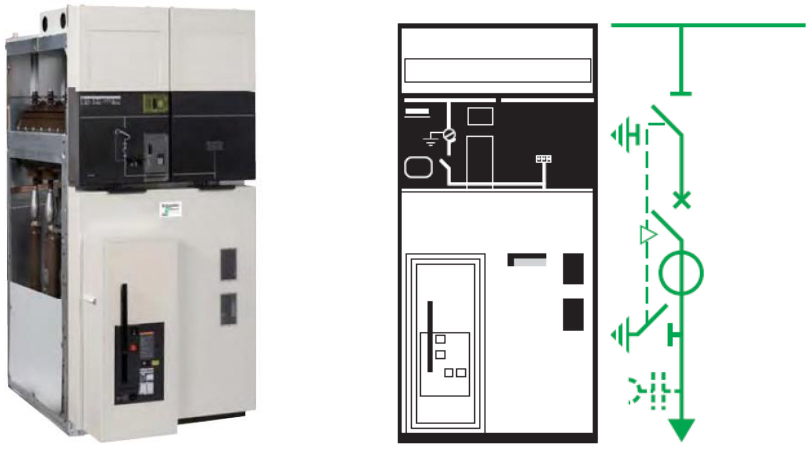

Figure A1. DM1A Cubicle of Schneider Electric a) layout b) electrical scheme

The CAD of the DM1A has been imported in UNITY software that has been used to create the virtual reality application. Unity gives users the ability to create experiences in 3D, and the engine offers a primary scripting API in C#, for both the Unity editor in the form of plugins as well as drag and drop functionality. Unity VR lets the user to target virtual reality devices directly from Unity, without any external plugins in projects. It provides a base API and feature set with compatibility for multiple devices. The device used in the project is the Oculus RIFT (see Figure A2).

The drawing of the DM1A has been combined with a large screen display in which visualizes the steps of the procedures (see Figure A3).

The selected maintenance procedure derived from the DM1A User Manual is the startups and operating instructions composed by three main sub-procedures:

- circuit breaker no-load operations;
- energising the load side of the installation;
- de-energising the load side of the installation.

The "circuit breaker no-load operations" sub-procedure is composed by the following steps (the labels indicated in the sub-procedure can be identified in Figure A3):

- Lock the lever insertion point E of the feeder disconnector with the key inserted at point B (an example of key in B is provided in Figure A8).
- Remove the key from B then insert it at point C. Unlock then charge the circuit breaker (an example of key in C is provided in Figure A5)
- Close the circuit breaker by pressing pushbutton I (an example of pushbutton I is provided in Figure A9)
- Open the circuit breaker by pressing pushbutton O (an example of pushbutton O is provided in Figure A4)
- Lock circuit breaker open with key in C position by pressing pushbutton O
- Remove the key from C position and insert it at point B. Unlock the opening of lever E of the feeder disconnector.

The “energising the load side of the installation” sub-procedure is composed by the following steps (the labels indicated in the sub-procedure can be identified in Figure A3):

- Set the feeder disconnector to open position using the operating lever.
- Set the feeder disconnector to closed position, then lock lever insertion point E of feeder disconnector with key to A (an example of key in A is provided in Figure A6).
- Remove key from A, place in C and then unlock the circuit breaker. Charge the circuit breaker (an example of key in C is provided in Figure A5).
- Close circuit breaker by pressing pushbutton I. The load side of the installation is energized (an example of an example of pushbutton I is provided in Figure A9).

The “de-energising the load side of the installation” sub-procedure is composed by the following steps (the labels indicated in the sub-procedure can be identified in Figure A3):

- Open circuit breaker by pressing pushbutton O (an example of pushbutton O is provided in Figure A4).
- Lock the circuit breaker open with key in C by pressing pushbutton O (an example of key in C is provided in Figure A5).
- Remove key from C and then insert it in point A. Unlock lever insertion point E of feeder disconnector (an example of key in A is provided in Figure A6).
- Set feeder disconnector E to open position (an example of key in E is provided in Figure A7).
- Set feeder disconnector to earth position. The front panel can be removed.


Figure A2. Oculus RIFT

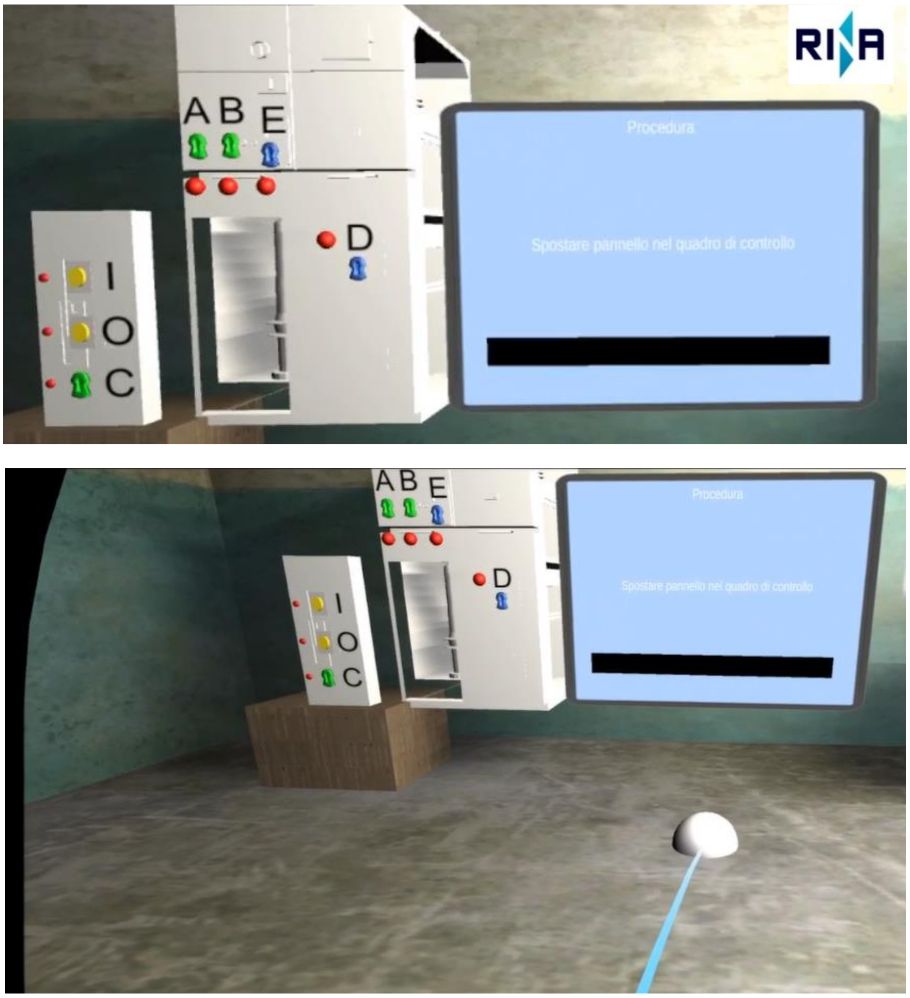


Figure A3. Overview of DM1A cubicle imported in Unity with large screen display for procedure presentation

Figure A4. Example of pushbutton O

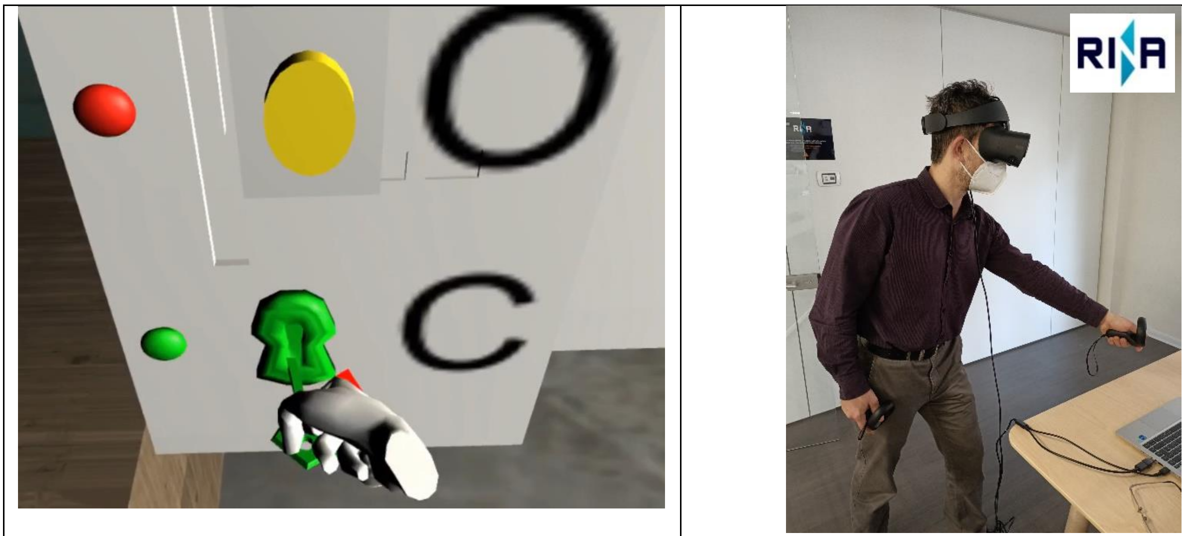

Figure A5. Example of Key in C

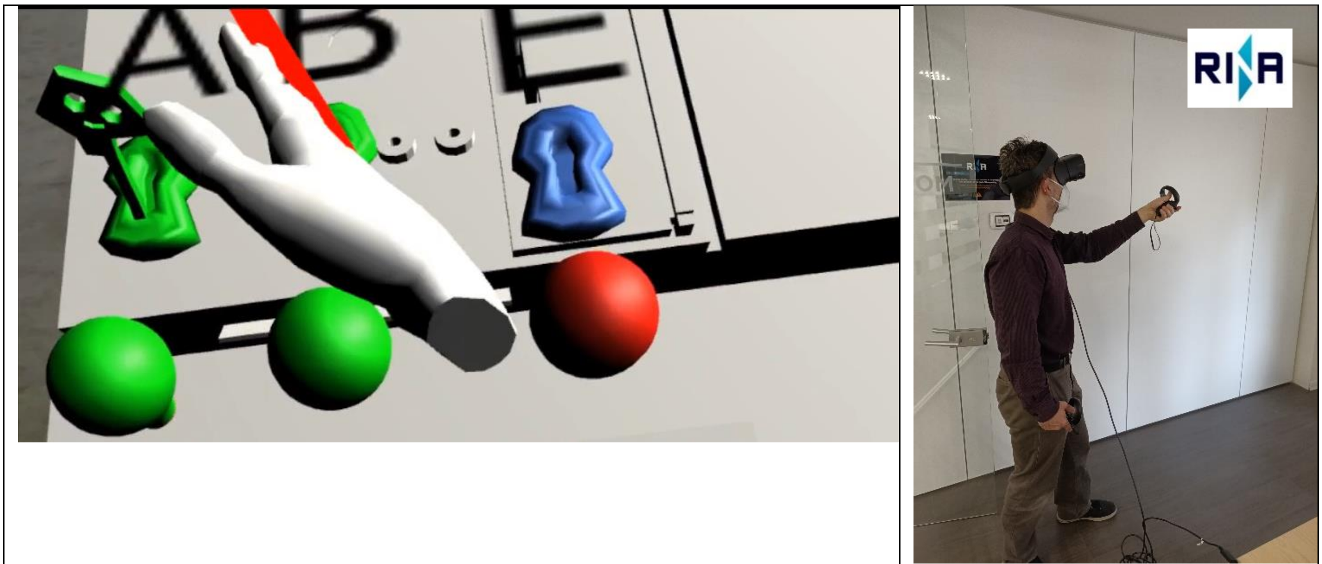

Figure A6. Example of key in A

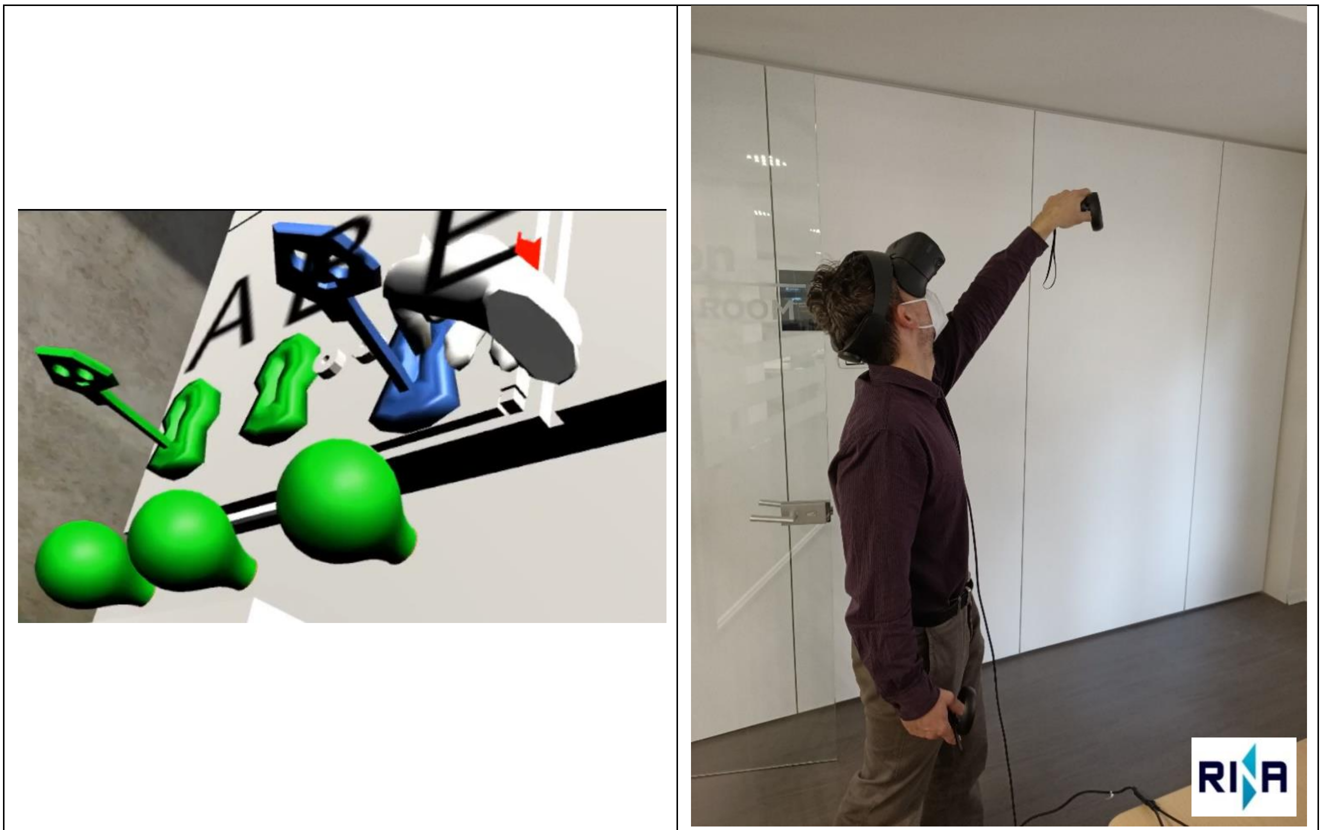


Figure A7. Example of key in E

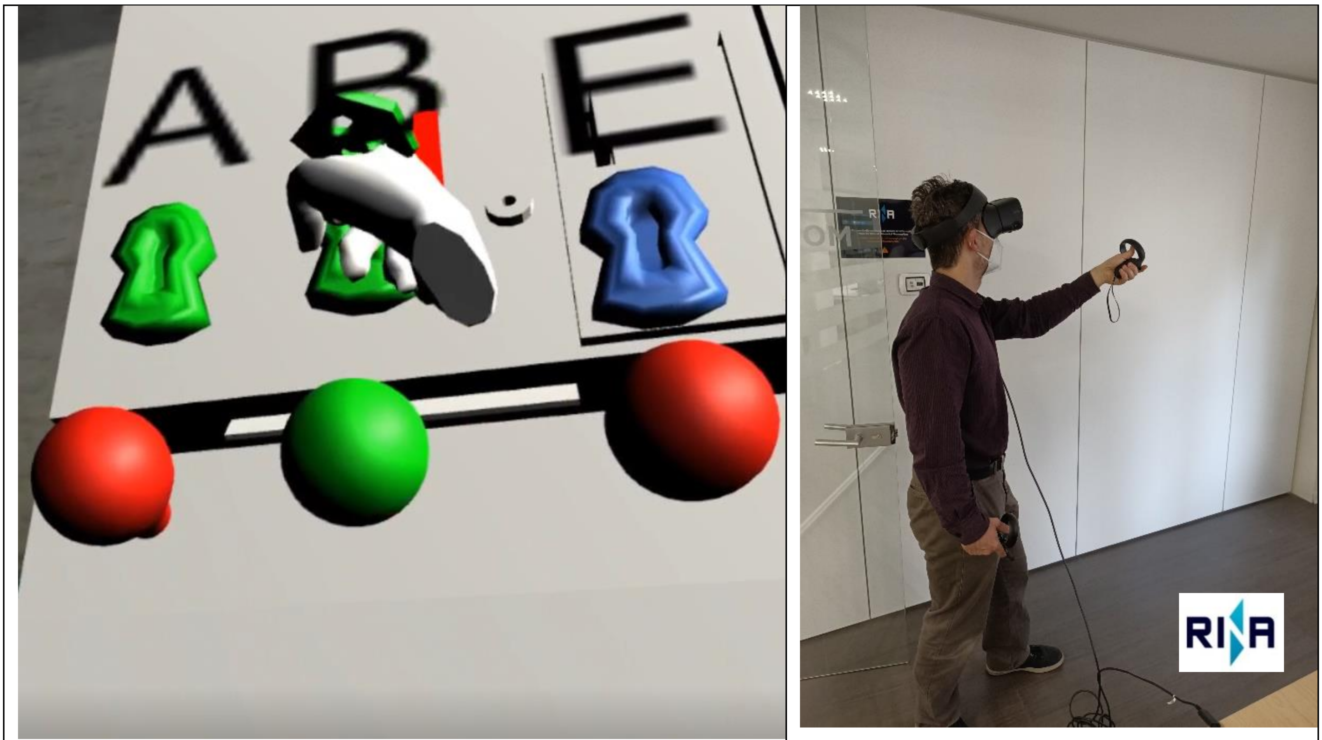


Figure A8. Example of key in B

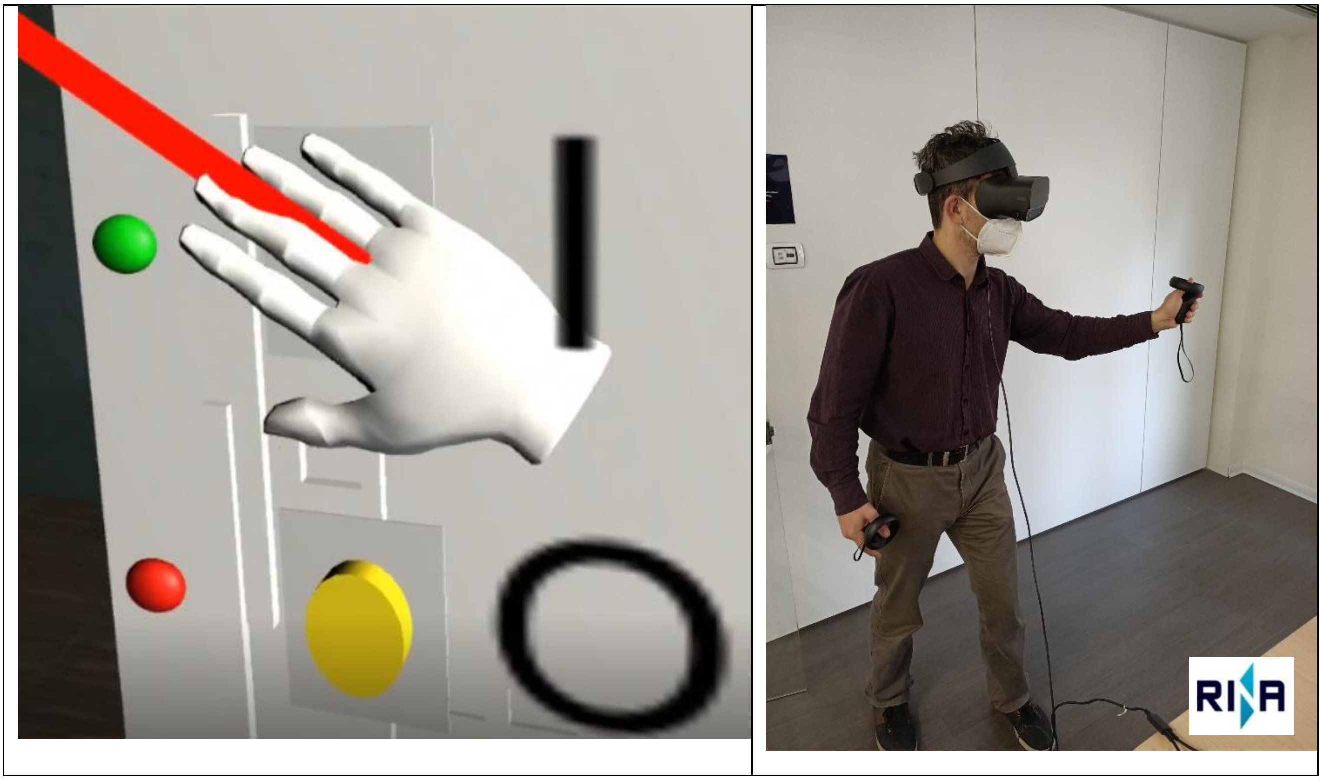

Figure A9. Example of pushbutton I

## Annex B. BOSIET certificate

**Purpose**

When working at offshore sites, basic training in how to deal with emergencies must be carried out. Offshore facilities are miles away from any means of rescue, then being able to handle yourself in such an environment demands the necessary skillset and know-how.

In a Basic Offshore Safety Induction and Emergency Training course, the trainee will acquire the necessary skills to handle a variety of emergency scenarios working offshore. BOSIET is the first entry level. After completing a BOSIET course, more specialised and further emergency training courses follow.

Typical three days course deal with training in general safety, escaping different types of places, sea survival, and firefighting. Learning about general safety deals with all the necessary steps that an offshore worker is required to follow when working in a high-risk scenario. The most common danger scenarios will be covered, such as first aid and evacuation procedures.

Escaping from the various types of confined and irregular locations on an offshore facility is also an essential skill to be achieved through a BOSIET course. Boarding and general safety around a helicopter are some of the features on this part of the course.

Surviving at sea implies the acquisition of necessary survival skills. Scenarios include the need to abandon the platform or vessel, or for any reason getting submerged into the sea. Training may also introduce a preliminary experience with the equipment involved in the platform process if this is instrumental at learning about survival in harsh conditions.

**Target Trainees**

The training course introduces basic knowledge about living and working in an offshore facility and aims at expanding skills in handling dangerous situations. It is then targeted at people who are new to the offshore workplace, but it is useful to refresh who has already worked at offshore facilities, after a period of non-occupancy.

**Applicable normative and pre-requisites for the course**

Assumed that BOSIET course is for both workers and personnel already working in an offshore environment and for people who have not yet begun working offshore, this may be treated differently among countries having different legal regulations and requirements. That makes it hard to pinpoint the people who will need BOSIET training. If in doubt you will need to ask a safety officer at your workplace to guide you to the correct course. In many cases, if you work offshore, BOSIET is required by state law and company policies.

The participants are usually required to be at least 16 years old and are subject to tests and medical exams before entering the course.

A BOSIET certification typically lasts four years. An additional course (FOET which stands for Further Offshore Emergency Training), which validates the certificate for a further four years, must be carried out within those four years to obtain the extension.

**Additional BOSIET features**

BOSIET with CA-EBS (Compressed Air Emergency Breathing System) trains personnel who will be issued a compressed air emergency breathing system (CA-EBS) while travelling offshore by helicopter.

T-BOSIET - Tropical BOSIET sets this certificate apart from the regular BOSIET. Working in the tropics brings specific challenges when it comes to risk assessment and handling. This course equips personnel to handle risk in tropical regions of the world.

**Specialised Training**

After the first level (BOSIET) training, additional specialised training sessions can be considered among those sponsored by the different organisations, namely:

- **OPITO** | Offshore Petroleum Industry Training Organisation: Since 1991 the organisation OPITO has set the standards for safety training in the oil and gas industry.
- **GWO** | Global Wind Organisation: The Global Wind Organisation is a non-profit body founded by wind turbine manufacturers and owners. They strive for an injury free work environment in the wind turbine industry, setting common international standards for safety training and emergency procedures.
- **STCW** Course | Training for Seafarers: A STCW Basic Safety Training course provides all required elements of STCW Basic Safety Training delivered in both theoretical and practical modules, each training element will be assessed by qualified assessors to meet the competence requirements of the STCW code.

Different accreditations are also available. Here just a few examples are reported for consideration to the present case:

- ECSI | Emergency Care & Safety Institute;
- GWO | Global Wind Organisation;
- GWO Basic Safety Training (BST) Blended Learning;
- HCA | Helideck Certification Agency;
- HSE | Health & Safety Executive;
- IMDG Code | International Maritime Dangerous Goods Code;
- IMO | International Maritime Organisation;
- IMO-STCW | International Maritime Organisation - Standards of Training, Certification and Watchkeeping for Seafarers;
- IOSH | Institution of Occupational Safety and Health;
- NEBOSH | National Examination Board in Occupational Safety and Health;
- SCFS | Step Change for Safety.