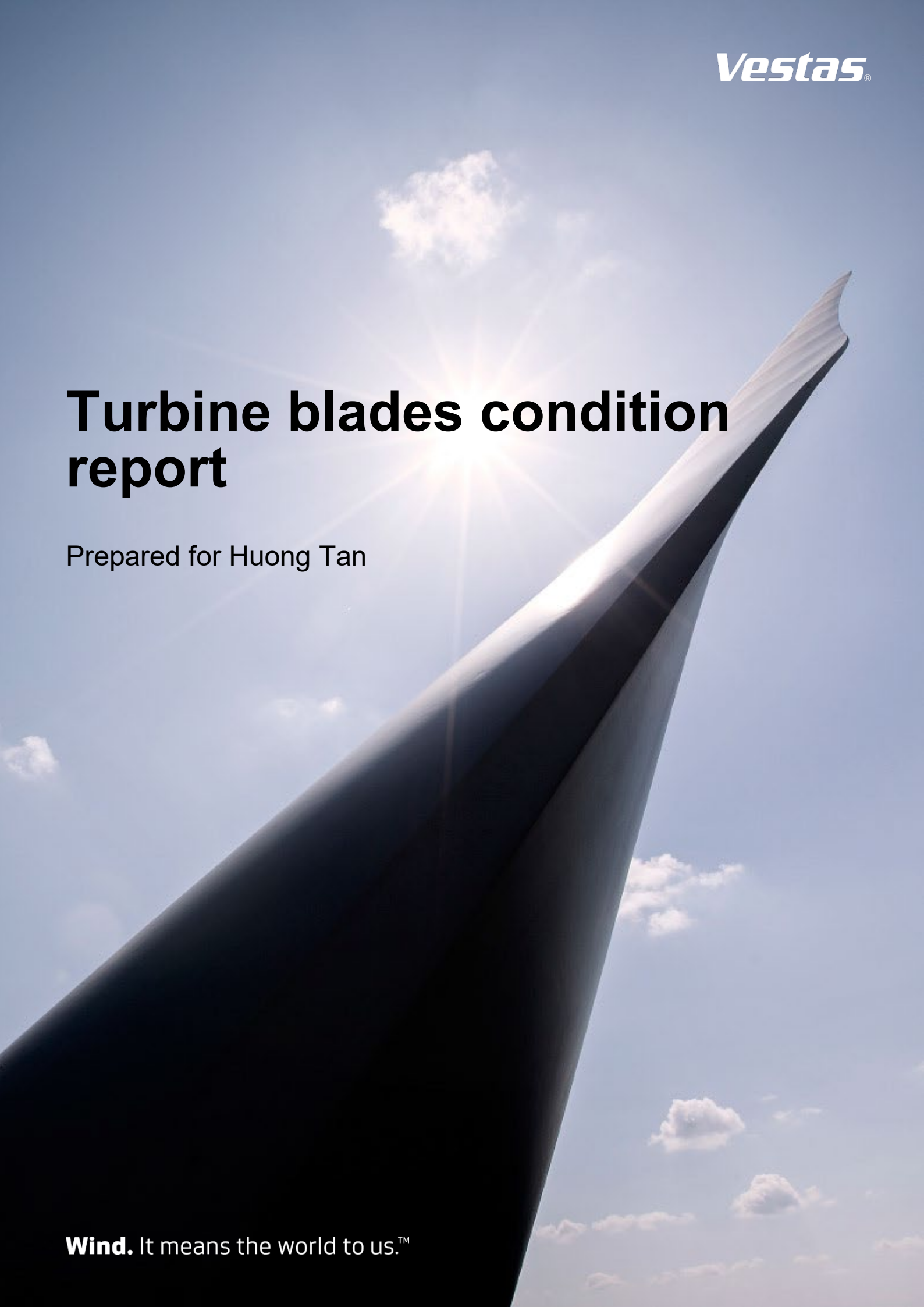

Turbine blades condition report

Prepared for Huong Tan

Wind. It means the world to us.™

Table of Content

Key Site Inspection Metrics for Huong Tan Wind Farm

- 11 Turbines inspected
- 33 blades inspected
- 6 days to inspect by drone
- 23 blades have category 3 damage
- 6 blades have category 4 damage
- 0 blades have category 5 damage

1 Executive summary

This report has been created to summarise current Blade conditions on the Wind Turbine Blades at Huong Tan Farm, the inspections were undertaken in August 2024. In total 11 turbines (33 blades) were inspected and the results are contained within this report.

The method of inspection was unmanned aerial vehicle (drone) to execute quality images in the fastest time possible. The inspection was conducted by SSL technicians. Photos were then reviewed for the compitation of this report by a Vestas Blade Technician.

The categories for inspecting turbine blades fall into five issue type classification categories:

Category	Finding Description	Recommended Action
1	**Cosmetic**	No action necessary Monitor at next inspection
2	**Minor** No impact on functional integrity of the blade	
3	**Functional** Minor impact to the functional integrity of the blade	Repair within 12 months and monitor according to timeline defined by Vestas engineering team
4	**Serious** Impact on the functional or structural integrity of the blade, but not threatening safe operation	Repair within 6 months and monitor according to timeline defined by Vestas engineering team
5	**Critical** Structural integrity of the blade is severely compromised, may lead to catastrophic failure	Immediate intervention required. WTG to remain in pause until approved to return to operation

This is a summary of blades inspected on Huong Tan Wind Farm site fall into the following categories:

CAT 3 - 23 blades in category 3.

CAT 4 - 6 blades in category 4.

CAT 5 - 0 blades in category 5.

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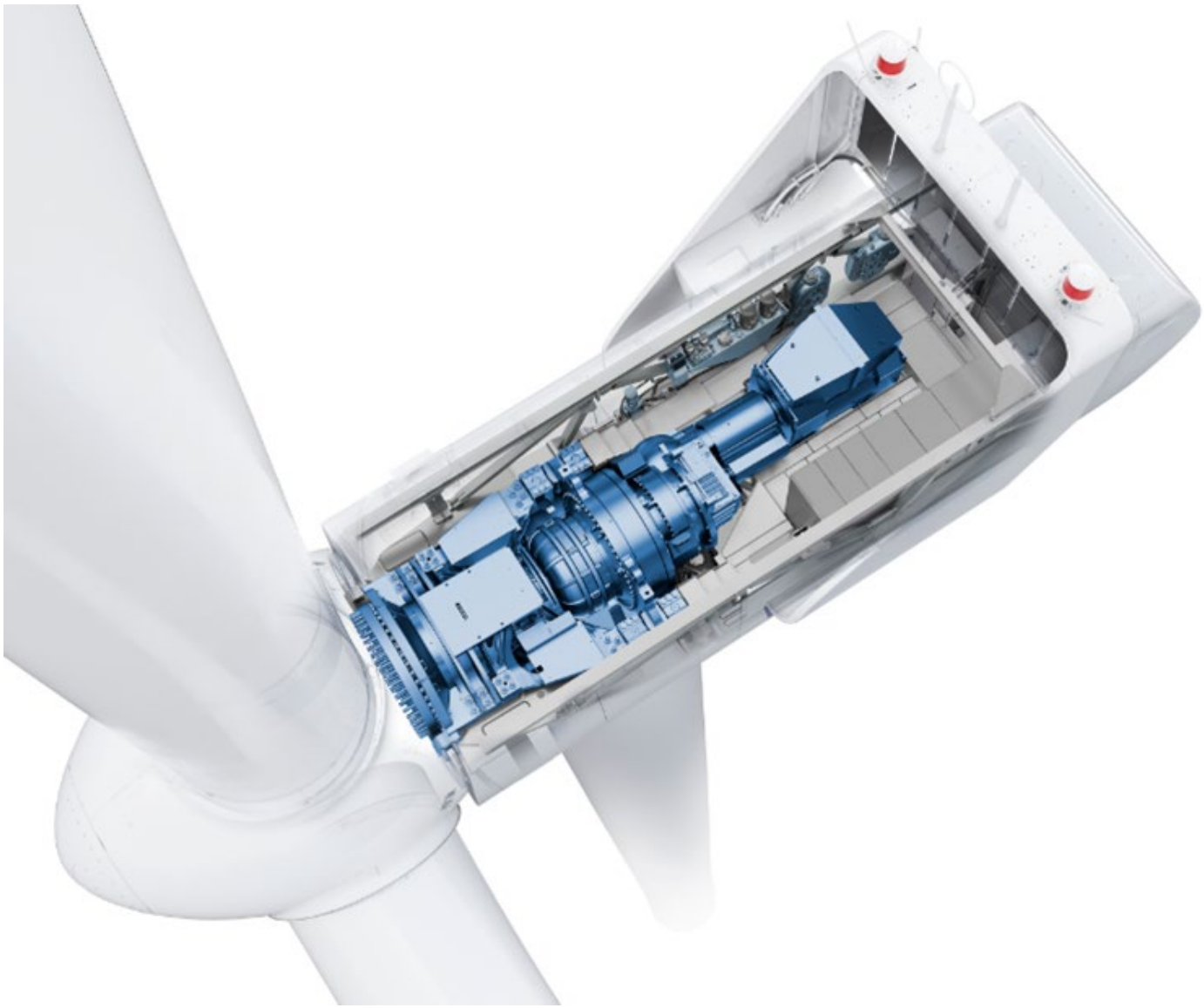


2 Site summary

Huong Tan Wind Farms consists of 11 x V150 4.2MW turbines in Hương Hóa that is contributing strongly to Vietnam’s renewable energy future.

Huong Tan Wind Farms is a 46-megawatt development in Hương Hóa, Quảng Trị, Vietnam.

3 Inspections

Vestas conducts blade inspections to deliver blade condition information and with prior customer agreement if outside contract scope, execute repairs while they are small and relatively inexpensive to fix. The inspection output if any damage is detected is a Blade Inspection Report (BIR) and any BIR's will be attachments listed in chapter 7.

3.1 Inspection scope

Inspection of Vestas V150 turbine #HT01 through turbine #HT11 to determine the structural integrity of the Blades remains in good working order. The use of UAV Drones to carry out inspections allows for an efficient method of gaining high quality images of the blade, with the ability to focus on specific areas of interest.

Inspection tool

3.2 Inspection details

Vestas was trying to identify all issues including any small issues that could be rectified quickly and inexpensively and any major issues that could cause energy production loss or potentially expensive and or expansive repairs.

3.3 Inspection methods

Vestas utilise a four-stage method utilising ground based and UAV photography to create a CIR that is investigated, compared and analysed to become a Blade Inspection Report (BIR). At Huong Tan farm, UAV were utilised for speed and accuracy.

3.4 Inspection historical data

Vestas stores all historical data on blade failures/repairs on a cloud based platform in the form of the CIR database.

3.5 Customer access to historical data

Vestas customers can request images or previous reports of their inspected turbines on Vestas Online under Blade Asset Management.

4 Inspection results

Vestas blade technicians create a component inspection report (CIR) that logs any blade issues. The CIR is the site based data that first highlights any blade issues or condition. Dedicated Vestas blade engineers review all CIR's and create BIR's to overlay expert recommendations.

4.1 Results at Site

This site has 11 turbines that were inspected, with each turbine having 3 blades.

The table in Appendix 1 details the summary information of the condition of all three blades on each turbine inspected.

4.2 Summary of Inspection Results

The following summarises overall blade conditions observed during the inspection.

- Structurally the blades are in good condition with 24 x CAT 3 and 6 x CAT 4 damage found.
- Minor CAT 1 and 2 damages such as contamination, scratches, minor erosion and smt- paint peel off also observed on the blades.

5 Recommendations

Vestas recommends finalising any remaining recommended repairs and repeating the blade inspections in approximately 12 - 24 months to ensure good blade condition is maintained for remaining life of wind farm.

Category 3 damages should be repaired within 12 months, Blade with category 4 damages should be repaired within 6 months and turbines with category 5 damaged should be paused until repairs are undertaken.

Appendix 1: Inspection Results

Category	Finding Description	Recommended Action
1	**Cosmetic**	No action necessary Monitor at next inspection
2	**Minor** No impact on functional integrity of the blade	
3	**Functional** Minor impact to the functional integrity of the blade	Repair within 12 months and monitor according to timeline defined by Vestas engineering team
4	**Serious** Impact on the functional or structural integrity of the blade, but not threatening safe operation	Repair within 6 months and monitor according to timeline defined by Vestas engineering team
5	**Critical** Structural integrity of the blade is severely compromised, may lead to catastrophic failure	Immediate intervention required. WTG to remain in pause until approved to return to operation

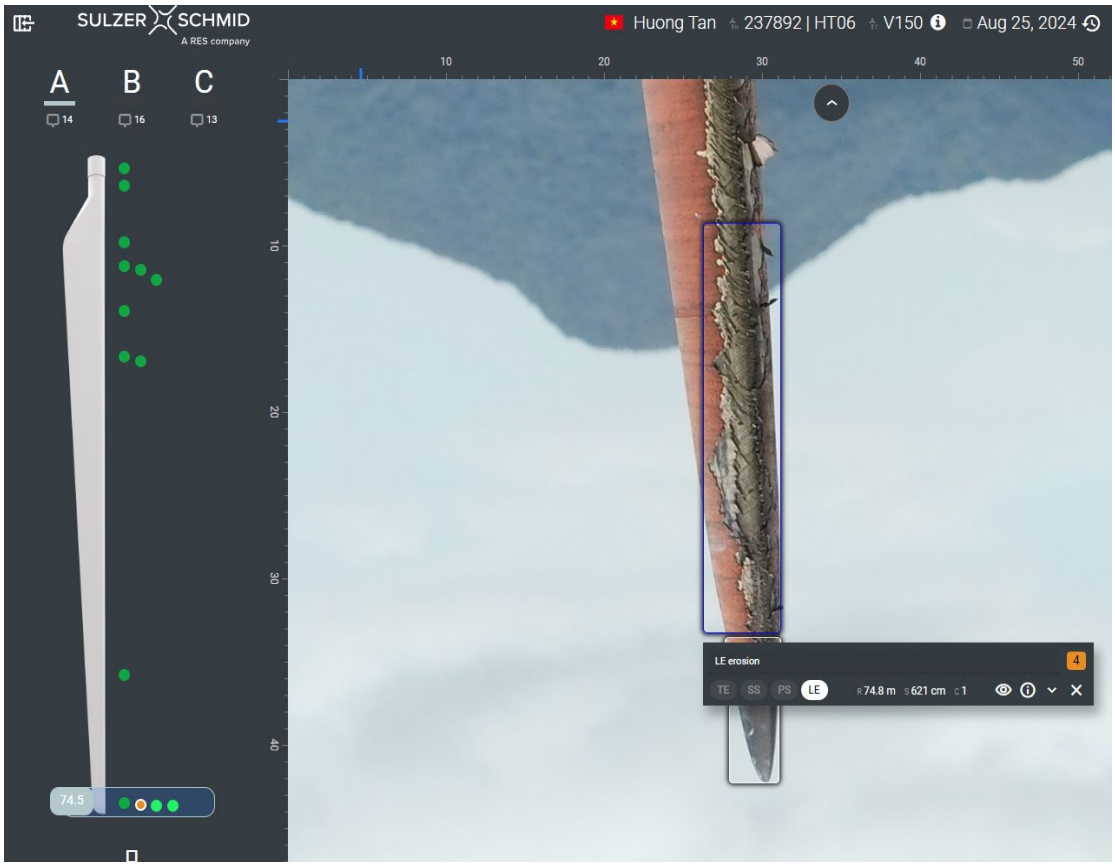
KEY	
SMT	SOLID METAL TIP
L/E	LEADING EDGE
T/E	TRAILING EDGE
L/W	LEEWARD (LOW PRESSURE) SIDE
W/W	WINDWARD (HIGH PRESSURE) SIDE
VG	VORTEX GENERATOR
LPS	LIGHTNING PROTECTION SYSTEM
SPL	SURFACE PROTECTION LAYER

Wind Park	Turbine	Blade index	Blade serial	Severity	Annotation type	Radius, final [m]	Engineering Comments
Huong Tan	237892 | HT06	A	29101070HAWEE253274	4	Blade | LE erosion	74.91	CAT-4\ LE Erosion
Huong Tan	237892 | HT06	B	29101070HAWEE253275	4	Blade | LE erosion	74.94	CAT-4\ LE Erosion
Huong Tan	237892 | HT06	C	29101070HAWEE253276	4	Blade | LE erosion	74.98	CAT-4\ LE Erosion
Huong Tan	237896 | HT03	A	29101070WHAEE253271	4	Blade | LE erosion	75.10	CAT-4\ LE Erosion
Huong Tan	237897 | HT05	A	29101070WHAEE253277	4	Blade | LE erosion	74.93	CAT-4\ LE Erosion
Huong Tan	237897 | HT05	B	29101070WHAEE253278	4	Blade | LE erosion	74.82	CAT-4\ LE Erosion
Huong Tan	237893 | HT08	A	29101070WHAEE253265	3	Blade | LE erosion	74.85	CAT-3\LE Erosion \Borderline to CAT4
Huong Tan	237893 | HT08	B	29101070WHAEE253266	3	Blade | LE erosion	74.92	CAT-3\LE Erosion \Borderline to CAT4
Huong Tan	237893 | HT08	C	29101070WHAEE253267	3	Blade | LPS Damage | Copper Cap / SMT-Lightning Attachment	70.77	CAT-3\ Lightning damage \Inform to CRM
Huong Tan	237893 | HT08	C	29101070WHAEE253267	3	Blade | LE erosion	74.91	CAT-3\LE Erosion \Borderline to CAT4
Huong Tan	237894 | HT11	A	29101070WHAEE253268	3	Blade | LE erosion	74.94	CAT-3\LE Erosion \Borderline to CAT4
Huong Tan	237894 | HT11	B	29101070WHAEE253269	3	Blade | LE erosion	75.04	CAT-3\LE Erosion
Huong Tan	237894 | HT11	C	29101070WHAEE253270	3	Blade | LE erosion	74.98	CAT-3\LE Erosion \Borderline to CAT4

Wind Park	Turbine	Blade index	Blade serial	Severity	Annotation type	Radius, final [m]	Engineering Comments
Huong Tan	237895 | HT09	A	29101070WHAEE253409	3	Blade | LE erosion	74.90	CAT-3\LE Erosion \Borderline to CAT4
Huong Tan	237895 | HT09	B	29101070WHAEE253410	3	Blade | LE erosion	74.85	CAT-3\LE Erosion
Huong Tan	237895 | HT09	C	29101070WHAEE253411	3	Blade | LE erosion	74.76	CAT-3\LE Erosion
Huong Tan	237896 | HT03	B	29101070WHAEE253272	3	Blade | LE erosion	75.00	CAT-3\LE Erosion \Borderline to CAT4
Huong Tan	237896 | HT03	C	29101070WHAEE253273	3	Blade | LE erosion	75.10	CAT-3\LE Erosion \Borderline to CAT4
Huong Tan	237897 | HT05	C	29101070WHAEE253279	3	Blade | LE erosion	74.91	CAT-3\LE Erosion \Borderline to CAT4
Huong Tan	237898 | HT04	A	29101070WHAEE253280	3	Blade | LE erosion	75.01	CAT-3\LE Erosion
Huong Tan	237898 | HT04	B	29101070WHAEE253281	3	Blade | LE erosion	74.99	CAT-3\LE Erosion
Huong Tan	237898 | HT04	C	29101070WHAEE253282	3	Blade | LE erosion	74.96	CAT-3\LE Erosion
Huong Tan	237899 | HT02	A	29101070WHYE256365	3	Blade | LE erosion	74.86	CAT-3\LE Erosion
Huong Tan	237899 | HT02	B	29101070WHYE256366	3	Blade | LE erosion	75.17	CAT-3\LE Erosion
Huong Tan	237899 | HT02	C	29101070WHYE256367	3	Blade | LE erosion	75.11	CAT-3\LE Erosion
Huong Tan	237900 | HT01	A	29101070WHAEE253286	3	Blade | LE erosion	75.00	CAT-3\LE Erosion
Huong Tan	237900 | HT01	C	29101070WHAEE253288	3	Blade | LE erosion	74.91	CAT-3\LE Erosion

Wind Park	Turbine	Blade index	Blade serial	Severity	Annotation type	Radius, final [m]	Engineering Comments
Huong Tan	237901 | HT07	A	29101070WHYE256368	3	Blade | LE erosion	74.94	CAT-3\LE Erosion
Huong Tan	237901 | HT07	B	29101070WHYE256369	3	Blade | LE erosion	74.90	CAT-3\LE Erosion
Huong Tan	237901 | HT07	C	29101070WHYE256370	3	Blade | LE erosion	74.89	CAT-3\LE Erosion \Borderline to CAT4
Huong Tan	237896 | HT03	A	29101070WHAEE253271	2	Blade | LPS Damage | SPL Mesh-Lightning Attachment	63.67	CAT-2 \Lightning damage\downgraded since defect stable and size of damage
Huong Tan	237902 | HT10	A	29101070WHYE256329	2	Blade | LPS Damage | SPL Mesh-Lightning Attachment	55.20	CAT-2\Lightning damage\downgraded since defect stable and size of damage

PICTURES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Huong Tan
237892 | HT06
V150
Aug 25, 2024
A
B
C
14
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13
74.5
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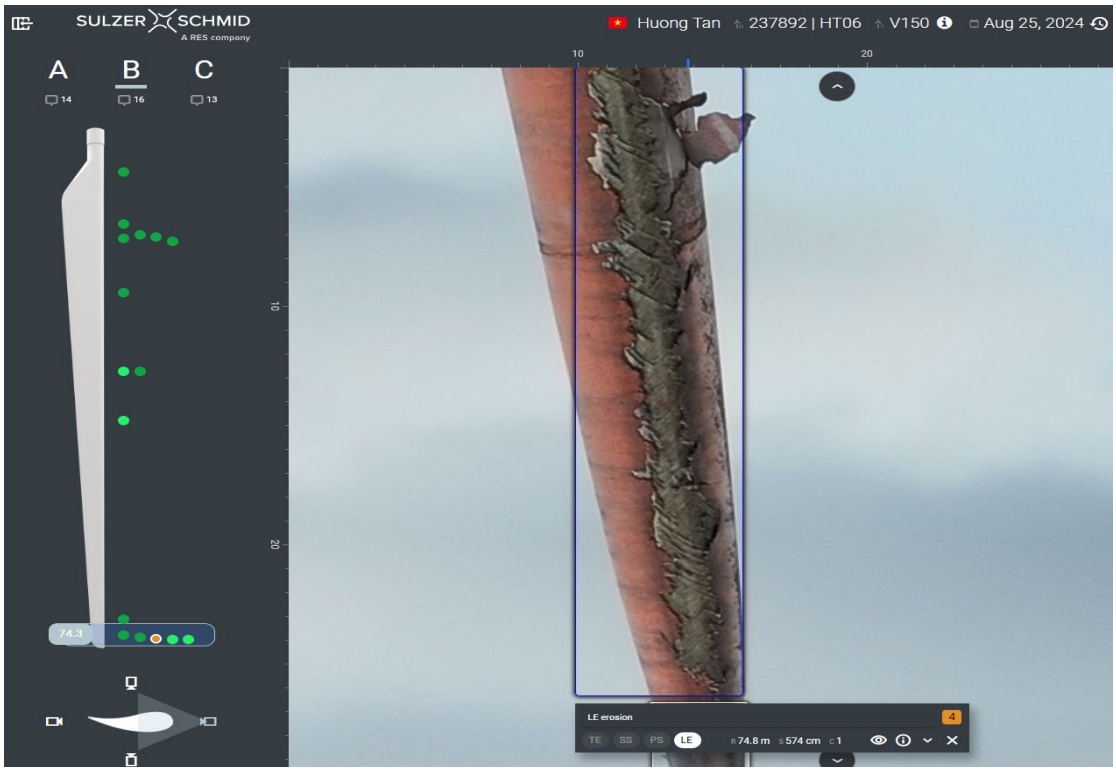
4
TE
SS
PS
LE
74.8 m
621 cm
1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V150
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A
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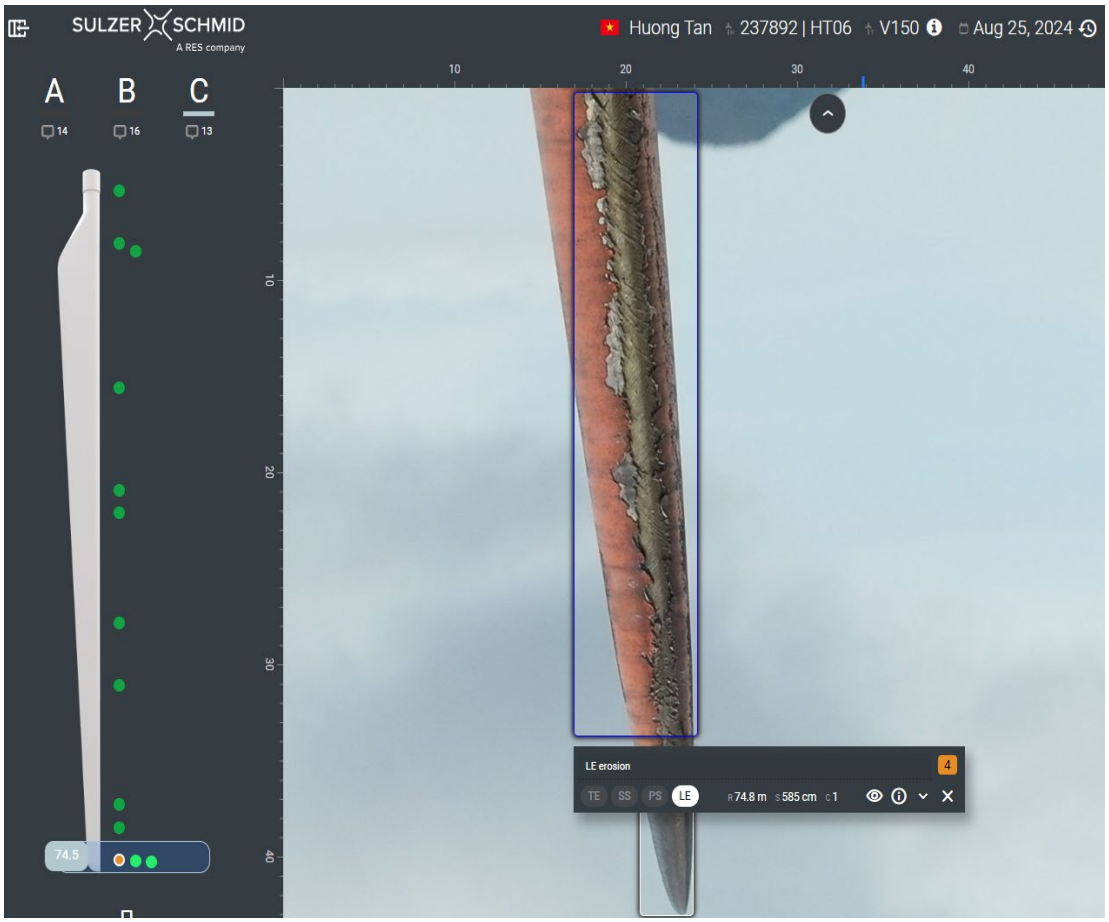
C
14
16
13
74.3
LE erosion
4
TE
SS
PS
LE
74.8 m
574 cm
1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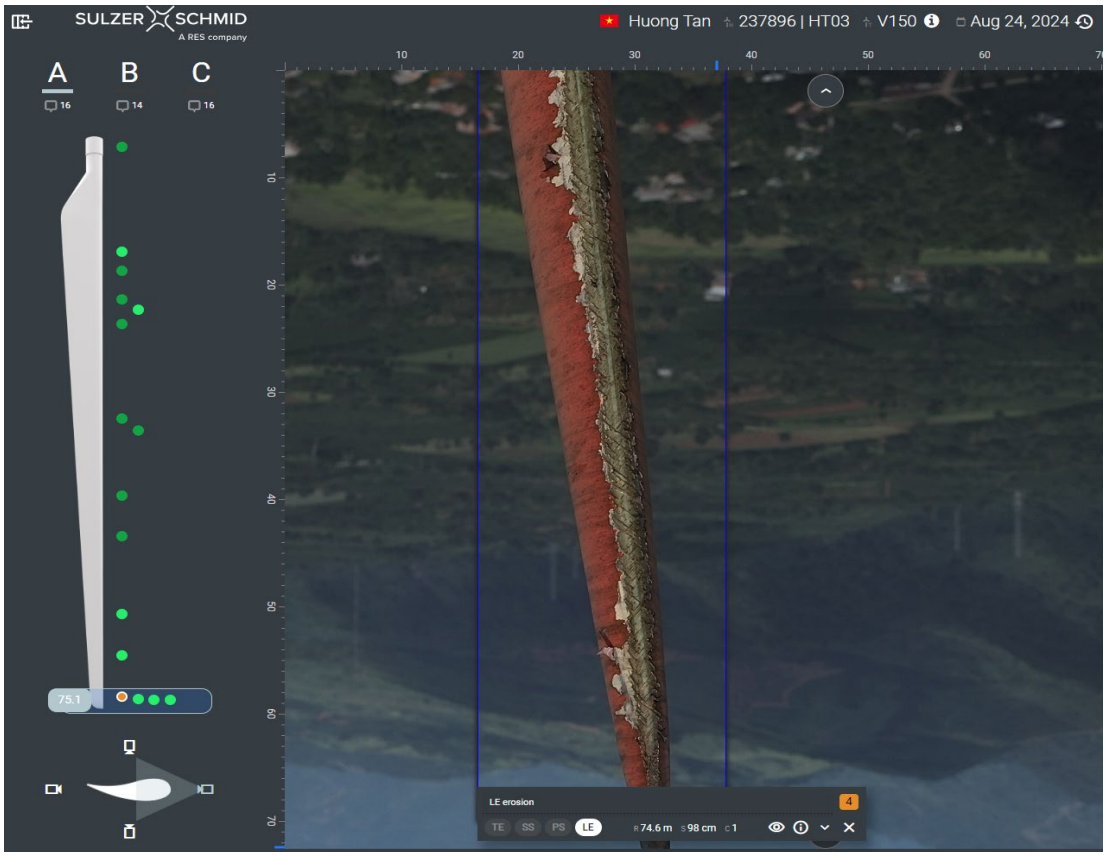
A
B
C
14
16
13
74.5
LE erosion
TE
SS
PS
LE
74.8 m
585 cm
1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V150
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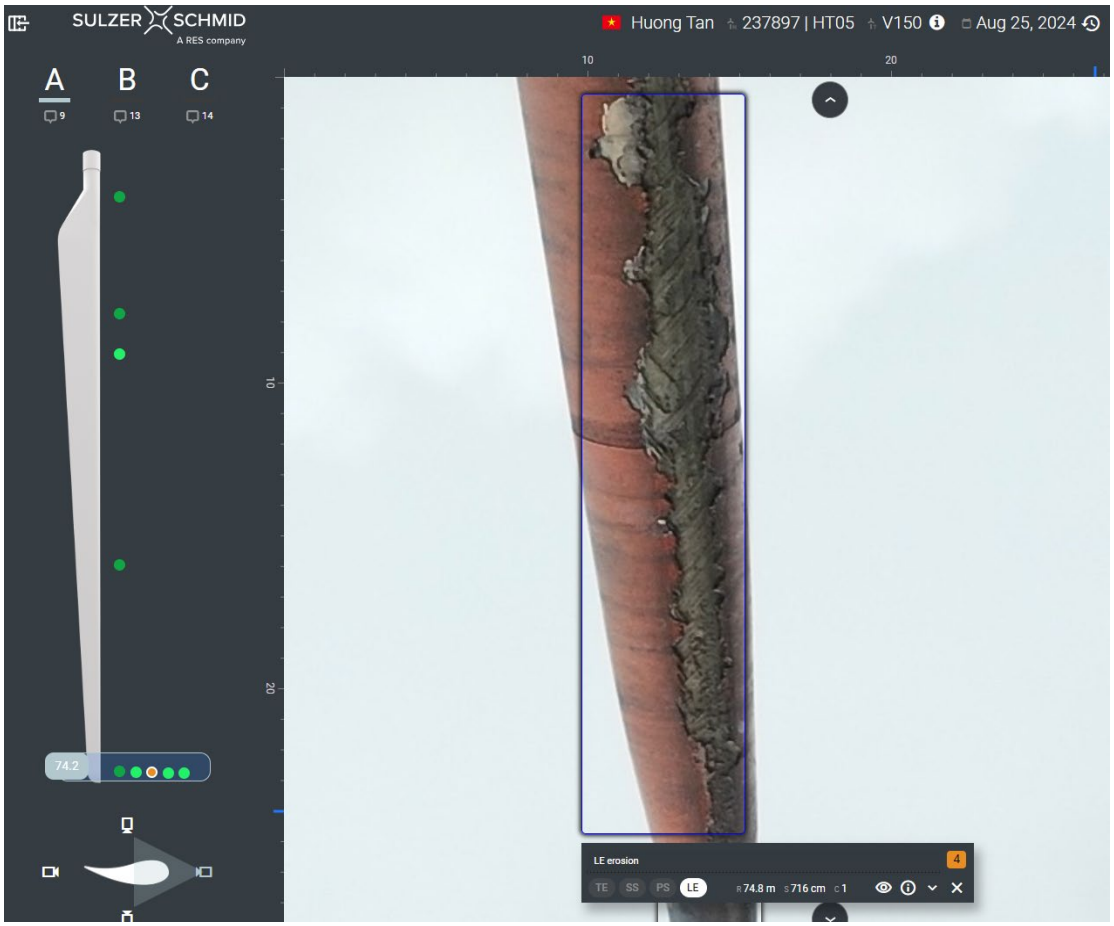
A
B
C
16
14
16
75.1
LE erosion
TE
SS
PS
LE
74.6 m
98 cm
1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237897 | HT05
V150
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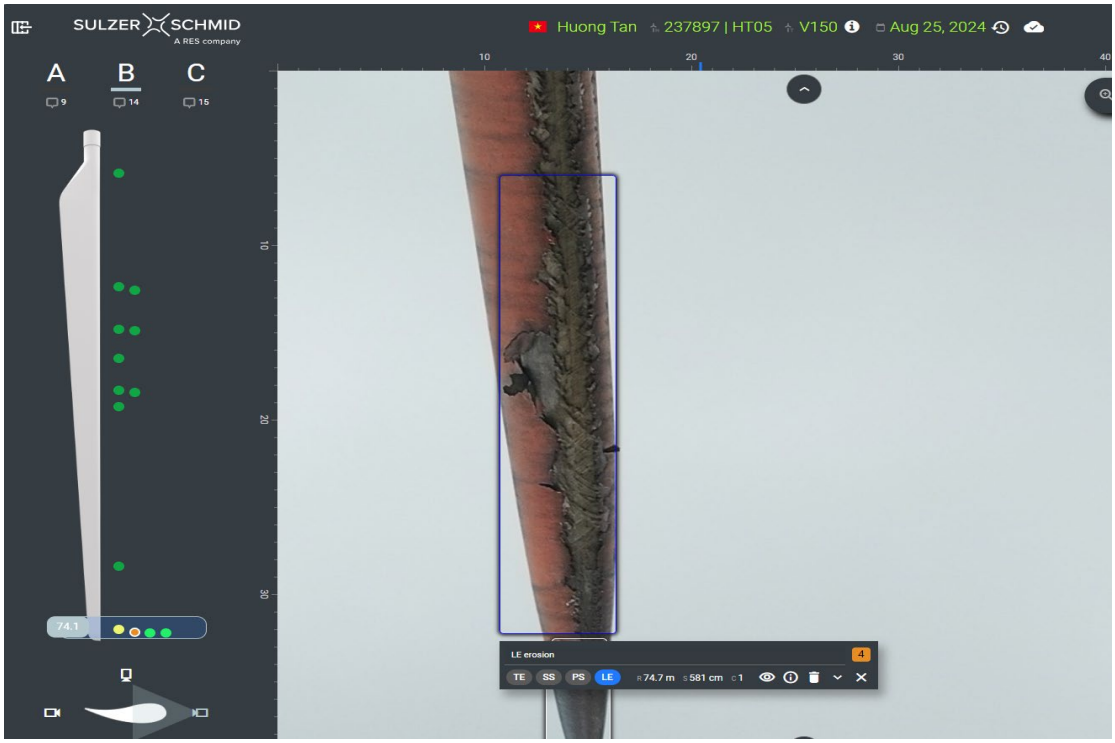
A
B
C
9
13
14
74.2
LE erosion
4
TE
SS
PS
LE
R 74.8 m
S 716 cm
C 1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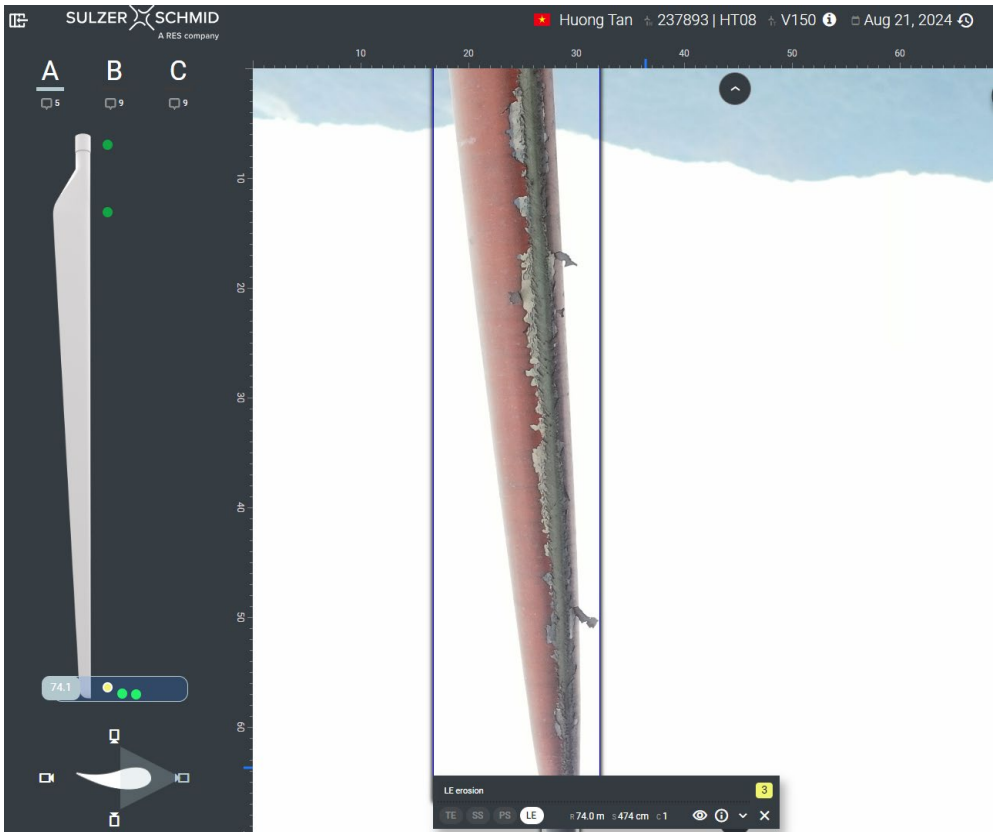
A
B
C
9
14
15
74.1
LE erosion
4
TE
SS
PS
LE
R 74.7 m
S 581 cm
C 1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V150
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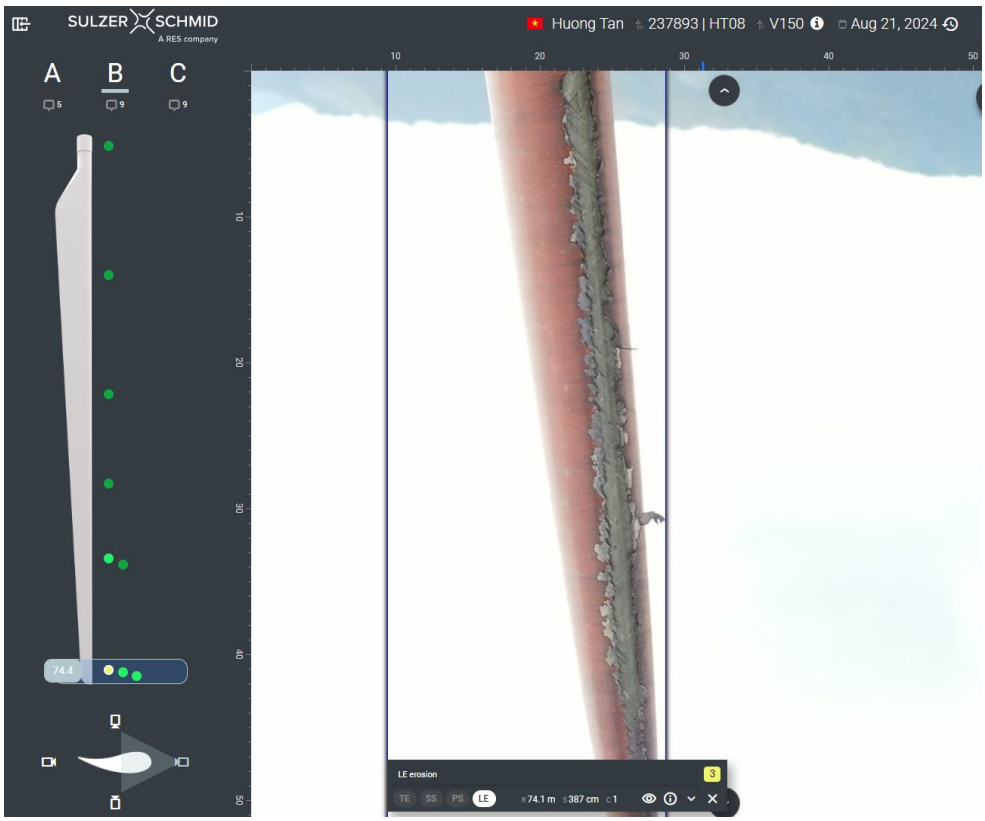
A
B
C
LE erosion
TE
SS
PS
LE
R 74.0 m
S 474 cm
C 1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Huong Tan
237893 | HT08
V150
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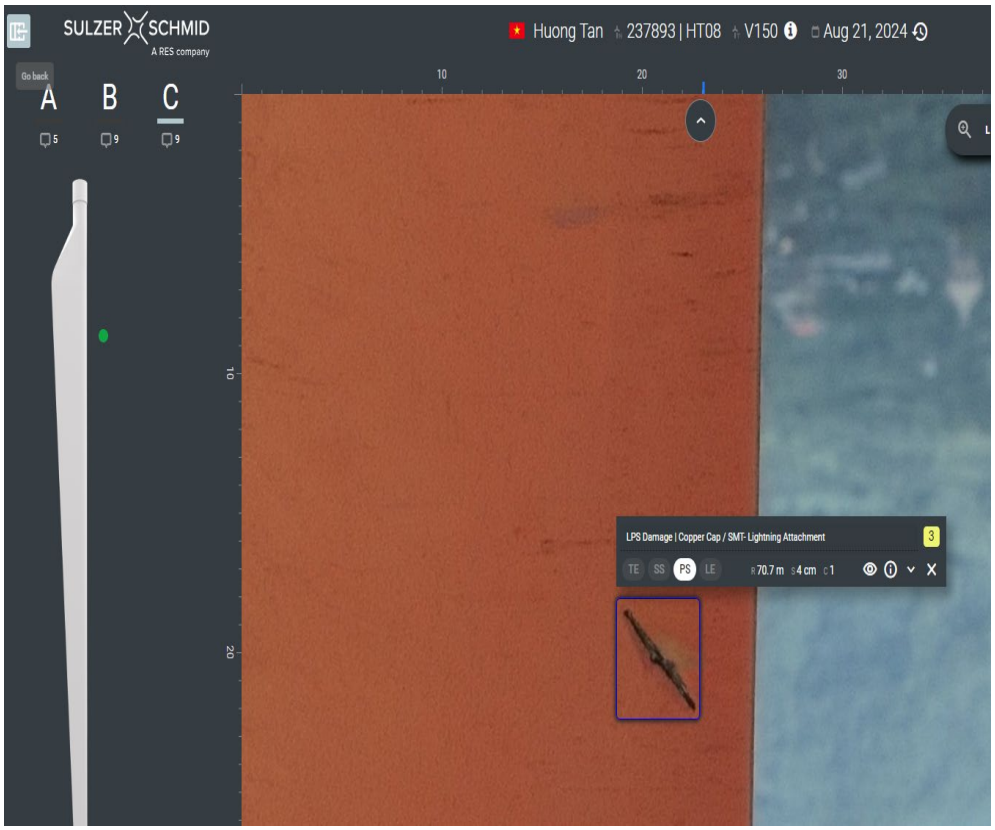
A
B
C
LE erosion
TE
SS
PS
LE
R 74.1 m
S 387 cm
C 1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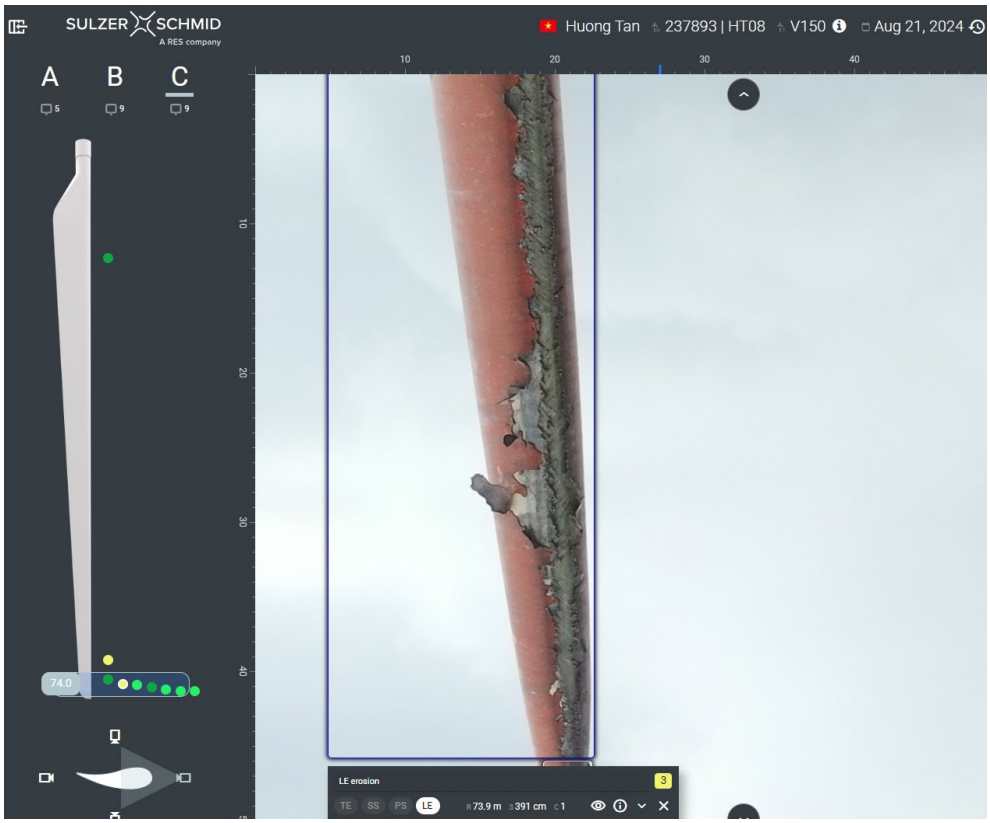
Huong Tan
237893 | HT08
V150
Aug 21, 2024
A
B
C
LPS Damage | Copper Cap / SMT- Lightning Attachment
3
TE
SS
PS
LE
R 70.7 m
S 4 cm
C 1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Huong Tan
237893 | HT08
V150
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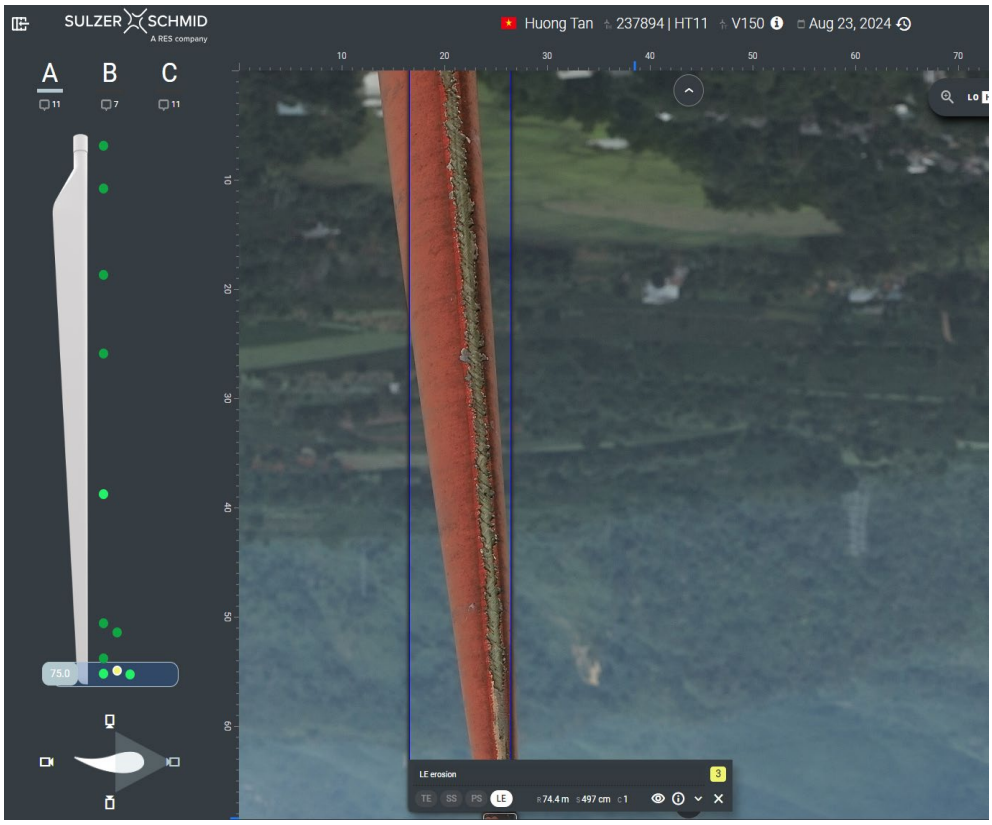
A
B
C
LE erosion
3
TE
SS
PS
LE
R 73.9 m
S 391 cm
C 1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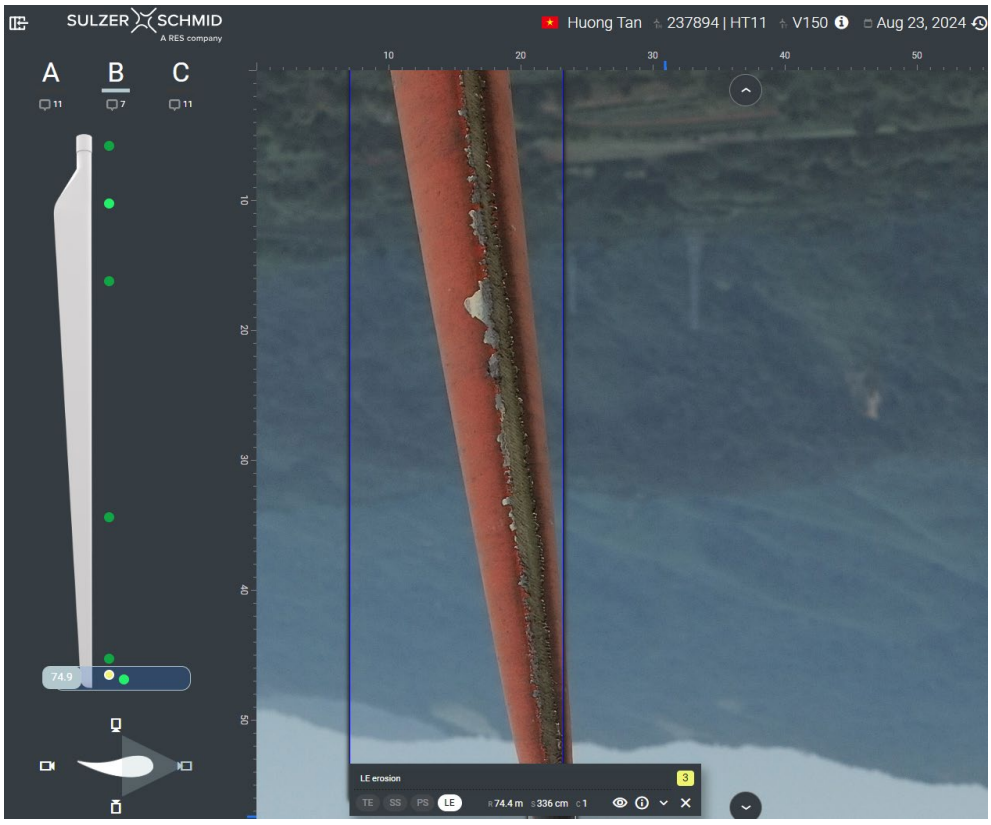
V150
Aug 23, 2024
A
B
C
LE erosion
TE
SS
PS
LE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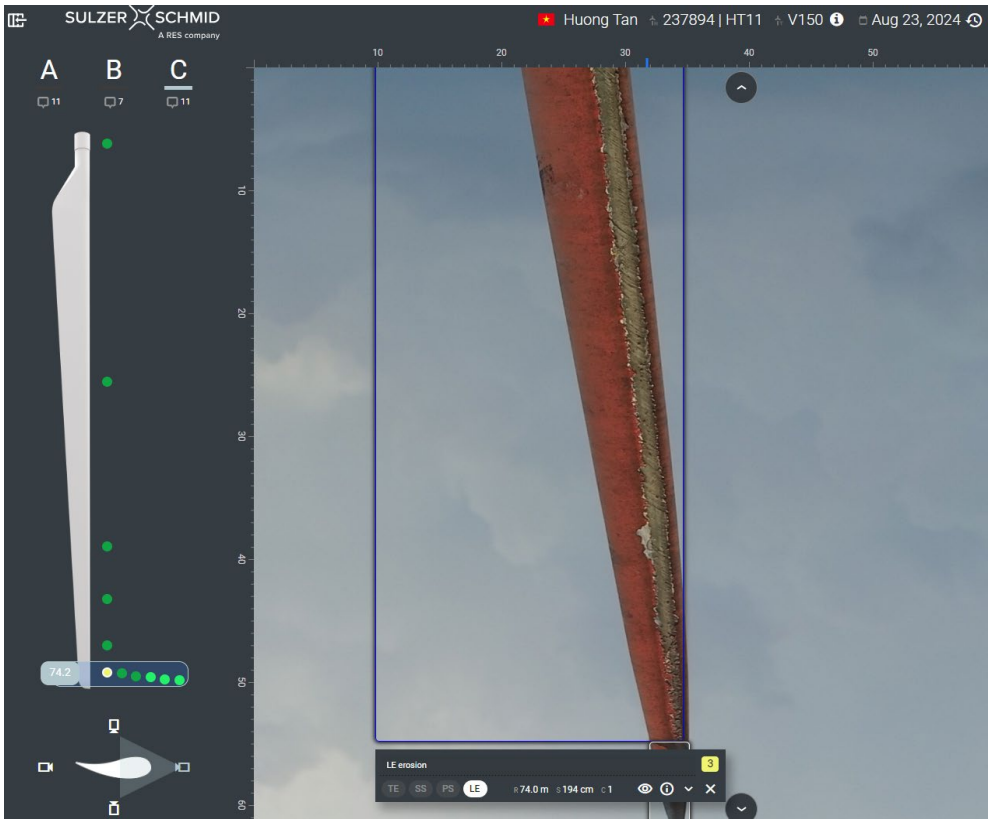
V150
Aug 23, 2024
A
B
C
LE erosion
TE
SS
PS
LE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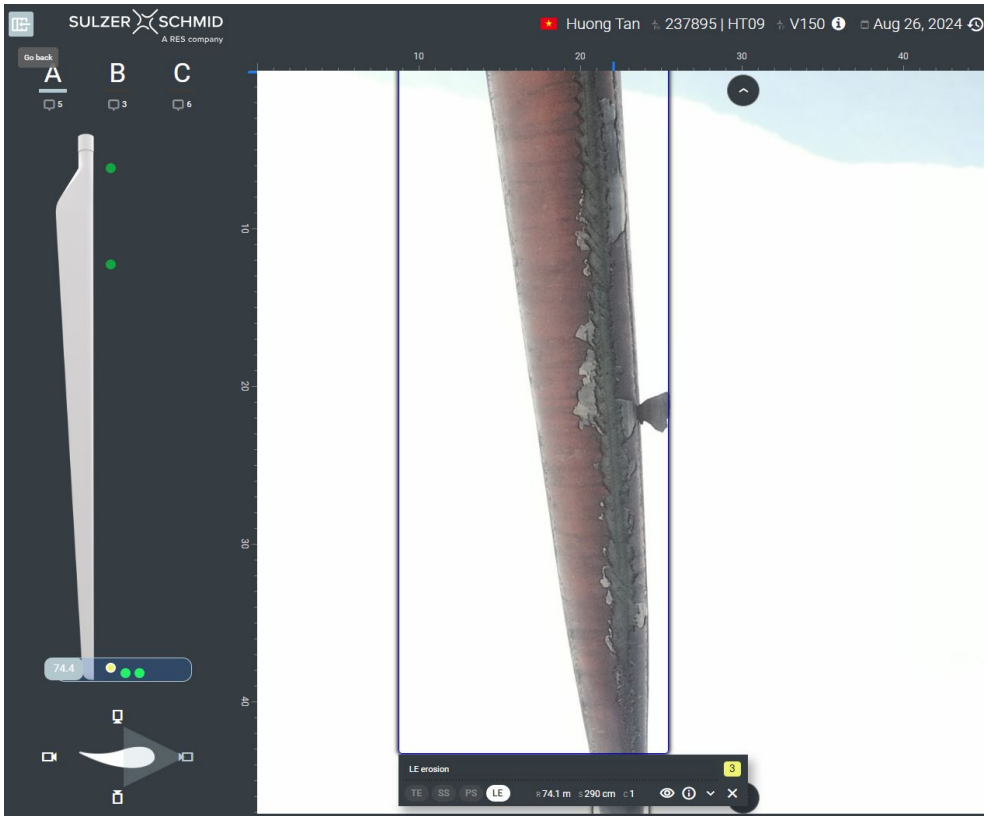
Huong Tan
237894 | HT11
V150
Aug 23, 2024
A
B
C
LE erosion
TE
SS
PS
LE
74.0 m
194 cm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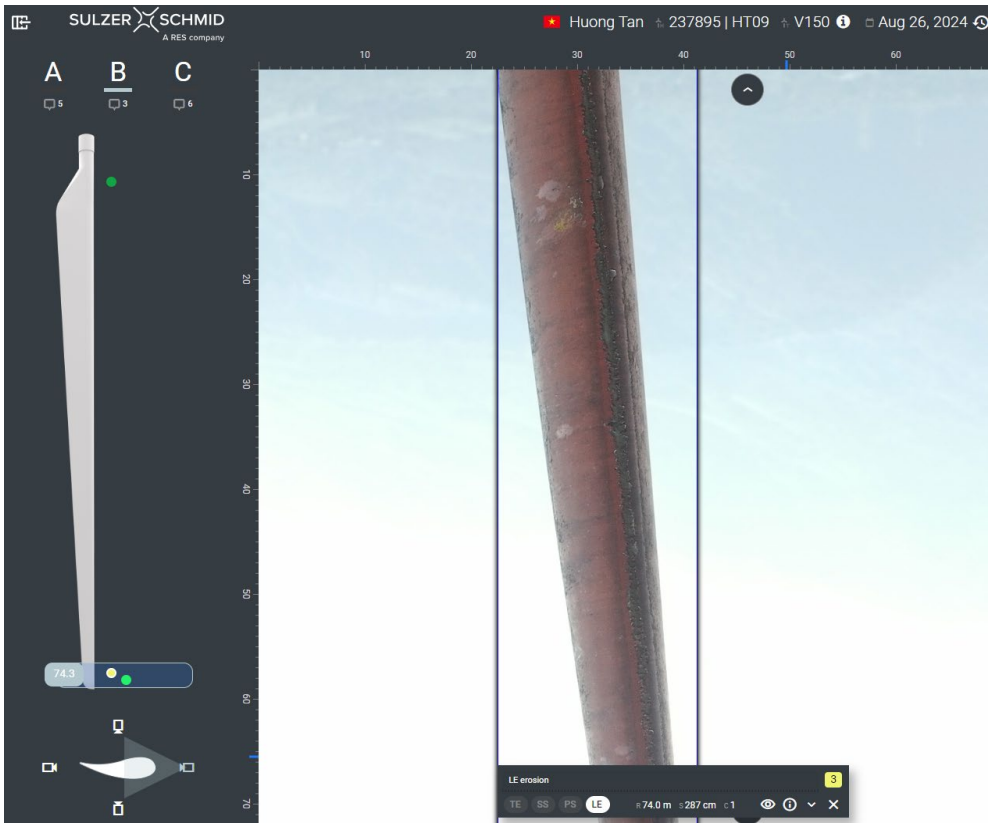
A RES company
Huong Tan
237895 | HT09
V150
Aug 26, 2024
Go back
A
B
C
LE erosion
TE
SS
PS
LE
74.1 m
290 cm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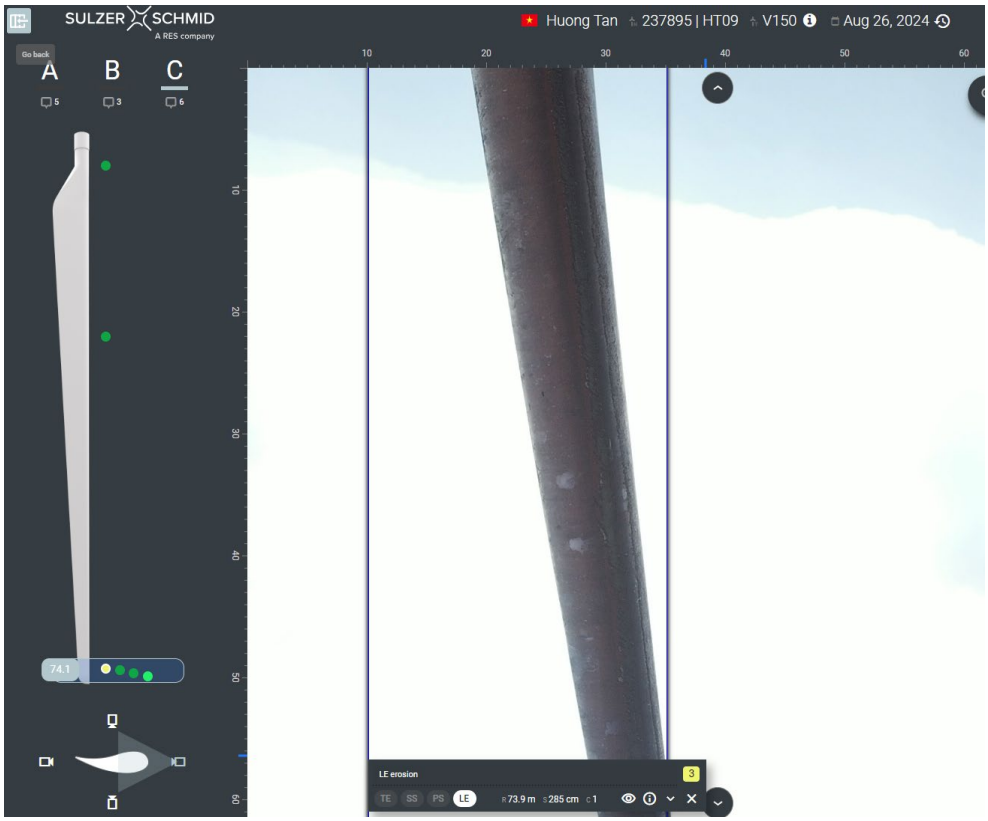
Huong Tan
237895 | HT09
V150
Aug 26, 2024
A
B
C
LE erosion
TE
SS
PS
LE
R 74.0 m
S 287 cm
C 1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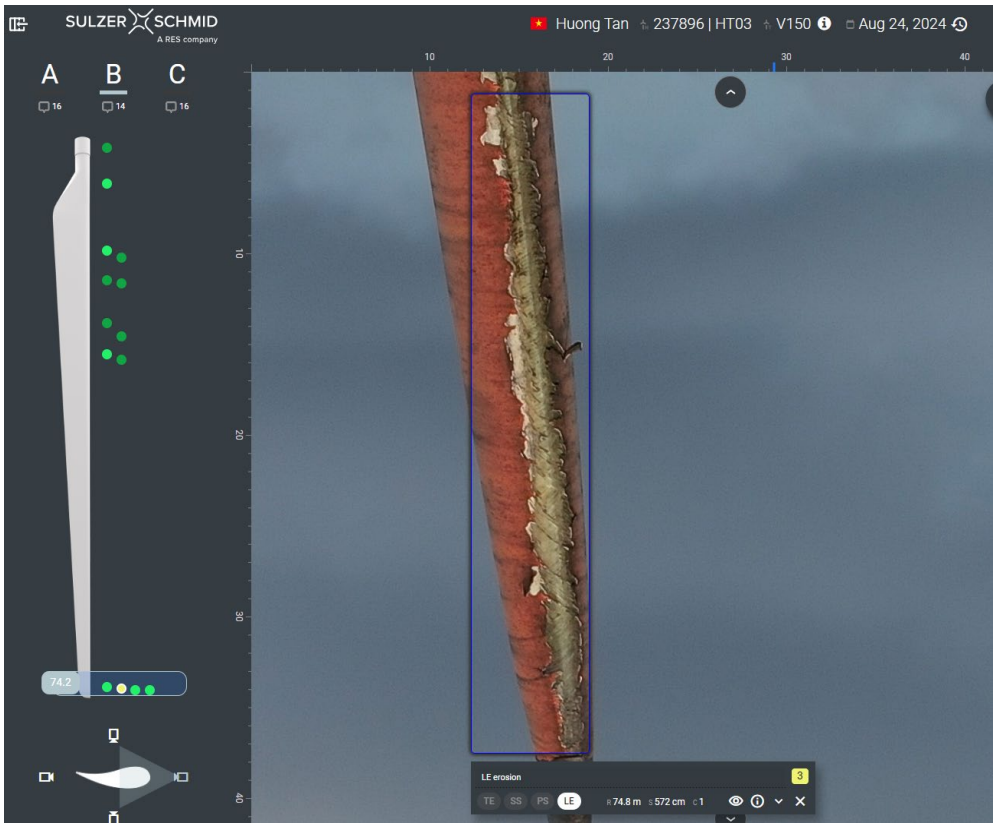
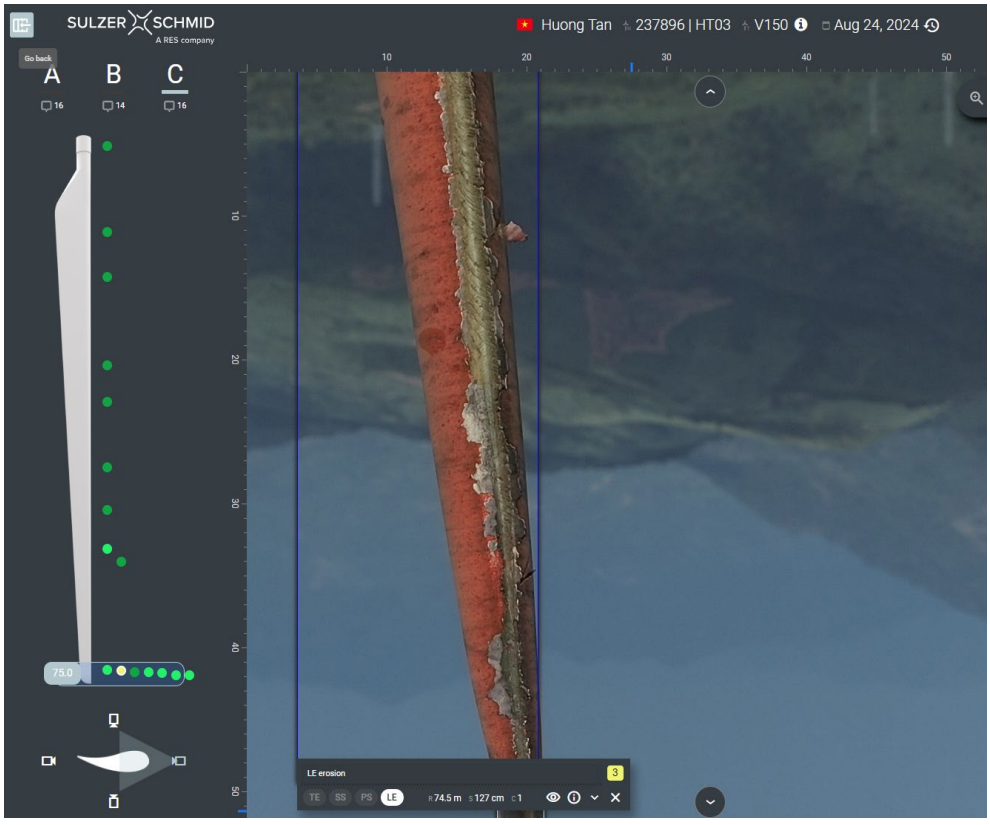
A RES company
Huong Tan
237895 | HT09
V150
Aug 26, 2024
A
B
C
LE erosion
TE
SS
PS
LE
R 73.9 m
S 285 cm
C 1


SULZER SCHMID
A RES company
Huong Tan
237896 | HT03
V150
Aug 24, 2024
A
B
C
16
14
16
74.2
LE erosion
3
TE
SS
PS
LE
74.8 m
572 cm
1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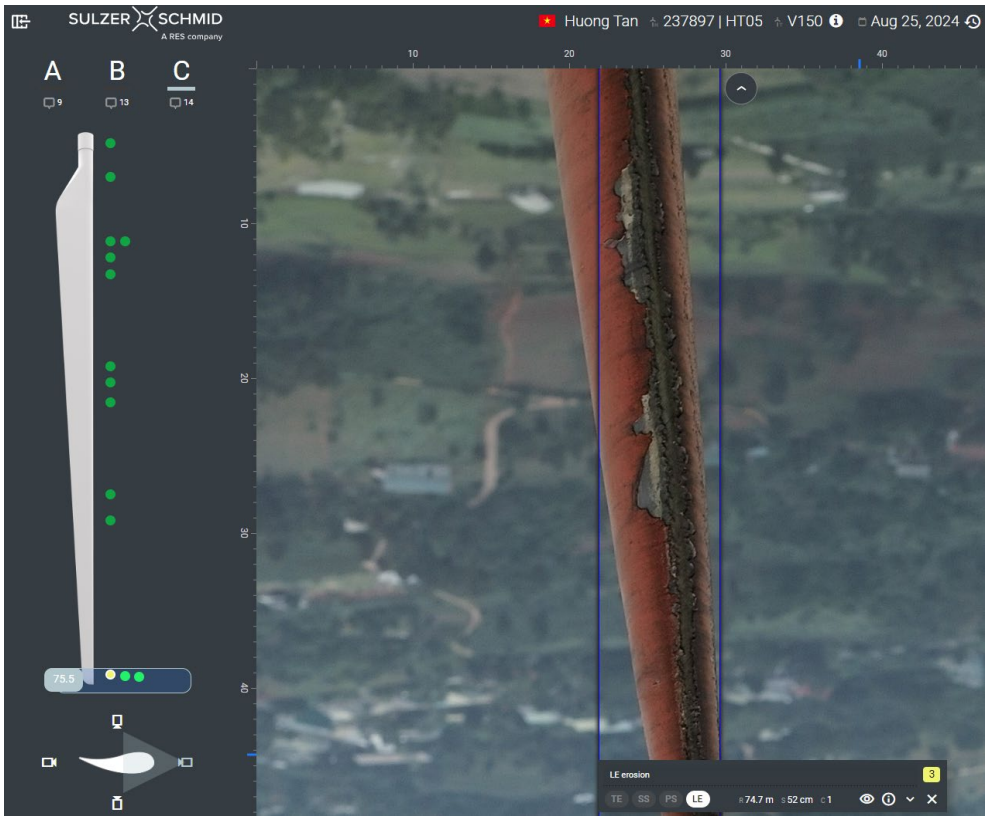
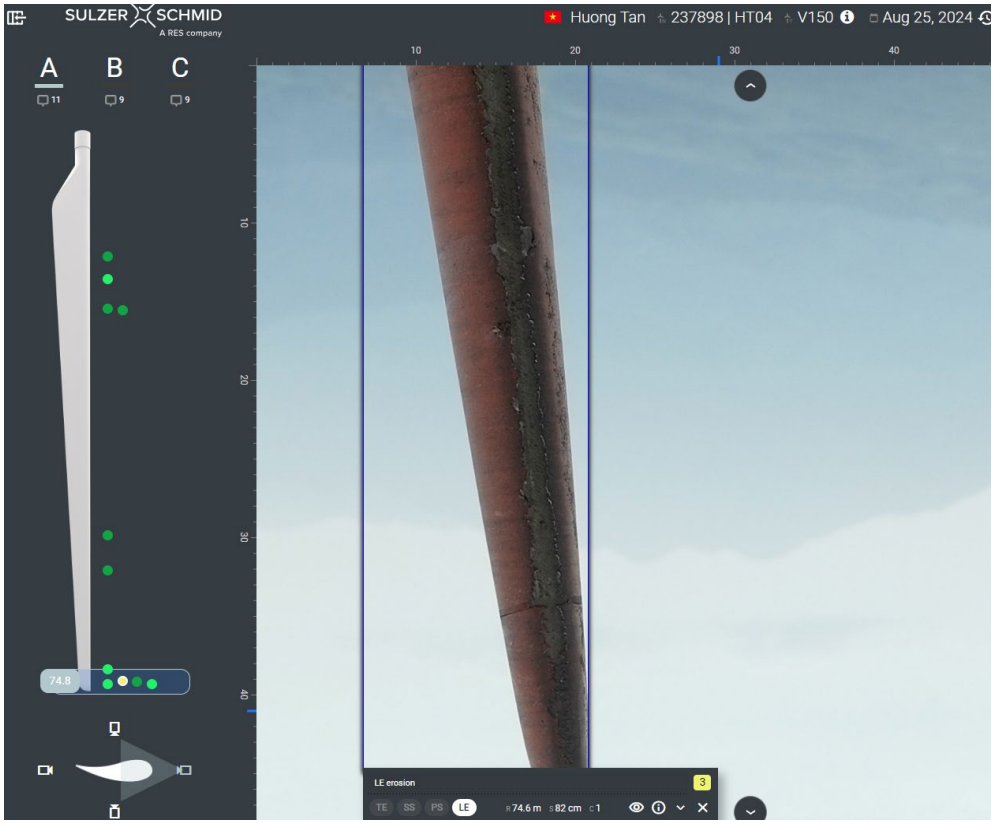
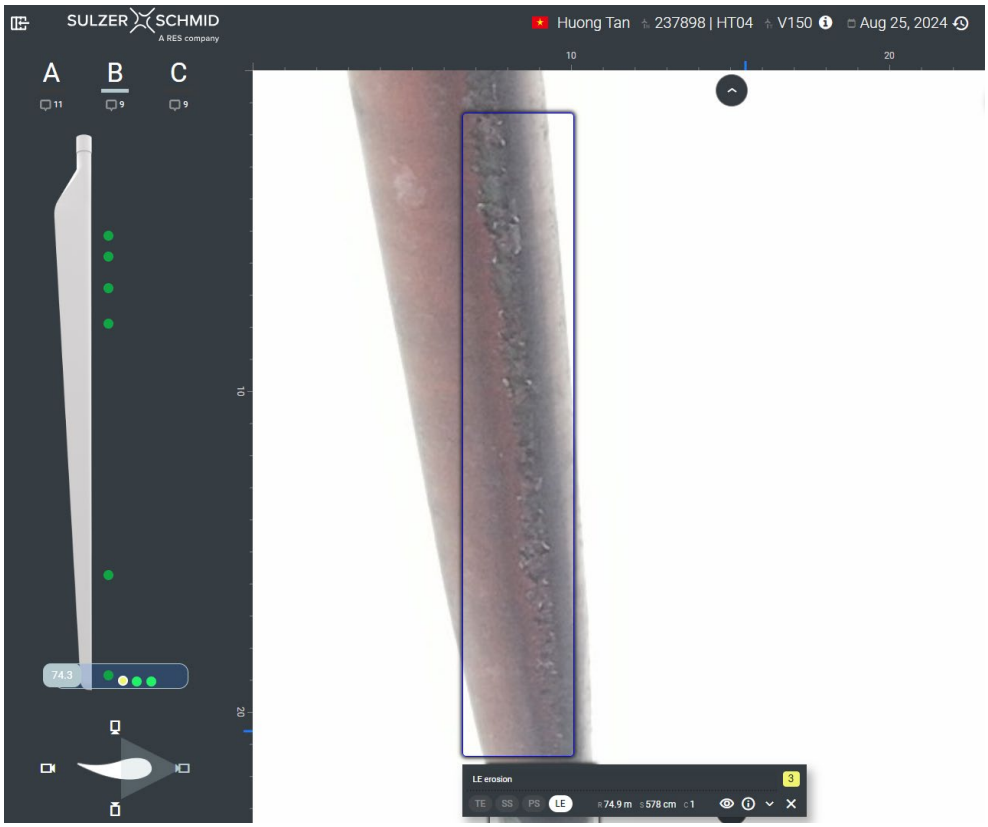
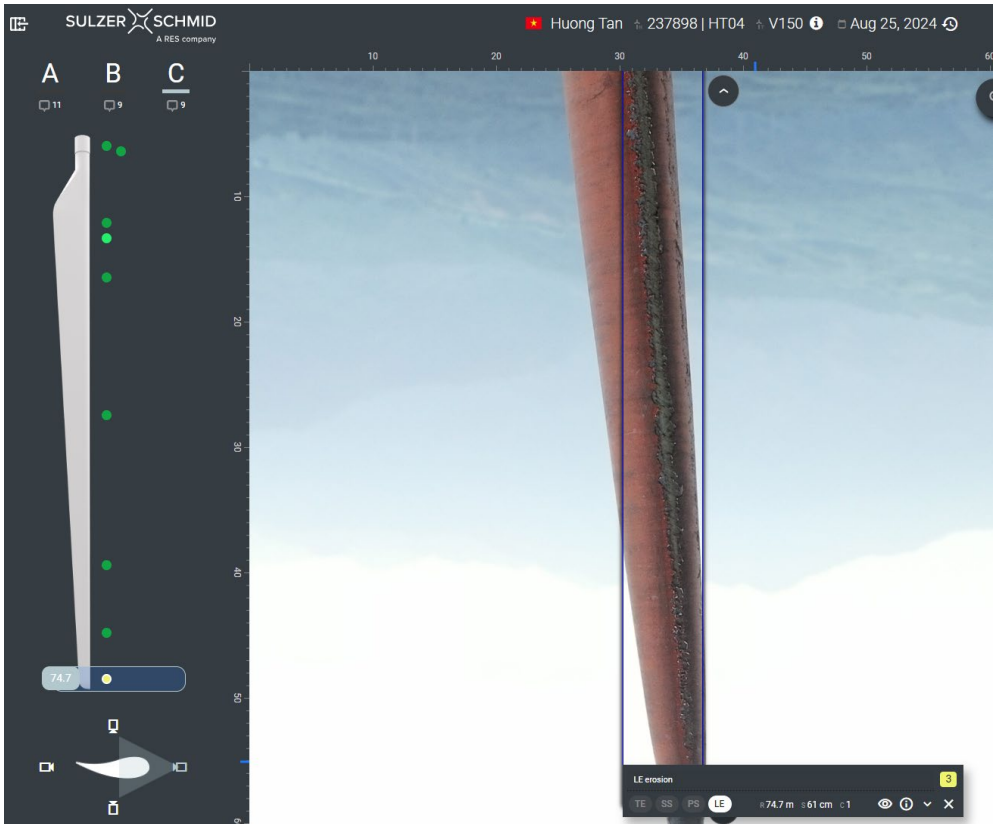
A RES company
Huong Tan
237896 | HT03
V150
Aug 24, 2024
Go back
A
B
C
16
14
16
75.0
LE erosion
3
TE
SS
PS
LE
74.5 m
127 cm
1


SULZER SCHMID
A RES company
Huong Tan
237897 | HT05
V150
Aug 25, 2024
A
B
C
9
13
14
10
20
30
40
75.5
LE erosion
3
TE
SS
PS
LE
74.7 m
52 cm
1


SULZER SCHMID
A RES company
Huong Tan
237898 | HT04
V150
Aug 25, 2024
A
B
C
11
9
9
10
20
30
40
74.8
LE erosion
3
TE
SS
PS
LE
74.6 m
82 cm
1


SULZER SCHMID
A RES company
Huong Tan
237898 | HT04
V150
Aug 25, 2024
A
B
C
LE erosion
TE
SS
PS
LE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A RES company
Huong Tan
237898 | HT04
V150
Aug 25, 2024
A
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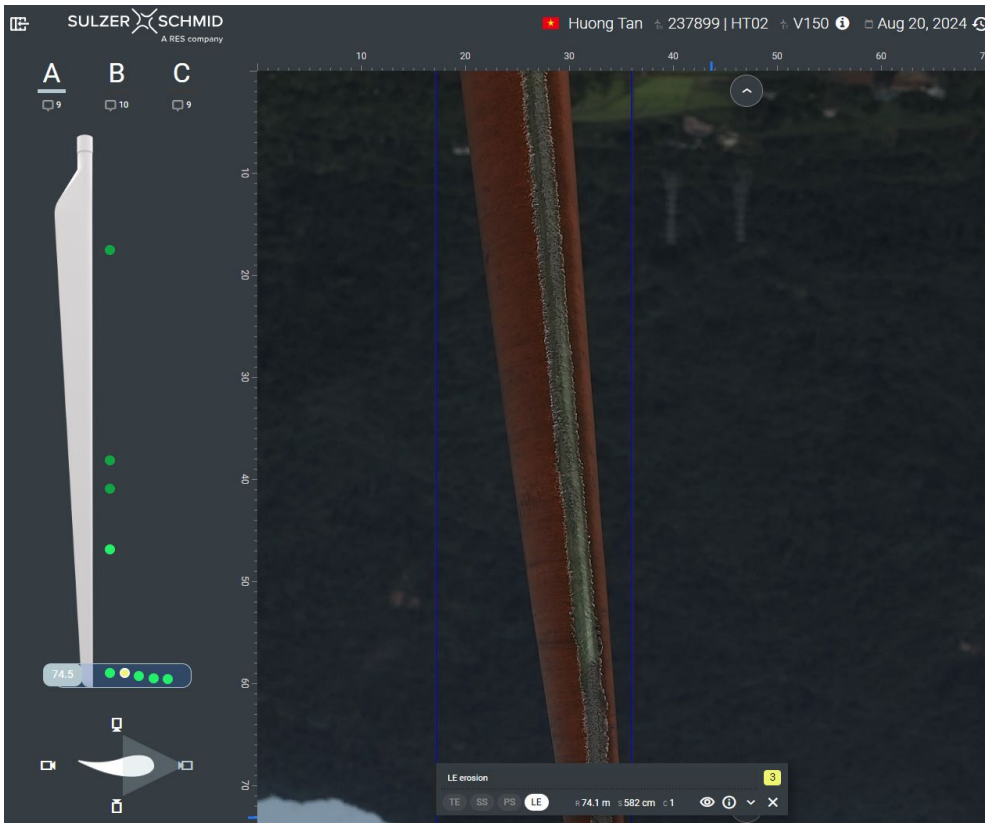
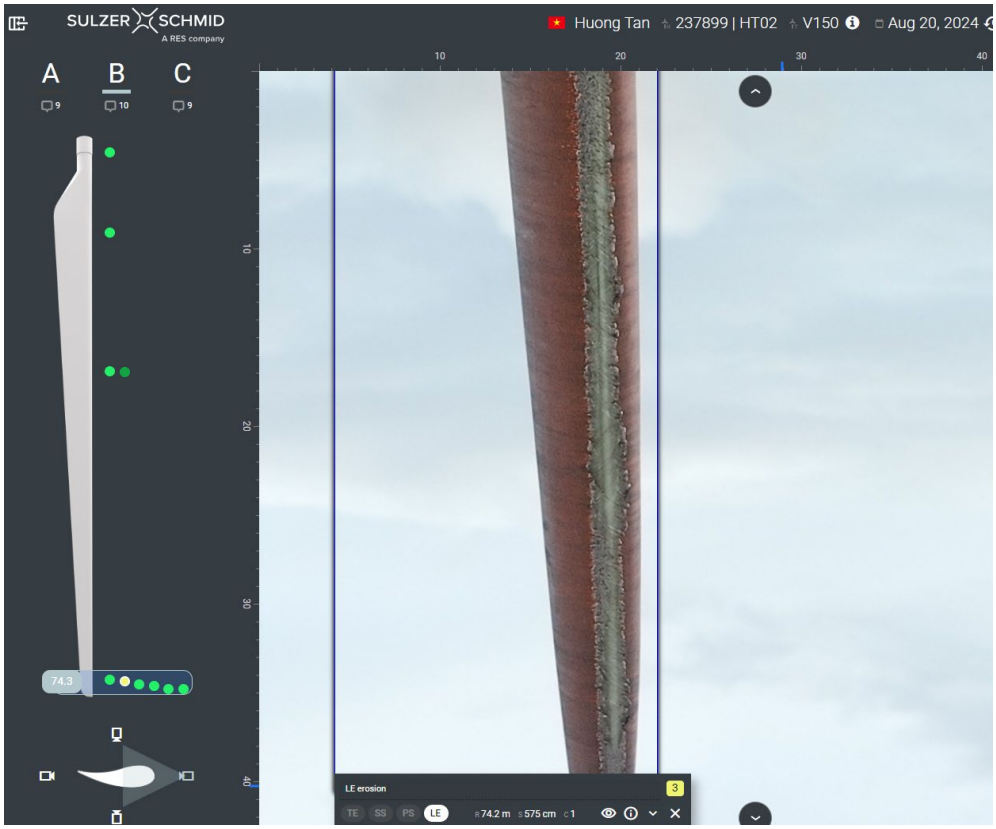
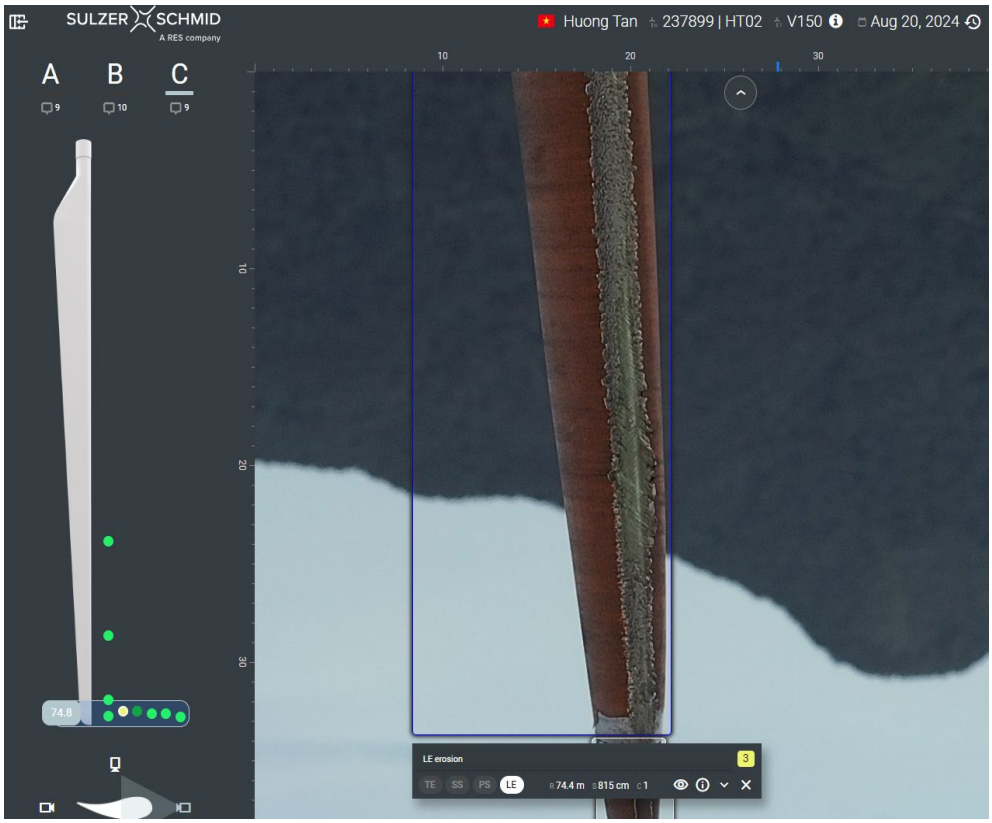
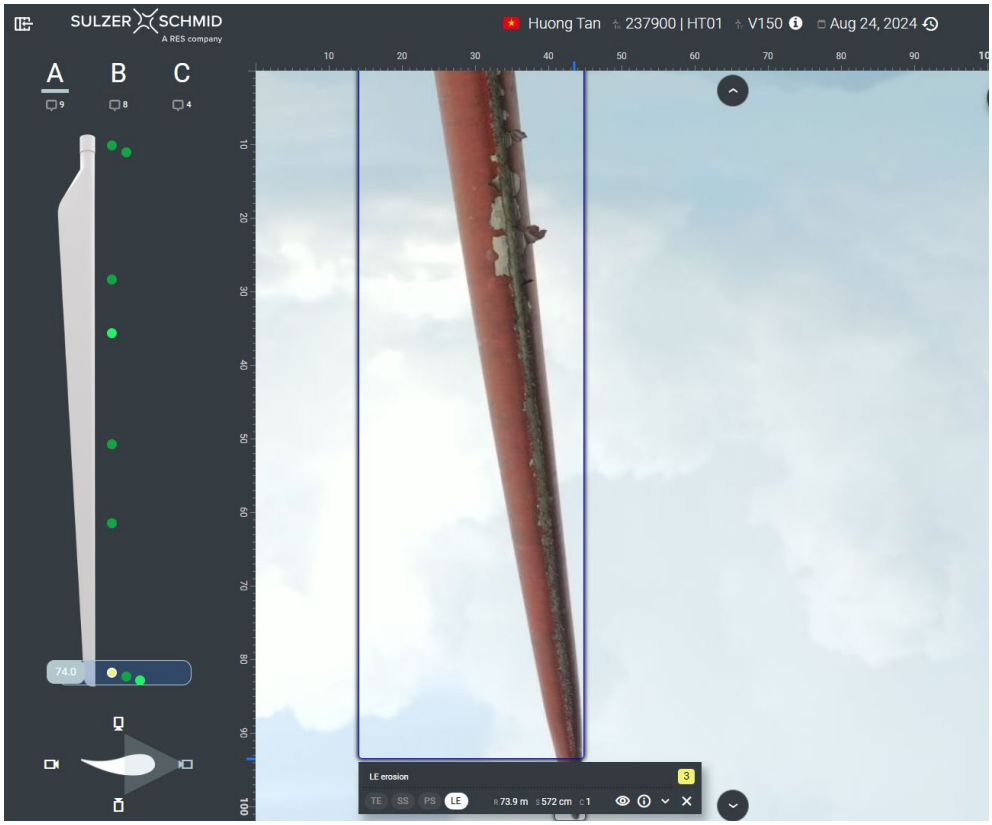
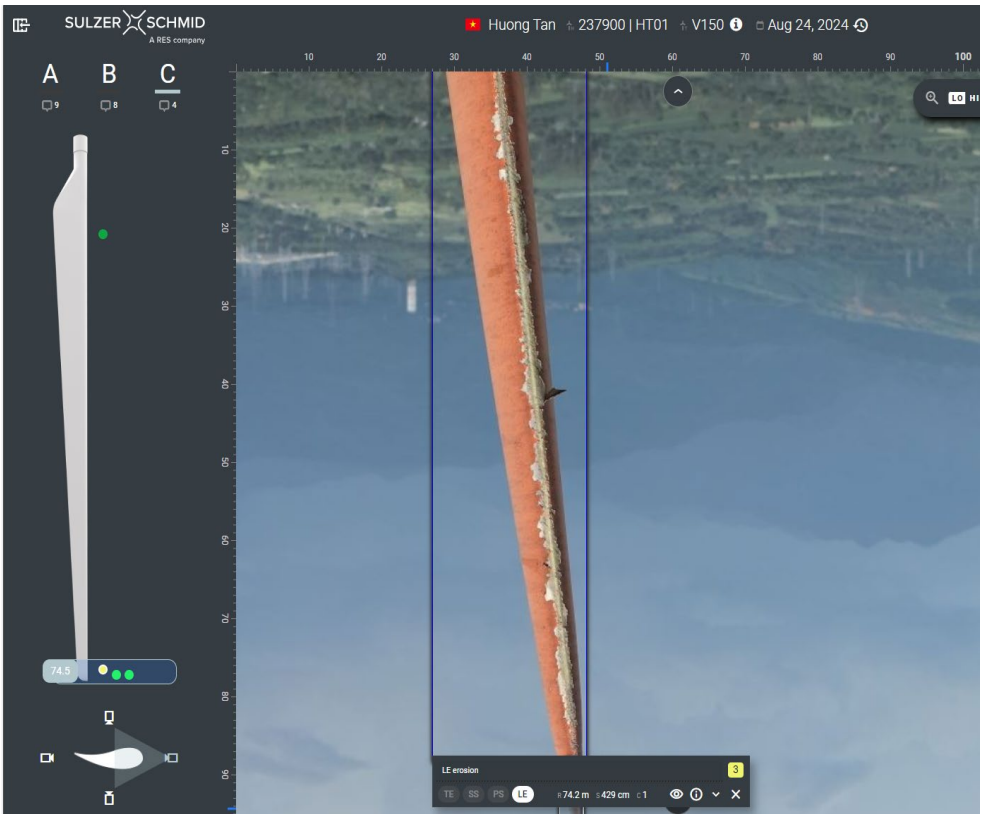
LE erosion
TE
SS
PS
LE

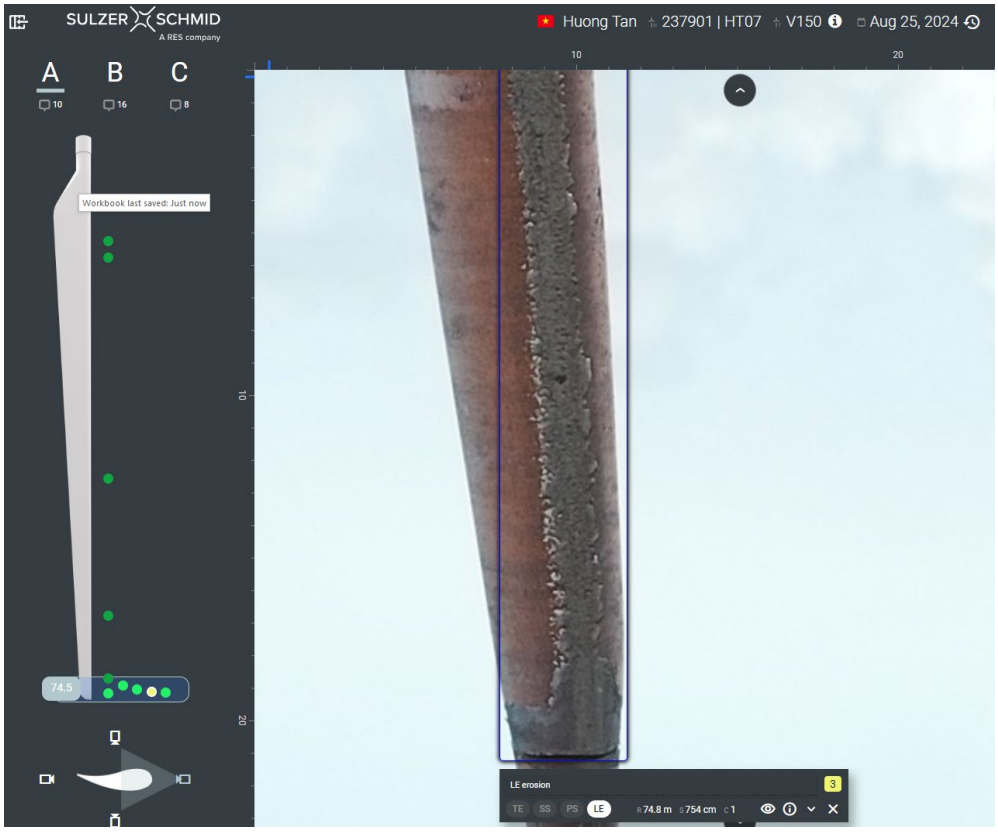

SULZER SCHMID
A RES company
Huong Tan
237899 | HT02
V150
Aug 20, 2024
A
B
C
LE erosion
TE
SS
PS
LE
74.1 m
582 cm

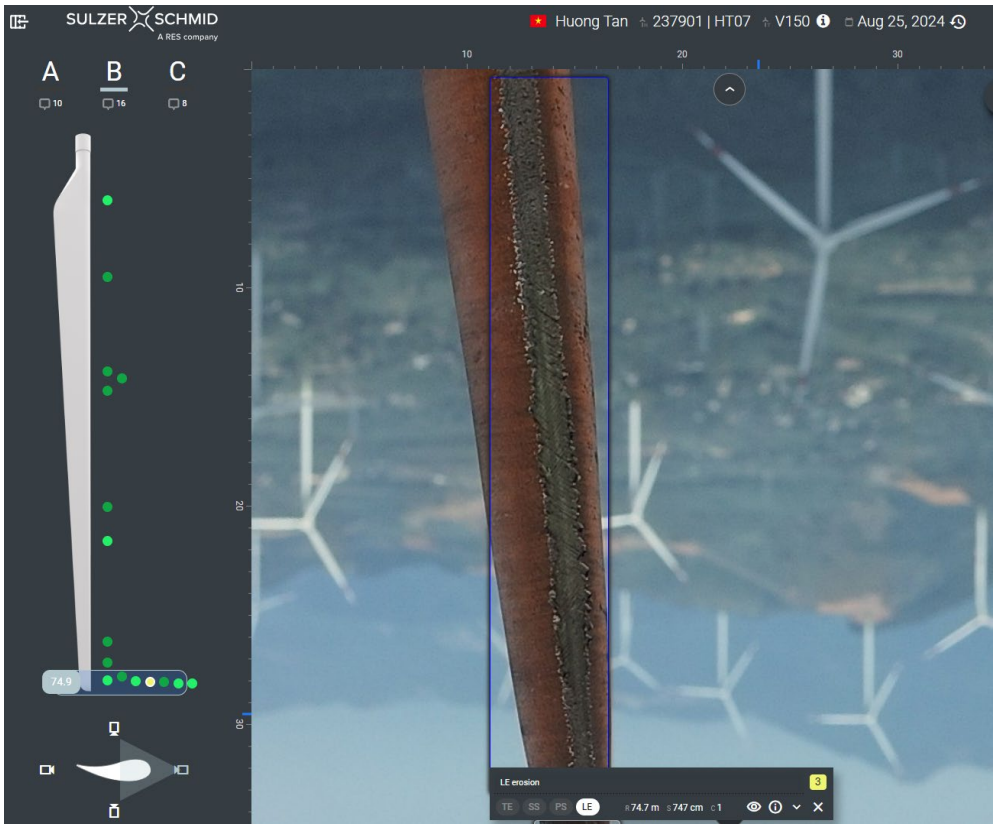

SULZER SCHMID
A RES company
Huong Tan
237899 | HT02
V150
Aug 20, 2024
A
B
C
LE erosion
TE
SS
PS
LE
74.2 m
575 cm

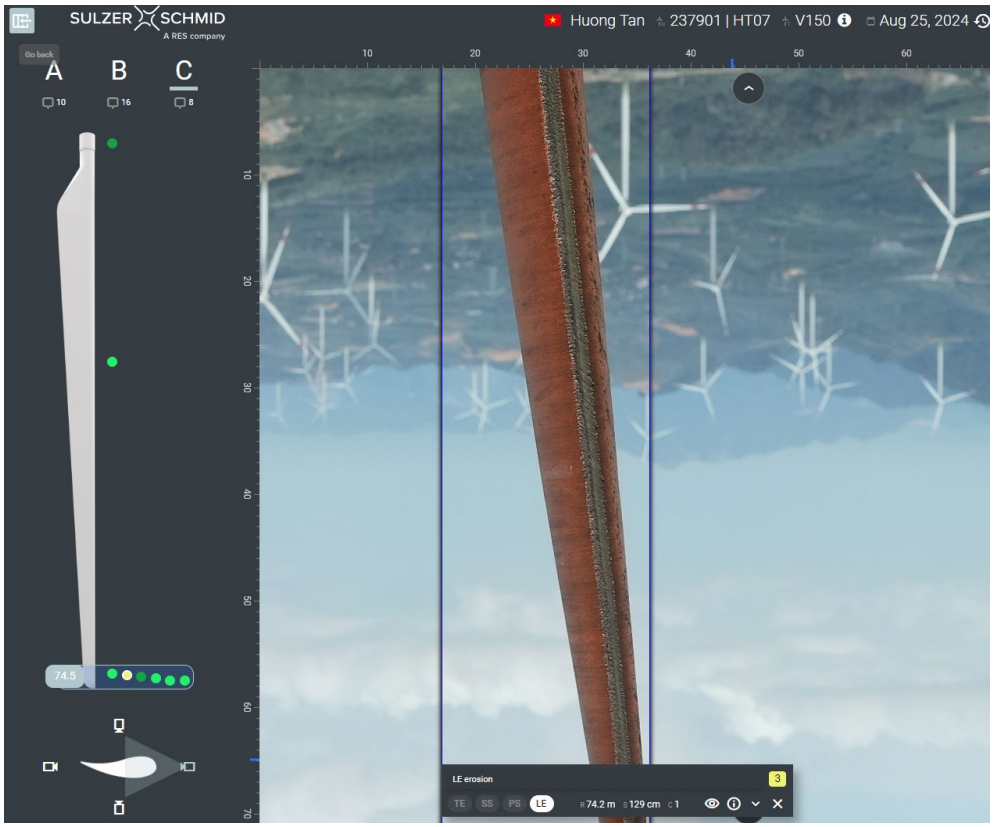

SULZER SCHMID
A RES company
Huong Tan
237899 | HT02
V150
Aug 20, 2024
A
B
C
LE erosion
TE
SS
PS
LE
74.4 m
815 cm

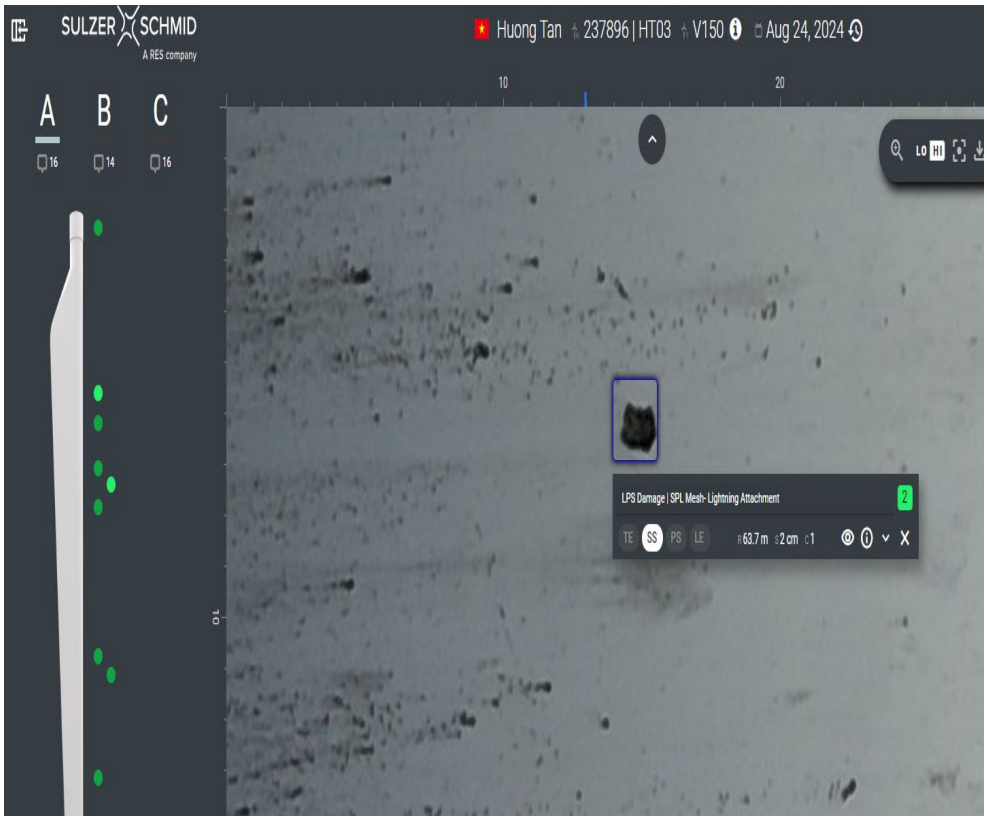

SULZER SCHMID
A RES company
Huong Tan
237900 | HT01
V150
Aug 24, 2024
A
B
C
LE erosion
TE
SS
PS
LE
73.9 m
572 cm

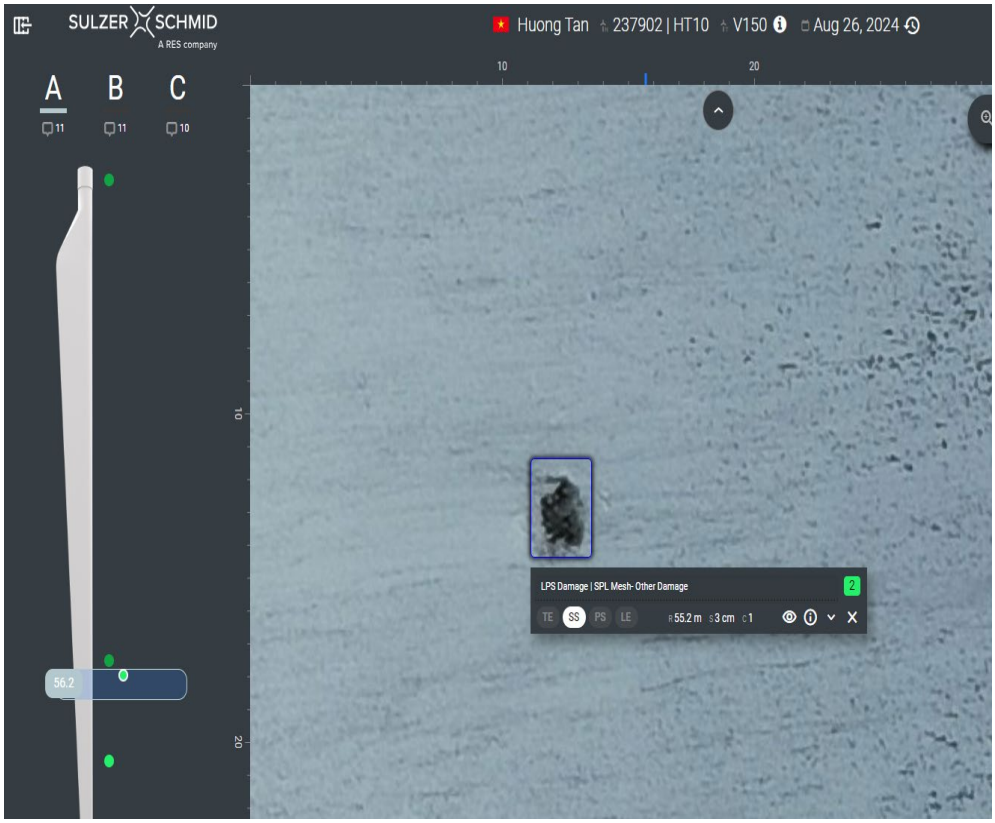

SULZER SCHMID
A RES company
Huong Tan
237900 | HT01
V150
Aug 24, 2024
A
B
C
LE erosion
TE
SS
PS
LE


SULZER SCHMID
A RES company
Huong Tan
237901 | HT07
V150
Aug 25, 2024
A
B
C
Workbook last saved: Just now
LE erosion
TE
SS
PS
LE


SULZER SCHMID
A RES company
Huong Tan
237901 | HT07
V150
Aug 25, 2024
A
B
C
10
16
8
74.9
LE erosion
3
TE
SS
PS
LE
74.7 m
747 cm
1


SULZER SCHMID
A RES company
Huong Tan
237901 | HT07
V150
Aug 25, 2024
A
B
C
10
16
8
74.5
LE erosion
3
TE
SS
PS
LE
74.2 m
129 cm
1


SULZER SCHMID
A RES company
Huong Tan
237896 | HT03
V150
Aug 24, 2024
A B C
16 14 16
10 20
LO HI
LPS Damage | SPL Mesh- Lightning Attachment
2
TE SS PS LE
R 63.7 m S 2 cm C 1


SULZER SCHMID
A RES company
Huong Tan
237902 | HT10
V150
Aug 26, 2024
A B C
11 11 10
10 20
LPS Damage | SPL Mesh- Other Damage
2
TE SS PS LE
R 55.2 m S 3 cm C 1
56.2

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