

ERASMUS+ PROJECT

windEXT

ADVANCED MAINTENANCE, LIFETIME EXTENSION & REPOWERING OF WIND FARMS
SUPPORTED BY ADVANCED DIGITAL



Co-funded by the
Erasmus+ Programme
of the European Union

SECTION 2 MOODLE: MAINTENANCE. HANDBOOKS AND VIRTUAL TOOLS



ESTEFANÍA ARTIGAO
UCLM



PROJECT STRUCTURE

Documentation + Virtual Reality



01
windEXT
Introduction to Wind Turbine Technology

Section 1 :
Introduction to
Wind Turbine
Technology

Access

02
windEXT
Maintenance

Section 2 :
Maintenance

Access

03
windEXT
HSE, Repowering & Life Extension

Section 3 :
Repowering, Life
Extension and
End of Life. HSE
Issues.

Access

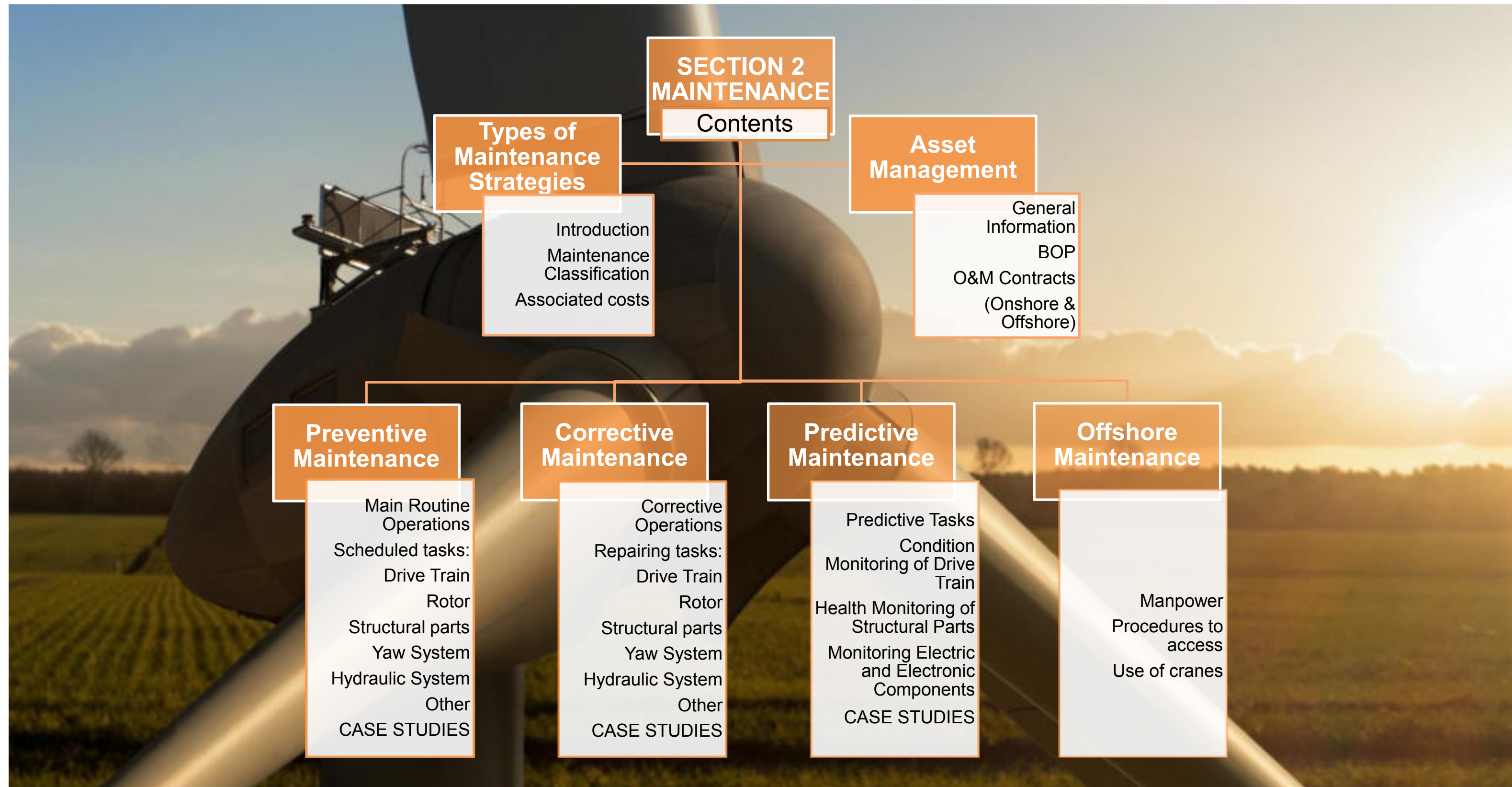
04
windEXT
Digital Tools

Section 4 : Digital
Tools

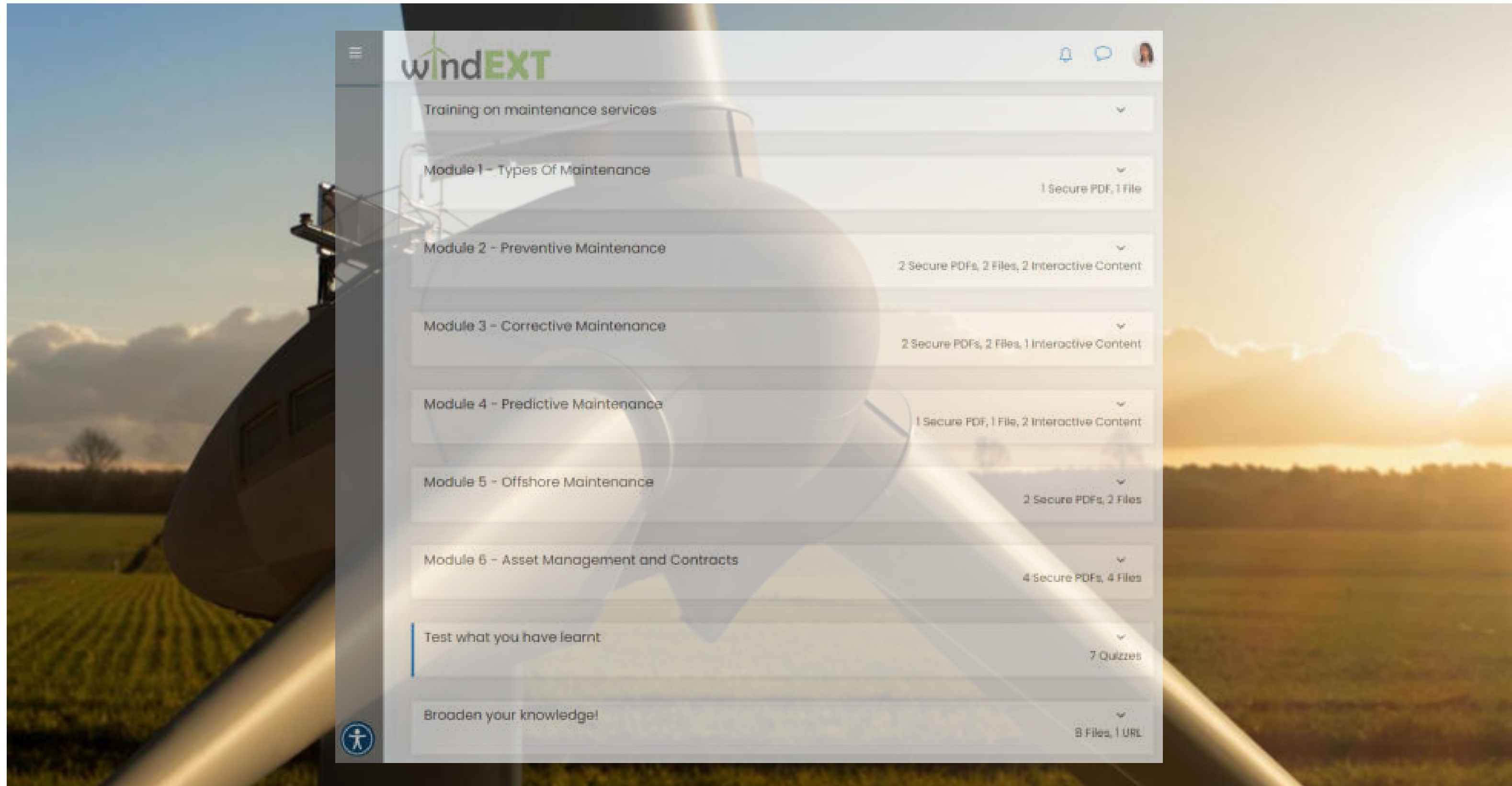
Access


WExViR
WExSiM
WExLaB

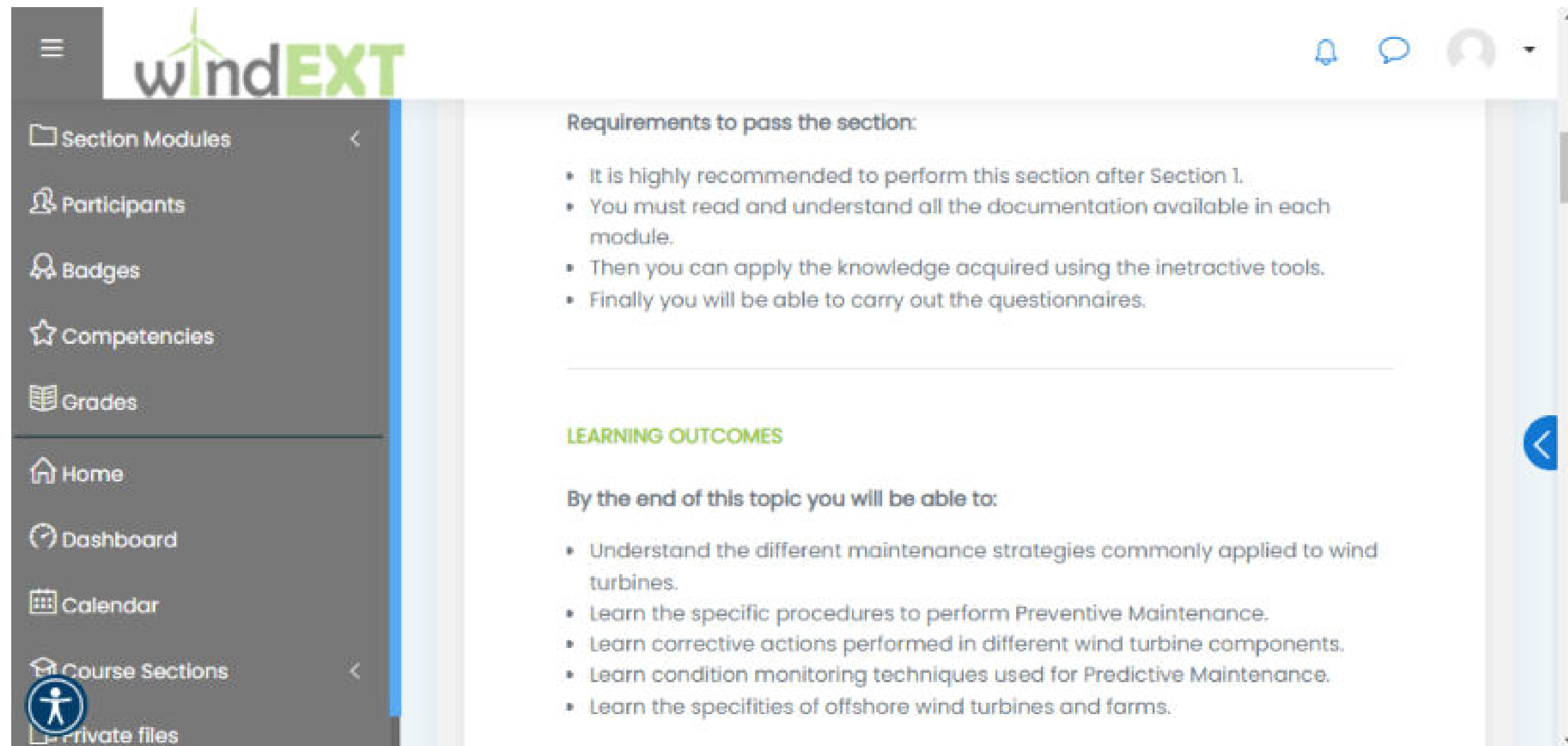
SECTION CONTENTS



SECTION CONTENTS



Training on maintenance services	
Module 1 - Types Of Maintenance	1 Secure PDF, 1 File
Module 2 - Preventive Maintenance	2 Secure PDFs, 2 Files, 2 Interactive Content
Module 3 - Corrective Maintenance	2 Secure PDFs, 2 Files, 1 Interactive Content
Module 4 - Predictive Maintenance	1 Secure PDF, 1 File, 2 Interactive Content
Module 5 - Offshore Maintenance	2 Secure PDFs, 2 Files
Module 6 - Asset Management and Contracts	4 Secure PDFs, 4 Files
Test what you have learnt	7 Quizzes
Broaden your knowledge!	8 Files, 1 URL

The screenshot shows the windEXT web application interface. On the left is a dark grey sidebar with a menu. The top of the sidebar has a hamburger menu icon and the windEXT logo. The menu items are: "Section Modules" (with a folder icon and a right arrow), "Participants" (with a person icon), "Badges" (with a badge icon), "Competencies" (with a star icon), "Grades" (with a book icon), "Home" (with a house icon), "Dashboard" (with a circular arrow icon), "Calendar" (with a calendar icon), "Course Sections" (with a graduation cap icon and a right arrow), and "Private files" (with a folder icon). The main content area on the right has a light grey header with a bell icon, a speech bubble icon, and a user profile icon. Below the header, the text "Requirements to pass the section:" is followed by a bulleted list. A horizontal line separates this from the "LEARNING OUTCOMES" section, which is followed by another bulleted list. A blue back arrow button is visible on the right edge of the main content area.

Requirements to pass the section:

- It is highly recommended to perform this section after Section 1.
- You must read and understand all the documentation available in each module.
- Then you can apply the knowledge acquired using the inetractive tools.
- Finally you will be able to carry out the questionnaires.

LEARNING OUTCOMES

By the end of this topic you will be able to:

- Understand the different maintenance strategies commonly applied to wind turbines.
- Learn the specific procedures to perform Preventive Maintenance.
- Learn corrective actions performed in different wind turbine components.
- Learn condition monitoring techniques used for Predictive Maintenance.
- Learn the specifities of offshore wind turbines and farms.







Module 1 - Types Of Maintenance 

1 Secure PDF, 1 File

READ IT! 

Read the following documentation related to this module:

 Types of Maintenance 

 Types of Maintenance 

Hidden from students



windEXT

Module 1 - Types Of Maintenance 

1 Secure PDF, 1 File

READ IT! 

Read the following documentation related to this module:

 Types of Maintenance	
 Types of Maintenance	
Hidden from students	







Module 2 - Preventive Maintenance

2 Secure PDFs, 2 Files, 2 Interactive Content

READ IT!

Read the following documentation related to this module:



PREVENTIVE MAINTENANCE - Handbook





PREVENTIVE MAINTENANCE - Checklist





PREVENTIVE MAINTENANCE - Handbook



Hidden from students



PREVENTIVE MAINTENANCE - Checklist



Hidden from students

APPLY IT!

- After reading the material please complete the following simulator activities.
- We recommend to practice with the Guided Tool first, and then you Move-Around freely!



PREVENTIVE MAINTENANCE - Guided Digital Tool





PREVENTIVE MAINTENANCE - Move-around Digital Tool



1 Table of contents

wind

1	Table of contents	2	
2	Introduction	6	
3	The Wind Turbine Maintenance Plan	11	
4	Scheduled tasks of Hub and Blades	16	
4.1	Nose Cone and External Hub Gr		
4.2	Hub Internal General Condition	6.6 Steps and Grating 55	
4.3	Gear Ring and Driving Pinion	6.7 Top Box 56	
4.4	Hub Cabinets	7 Scheduled task of Drive Train 59	
4.5	Blades	7.1 Connection of the Rotor Shaft/Hub 59	
4.6	Battery System	7.2 Main Bearing 59	
4.7	Secondary Brake System	7.3 Generator to Gearbox Coupling 63	
4.8	Brake Pad Exchange	7.4 Condition Monitoring System (if equipped) 9.12 Gearbox Internal Inspection 91	
4.9	Absolute Encoder Exchange	7.5 Rotor Position Reset Sensor (if equipped) 9.13 Oil Sampling Procedure 97	
5	Scheduled tasks of Pitch System	7.6 Main Shaft Flange Sensor (ALC) (if equip 9.14 Oil Filter Exchange 102	
5.1	Pitch Bearing	8 Scheduled tasks of Hydraulic System 105	
5.2	Pitch Bearing Lubrication	8.1 Accumulator 10.1 Generator Bearing 106	
5.3	Pitch Drives and Motors	8.2 Checking Hydraulic Oil Level 10.2 Generator Damper to Generator Frame Attachment 12.3 Tower Flanges 155	
5.4	Pitch Motor Brush Exchange	8.3 Hydraulic System Filter Exchange 10.3 Generator to Vibration Damper Attachment 12.4 Flange Bolts 155	
5.5	Pitch Gear Ring Teeth Lubricatio	8.4 Purging the Hydraulic System 10.4 Generator Slipping Compartment 12.5 Tower Walls 155	
5.6	Pitch System Limit Switch Inspe	8.5 Bleeding Hydraulic System Lines 10.5 Slipping 12.6 Bus Bar System 156	
5.7	Pitch Position Sensors	8.6 Hydraulic System Accumulator Check 10.6 Bedplate and Generator Frame 12.7 Power and Control Cables 157	
6	Nacelle	8.7 Brake Pad Air Gap Adjustment 10.7 Generator Support Frame 12.8 Power Cable Loop 157	
6.1	Nacelle	9 Scheduled tasks of Gearbox 10.8 Generator Shear Plate 12.9 Cable Twist Switch 159	
6.2	Nacelle Hoist	9.1 Gearbox General Condition 10.9 Generator Alignment 12.10 Ladder System 160	
6.3	Nacelle Mounting Brackets	9.2 Main Gearbox to the Bedplate Support 10.10 Generator Bearing Lubrication 12.11 Fall Protection 161	
6.4	Anemometer and Wind Vane	9.3 Shrink Disk 10.11 Generator Brush Exchange 12.12 Nacelle Access Ladder (Yaw Deck to Nacelle) 163	
6.5	Obstruction Light/Aviation Lights	9.4 Gearbox Desiccant/Ventilation Filter 11 Scheduled tasks of Yaw System 12.13 Tower Hoist 163	
		9.5 Gearbox Oil and Filter 11.1 Yaw Friction System 12.14 Optional Equipment 165	
		9.6 Oil Cooler 11.2 Yaw Friction Mounting Bolts 12.15 DTA Cabinets 166	
		9.7 Oil Heater Hose/Pump 11.3 Yaw Drive 12.16 Cabinet Ventilation System 167	
		9.8 Oil Particle Counter 11.4 Yaw Bearing 12.17 Turbine Control System 167	
		9.9 Offline Filtration System 11.5 Yaw Positioning 12.18 Safety Chain System Test Procedure 167	
		9.10 Oil Collection Pan 11.6 Yaw Gear Ring and Driving Pinion 12.19 Main Control Cabinet 171	
		9.11 Gearbox Air Filter Replacement 11.7 Replacement of Yaw Brake Pistons and Thrust Pieces 12.20 Power Distribution Cabinet 172	
			11.8 Yaw Puck Tensioning 12.21 Converter Filter Cabinet 173
			11.9 Yaw Bearing Greasing 12.22 Converter Bridge Cabinet 174
			11.10 Yaw Gear Ring Greasing 13 Foundation 175
12	Tower		13.1 Anchor Bolts (if equipped) 175
12.1	Tower Access Area/Door		13.2 Foundation Mounting Part (if equipped) 175
12.2	Platforms and Hatches		13.3 Foundation Drainpipe 176
			13.4 Pad Mount Transformer 176

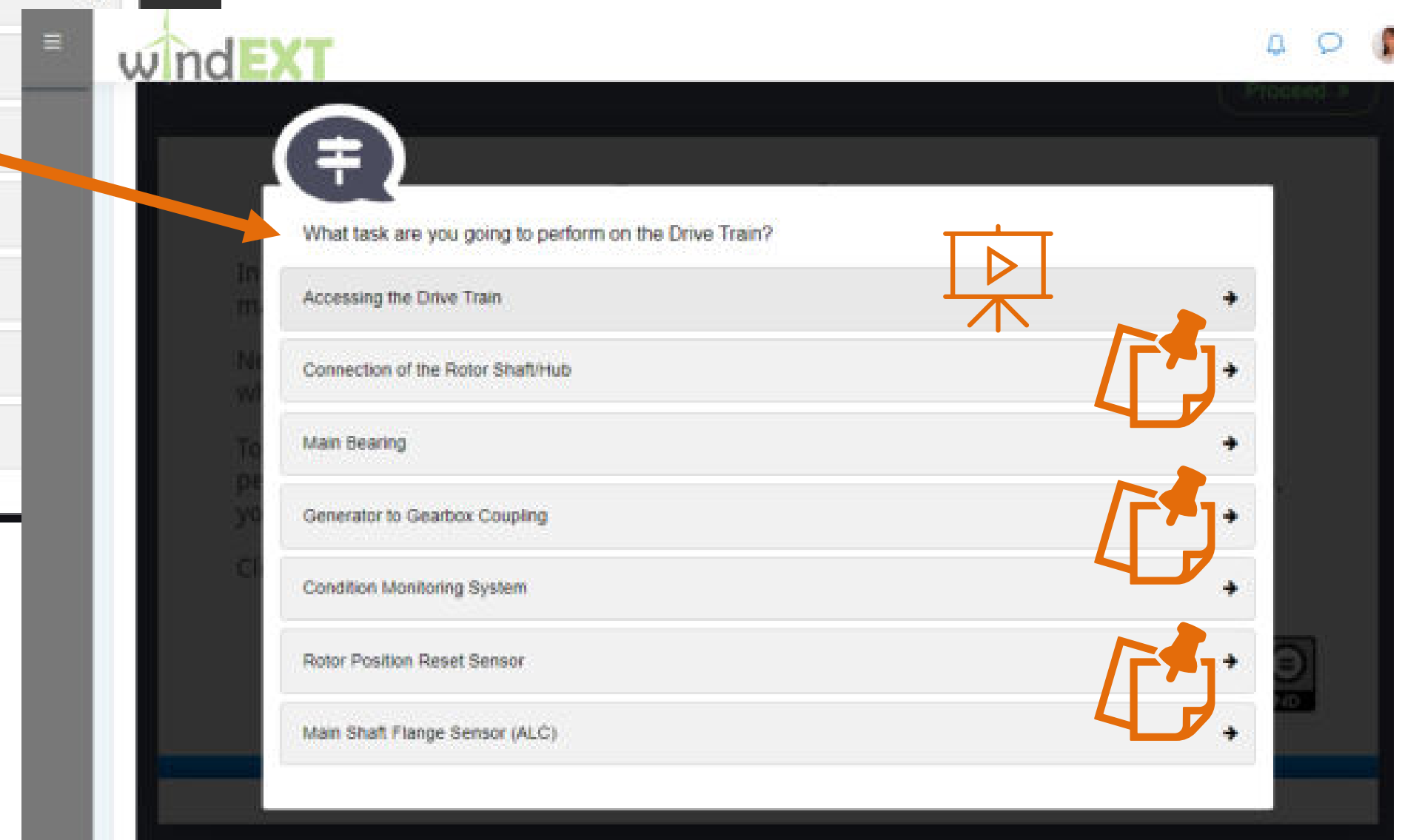
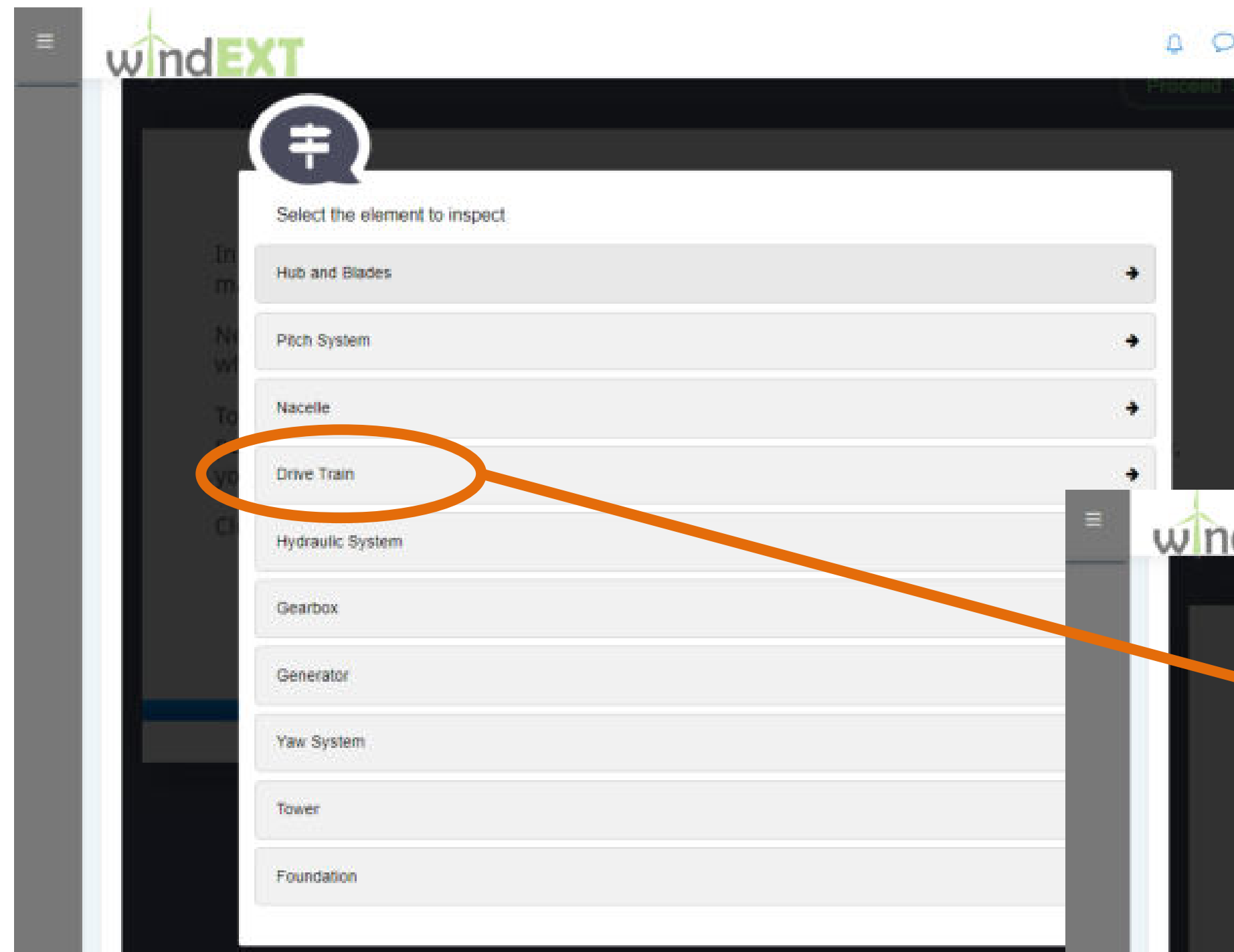
HANDBOOK



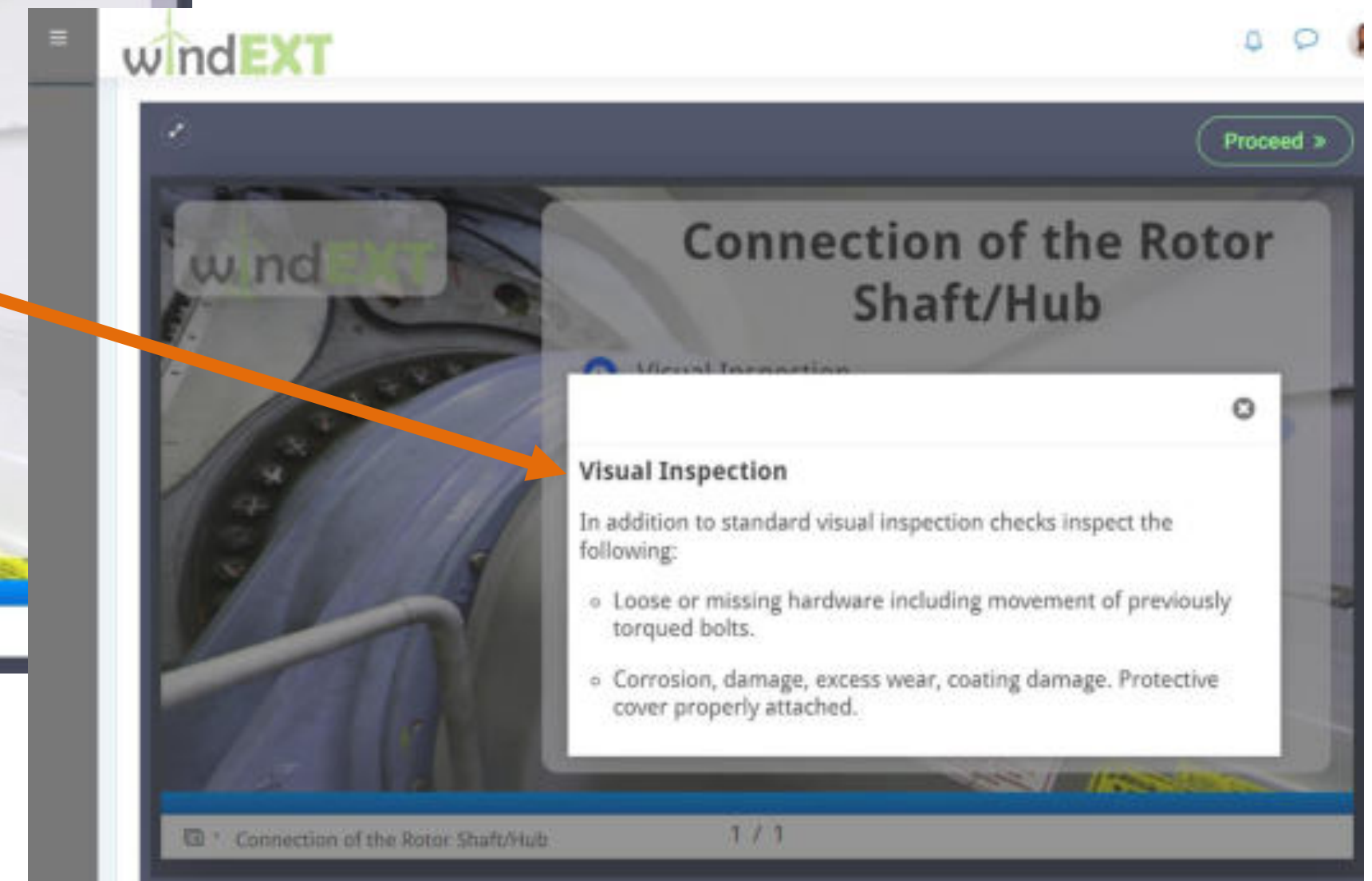
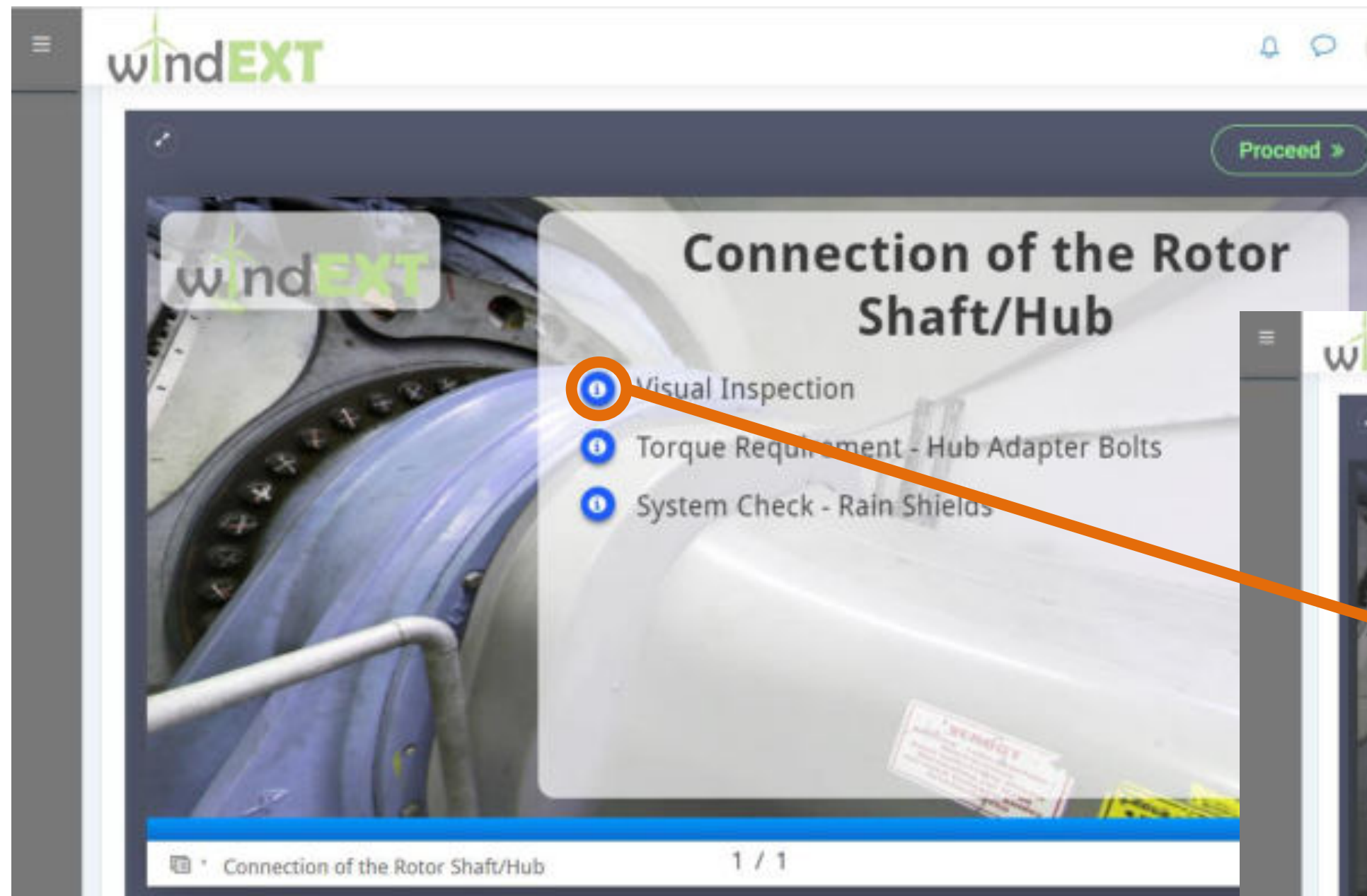
Wtg numb DATE: Wtg model Commissioning Date: Hours of wj Technicians: Company:					RANGE - TIME					
Description Okay Not ok N / A PENDING OBSERVATION					8 M	12 M	18 M	24 M	30 M	36 M
4 HUB AND BLADES:										
4.1 Nose Cone and External Hub General Condition										
Visual Inspection										
Cone fiber cleaning (inside)					x	x	x	x	x	
No cracks in the cone fiber and metal ties					x	x	x	x	x	
State of rollers access to hub					x	x	x	x	x	
Absence of grease leaks from the outer seals of the blades					x	x	x	x	x	
4.2 Hub Internal General Condition										
Visual Inspection										
Checking the bushing/Main Shaft joint tightening torque					x	x	x	x	x	
Greasing the bearings of the 3 blades					x	x	x	x	x	
Ballul recalibration in hydraulic cylinders (Hydraulic Proch)					x	x	x	x	x	
Valve setting in pitch cylinder blocks					x	x	x	x	x	
Ball inspection in pitch cylinders					x	x	x	x	x	
Limit switch calibration					x	x	x	x	x	
TOP-HUB communication check					x	x	x	x	x	
4.3 Gear Ring and Driving Pinion										
Visual Inspection										
Checking and greasing the teeth on driving rings					x	x	x	x	x	
Change Automatic lubrication device batteries if used						x		x		
4.4 Hub Cabinets										
Visual Inspection										
Air-tightness in cabinet's HUB					x	x	x	x	x	
Change of air filters in cabinet's HUB						x		x		
Check electrical connections										
Variable adjustment on electric motors (Electric Proch)						x		x		
4.5 Blades										
Visual Inspection										
Visual inspection from the ground of the 3 blades + hub cone					x	x	x	x	x	
Checking the tightening torque of the blade-hub joint										
Blade-Bearing Blade Union Tightening Torque Check										
Telescope inspection of Pressure Shell Cracks (Blade 1)										
Telescope inspection of cracks in suction shell (Blade 1)										
Telescope inspection of leading edge damage (Blade 1)										
Telescope inspection of trailing edge damage (Blade 1)										
Telescope inspection of the lightning rod system (Blade 1)										
Inspection from nacelle of the lightning rod system, measurement of					x	x	x	x	x	
Inspection from nacelle of cracks in the blade base (Blade 1)					x	x	x	x	x	
Telescope inspection of Pressure Shell Cracks (Blade 2)										
Telescope inspection of cracks in suction shell (Blade 2)										
Telescope inspection of leading edge damage (Blade 2)										
Telescope inspection of trailing edge damage (Blade 2)										
Telescope inspection of the lightning rod system (Blade 2)										
Inspection from nacelle of the lightning rod system, measurement of					x	x	x	x	x	
Inspection from nacelle of cracks in the blade base (Blade 2)					x	x	x	x	x	
Telescope inspection of pressure shell cracks (Blade 3)										
Telescope inspection of cracks in suction shell (Blade 3)										
Leading edge damage inspection with a telescope (Blade 3)										
Telescope inspection of trailing edge damage (Blade 3)										
Telescope inspection of the lightning rod system (Blade 3)										
Inspection from nacelle of the lightning rod system, measurement of					x	x	x	x	x	
Inspection from nacelle of cracks in the blade base (Blade 3)					x	x	x	x	x	
4.6 Battery System										
Visual Inspection										
4.7 Secondary Brake System										

Visual Inspection										
4.8 Brake Pad Exchange										
Visual Inspection										
4.9 Absolute Encoder Exchange										
Visual Inspection										
5 Scheduled tasks of Proch System										
5.1 Pitch Bearing										
Visual Inspection										
Change Automatic lubrication device batteries if used					x		x			
5.2 Pitch Bearing Lubrication										
Visual Inspection										
5.3 Pitch Drives and Motors										
Visual Inspection										
Measure and record pitch motor brush length AUC units									x	
Measure and record pitch motor brush length non-AUC units										
5.4 Pitch Motor Brush Exchange										
Visual Inspection										
5.5 Pitch Gear Ring Teeth Lubrication										
Visual Inspection										
5.6 Pitch System Limit Switch Inspection										
Visual Inspection										
5.7 Pitch Position Sensors										
Visual Inspection										
6 Nacelle										
6.1 Nacelle										
Visual Inspection										
Leak in nacelle					x	x	x	x	x	
Review of the condition of the nacelle floor and insulating elements						x		x		
Aisle and rack cleaning					x	x	x	x	x	
Nacelle fire fighting kit check: revision date, expiration date, pressure					x	x	x	x	x	
Nacelle cooling motor operation					x	x	x	x	x	
Clearance light check and day / night switching					x	x	x	x	x	
6.2 Nacelle Moist										
Visual Inspection										
Review of stairs access to nacelle					x	x	x	x	x	
Functional check of the hoist load lifting system					x	x	x	x	x	
Review of the condition of the bridge crane: anchorage on beams, slendblocks					x	x	x	x	x	
Review of ventilation flap					x	x	x	x	x	
Air filter change						x		x		
6.3 Nacelle Mounting Brackets										
Visual Inspection										
6.4 Anemometer and Wind Vane										
Visual Inspection										
6.5 Obstruction Lights/Aviation Lights (if equipped)										
Visual Inspection										
Nacelle weather station and lightning rod inspection					x	x	x	x	x	
Azimuth alignment sensor station					x	x	x	x	x	
Checking the functioning of all emergency mushrooms in nacelle					x	x	x	x	x	
6.6 Steps and Grating										

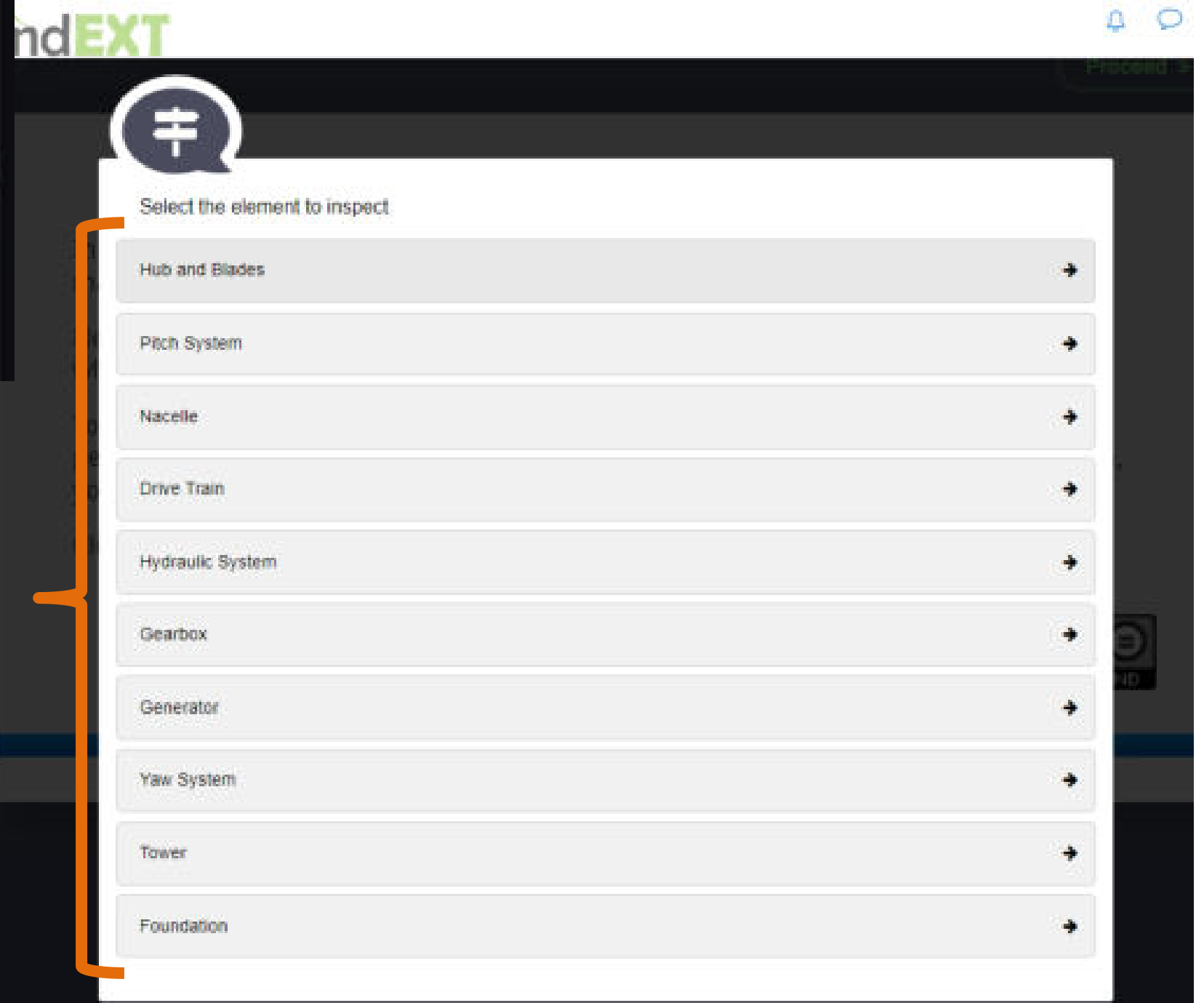
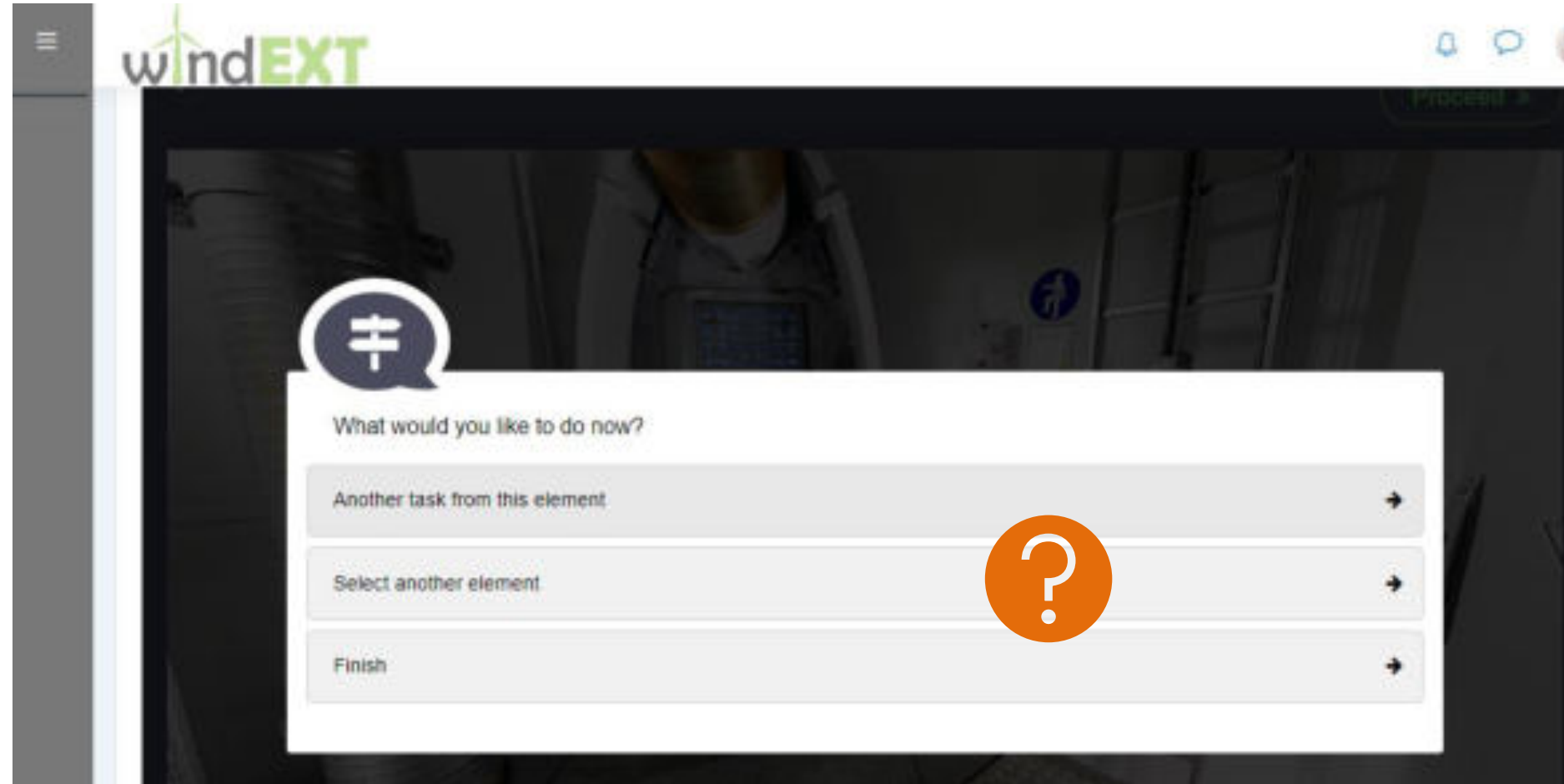
Visual Inspection								
6.7	Top Box							
	Visual Inspection							
	Exterior access hatch condition	x	x	x	x	x	x	
	Review of the mooring points for operators inside nacelle and roof	x	x	x	x	x	x	
7 Scheduled tasks of Drive Train								
7.1	Connection of the Rotor Shaft/Hub							
	Visual Inspection							
	Absence of internal and external net leakage	x	x	x	x	x	x	
	Absence of noise and friction	x	x	x	x	x	x	
7.2	Main Bearing							
	Visual Inspection							
	Check tightening torque Main shaft and frame				x			
	Inspection of possible cracks in the frame	x	x	x	x	x	x	
	Inspection of possible cracks in the rear frame	x	x	x	x	x	x	
	Checking the tightening torque of the bolted connection between the front and rear frames				x			
	Grease main shaft bearing/s at 500rpm	x	x	x	x	x	x	
7.3	Change Automatic lubrication device batteries if used		x		x			
	Generator to Gearbox Coupling							
	Visual Inspection							
	Check tightening torque for bolted connections		x		x			
	Axial measurement	x	x	x	x	x	x	
	Checking for cracks or deformations in the fiber elements	x	x	x	x	x	x	
7.4	Condition Monitoring System (if equipped)							
	Visual Inspection							
7.5	Rotor Position Reset Sensor (if equipped)							
	Visual Inspection							
7.6	Main Shaft Flange Sensor (AUC) (if equipped)							
	Visual Inspection							
8 Scheduled tasks of Hydraulic System								
8.1	Accumulator							
	Visual Inspection							
	Check nitrogen pressure in emergency accumulators	x	x	x	x	x	x	
	Calibration of pressure limiting valves	x	x	x	x	x	x	
	Functioning tests and setting of solenoid valves: cycle and negative	x	x	x	x	x	x	
8.2	Checking Hydraulic Oil Level							
	Visual Inspection							
	No leaks in hydraulic unit	x	x	x	x	x	x	
	Taking oil sample for laboratory analysis		x		x			
	Oil level 100%	x	x	x	x	x	x	
	Exchange hydraulic oil	12/36 MONTHS					12/36 MONTH	
	Exchange hydraulic filter	12/36 MONTHS					12/36 MONTH	
	Hydraulic System Filter Exchange							
	Visual Inspection							
8.4	Purging the Hydraulic System							
	Visual Inspection							
8.5	Bleeding Hydraulic System Lines							
	Visual Inspection							
8.6	Hydraulic System Accumulator Check							
	Visual Inspection							
8.7	Brake Pad Air Gap Adjustment							
	Visual Inspection							



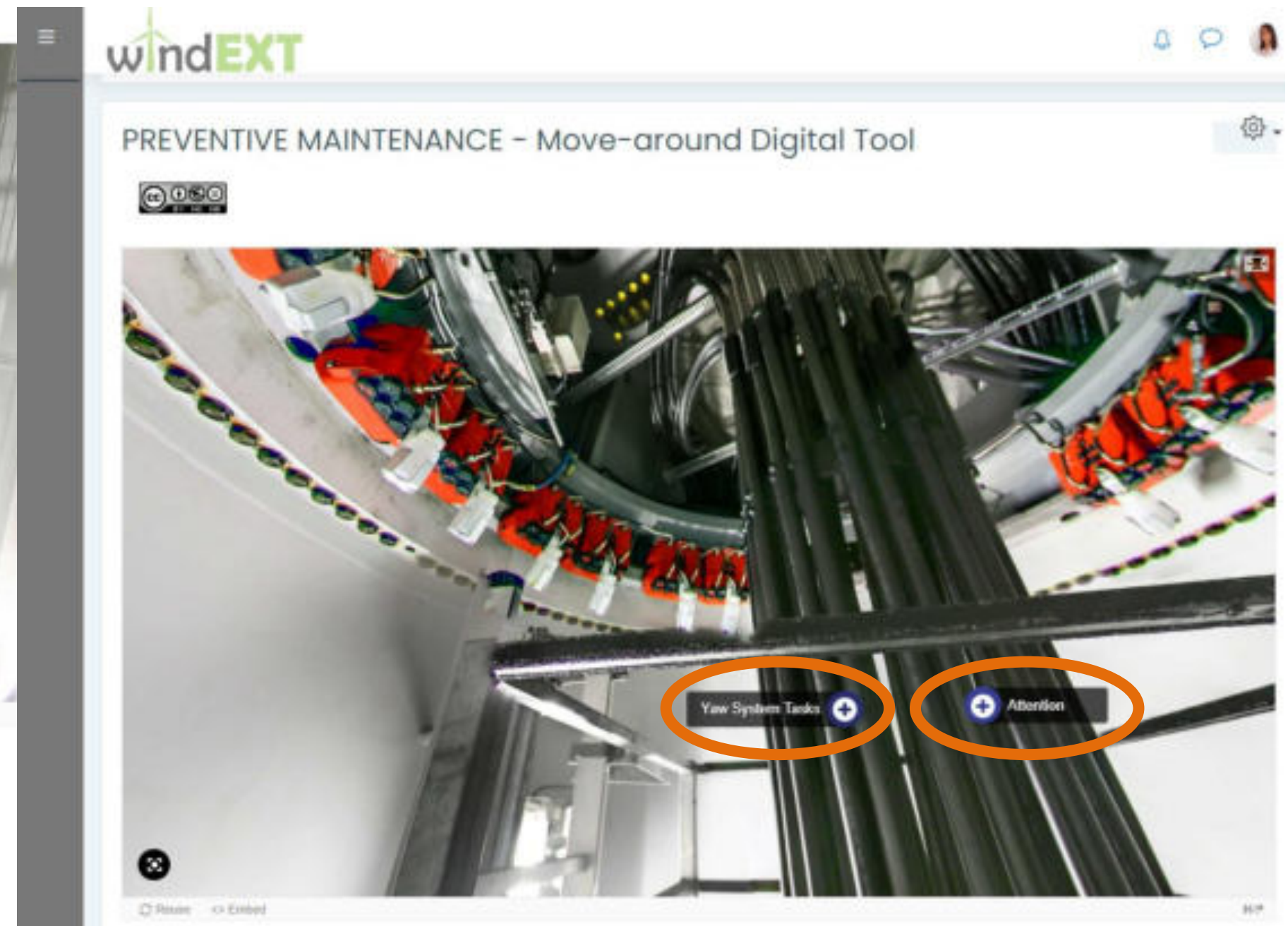
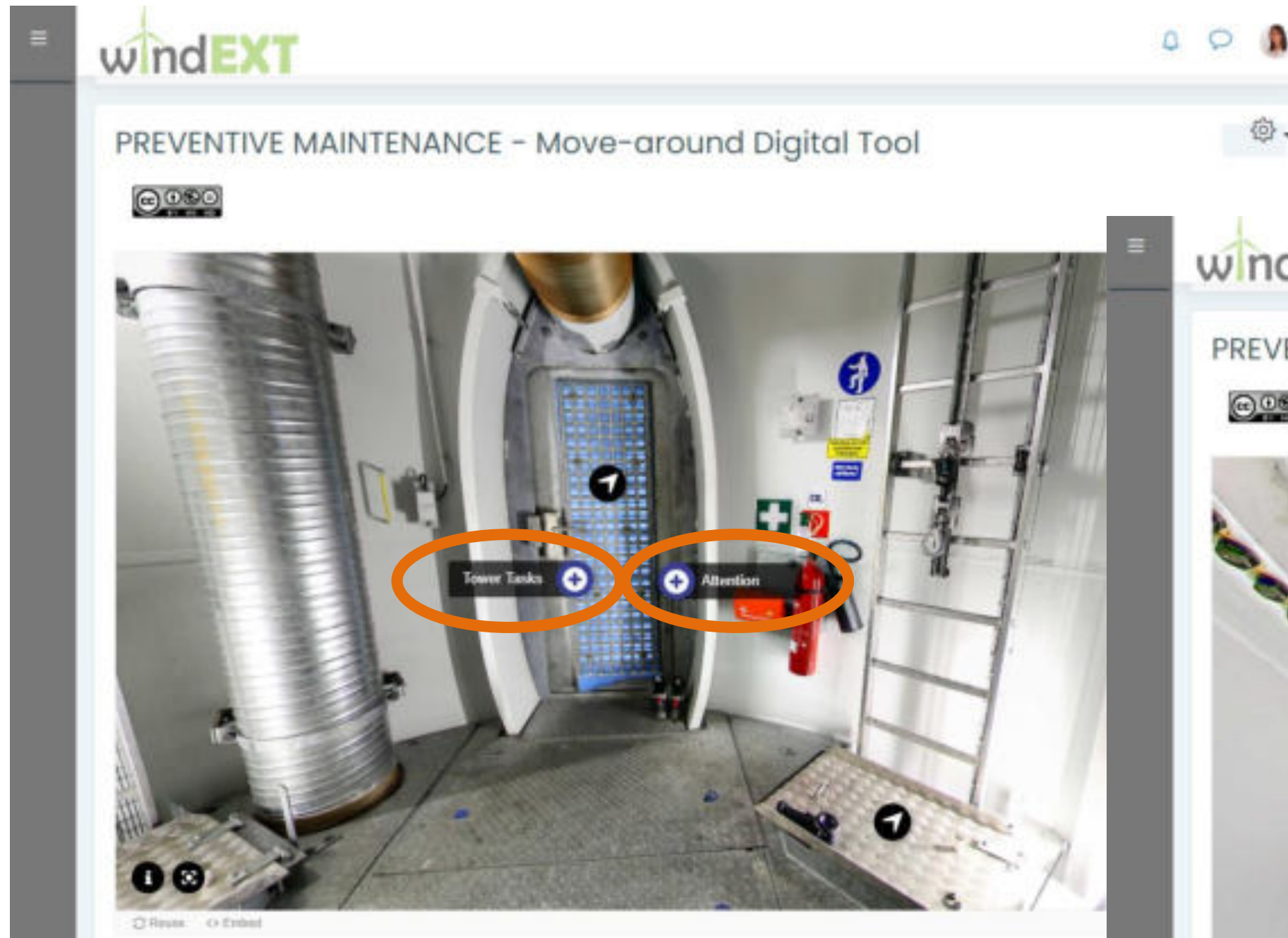
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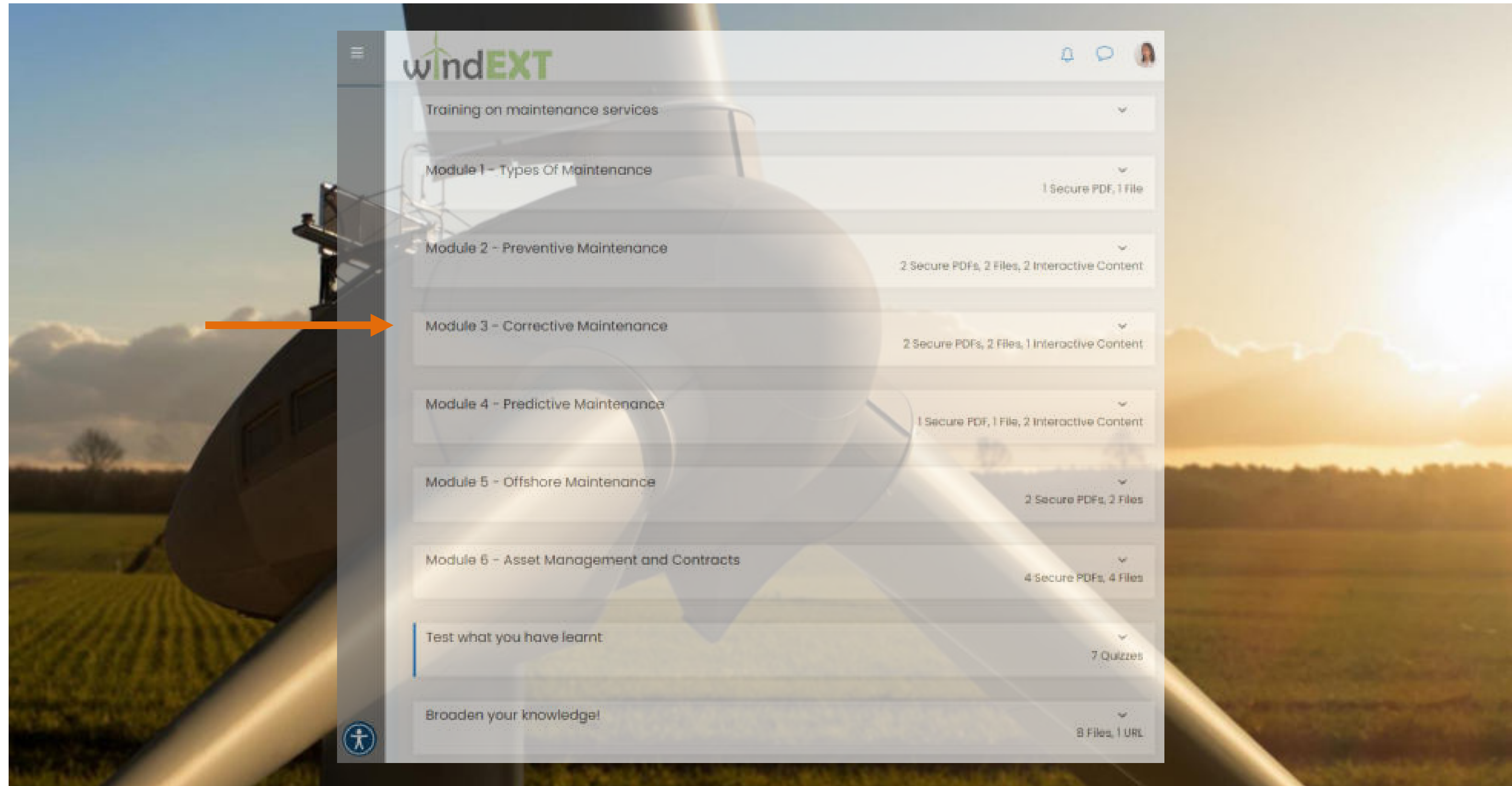


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MOVE AROUND DIGITAL-TOOL

SECTION CONTENTS



The screenshot displays the WindEXT training interface. The menu is as follows:

Item	Content
Training on maintenance services	
Module 1 - Types Of Maintenance	1 Secure PDF, 1 File
Module 2 - Preventive Maintenance	2 Secure PDFs, 2 Files, 2 Interactive Content
Module 3 - Corrective Maintenance	2 Secure PDFs, 2 Files, 1 Interactive Content
Module 4 - Predictive Maintenance	1 Secure PDF, 1 File, 2 Interactive Content
Module 5 - Offshore Maintenance	2 Secure PDFs, 2 Files
Module 6 - Asset Management and Contracts	4 Secure PDFs, 4 Files
Test what you have learnt	7 Quizzes
Broaden your knowledge!	8 Files, 1 URL







Module 3 - Corrective Maintenance

2 Secure PDFs, 2 Files, 1 Interactive Content

READ IT!

Read the following documentation related to this module:


CORRECTIVE MAINTENANCE - Handbook

✓


TIPS FOR TROUBLESHOOTING

✓


CORRECTIVE MAINTENANCE - Handbook

✓

Hidden from students


TIPS FOR TROUBLESHOOTING

✓

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APPLY IT!

- After reading the material please complete the following simulator activities:


CORRECTIVE MAINTENANCE - Guided Digital Tool

✓

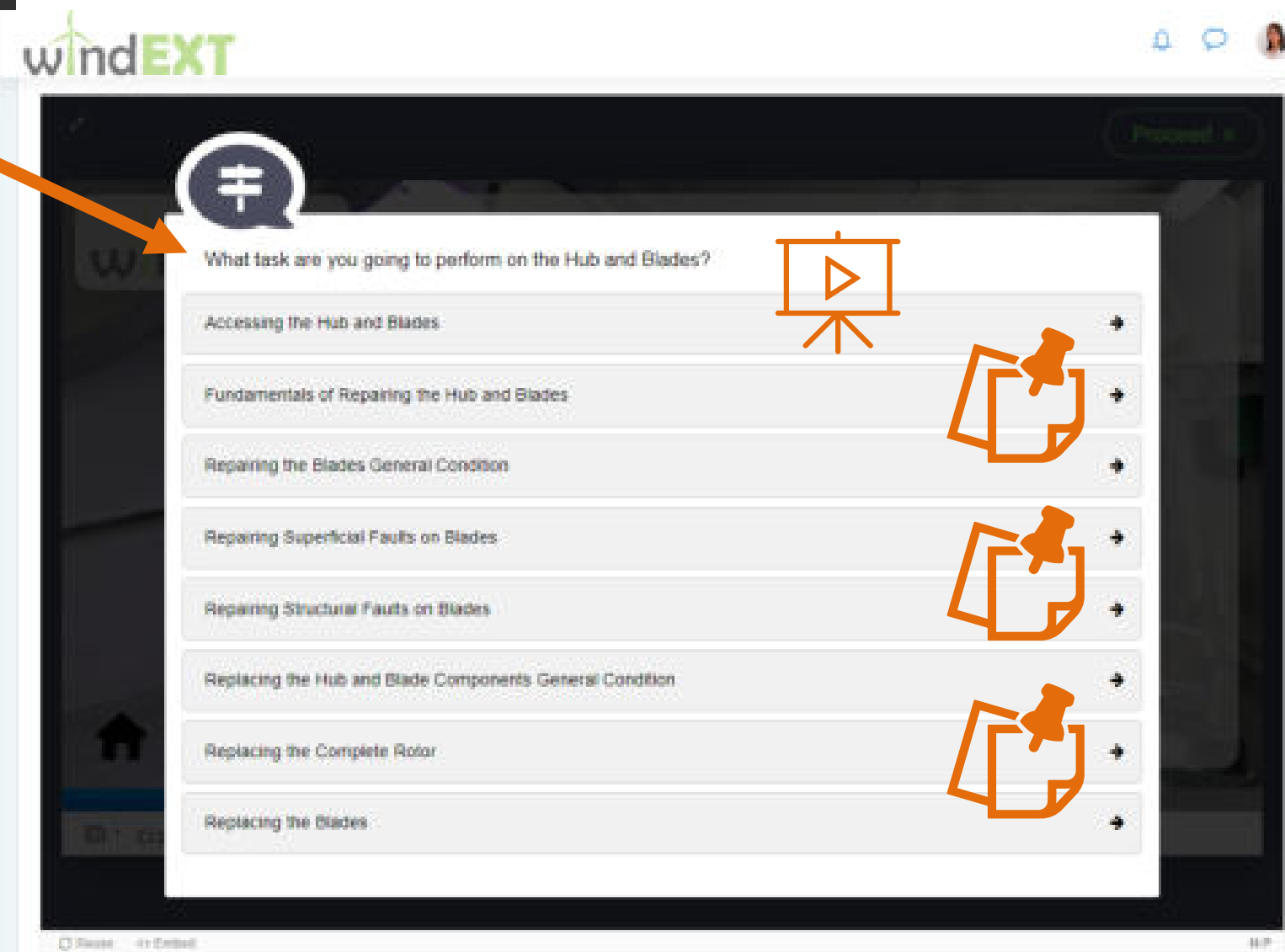
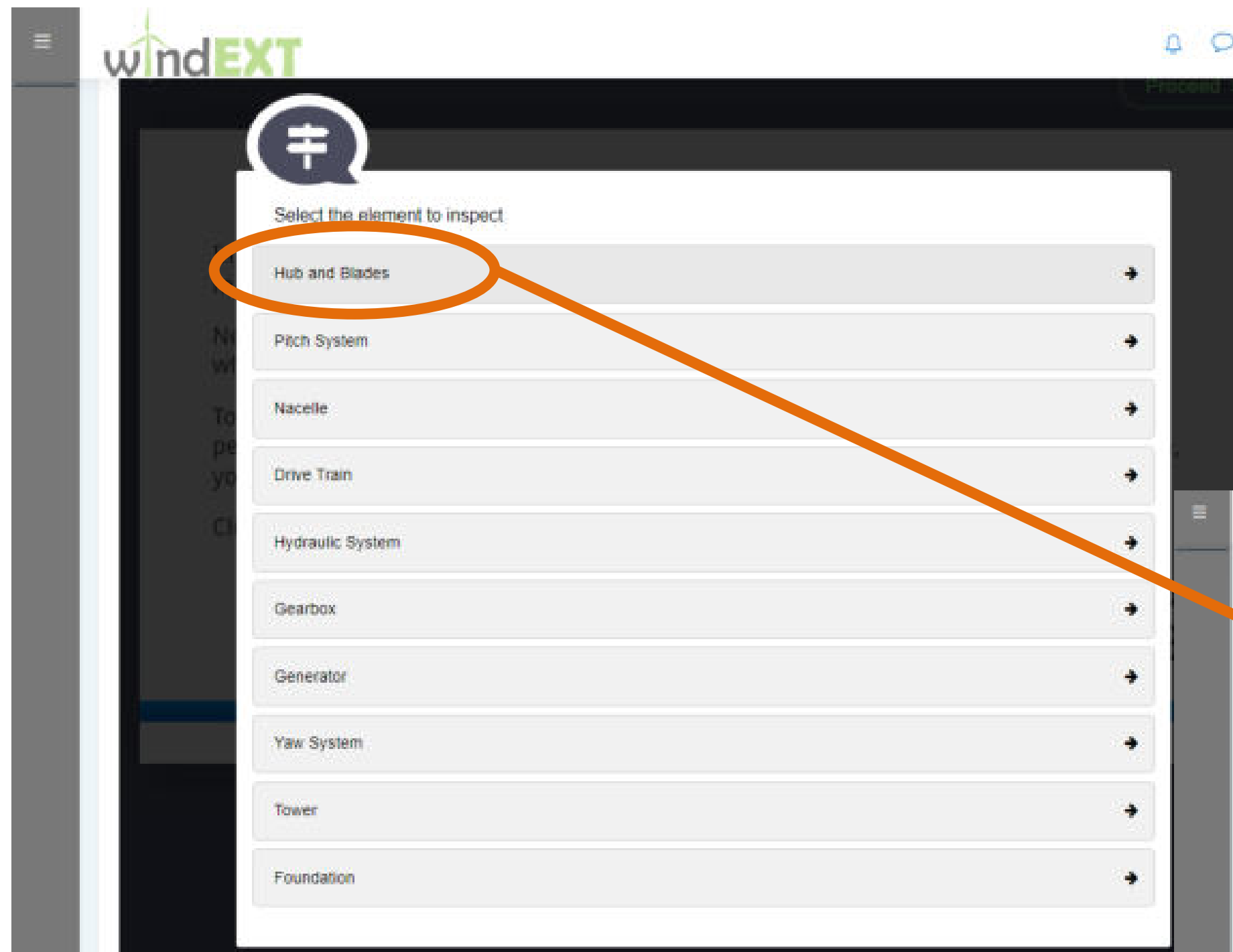


Table of contents

1	Introduction.....	5
2	Corrective Maintenance.....	6
3	Repairing the Hub and Blades.....	7
3.1	Basic fundamentals of repairing the hub and blades.....	7
3.1.1	Sanitizing.....	7
3.1.2	Gluing.....	7
3.1.3	Chamfering.....	7
3.1.4	Laminating.....	7
3.1.5	Finishing.....	8
3.2	Blades.....	8
3.2.1	Superficial faults on the blade.....	9
3.2.2	Structural faults on the blade.....	11
4	Replacing the Hub and Blades.....	18
4.1	Complete rotor.....	18
4.2	Blades.....	19
5	Repairing and replacing the Pitch System.....	21
5.1	Pitch bearings.....	22
5.2	Hydraulic pitch system.....	22
5.3	Replacement Pitch Motor Bearing Procedure.....	24
6	Repairing the Nacelle.....	38
6.1	Bedplate joints.....	38
7	Replacing the Drive Train.....	42
7.1	Main bearing and shaft.....	42
7.2	High-speed shaft.....	44
7.3	High-Speed Shaft Replacement.....	45
8	Repairing the Hydraulic System.....	52
8.1	Leaks.....	52
8.1.1	Leak as a drop.....	52
8.1.2	Leak as a stream.....	53
8.2	Accumulator.....	53
8.3	Solenoid valve.....	54
8.4	Hydraulic system pump.....	54

8.5	Rotary joint.....	54
8.6	Guidance system.....	56
8.7	Heat exchanger.....	56
9	Repairing the Gearbox.....	57
10	Replacing the Gearbox.....	60
11	Replacing the Fan Motor and Radiator of an Oil/Air Cooler from a Gearbox.....	61
12	Repairing the Generator.....	63
13	Replacing the Generator.....	65
13.1	Generator Bearing Replacement Procedure.....	66
14	Generator Slip Ring Brush Replacement Procedure.....	72
15	Repairing the Yaw System.....	75
15.1	Reducer motor.....	75
15.2	Replacing the brakes or jaws.....	75
15.3	Replacement of brushing slipping pads.....	76
15.4	Repairing the jaw tooth.....	76
15.5	Substitution of orientation bearings.....	78
16	Repairing the Tower.....	79
17	Repairing the Foundations.....	81
17.1	Mechanical reinforcement.....	81
17.2	Resin injection.....	82
18	Other Components.....	83
18.1	Electric Components.....	83
18.1.1	Measuring instruments.....	83
18.1.2	Security equipment.....	83
18.1.3	Motors and fans.....	84
18.1.4	Repairing the Transformer.....	84
18.1.5	Replacing the Transformer.....	84
18.1.6	Top cabinet.....	85
18.2	Platforms, baskets and ropes.....	86
18.3	Big components. Logistics.....	87
18.3.1	Payment of an annual fee.....	87
18.3.2	Combined model of exchanges and repairs.....	87
18.4	Documentation. Reports.....	88
18.4.1	Reports.....	88
18.4.2	Corrective reports.....	88

18.4.3	Big corrective reports.....	89
18.4.4	Workshop reports.....	90
18.4.5	Accident reports.....	90
19	Typical breakages and diagnosis.....	91
20	Practical case.....	95
20.1	Steps to perform.....	95
20.2	Description of the operation.....	95
20.3	Estimated terms.....	96
20.4	Tools and equipment.....	97



GUIDED DIGITAL-TOOL









Repairing the nacelle

The nacelle is part of the wind turbine structure, and it is responsible for protecting all the components of the generator. Therefore, in the case of repairing or replacing one of the internal elements of the nacelle, it is necessary to open a gate located at the top of the nacelle.





 Repairing the nacelle

1 / 8 ▶

 Reuse
  Embed





 Crack inside the nacelle

The first step to take when a crack is found inside the nacelle is to determine its importance and identify it.

In this case, it is necessary to reinforce the joints of the interior of the structure to avoid deeper cracks that are difficult to repair and develop a safety weld procedure.



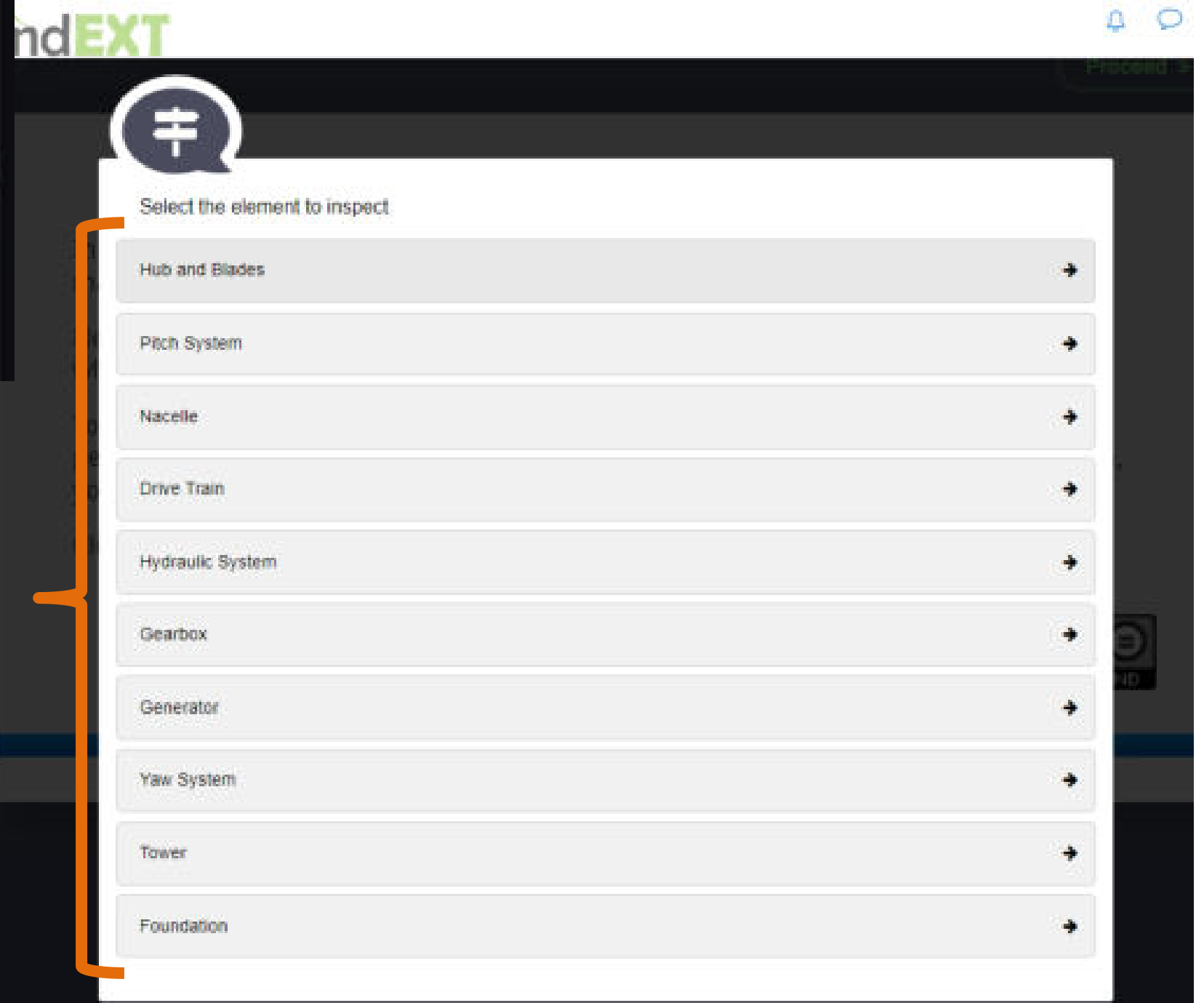
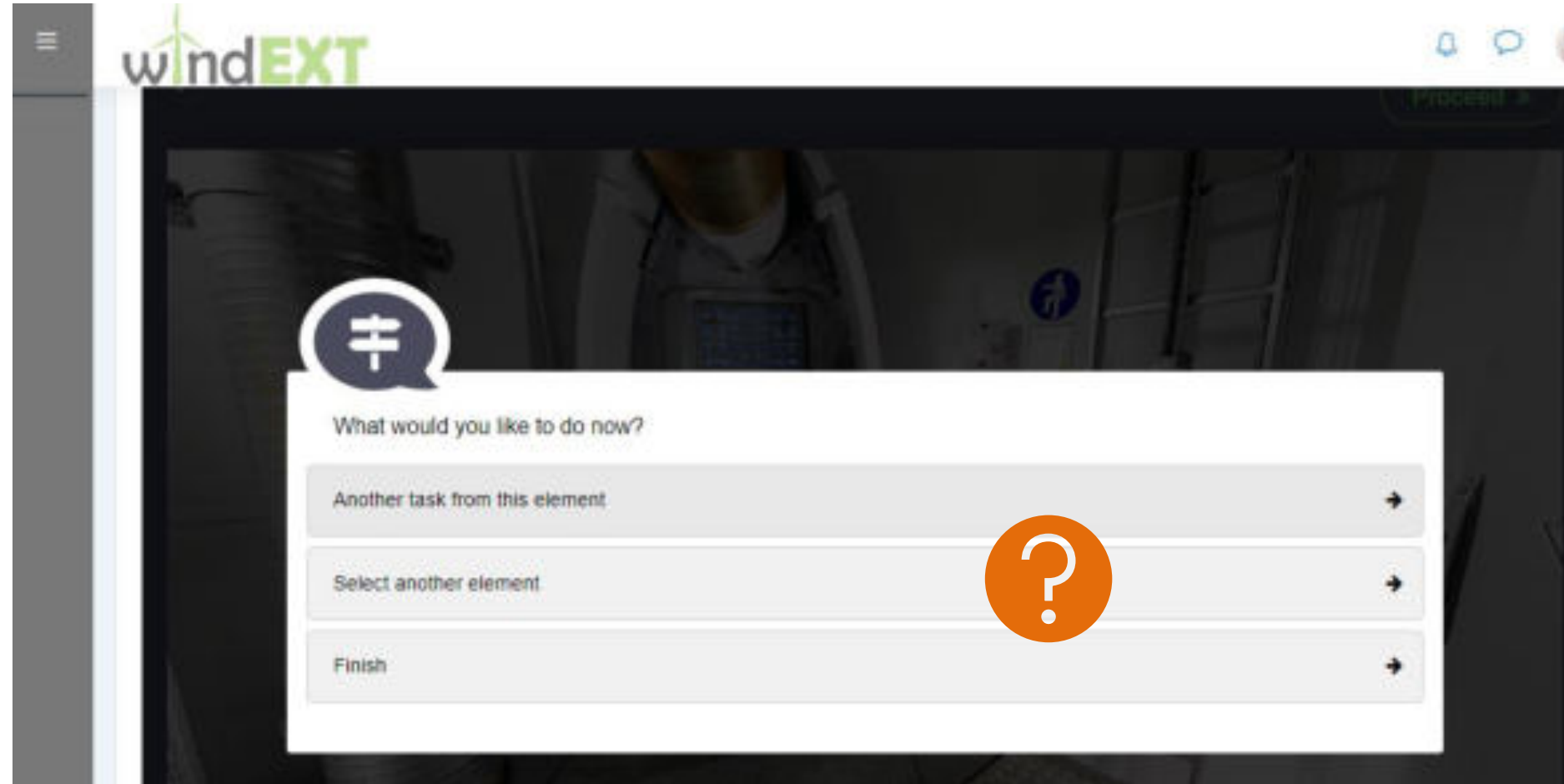


 Crack inside the nacelle

◀ 3 / 8 ▶

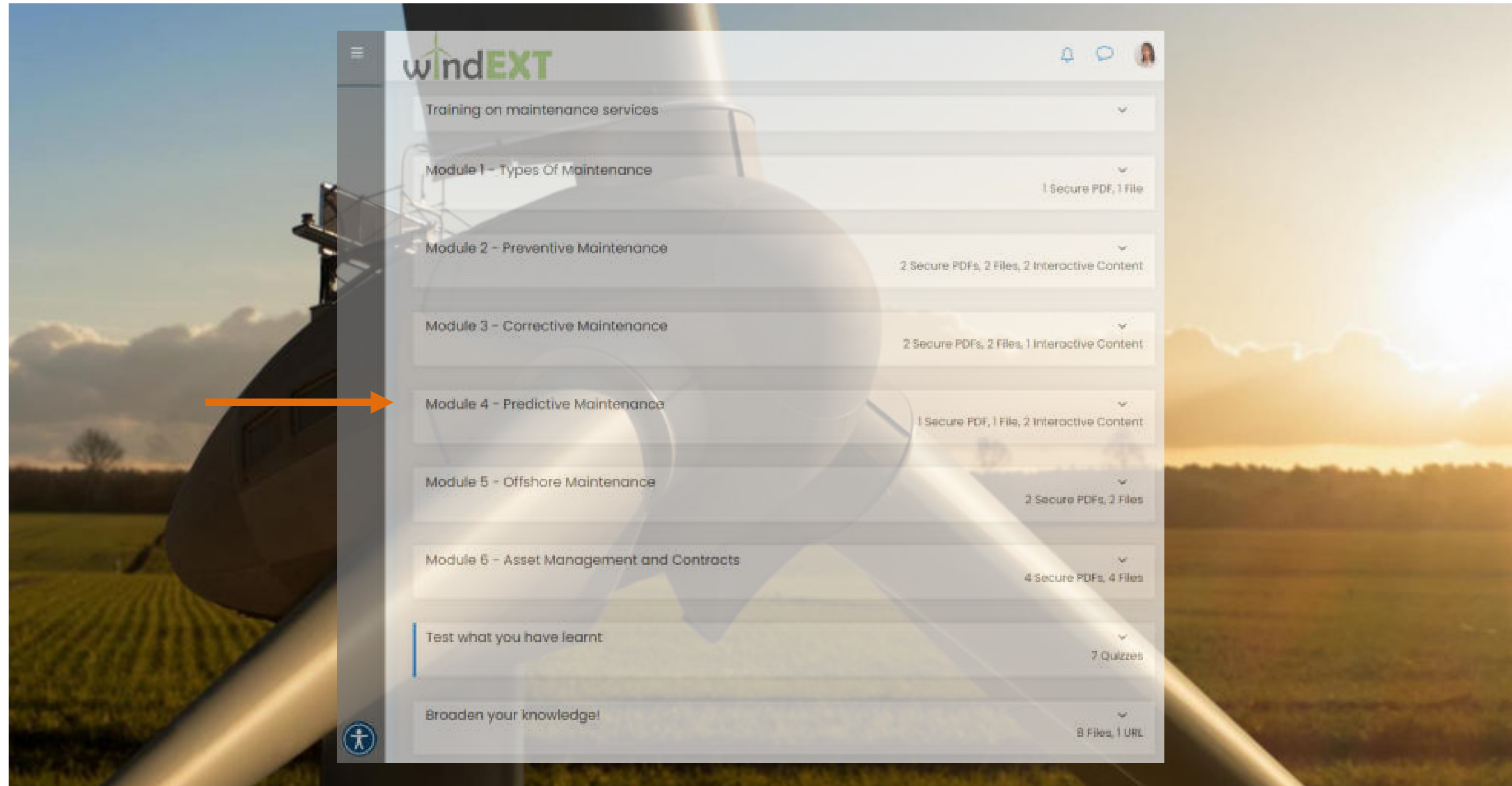
 Reuse
  Embed

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SECTION CONTENTS



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Training on maintenance services	
Module 1 - Types Of Maintenance	1 Secure PDF, 1 File
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Broaden your knowledge!	8 Files, 1 URL









Module 4 - Predictive Maintenance

1 Secure PDF, 1 File, 2 Interactive Content

READ IT!

Read the following eDocs and articles related to this module:

 PREDICTIVE MAINTENANCE - Handbook

 PREDICTIVE MAINTENANCE - Handbook

Hidden from students

APPLY IT!

After reading the material please complete the following simulator activities:

 PREDICTIVE MAINTENANCE - Guided Digital Tool

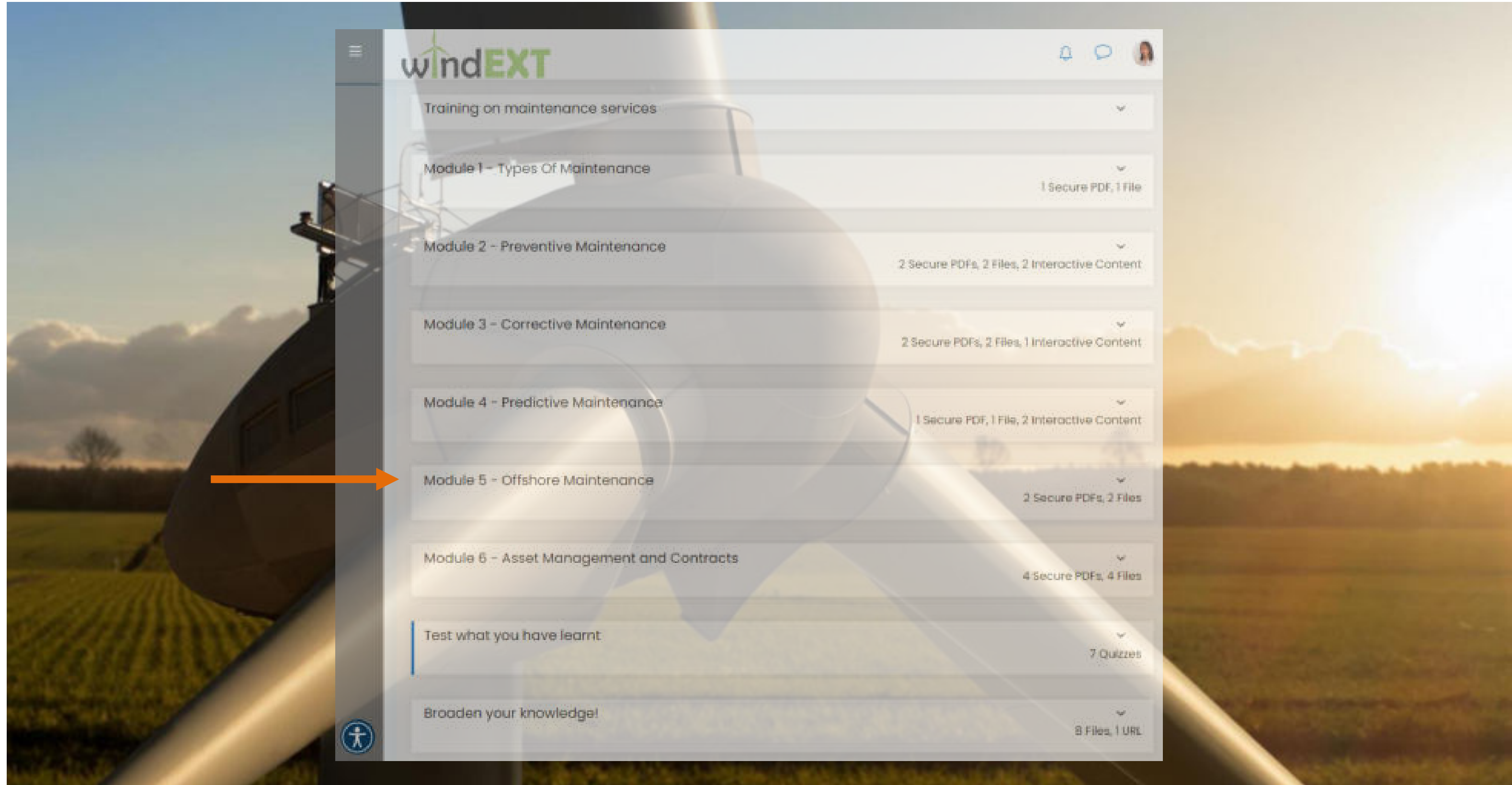
 PREDICTIVE MAINTENANCE - Move-around Digital Tool



1	Introduction.....	3
2	Predictive Maintenance	4
3	Condition Monitoring of Drive Train	9
3.1	Oil	9
3.2	Vibration	10
3.3	SCADA	12
3.4	Current Signature Analysis	14
3.5	Acoustic Emission	16
3.6	Torque	16
3.7	Thermography	17
3.8	Shock Pulse	17
4	Health Monitoring of Structural Parts	18
4.1	Vibration	18
4.2	Strain	18
4.3	Ultrasonic techniques	18
4.4	Radiography	18
4.5	Acoustic Emission	19
4.6	Thermography	19
5	Monitoring Electric and Electronic Components	20
5.1	Performance Monitoring (or Process Parameter)	20
5.2	Thermography	20
6	Case studies	21



SECTION CONTENTS



The screenshot displays the WindEXT training interface. The menu is as follows:

Section	Content
Training on maintenance services	
Module 1 - Types Of Maintenance	1 Secure PDF, 1 File
Module 2 - Preventive Maintenance	2 Secure PDFs, 2 Files, 2 Interactive Content
Module 3 - Corrective Maintenance	2 Secure PDFs, 2 Files, 1 Interactive Content
Module 4 - Predictive Maintenance	1 Secure PDF, 1 File, 2 Interactive Content
Module 5 - Offshore Maintenance	2 Secure PDFs, 2 Files
Module 6 - Asset Management and Contracts	4 Secure PDFs, 4 Files
Test what you have learnt	7 Quizzes
Broaden your knowledge!	8 Files, 1 URL







Module 5 - Offshore Maintenance

2 Secure PDFs, 2 Files

READ IT!

Read the following documentation related to this module:

 OFFSHORE MAINTENANCE - General requirements

 OFFSHORE MAINTENANCE - Foundations

 OFFSHORE MAINTENANCE - General requirements

 OFFSHORE MAINTENANCE - Foundations

Hidden from students

Hidden from students










Module 6 - Asset Management and Contracts

4 Secure PDFs, 4 Files

READ IT!

Read the following documentation related to this module:

-  ASSET MANAGEMENT AND CONTRACTS - general information
-  EXAMPLE - BOP contract
-  EXAMPLE - O&M contract
-  EXAMPLE - Offshore O&M contract
-  ASSET MANAGEMENT AND CONTRACTS - General Information
-  Hidden from students
-  EXAMPLE - BOP Contract
-  Hidden from students
-  EXAMPLE - O&M Contract
-  Hidden from students
-  EXAMPLE - OFFSHORE O&M Contract
-  Hidden from students



Test what you have learnt

7 Quizzes

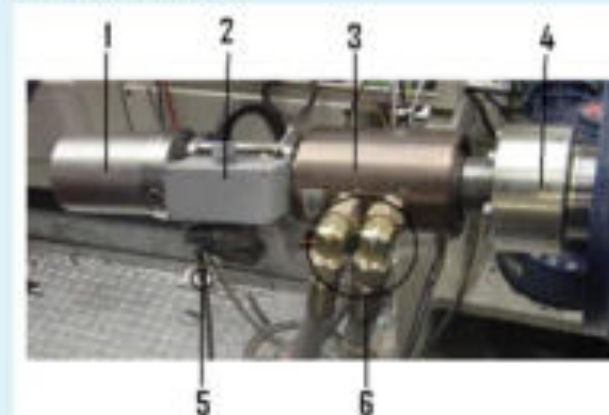
-  PREVENTIVE MAINTENANCE - I
-  PREVENTIVE MAINTENANCE - II
-  PREVENTIVE MAINTENANCE - III
-  PREVENTIVE MAINTENANCE - IV
-  PREVENTIVE MAINTENANCE - V
-  PREVENTIVE MAINTENANCE - VI
-  PREVENTIVE MAINTENANCE - VII

Section 2 : Maintenance

[Home](#) [Course Sections](#) [section 2 : maintenance](#) [Test what you have learnt](#) [PREVENTIVE MAINTENANCE - I](#) [Preview](#)

Question 8
Not yet answered
Marked out of 1.00
[Flag question](#)
[Like question](#)

What is the number 3?



Select one:

- ☐ a. Rotating joint adapter
- ☐ b. Hydraulic rotating joint
- ☐ c. Pressure and return hoses
- ☐ d. WA-78 cable

Quiz navigation

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15			

Finish attempt...

[Start a new preview](#)

Evaluation

EVALUATION
Windext Pilot test
Windext form

[Previous page](#)

[Next page](#)







Broaden your knowledge!

8 Files, 1 URL

Who can access a wind turbine? ☒

 GWO: Wind Limited Access Standard ☒

This standard describes the requirements for Wind Limited Access that are recommended by the members of the Global Wind Organization (GWO).

It covers the minimum knowledge required for visiting an onshore and offshore WTG safely, including transfer to offshore wind turbines. Applying this standard does not provide the training necessary to enter energised assets or carry out work in an onshore or offshore environment, but merely to visit, inspect and observe when supervised by at least two experienced GWO BST trained persons.

☒

Preventive Maintenance - Additional Information ☒

 POWER CONVERTER ☒

 SEMINAR OF LUBRICATION ☒

☒

Offshore Maintenance - Additional Information ☒

 OFFSHORE FOUNDATION ☒

 Impact of Robotics ☒

 Autonomous Ship Project ☒

 Risks to Project Development ☒

 International Comparative Analysis ☒

 Substructure Monitoring and Inspection ☒



THANK YOU!

ERASMUS+ PROJECT

windEXT

ADVANCED MAINTENANCE, LIFETIME EXTENSION & REPOWERING OF WIND FARMS
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