



INCOMING INSPECTION REPORT



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MS6001FA (GE Frame 6FA) 3rd Stage Bucket Set

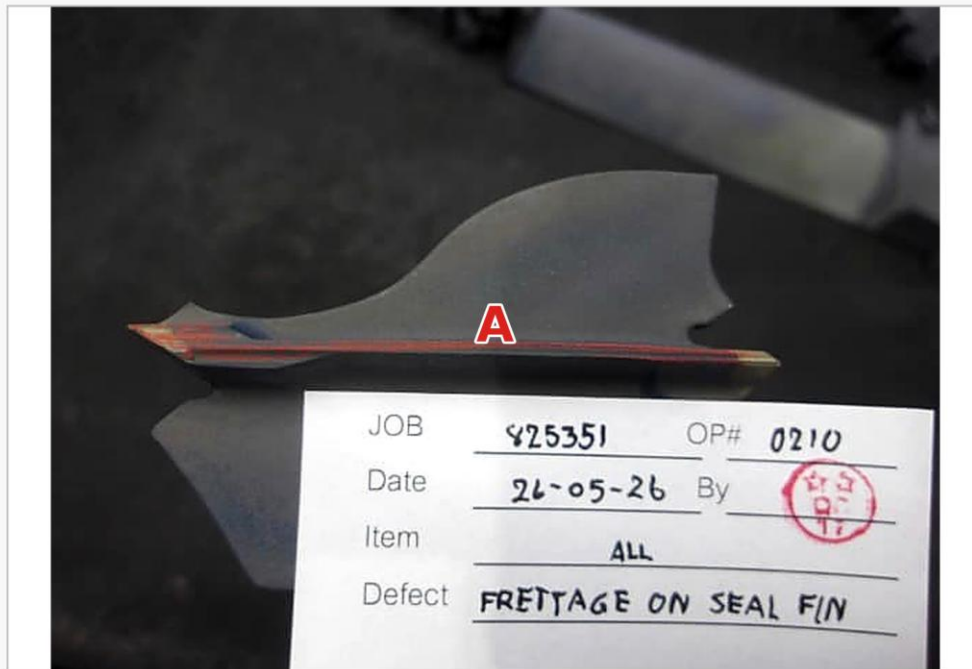
Work Order WO-1004061634 / WO-1004061642

Customer	Nghi Son Refinery & Petrochemical LLC	Report Date	29 May 2026
Customer P.O. No.	WO-1004061634 / WO-1004061642	Component	MS6001FA 3rd Stage Bucket
Engine Type	MS6001FA (GE Frame 6FA)	Qty. Received	92 pieces (1 complete set)
Component Part No.	101T5421 G001 / 101T5421 G002	As-Received Coating	No coating
Material	GTD 111	Severity Category	Severe Heavy Repair
Repair Classification	HEAVY REPAIR, LEVEL 9	Previous Repairs	1
Service Cycle	2	Fuel Hours	Diesel 3,878 / LPG 17,727
Total Running Hours	21,605 hours	Disposition	Repair and restore per the Level 9 scope

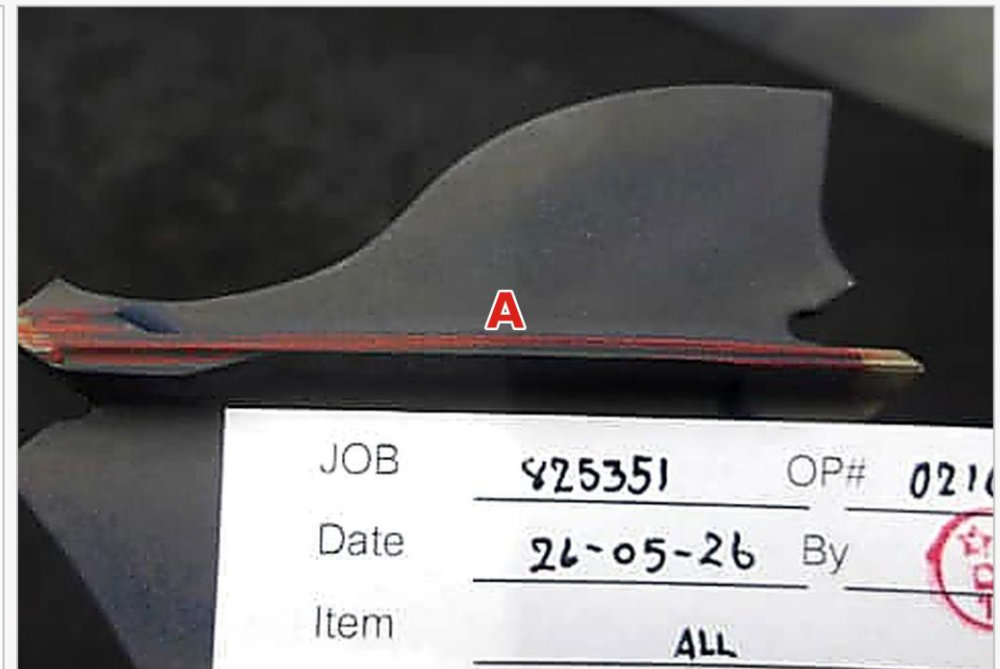
Report Reviewed and Approved By

Paul McGuire
Engineering Manager

FIG. 13 - FRETTAGE AND DIMENSIONAL LOSS - SEAL FIN



ORIGINAL INSPECTION PHOTOGRAPH



MAGNIFIED VIEW A

SEAL FIN HEIGHT: 2.00 mm MIN | MEASURED 1.36-1.67 mm | 46/46 BELOW | 92/92 REJ

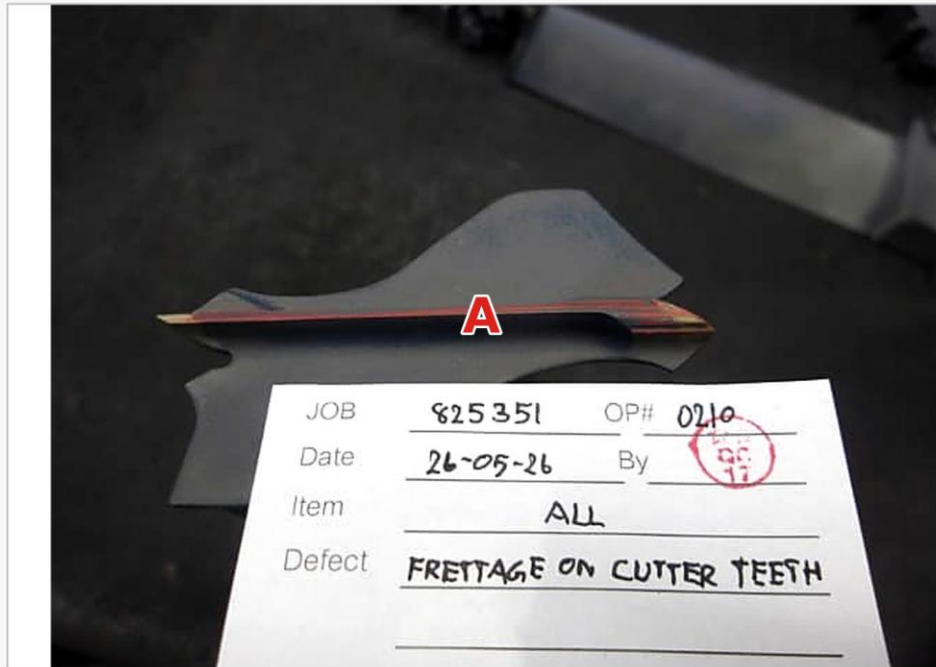
HEAVY REPAIR BASIS

Fretting affects the gas-path seal fin on 92 of 92 buckets; the measured loss is not marginal.

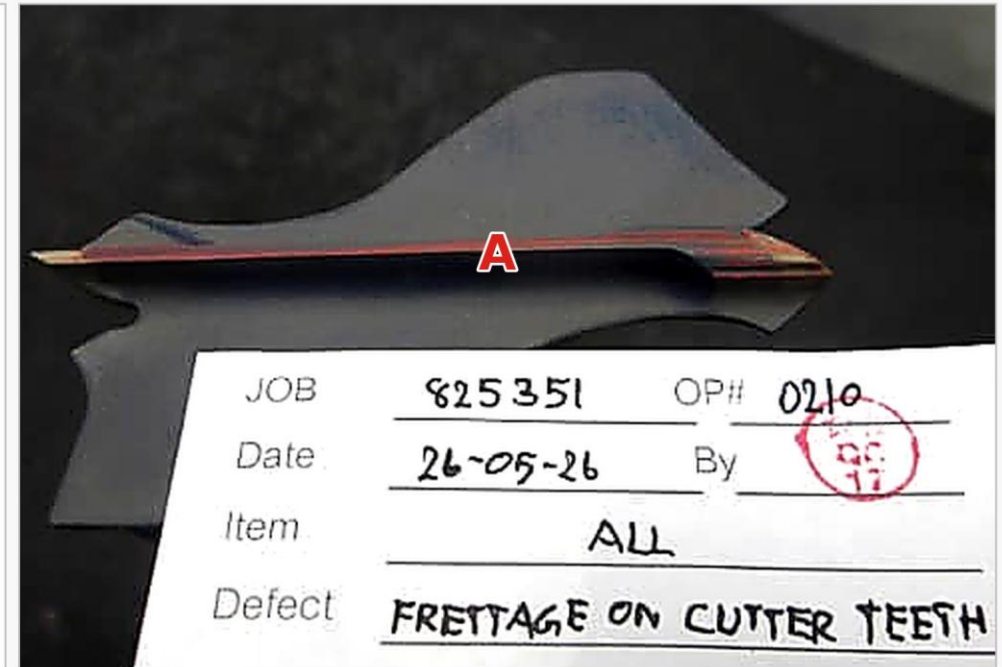
Mean height is 1.528 mm (23.6% below minimum); even the best measured bucket is 16.5% below.

Blend-only correction cannot restore height; weld build-up, machining, EDM, repeated FPI, and verification are required.

FIG. 14 - FRETTAGE - CUTTER TEETH



ORIGINAL INSPECTION PHOTOGRAPH



MAGNIFIED VIEW A

FULL-SET ROUTING: SEAL FIN / CUTTER TEETH WM ON 92/92 BUCKETS

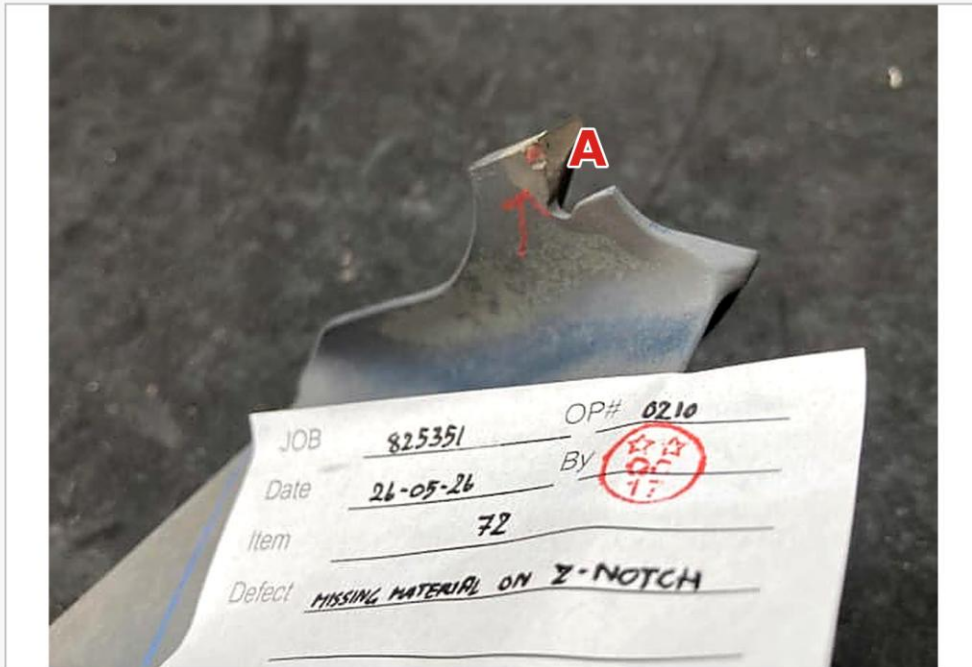
HEAVY REPAIR BASIS

Cutter-tooth geometry works with the seal fin to control tip sealing and rubbing clearance.

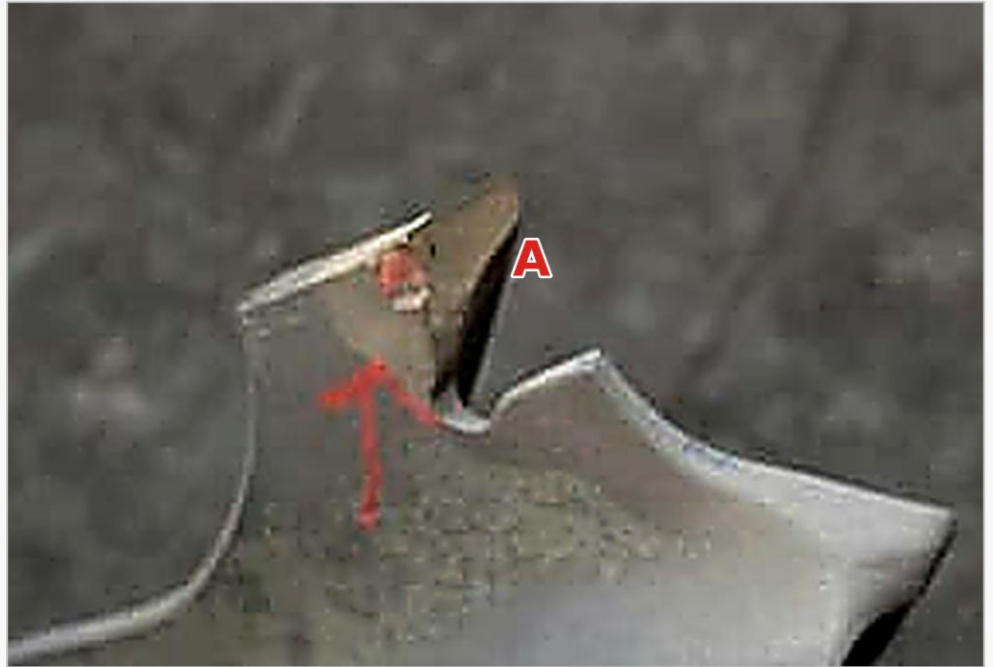
The repair record routes all 92 buckets to Weld and Machining (WM): full-set geometry reconstruction.

Recovery requires weld build-up, precision machining/EDM, heat treatment, NDT, moment weighing, and balance control.

FIG. 15 - MISSING MATERIAL - Z-NOTCH



ORIGINAL INSPECTION PHOTOGRAPH



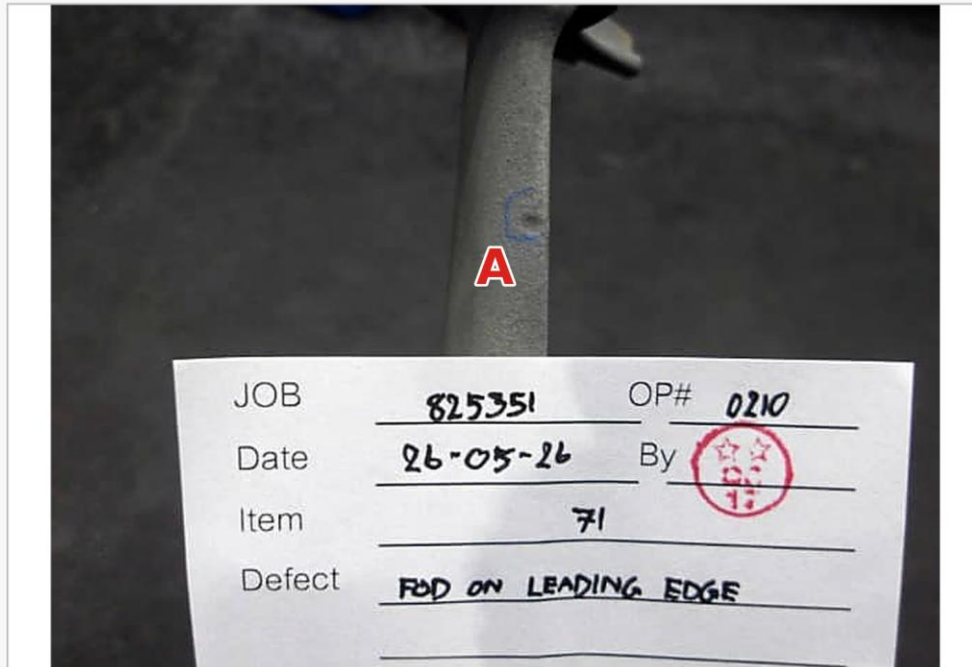
MAGNIFIED VIEW A

ITEM 72: 2 mm x 3 mm MISSING MATERIAL | 1.5 mm DEPTH > 0.5 mm BLEND LIMIT

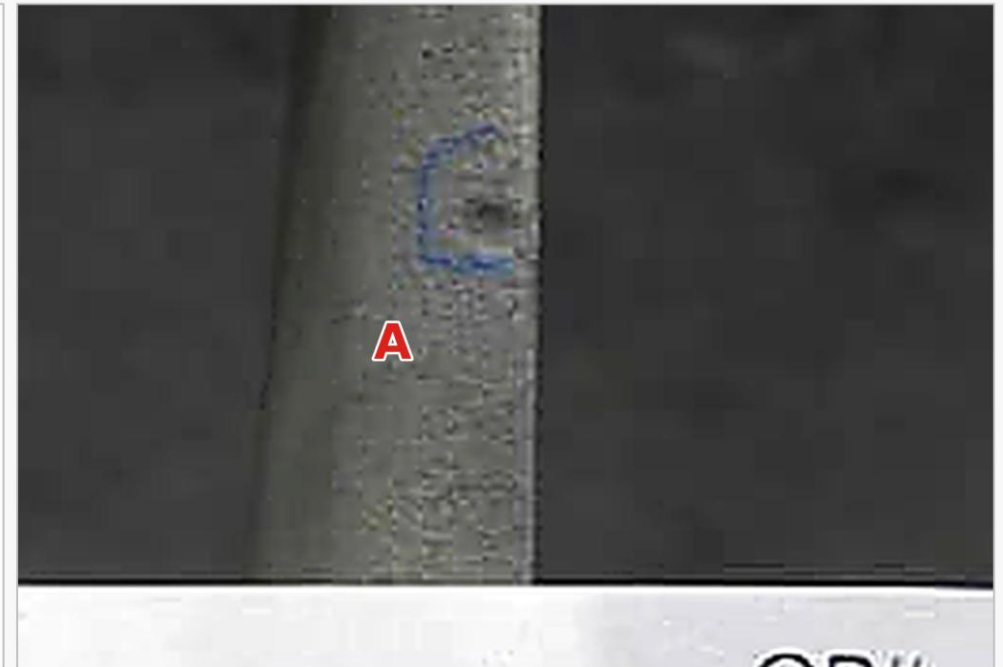
HEAVY REPAIR BASIS

The Z-notch is a bucket-to-bucket engagement and load-transfer feature, not a cosmetic edge.
The measured defect covers approximately 6 square millimetres and is three times the local blend-depth limit.
Item 72 routes to welding and EDM; full-set Z-notch/shroud fretage requires controlled profile recreation.

FIG. 17 - FOREIGN OBJECT DAMAGE - LEADING EDGE



ORIGINAL INSPECTION PHOTOGRAPH



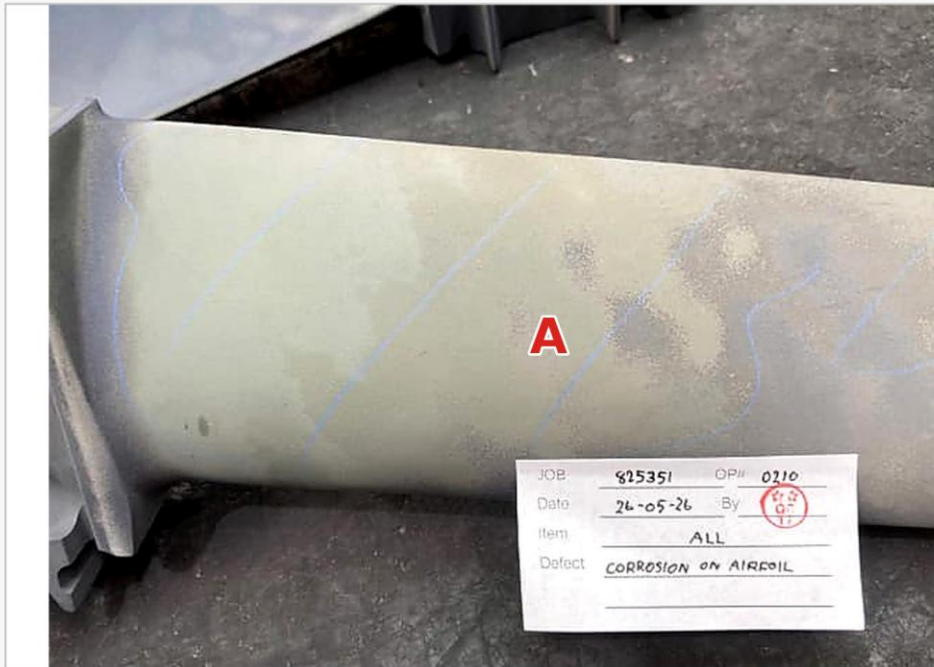
MAGNIFIED VIEW A

LEADING-EDGE FOD: 7/92 | MAX 3 x 2 mm | 0.6 mm DEPTH > 0.3 mm LIMIT

HEAVY REPAIR BASIS

Leading-edge damage changes the aerodynamic profile and creates a crack-initiation stress concentration. This photograph records Item 71; the dimensions shown are set-wide report data, not photo-derived measurements. The maximum depth is twice the blend limit, requiring controlled removal, weld review, and post-repair FPI.

FIG. 18 - OXIDATION-CORROSION - AIRFOIL HOT GAS PATH



ORIGINAL INSPECTION PHOTOGRAPH



MAGNIFIED VIEW A

AIRFOIL CORROSION: 92/92 | SUBSTRATE DEPLETION 60-90 MICROMETRES | GTD 111, 40.2 HRC

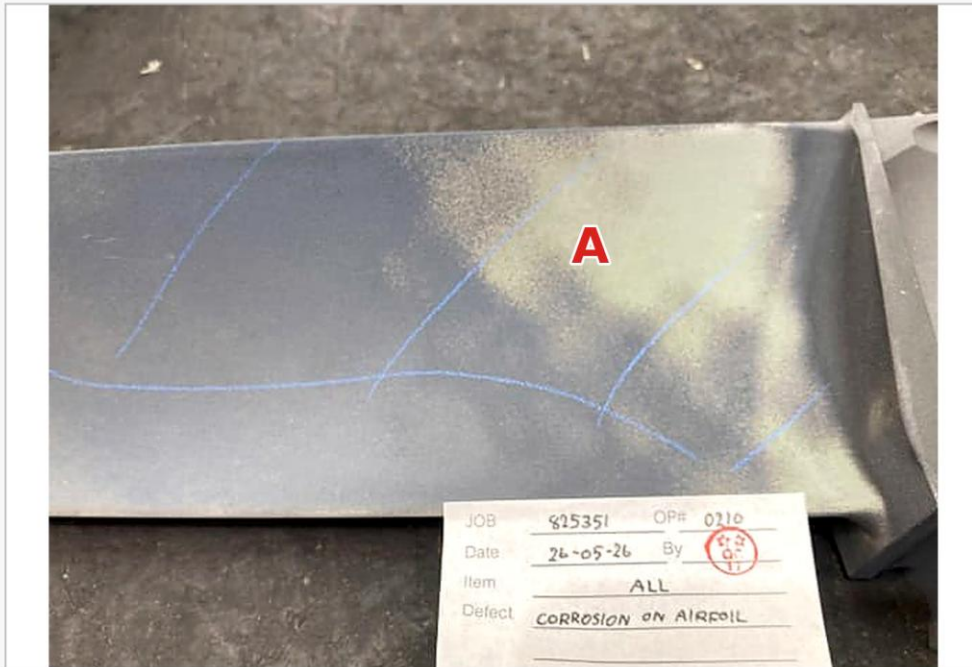
HEAVY REPAIR BASIS

The uncoated hot-gas-path surface shows widespread oxidation-corrosion, confirmed by Items 42 and 92 sectioning.

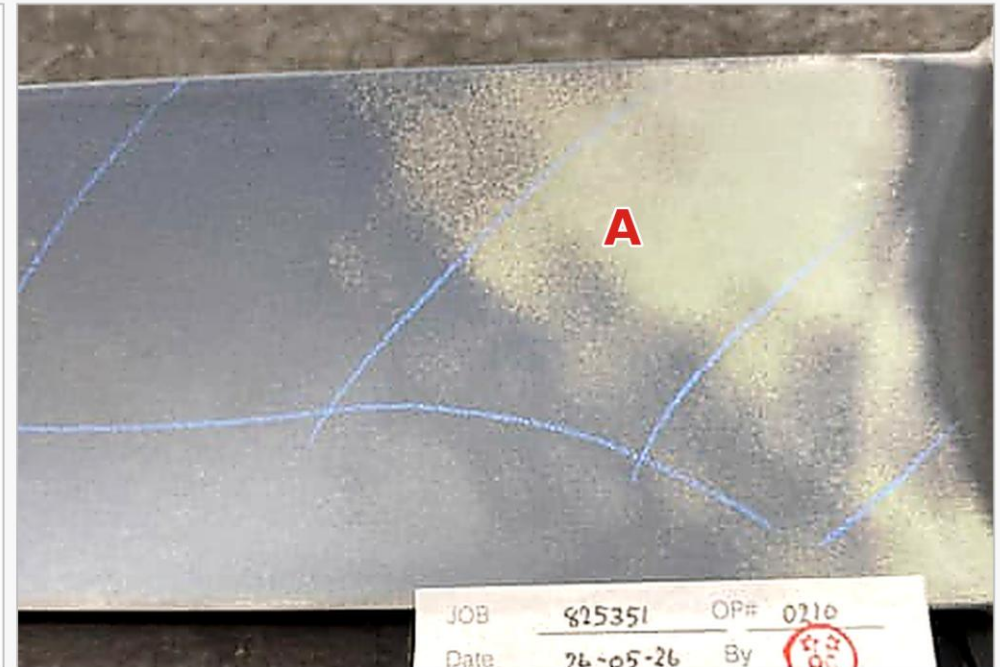
The affected layer is recoverable only by controlled surface removal followed by metallurgical acceptance.

Combined with full-set weld restoration and heat treatment, this base-metal condition supports Level 9.

FIG. 20 - EXTENSIVE SURFACE CORROSION - AIRFOIL



ORIGINAL INSPECTION PHOTOGRAPH



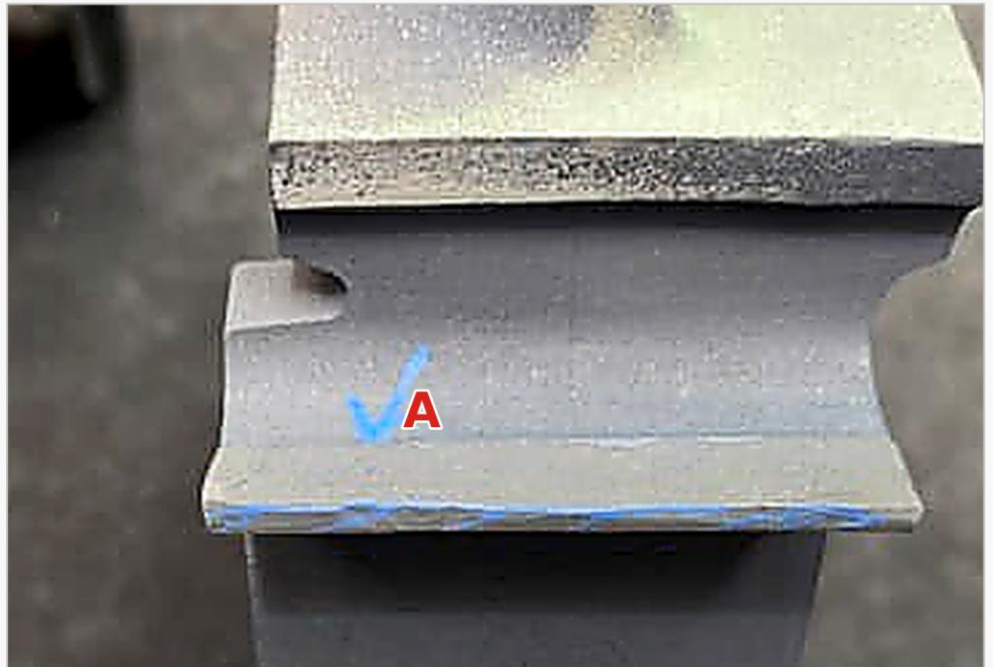
MAGNIFIED VIEW A

CONFIRMED SET-WIDE CONDITION: 92/92 AIRFOILS | 60-90 MICROMETRES SUBSTRATE DEPLETION

HEAVY REPAIR BASIS

This alternate airfoil view documents a broad surface condition rather than one isolated spot. Visual/FPI records confirm corrosion on 92 of 92 buckets; sectioning confirms associated substrate depletion. Controlled cleaning, affected-material removal, heat treatment, and repeated NDT are required before release.

FIG. 21 - FOREIGN OBJECT DAMAGE - ANGEL WING



ANGEL-WING FOD: 36/92 (39.1%) | MAX 4 x 3 mm | 1.0 mm DEPTH > 0.5 mm LIMIT

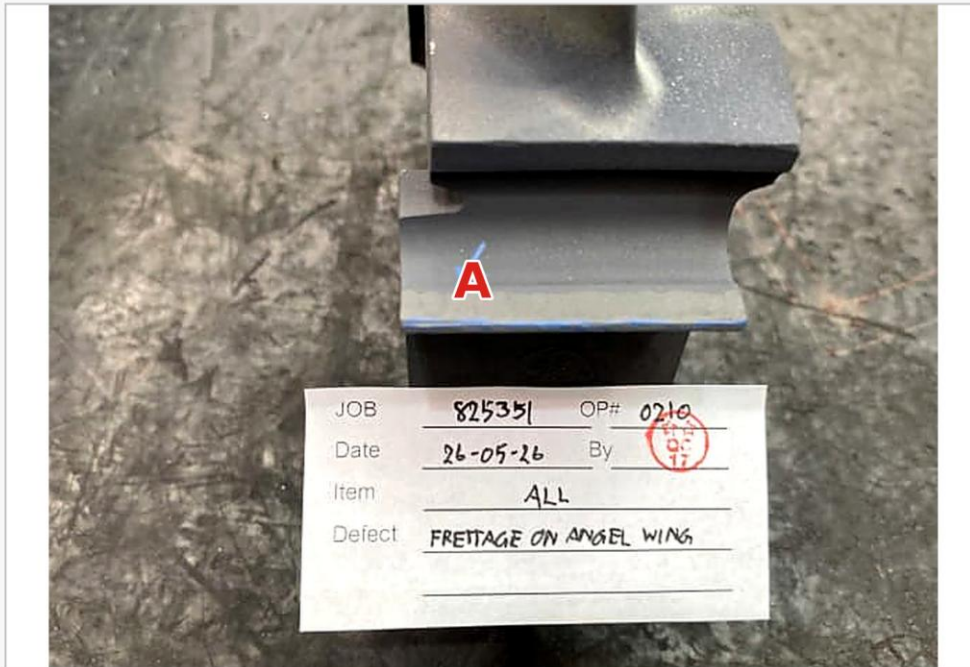
HEAVY REPAIR BASIS

The angel wing is a critical wheel-space sealing and interface feature, so condition is not cosmetic.

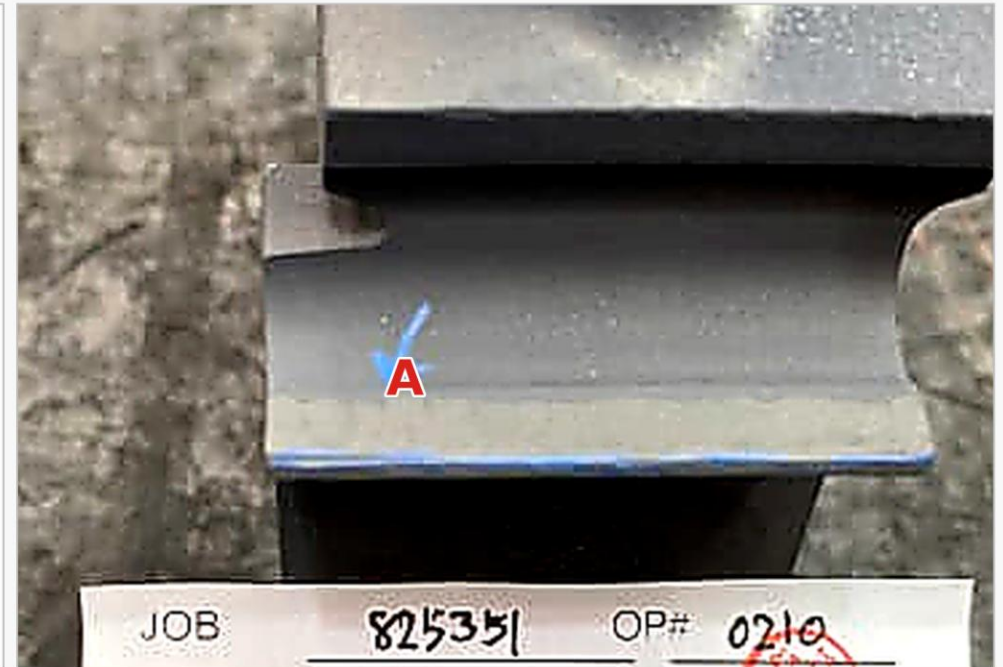
The size/depth figures are set-wide report data; the documented maximum depth is twice the blend limit.

Heavy restoration requires weld build-up where beyond limit, machining to recreate dimensions, and FPI/NDT.

FIG. 22 - FRETTAGE - ANGEL WING



ORIGINAL INSPECTION PHOTOGRAPH



MAGNIFIED VIEW A

ANGEL-WING FRETTAGE: 92/92 | 36/92 ALSO REQUIRE WB ROUTING FOR FOD

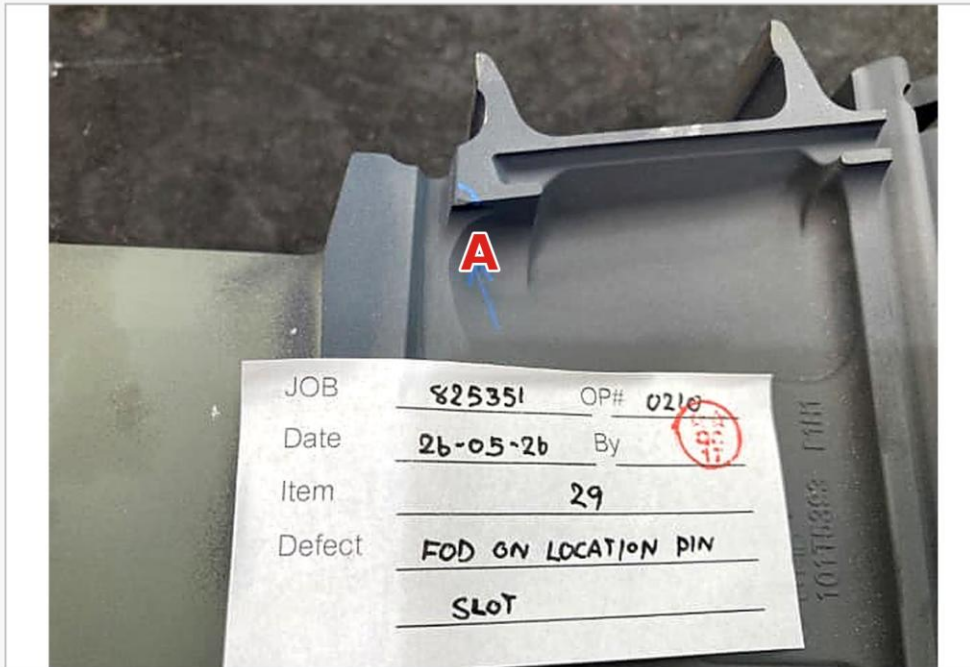
HEAVY REPAIR BASIS

Fretting is present on every angel wing at a functional sealing and contact interface.

Surface grading does not reduce the repair class when restoring the location requires rebuilt geometry.

All 92 require profile restoration and machining; at least 36 require weld build-up for FOD beyond blend limits.

FIG. 23 - FOREIGN OBJECT DAMAGE - LOCATION PIN SLOT



ORIGINAL INSPECTION PHOTOGRAPH



MAGNIFIED VIEW A

LOCATION-PIN-SLOT FOD: 40/92 (43.5%) | MAX 5 x 3 mm | 0.8 mm DEPTH > 0.4 mm LIMIT

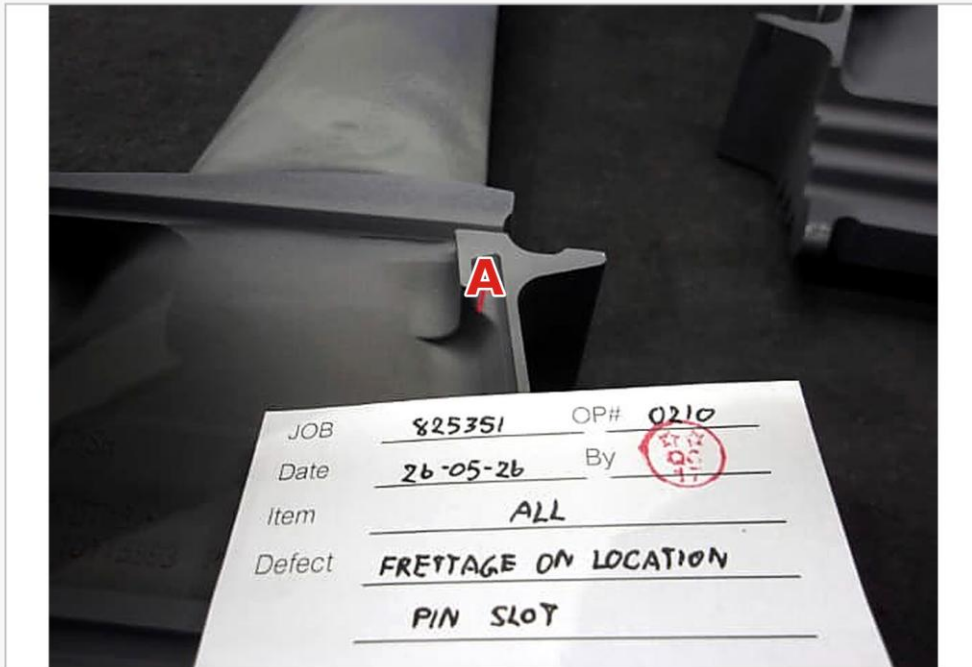
HEAVY REPAIR BASIS

The location pin slot is a locating and fit-up feature that controls bucket assembly stability.

The size/depth values are set-wide report data; the maximum depth is twice the local blend limit.

Repair requires controlled removal, weld restoration where required, contact recovery, and dimensional verification.

FIG. 24 - FRETTAGE - LOCATION PIN SLOT



ORIGINAL INSPECTION PHOTOGRAPH



MAGNIFIED VIEW A

LOCATION-PIN-SLOT FRETTAGE: 92/92 | 40/92 ALSO REQUIRE WB ROUTING FOR FOD

HEAVY REPAIR BASIS

Full-set fretting affects a feature responsible for repeatable location, contact, and fit-up.

Nearly half the set also carries FOD routing, so the scope is population-wide rather than isolated correction.

Blend/weld restoration, stress-concentration removal, dimensional checks, and serial-controlled release are required.



INCOMING INSPECTION REPORT

1. Executive Summary

UNEW received one complete set of ninety two (92) MS6001FA 3rd stage buckets from Nghi Son Refinery & Petrochemical LLC (NSRP) for incoming inspection under work order WO-1004061634 / WO-1004061642. The set is ninety one (91) pieces of part number 101T5421 G001 and one (1) piece of part number 101T5421 G002. The material is GTD 111. The buckets were received uncoated, with one previous repair, and are in their second service cycle after 21,605 total running hours.

The incoming inspection found damage in several critical areas across the full set. The main findings are fretting on the seal fin and cutter teeth, fretting and missing material at the Z-notch, fretting and foreign object damage on the angel wing, fretting and foreign object damage at the location pin slot, foreign object damage on some leading edges, and corrosion with substrate alloy depletion on the hot gas path airfoil surface.

The repair classification is **HEAVY REPAIR, LEVEL 9 (Severe Heavy Repair)** on the UNEW ten level repair severity scale. Repair severity follows the condition and location of the affected features and the restoration required to return them to service, not the size of any single defect. For this set the restoration covers weld build-up and machining or EDM recovery of critical sealing and engagement features across the full set, multiple heat treatment cycles, repeated FPI and NDT, full dimensional verification, and set level moment weighing and balance control.

1.1 Minimum Technical Basis for Heavy Repair (Level 9)

The minimum technical basis for Heavy Repair, Level 9 is the full-set rejection of the critical seal fin dimension. Dimension E (tip seal fin height) has a minimum acceptance requirement of 2.00 mm. The measured population records 1.36 to 1.67 mm on 46 measured buckets, with 46 of 46 measurements below the minimum limit. The best measured bucket remains 16.5% below the minimum, the worst is 32.0% below the minimum, and the mean shortfall is 23.6%. The defect legend records seal fin height as REJ on 92 of 92 buckets (Appendix B). Because the seal fin is a critical gas path sealing feature, this condition cannot be corrected by blending: it requires weld build-up, machining and EDM restoration, dimensional verification, repeated FPI and NDT, heat treatment, moment weighing, and balance chart control.

Heavy Repair Driver	Objective Evidence	Why a Lower Repair Level Is Not Applicable
Full-set seal fin rejection	Dimension E minimum 2.00 mm; measured 1.36-1.67 mm; 46/46 below limit; defect legend 92/92 REJ	Blend repair cannot restore missing seal fin height
Critical sealing / interlock features affected	Seal fin/cutter tooth, Z-notch/shroud, angel wing, location pin slot	These are functional sealing, engagement, and fit-up features, not cosmetic areas
Z-notch missing material	Item 72: 2 mm x 3 mm, approximately 6 mm ²	The Z-notch is a load-transfer / interlock feature requiring geometry restoration
Angel wing FOD	36 of 92 buckets, in addition to full-set fretting	Wheel-space sealing / interface feature; not cosmetic damage



INCOMING INSPECTION REPORT

Location pin slot FOD	40 of 92 buckets, in addition to full-set frettage	Locating and fit-up feature; affects assembly stability
Airfoil corrosion	92 of 92 airfoils; substrate alloy depletion confirmed by sectioning	Requires controlled material removal and metallurgical acceptance
Metallurgical condition	GTD 111 confirmed; 60-90 micrometre oxidation-corrosion / substrate depletion; 40.2 HRC	Repairable, but only under a controlled heavy repair scope
Repair burden	3 heat treatment cycles; at least 5 FPI/NDT control points; moment weighing and balance chart	Exceeds standard / medium refurbishment control

2. Introduction and Component Function

The MS6001FA 3rd stage bucket is a rotating hot gas path component in the GE Frame 6FA gas turbine. It operates under high temperature gas flow, centrifugal load, vibration, and thermal cycling. The seal fin, cutter teeth, Z-notch, shroud contact faces, angel wings, and location pin slot control gas path sealing, bucket to bucket engagement, contact stability, and set assembly fit. Damage to these features affects sealing, clearance control, mechanical stability, and the safe assembly of the rotating set.

The customer supplied service history records 21,605 total running hours from August 2023, including 3,878 diesel hours and 17,727 LPG hours. The set has one previous repair and is in service cycle 2. This report records the incoming inspection findings and gives the repair severity classification based on the UNEW repair severity method.

3. Inspection Summary

Based on the incoming inspection, the following disposition applies to the complete set.

Item	Disposition
Repair Classification	HEAVY REPAIR, LEVEL 9
Repair Category	Severe Heavy Repair
Scrap Recommendation	None at incoming stage
Set Disposition	Repair and restore per the Level 9 scope
Final Release	Subject to completed repair, dimensional verification, FPI and NDT results, heat treatment records, moment and balance verification, and final acceptance documentation

4. UNEW Repair Severity Classification Method

UNEW classifies repair severity using a ten level scale. The level is set by the actual incoming condition of the component and by the restoration effort needed to return the part to a serviceable

condition. The process name alone does not set the level. Cleaning, standard inspection, FPI and NDT, dimensional check, heat treatment, coating, assembly, and standard consumable replacement may be part of normal refurbishment, unless the damage extent, the repair volume, the dimensional recovery, the material condition, or the engineering risk makes the work more severe.

Classification Bands

Level Range	Classification	Working Meaning
Levels 1 to 3	Light Repair	Minor cleaning, inspection, and limited local correction. No major structural restoration.
Levels 4 to 7	Standard / Medium Refurbishment	Normal to significant restoration within the expected refurbishment range.
Levels 8 to 10	Heavy Repair	Repair exceeds normal refurbishment because of damage extent, critical location, restoration risk, or reparability limit.

Core Technical Review Categories

Category	Review Basis
Welding and Material Build-up	Crack excavation, weld gap, weld area, missing material, multi pass build-up, braze or TPR restoration.
Dimensional Restoration	Airfoil profile, platform, shroud, tip, seal surfaces, root and fit-up, roundness, gap, throat area, clearance, and assembly alignment.
Coating and Base Metal Condition	Coating loss, oxidation, corrosion, hot corrosion, base metal exposure, substrate attack, and required coating restoration.
Cooling Hole and Cooling Passage Recovery	Blocked cooling holes, restricted passages, EDM recovery, flow recovery, and internal cavity condition.
Inspection, Heat Treatment, and Engineering Risk	Multiple FPI and NDT cycles, heat treatment, engineering disposition, reparability limit, critical location, previous repair history, and turbine reliability risk.

Important Engineering Note

The repair level is not set by the size of the defect alone. The level also depends on the location of the defect, the function of the affected area, the local wall thickness, the stress level, the sealing function, the fit-up requirement, the previous repair history, the remaining repair margin, and the turbine reliability risk.

A larger defect in a non critical area may stay within standard or medium repair. A much smaller defect in a critical location, for example near a seal slot, a shroud contact face, a root or attachment area, or a thin or highly loaded section, may require heavy repair or may not be repairable. A surface condition that looks light is therefore classified by what its restoration requires at that location, not by its size. When more than one criterion applies, the more severe technical condition governs the classification.

5. Summary of Incoming Findings

The findings below come from the visual inspection, the fluorescent penetrant inspection, the dimensional inspection, the per bucket defect legend record sheet, the defect map, and the metallurgical evaluation. The damage is present across the full set of 92 buckets at several critical features.

Feature	Incoming Finding	Required Restoration
Seal fin and cutter teeth	Fretage on 92 of 92 buckets. Seal fin height recorded as REJ (dimension unacceptable, repair required) across the set.	Critical sealing feature. Requires weld build-up and machining or EDM to restore the seal fin and cutter tooth.
Z-notch	Fretage on 92 of 92 buckets. Item 72 shows 2 mm x 3 mm (approximately 6 mm ²) missing material at the Z-notch.	Critical engagement and load transfer feature. Requires weld build-up and EDM to recreate the Z-notch and shroud profiles.
Angel wing	Fretage on 92 of 92 buckets. Foreign object damage on 36 of 92 buckets (39.1%).	Critical interface and sealing feature. Requires restoration on 92 of 92 buckets, with weld build-up where defect depth exceeds the blend limit, and machining to recreate the angel wing dimensions.
Location pin slot	Fretage on 92 of 92 buckets. Foreign object damage on 40 of 92 buckets (43.5%).	Locating and fit-up feature. Requires blend and weld repair and recovery of contact and fit-up across nearly half the set.
Leading edge	Foreign object damage on 7 of 92 buckets (7.6%): Items 1, 2, 25, 53, 67, 71, 72.	Airfoil aerodynamic surface. Requires blend and weld repair and FPI verification. Affects crack initiation risk.
Airfoil (hot gas path)	Corrosion on 92 of 92 airfoils. Metallurgical sectioning shows oxidation corrosion with substrate alloy depletion.	Base metal attack across the full set. Requires grit blast, controlled material removal, metallurgical acceptance, and heat treatment.
Base material	GTD 111 confirmed. Repairable after grit blast cleaning.	Repairable. Restored under the full set repair scope with final inspection verification.

Non-typical defect measured detail versus location blend limits.

Feature	Affected Qty	Typical / Max Size	Max Depth	Blend Limit at Location	Required Repair
Z-notch missing material (Item 72)	1 of 92	2 mm x 3 mm (approx. 6 mm ²)	1.5 mm	0.5 mm	Weld build-up + EDM geometry recreation
Angel wing FOD	36 of 92	Typical 2 x 2 mm; max 4 x 3 mm	1.0 mm	0.5 mm	Weld / machine where beyond blend limit
Location pin slot FOD	40 of 92	Typical 2 x 2 mm; max 5 x 3 mm	0.8 mm	0.4 mm	Restore fit-up contact surface

Leading edge FOD	7 of 92	Typical 1 x 1 mm; max 3 x 2 mm	0.6 mm	0.3 mm	Blend / weld repair + FPI
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In each case the recorded maximum defect depth exceeds the blend limit permitted at the location, so blend-only correction is not available and the defect routes to weld repair under the Section 10 legend codes. These findings are additional to, not instead of, the full-set frettage recorded on the same features.

6. Numeric Defect and Restoration Summary

The table below lists the incoming findings and the restoration required for each feature, with the engineering basis for that restoration. The repair level for the complete set is determined in Section 7.

No.	Defect Basis	Numeric Finding	Required Restoration	Restoration Basis
1	Total set received	92 buckets: 91 pcs P/N 101T5421 G001 and 1 pc P/N 101T5421 G002, GTD 111.	Full set inspection, segregation, defect mapping, dimensional verification, repair routing, moment weigh, and balance chart.	The set must be controlled, balanced, and released as one turbine bucket set, not as isolated single bucket repairs.
2	Service exposure and repair history	21,605 total running hours; 3,878 diesel hours; 17,727 LPG hours; 1 previous repair; service cycle 2.	Material evaluation, solution heat treatment, repairability review, repeated NDT, and final acceptance inspection.	High accumulated service exposure and a second service cycle raise engineering and acceptance risk.
3	Seal fin and cutter tooth condition	Frettage on the seal fin and cutter teeth on 92 of 92 buckets.	Weld build-up of the tip seal fin, restoration of cutter tooth areas, and machining and EDM to restore the seal fin and cutter tooth configuration.	Critical sealing features need material restoration and precision geometry recovery across the full set.
4	Seal fin height (dimensional rejection)	Seal fin height recorded as REJ across the bucket population.	Recover the seal fin height and profile by weld build-up, machining and EDM, dimensional inspection, and repeated FPI.	A full set dimensional rejection on a critical sealing feature requires weld build-up and machining recovery.

5	Z-notch condition	Z-notch frettage on 92 of 92 buckets, on a critical engagement and load transfer feature. Item 72 shows 2 mm x 3 mm (approximately 6 mm ²) missing material at the Z-notch.	Weld build-up of the Z-notch and shroud areas, EDM to recreate the Z-notch and shroud profiles, dimensional restoration, and NDT.	The Z-notch is a critical engagement and load transfer feature. Small missing material at this location plus full set frettage needs controlled geometry restoration.
6	Angel wing condition	Angel wing frettage on 92 of 92 buckets, on a critical interface feature. Angel wing FOD on 36 of 92 buckets (39.1%).	Weld build-up of the angel wings, machining to recreate the angel wing dimensions, and blend and inspect.	The angel wing is a critical interface and sealing feature. Full set frettage plus 39.1% FOD needs widespread restoration and dimensional control.
7	Location pin slot condition	Location pin slot frettage on 92 of 92 buckets, on a locating and fit-up feature. FOD on 40 of 92 buckets (43.5%).	Blend and weld repair review at the pin slot areas, restore contact and fit-up, and inspect for stress concentration.	A locating and fit-up feature with FOD on nearly half the set, requiring restoration of contact and fit-up across the set.
8	Leading edge FOD	Leading edge FOD on 7 of 92 buckets (7.6%): Items 1, 2, 25, 53, 67, 71, 72.	Blend and weld repair review of the leading edge, removal of stress concentration, and FPI after repair.	Airfoil leading edge damage affects the aerodynamic profile and the crack initiation risk.
9	Airfoil corrosion and oxidation	Corrosion on 92 of 92 airfoils. Metallurgical sectioning shows oxidation corrosion with substrate alloy depletion.	Grit blast and surface cleaning, removal of affected material, metallurgical acceptance, and heat treatment and NDT as applicable.	The full airfoil population shows corrosion exposure and the base metal shows substrate alloy depletion.
10	Welding and material build-up scope	Weld build-up of the seal fin and cutter tooth, the Z-notch and shroud, and the angel wing areas across the affected set.	Weld build-up, blend, machining and EDM, intermediate FPI, post repair heat treatment, and final inspection.	This is not one local weld. It is multi feature material restoration across the full set.
11	Machining and EDM scope	Machining and EDM to restore the seal fin and cutter tooth configuration, recreate the Z-notch and shroud profiles, and recreate the angel wing dimensions.	Precision machining and EDM, CMM and dimensional verification, profile restoration, and final visual and FPI inspection.	Major geometry recovery of multiple critical features. Function depends on restored sealing, engagement, and fit-up dimensions.

12	Heat treatment and inspection burden	At least 3 heat treatment cycles (incoming solution, post repair solution, final age) and at least 5 FPI and NDT control points.	Full thermal recovery sequence, repeated NDT, dimensional inspection, final QA, and balance chart.	Multiple heat treatment and NDT cycles create high repair complexity and engineering risk.
13	Set level balance and release control	Moment weigh of all buckets and balance chart required. Blade location labeling required for assembly.	Moment weigh, balance chart, blade location labeling, final visual inspection, final report, and controlled packing.	Set level balance and positional control confirm a complete set restoration process.

7. Repair Severity Determination (Level 9 Basis)

Each core review category is assessed against the measured incoming condition of the set and assigned a severity level on the UNEW ten level scale.

Review Category	Level	Basis from the Measured Condition	Band
Welding and Material Build-up	9	Full-set weld build-up on the seal fin/cutter tooth (WM routing) and Z-notch/shroud (WB routing) on 92 of 92 buckets, plus angel wing weld build-up where defect depth exceeds the blend limit (36 buckets with FOD as the minimum weld population). This is not one local weld. It is multi feature reconstruction across the full set.	Heavy
Dimensional Restoration	9	Seal fin height rejected across the full set. EDM and machining required to recreate seal fin, cutter tooth, Z-notch, shroud, and angel wing geometry. Set level moment weigh and balance chart required.	Heavy
Coating and Base Metal Condition	8	Corrosion on 92 of 92 airfoils. Metallurgical sectioning confirms oxidation corrosion with substrate alloy depletion on the uncoated hot gas path surface. Controlled material removal and metallurgical acceptance required.	Heavy
Cooling Hole and Cooling Passage Recovery	N/A	The 3rd stage bucket is a solid (uncooled) component, so cooling passage recovery is not a driver. The related gas path concern is sealing and engagement, which is covered under welding and dimensional restoration.	Not a driver
Inspection, Heat Treatment, and Engineering Risk	9	At least 5 FPI and NDT control points and at least 3 heat treatment cycles. Full dimensional verification, set level moment and balance control, and serial control of all 92 buckets. Second service cycle and 21,605 service hours increase engineering and acceptance risk.	Heavy

Governing classification. Under the UNEW method the more severe technical condition governs the classification. The welding, the dimensional restoration, and the inspection and engineering risk

categories each fall in the Level 9 band, and the base metal condition falls in the Level 8 band. Taken together, the set is classified as **HEAVY REPAIR, LEVEL 9 (Severe Heavy Repair)**.

Composite severity scoring (applicable-category basis). Each applicable review category carries a maximum score of 5. The measured incoming condition scores as follows:

Review Category	Assigned Level	Score (max 5)
Welding and Material Build-up	9	5
Dimensional Restoration	9	5
Coating and Base Metal Condition	8	4
Cooling Hole and Cooling Passage Recovery	N/A - feature not present	Excluded
Inspection, Heat Treatment, and Engineering Risk	9	5
Composite severity score	-	19 of 20 applicable (95%)

Scoring rule for non-applicable categories. Under the UNEW method, a category that does not exist on the component type is excluded from both the score and the applicable maximum; it is not scored as zero. The 3rd stage bucket is a solid, uncooled casting: it has no cooling holes or internal passages to assess. Scoring a feature the component does not possess would treat the absence of a feature as the absence of damage, which is not a valid measurement. The composite severity is therefore 19 of 20 applicable points (95%), with three of the four applicable categories at the maximum score of 5. On the full five-category scale used for cooled components, the Level 9 band corresponds to 82-100% of the applicable maximum; at 95%, this set sits in the upper region of the Level 9 band. The governing-condition rule in Section 4 reaches the same result independently: the most severe applicable condition, Level 9, is present in three separate categories and governs the classification.

Why the set is not Level 8. Level 8 covers heavy repair concentrated at a single critical feature or a limited part of the population. This set requires simultaneous multi-feature reconstruction of three critical features - seal fin/cutter tooth, Z-notch/shroud, and angel wing - on 100% of the 92-bucket population, together with a full-set dimensional rejection of the seal fin height (Section 8, all measured items below the acceptance minimum) and foreign object damage on 43.5% (location pin slot) and 39.1% (angel wing) of the set. The workload is set-wide and multi-feature; it cannot be contained within the single-feature envelope of Level 8.

Why the set is not Level 10. Level 10 applies where the base material condition or the restoration risk places the component beyond economical repair and into replacement. The metallurgical sectioning result in Section 9 confirms the GTD 111 base material as sound, with the oxidation corrosion layer and substrate alloy depletion removable by controlled cleaning and grit blasting. The sound base material is the sole reason this set remains within the repairable range: the set is held at Level 9 of 10 (upper boundary of the repairable band), and not at Level 10 replacement.



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8. Dimensional Measurement Summary

General dimensional measurements were recorded for 46 inspected bucket items at dimensions A, B, C, D, E, and G. The range below is the dimensional baseline used for repair and post repair verification. The classification is not based on the dimensional spread alone. It is based on the combined damage and restoration requirement across the critical features.

Dimension	Minimum (mm)	Maximum (mm)	Range (mm)	Measured Items
A	416.34	416.68	0.34	46
B	75.83	76.06	0.23	46
C	33.00	33.11	0.11	46
D	33.97	34.15	0.18	46
E	1.36	1.67	0.31	46
G	32.94	33.21	0.27	46

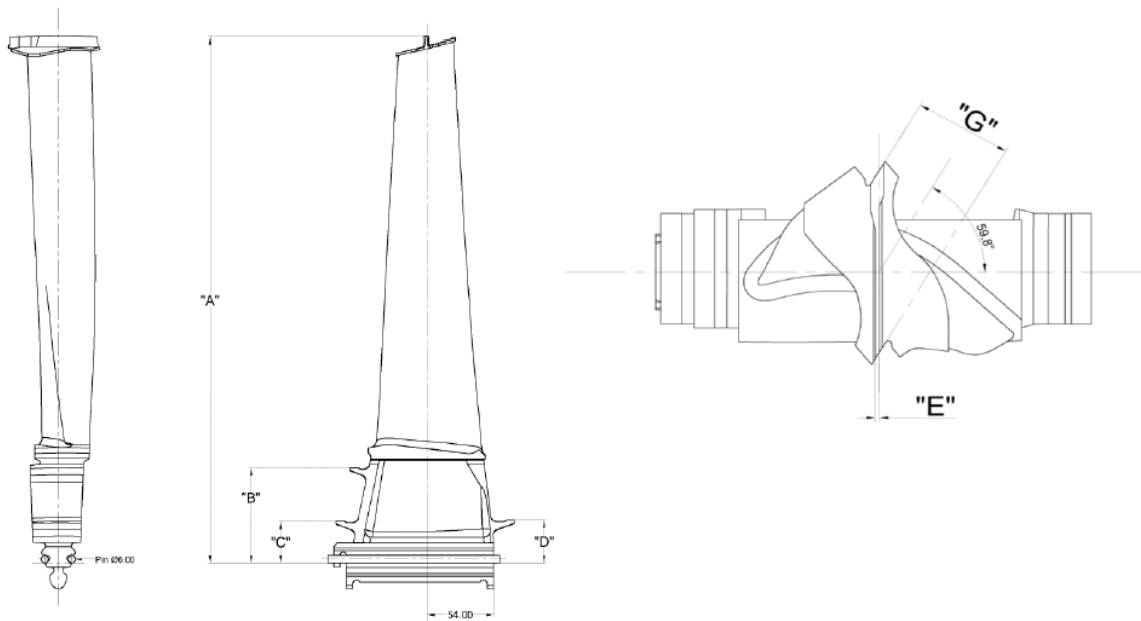
General dimensions data table (unit: mm).

Item	A	B	C	D	E	G
2	416.52	75.88	33.02	34.04	1.54	33.03
4	416.58	75.94	33.11	34.09	1.51	33.09
10	416.59	76.02	33.03	34.09	1.59	33.05
11	416.46	75.84	33.02	33.97	1.43	32.99
13	416.57	75.94	33.02	33.98	1.52	33.09
14	416.52	75.92	33.06	34.02	1.57	33.01
15	416.57	75.93	33.05	34.05	1.36	32.95
16	416.58	75.99	33.06	34.10	1.60	33.11
17	416.55	75.95	33.07	34.08	1.38	33.12
19	416.53	75.92	33.02	34.03	1.59	32.94
20	416.54	75.90	33.05	33.98	1.52	33.06
24	416.57	75.93	33.04	34.05	1.56	33.14
26	416.57	75.89	33.03	34.01	1.52	33.13
30	416.57	75.94	33.10	34.09	1.67	33.21
32	416.60	75.83	33.04	34.05	1.54	32.97
34	416.58	75.90	33.06	34.03	1.52	33.08
35	416.55	75.99	33.01	34.08	1.47	33.06
37	416.48	75.83	33.00	34.01	1.42	33.00
39	416.57	75.90	33.04	34.01	1.53	33.11
41	416.59	75.93	33.03	34.04	1.59	33.03
43	416.34	76.05	33.06	34.10	1.56	33.12
44	416.61	76.04	33.10	34.06	1.50	33.10
45	416.62	75.93	33.00	34.02	1.49	33.18
48	416.53	76.02	33.09	34.08	1.60	33.00



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50	416.57	75.83	33.01	34.09	1.58	33.06
56	416.57	75.97	33.05	34.08	1.49	33.04
59	416.60	76.01	33.06	34.08	1.52	33.15
63	416.57	75.98	33.01	34.09	1.41	33.03
64	416.68	75.85	33.00	34.15	1.57	33.09
66	416.62	75.99	33.06	34.01	1.51	33.06
68	416.55	75.98	33.04	34.07	1.51	33.06
69	416.62	76.04	33.03	34.13	1.64	33.13
70	416.66	75.91	33.03	34.01	1.56	33.12
73	416.51	75.99	33.08	34.00	1.50	33.11
74	416.58	75.93	33.02	34.06	1.52	33.09
75	416.60	75.96	33.03	34.10	1.52	33.14
76	416.59	75.94	33.00	33.99	1.49	33.06
77	416.62	75.91	33.02	34.02	1.57	33.07
78	416.61	75.95	33.00	34.04	1.50	33.14
82	416.60	75.98	33.07	34.05	1.42	33.21
83	416.59	76.06	33.04	34.12	1.62	33.13
84	416.58	75.97	33.03	33.97	1.57	33.12
85	416.61	75.99	33.06	34.10	1.58	33.09
86	416.57	75.95	33.03	34.05	1.55	33.00
88	416.59	75.90	33.03	34.09	1.52	33.11
91	416.54	75.91	33.03	34.00	1.56	33.07



Dimension key and acceptance basis.

Dimension	Feature	Acceptance Basis at Incoming
A	Overall bucket length, root datum to tip	Reference baseline for repair and post-repair verification
B	Platform width	Reference baseline
C	Fir-tree root width at top serration	Reference baseline
D	Fir-tree root depth	Reference baseline

E	Tip seal fin height above shroud surface	Acceptance minimum 2.00 mm; below minimum = REJ
G	Tip shroud width across Z-notch contact faces	Reference baseline

Seal fin height (Dimension E) rejection analysis - measured basis.

Measurement Item	Measured Result
Measured population	46 of 92 buckets, alternating coverage across the serial range
Acceptance minimum (seal fin height)	2.00 mm
Measured range	1.36 mm (Item 15) to 1.67 mm (Item 30)
Mean / standard deviation	1.528 mm / 0.065 mm
Items below acceptance minimum	46 of 46 (100%); items within limit: 0
Shortfall below minimum	Worst 0.64 mm = 32.0% (Item 15); smallest 0.33 mm = 16.5% (Item 30); mean 0.47 mm = 23.6%
Statistical population bound	Mean + 3 sigma = 1.72 mm, still 13.8% below the acceptance minimum
Corroboration	Defect legend record: seal fin height REJ on 92 of 92 buckets

Interpretation. Every measured bucket fails the seal fin height acceptance minimum, and the shortfall is not marginal: the best bucket in the measured population is 16.5% below the minimum and the mean shortfall is 23.6%. The statistical upper bound of the measured population (mean plus three standard deviations, 1.72 mm) remains 13.8% below the acceptance minimum, and the 2.00 mm acceptance minimum lies 7.3 standard deviations above the measured mean. No measured bucket approaches the limit. The measured data, together with the 92 of 92 REJ record on the defect legend sheet (Appendix B), supports full-set rejection. This is the direct measured driver for the Score 5 Dimensional Restoration assessment in Section 7: the deficit is lost material on a critical sealing feature, and no blend-only route exists - recovery requires weld build-up followed by machining and EDM to recreate the seal fin and cutter tooth geometry on every bucket.

Measurement coverage and method. The 46 measured items were selected on an alternating basis across the serial range to provide representative coverage of the 92-bucket population; the complete per-bucket condition record for all 92 buckets is issued as Appendix B of this report (key per Section 10). Dimensions were recorded with a calibrated digital height gauge and CMM under the UNEW gauge control register. Dimensions A to D and G show tight, uniform spreads (0.11 to 0.34 mm across 46 items) and are recorded as the repair baseline only; they carry no incoming acceptance limit and do not offset the seal fin rejection.

9. Material and Metallurgical Evaluation

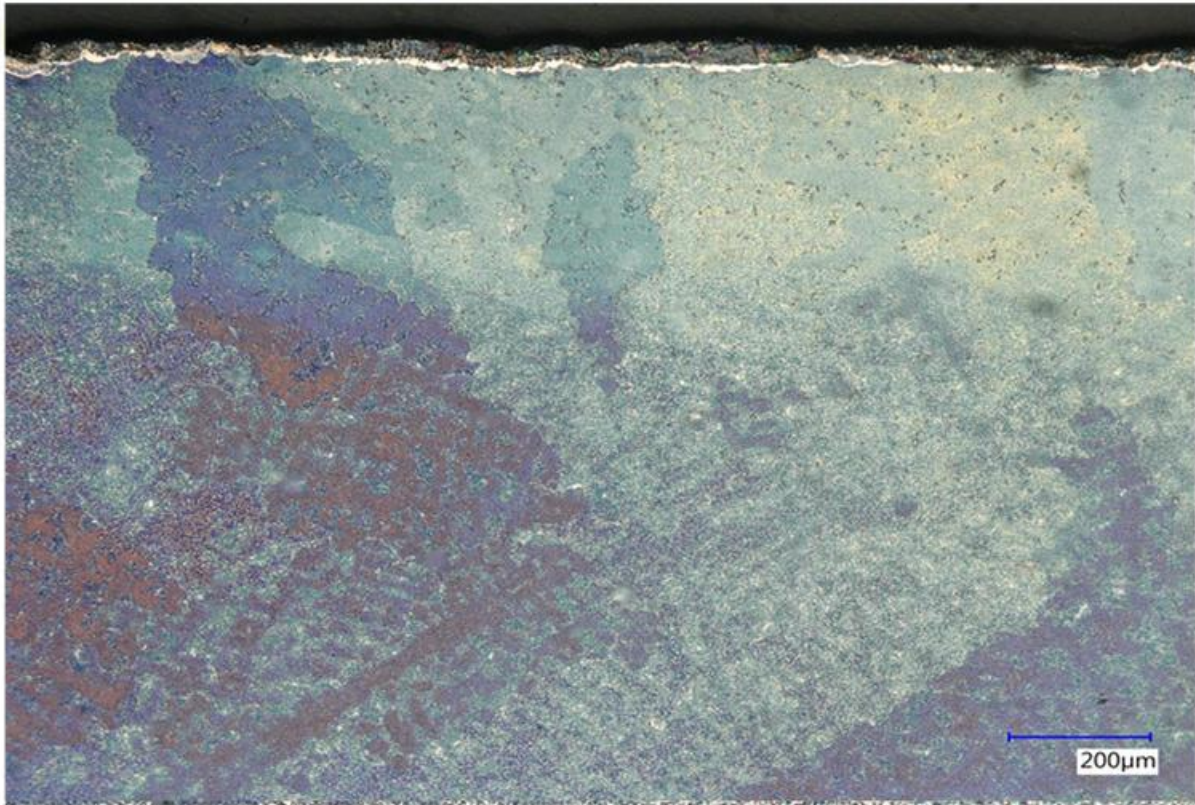


Fig.1 Showing the hot gas path surface condition. (Etched)

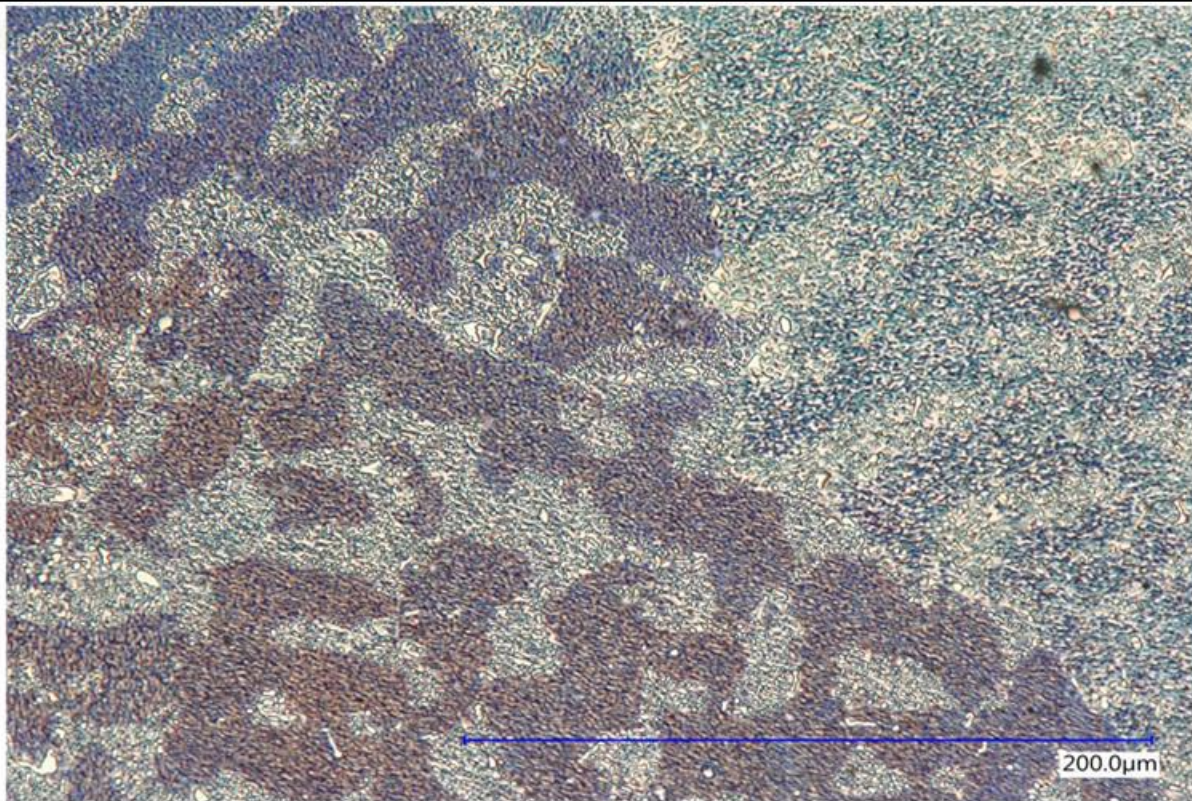


Fig.2 Showing the typical microstructure at higher magnification. (Etched)

A cut section taken from NSRP bucket Item 42 (Serial E1SH018093), shroud cutting location, was mounted under Report No. L11447 to confirm whether the serviced material remains acceptable for repair. The hot gas path surface was uncoated and showed oxidation corrosion with associated substrate alloy depletion. The base material was confirmed as GTD 111 alloy, with fine grain boundary carbide and a gamma matrix with fine gamma prime, primary carbide, and dispersed secondary carbide.

Element	Co	Cr	Ni	Ti	W	Ta	Mo	Fe	Al
Nominal	9.5	14.0	Bal	4.9	3.8	2.8	-	-	4.0
Result	9.7	13.1	59.8	4.7	4.0	2.9	-	-	4.0

Coating type: no coating. Nearest alloy: GTD 111.

The base material is repairable after removal of the oxidation corrosion products and the affected surface material by controlled cleaning and grit blasting. However, the combined surface degradation, the weld build-up, the EDM and machining, the repeated inspection, and the heat treatment scope support the Level 9 classification. Final acceptance is subject to dimensional restoration, heat treatment, FPI and NDT verification, and final acceptance inspection.

Sectioning representativeness and quantified results. A second confirmation section was taken at the same shroud cutting location from Item 92 (Serial E1SH017520) and showed equivalent microstructure and surface condition; the result is held on file under Report No. L11447. The

measured depth of the oxidation corrosion layer with associated substrate alloy depletion is approximately 60 to 90 micrometres below the hot gas path surface, within the range recoverable by controlled surface removal. Hardness of the sectioned coupon was recorded at 40.2 HRC, within the UNEW acceptance range for serviced GTD 111 and consistent with weld repair eligibility after solution heat treatment. The sectioned coupons are representative of the full population: airfoil corrosion was verified on 92 of 92 buckets by visual and fluorescent penetrant inspection, and both coupons were taken from the feature region with the highest surface exposure.

10. Defect Legend Record and Key

The per bucket defect legend record sheet records the required repair operation for each of the 92 buckets at each feature. Across the full set, the record shows Weld and Machining (WM) on the seal fin, Weld and Blend (WB) on the cutter teeth and shroud areas, Blend repair (B) at other locations, and seal fin height recorded as REJ (dimension unacceptable, repair required) on all 92 buckets. Single item findings such as the Z-notch missing material on Item 72 and the leading edge FOD on Items 1, 2, 25, 53, 67, 71, and 72 are also recorded. The full per bucket record sheet for all 92 buckets is issued as Appendix B of this report.

Grading versus classification. The light / medium / heavy grading recorded on the defect map and legend sheet describes surface appearance for process routing only; the repair classification follows the restoration that the affected location demands (Section 4). The seal fin, Z-notch, and angel wing carry near-zero blend allowance: even light-graded fretting on a dimensionally rejected sealing feature mandates weld build-up, machining and EDM, and full geometry recreation. A light-graded surface condition on a critical sealing or engagement feature therefore remains a heavy repair driver.

Defect map reconciliation. On the map sheets, the IPRS process designation GEBL03M6FA is the UNEW internal routing code corresponding to P/N 101T5421 G001 / 101T5421 G002. The authoritative item enumerations are those recorded in this section and Section 6: leading edge FOD on Items 1, 2, 25, 53, 67, 71, and 72 (7 of 92 buckets); location pin slot FOD on 40 of 92 buckets; angel wing FOD on 36 of 92 buckets; Z-notch missing material on Item 72; and metallurgical sectioning locations at the shroud on Items 42 and 92.

Code	Meaning
B	Blend repair to be performed within the location blend limits.
WB	Weld and Blend to be performed based on the area limits and the defects detected.
WM	Weld and Machining to rebuild material and restore the original dimensions and contours.
WE	Welding and EDM to rebuild material and restore the original dimensions.
TPR	Transient Phase Restoration to be performed based on the defects detected.
ACC	Acceptable as is.
REJ	Dimension unacceptable. Repair required, or cause for scrap.
S	Non repairable / scrap.

11. Damage Summary and Disposition

Damage Category	Finding (As Inspected)	Disposition
Seal fin and cutter teeth frettage and wear	Frettage on the seal fin and cutter teeth on 92 of 92 buckets. Seal fin height recorded as REJ across the set.	Weld build-up, machining and EDM restoration, FPI, and dimensional verification.
Z-notch wear and missing material	Z-notch frettage on 92 of 92 buckets, on a critical engagement feature. Item 72 shows 2 mm x 3 mm (approximately 6 mm ²) missing material at the Z-notch.	Weld build-up, EDM and machining to recreate the Z-notch and shroud profiles, and repeated FPI and NDT.
Angel wing frettage and FOD	Angel wing frettage on 92 of 92 buckets, on a critical interface feature. Angel wing FOD on 36 of 92 buckets.	Weld build-up, machining to recreate the angel wing dimensions, and profile restoration.
Airfoil corrosion and surface degradation	Corrosion on 92 of 92 airfoils. Metallurgical sectioning shows oxidation corrosion and substrate alloy depletion.	Controlled cleaning, defect removal, blending, and FPI verification.
Leading edge and location pin slot FOD	Leading edge FOD on 7 of 92 buckets. Location pin slot FOD on 40 of 92 buckets.	Blend repair, weld repair where required, and dimensional and visual verification.
Base material condition	GTD 111 base material confirmed. Considered repairable after grit blast cleaning.	Repairable under the Level 9 scope with final inspection verification.

12. Required Restoration Scope

The following scope is required to return the set to a serviceable, warrantable condition. The scope is applied across the full set under serial control.

- Weld build-up and restoration of the seal fin and cutter tooth areas.
- Weld build-up and restoration of the Z-notch and shroud areas.
- Weld build-up and restoration of the angel wing areas where defect depth exceeds the blend limit, with machining to recreate the angel wing dimensions on all buckets.
- Machining and EDM to restore the seal fin and cutter tooth configuration.
- EDM to recreate the Z-notch and shroud profiles.
- Machining to recreate the angel wing dimensions.
- Blend repair and removal of defects at the leading edge and the location pin slot as required.
- Grit blast cleaning and removal of oxidation corrosion and affected surface material.
- Incoming solution heat treatment, post repair solution heat treatment, and final age heat treatment (at least 3 cycles).
- FPI and NDT at incoming, after defect preparation, after weld and profile restoration, after post repair solution heat treatment, and after final age heat treatment (at least 5 control points).

- Dimensional and CMM verification.
- Shot peen of the fir-tree root.
- Moment weighing of all buckets, balance chart, and blade location labeling.
- Final visual inspection, final report, controlled packing, and shipment.

Weld reconstruction routing evidence.

Feature	Quantity Affected	Repair Code (Section 10 key)	Evidence
Seal fin / cutter tooth	92 of 92	WM	Defect legend (Appendix B); Dimension E REJ analysis (Section 8)
Z-notch / shroud	92 of 92	WB (WE at Item 72)	Defect legend (Appendix B); Item 72 missing material (Section 5)
Angel wing	92 of 92 restoration; weld on min. 36 of 92	B; WB where beyond blend limit	Defect legend (Appendix B); FOD count and measured detail (Section 5)

Quantified restoration workload. Expressed as countable operations, the scope above comprises: 184 full-set weld reconstructions on the seal fin/cutter tooth (WM) and Z-notch/shroud (WB) features (2 features x 92 buckets), plus angel wing weld build-up on a minimum of 36 buckets where defect depth exceeds the blend limit - at least 220 weld operations in total; 92 machining and EDM geometry recoveries covering the seal fin/cutter tooth, Z-notch/shroud, and angel wing dimensions; at least 460 FPI and NDT inspections (5 control points x 92 buckets); 276 furnace exposures (3 heat treatment cycles x 92 buckets); 92 fir-tree root shot peen operations; and 92 individual moment weighs consolidated into one set level balance chart, under serial number control of all 92 buckets from receipt to release.

13. Serviceability

The affected features control gas path sealing, clearance, bucket to bucket engagement, contact stability, and set balance. UNEW restores these features to their design condition across the full set so that the set returns to a reliable, serviceable condition that UNEW can warrant.

The Level 9 scope, with weld build-up, geometry recovery, heat treatment, NDT, dimensional verification, and set level balance control, returns the set fully restored and under warranty. The set is handled as one balanced turbine bucket set under serial control of all 92 buckets.

14. Repair Recommendation

Based on the incoming inspection, UNEW recommends that the complete set of 92 MS6001FA 3rd stage buckets be restored under the Level 9 scope defined in this report. Repair severity follows the condition and location of the affected features and the restoration they require across the full set, in line with the UNEW repair severity method in Section 4.

- Proceed with the Level 9 restoration scope defined in Section 12, applied to all 92 buckets under serial number control.

- Treat the set as one balanced turbine bucket set. Do not plan, release, or classify the work as isolated single bucket repairs.
- Maintain serial number control for all 92 buckets through every step, from incoming inspection to final moment weigh and balance chart.
- The repair is held at the agreed customer hold point pending NSRP authorization to proceed with the Level 9 Heavy Repair scope.
- Carry out the staged inspection and heat treatment plan in full, with FPI and NDT at each control point and the three heat treatment cycles described in Section 12.
- Complete dimensional and CMM verification, moment weighing, balance chart, blade location labeling, and final visual inspection before release.
- Release the set only after successful repair, dimensional verification, FPI and NDT results, heat treatment records, and moment and balance verification, with final acceptance documentation.

UNEW Engineering classifies this set as **HEAVY REPAIR, LEVEL 9**. NSRP authorization is required to proceed with the defined Level 9 repair scope so that the complete set can be returned fully restored and under warranty.

15. Final Classification

Classification Item	Disposition
Repair Classification	HEAVY REPAIR
Repair Level	LEVEL 9, SEVERE HEAVY REPAIR
Governing Basis	Severe condition in multiple critical areas across the full set requiring multi feature weld reconstruction, major dimensional restoration, multiple heat treatment cycles, repeated FPI and NDT, and set level balance control. The welding, dimensional restoration, base metal, and inspection and engineering risk categories together place the set in the heavy band.
Scrap Recommendation	None at incoming stage.
Repair Recommendation	Proceed with the Level 9 scope and final verification before release.
Final Acceptance	Subject to successful repair, dimensional verification, FPI and NDT, heat treatment records, moment and balance verification, and final release documentation.

Based on the incoming inspection findings, this set requires repair beyond the standard and medium refurbishment scope. The classification is **HEAVY REPAIR, LEVEL 9 (Severe Heavy Repair)**.

Classification basis - summary statement. Dimension E seal fin height is below the 2.00 mm minimum on 46 of 46 measured buckets, with 92 of 92 REJ confirmed by the defect legend (Appendix B). This full-set rejection is combined with Z-notch/shroud, angel wing, and location pin slot damage on critical sealing and fit-up features, confirmed airfoil corrosion with substrate alloy depletion, multiple weld, machining and EDM operations, three heat treatment cycles, at least five



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FPI/NDT control points, and set level moment and balance control. Any classification below HEAVY REPAIR, LEVEL 9 does not reflect the measured incoming condition or the required restoration scope.



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Appendix A. Serial Number Correlation

Incoming inspection part number correlation sheet for the complete set of 92 buckets. This sheet is for identification and serial control only and is not to be used for blade assembly or positioning. Material for all items is GTD 111.

Item	Part No.	Serial No.	Item	Part No.	Serial No.
1	101T5421 G002	E1SH017665	47	101T5421 G001	E1SH017855
2	101T5421 G001	E1SH017850	48	101T5421 G001	E1SH017875
3	101T5421 G001	E1SH018088	49	101T5421 G001	E1SH018102
4	101T5421 G001	E1SH017854	50	101T5421 G001	E1SH017991
5	101T5421 G001	E1SH017864	51	101T5421 G001	E1SA001923
6	101T5421 G001	E1SH017990	52	101T5421 G001	E1SA001867
7	101T5421 G001	E1SH018098	53	101T5421 G001	E1SH018005
8	101T5421 G001	E1SA001872	54	101T5421 G001	E1SA001877
9	101T5421 G001	E1SH018006	55	101T5421 G001	E1SH018096
10	101T5421 G001	E1SH018091	56	101T5421 G001	E1SH017860
11	101T5421 G001	E1SH018003	57	101T5421 G001	E1SH017858
12	101T5421 G001	E1SH017876	58	101T5421 G001	E1SH018009
13	101T5421 G001	E1SH018023	59	101T5421 G001	E1SH018004
14	101T5421 G001	E1SA001879	60	101T5421 G001	E1SA001887
15	101T5421 G001	E1SH017872	61	101T5421 G001	E1SH017859
16	101T5421 G001	E1SA001876	62	101T5421 G001	E1SA001875
17	101T5421 G001	E1SH017606	63	101T5421 G001	E1SH018007
18	101T5421 G001	E1SA001913	64	101T5421 G001	E1SA001921
19	101T5421 G001	E1SH018092	65	101T5421 G001	E1SH017871
20	101T5421 G001	E1SH018090	66	101T5421 G001	E1SH017998
21	101T5421 G001	E1SA001954	67	101T5421 G001	E1SH018089
22	101T5421 G001	E1SH018108	68	101T5421 G001	E1SH018104
23	101T5421 G001	E1SH018021	69	101T5421 G001	E1SH017849
24	101T5421 G001	E1SH018106	70	101T5421 G001	E1SH017995
25	101T5421 G001	E1SH018033	71	101T5421 G001	E1SA001950
26	101T5421 G001	E1SH018097	72	101T5421 G001	E1SH018103
27	101T5421 G001	E1SH017861	73	101T5421 G001	E1SA001885
28	101T5421 G001	E1SH018094	74	101T5421 G001	E1SH017996
29	101T5421 G001	E1SH017873	75	101T5421 G001	E1SH017867
30	101T5421 G001	E1SH017857	76	101T5421 G001	E1SH018107
31	101T5421 G001	E1SH017993	77	101T5421 G001	E1SH017992
32	101T5421 G001	E1SH017999	78	101T5421 G001	E1SH018095
33	101T5421 G001	E1SH018010	79	101T5421 G001	E1SA001874



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34	101T5421 G001	E1SH018109	80	101T5421 G001	E1SH018000
35	101T5421 G001	E1SA001888	81	101T5421 G001	E1SH017862
36	101T5421 G001	E1SA001869	82	101T5421 G001	E1SH017877
37	101T5421 G001	E1SA001880	83	101T5421 G001	E1SH018038
38	101T5421 G001	E1SH018100	84	101T5421 G001	E1SH017997
39	101T5421 G001	E1SH018008	85	101T5421 G001	E1SA001912
40	101T5421 G001	E1SH018022	86	101T5421 G001	E1SH017878
41	101T5421 G001	E1SA001878	87	101T5421 G001	E1SH017994
42	101T5421 G001	E1SH018093	88	101T5421 G001	E1SH018001
43	101T5421 G001	E1SH018002	89	101T5421 G001	E1SA001939
44	101T5421 G001	E1SH018105	90	101T5421 G001	E1SH017863
45	101T5421 G001	E1SH018111	91	101T5421 G001	E1SH017874
46	101T5421 G001	E1SH018110	92	101T5421 G001	E1SH017520

Appendix B. Per-Bucket Defect Legend Record

The per-bucket defect legend record for the complete set of 92 buckets is issued below as Appendix B. Codes are per the Section 10 key (B = blend within location limits; WB = weld and blend; WM = weld and machining; WE = welding and EDM; ACC = acceptable as is; REJ = dimension unacceptable, repair required). Angel wing and location pin slot entries marked WB identify the buckets with recorded foreign object damage in addition to the full-set frettage; all remaining locations carry blend routing for frettage and surface corrosion. Item numbers correlate to serial numbers per Appendix A.

Item	Seal Fin Height	Seal Fin / Cutter Teeth	Z-notch / Shroud	Angel Wing	Location Pin Slot	Leading Edge	Airfoil (HGP)
1	REJ	WM	WB	B	WB	WB	B
2	REJ	WM	WB	WB	WB	WB	B
3	REJ	WM	WB	WB	B	ACC	B
4	REJ	WM	WB	B	B	ACC	B
5	REJ	WM	WB	WB	B	ACC	B
6	REJ	WM	WB	WB	WB	ACC	B
7	REJ	WM	WB	WB	B	ACC	B
8	REJ	WM	WB	WB	B	ACC	B
9	REJ	WM	WB	WB	WB	ACC	B
10	REJ	WM	WB	WB	B	ACC	B
11	REJ	WM	WB	B	WB	ACC	B
12	REJ	WM	WB	WB	WB	ACC	B
13	REJ	WM	WB	WB	B	ACC	B



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14	REJ	WM	WB	WB	WB	ACC	B
15	REJ	WM	WB	WB	WB	ACC	B
16	REJ	WM	WB	WB	WB	ACC	B
17	REJ	WM	WB	WB	WB	ACC	B
18	REJ	WM	WB	WB	B	ACC	B
19	REJ	WM	WB	WB	B	ACC	B
20	REJ	WM	WB	WB	B	ACC	B
21	REJ	WM	WB	WB	WB	ACC	B
22	REJ	WM	WB	WB	WB	ACC	B
23	REJ	WM	WB	B	WB	ACC	B
24	REJ	WM	WB	WB	WB	ACC	B
25	REJ	WM	WB	B	WB	WB	B
26	REJ	WM	WB	WB	WB	ACC	B
27	REJ	WM	WB	WB	WB	ACC	B
28	REJ	WM	WB	WB	B	ACC	B
29	REJ	WM	WB	WB	WB	ACC	B
30	REJ	WM	WB	B	WB	ACC	B
31	REJ	WM	WB	B	B	ACC	B
32	REJ	WM	WB	WB	B	ACC	B
33	REJ	WM	WB	WB	WB	ACC	B
34	REJ	WM	WB	B	B	ACC	B
35	REJ	WM	WB	WB	WB	ACC	B
36	REJ	WM	WB	B	B	ACC	B
37	REJ	WM	WB	B	B	ACC	B
38	REJ	WM	WB	B	WB	ACC	B
39	REJ	WM	WB	WB	WB	ACC	B
40	REJ	WM	WB	B	B	ACC	B
41	REJ	WM	WB	B	WB	ACC	B
42	REJ	WM	WB	B	B	ACC	B
43	REJ	WM	WB	WB	B	ACC	B
44	REJ	WM	WB	WB	WB	ACC	B
45	REJ	WM	WB	WB	WB	ACC	B
46	REJ	WM	WB	WB	WB	ACC	B
47	REJ	WM	WB	WB	WB	ACC	B
48	REJ	WM	WB	WB	WB	ACC	B
49	REJ	WM	WB	WB	WB	ACC	B
50	REJ	WM	WB	B	B	ACC	B
51	REJ	WM	WB	WB	B	ACC	B



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52	REJ	WM	WB	B	B	ACC	B
53	REJ	WM	WB	B	WB	WB	B
54	REJ	WM	WB	B	B	ACC	B
55	REJ	WM	WB	B	WB	ACC	B
56	REJ	WM	WB	B	WB	ACC	B
57	REJ	WM	WB	B	WB	ACC	B
58	REJ	WM	WB	B	B	ACC	B
59	REJ	WM	WB	B	WB	ACC	B
60	REJ	WM	WB	B	B	ACC	B
61	REJ	WM	WB	B	B	ACC	B
62	REJ	WM	WB	B	B	ACC	B
63	REJ	WM	WB	B	B	ACC	B
64	REJ	WM	WB	B	B	ACC	B
65	REJ	WM	WB	B	WB	ACC	B
66	REJ	WM	WB	B	B	ACC	B
67	REJ	WM	WB	B	B	WB	B
68	REJ	WM	WB	B	WB	ACC	B
69	REJ	WM	WB	B	WB	ACC	B
70	REJ	WM	WB	B	WB	ACC	B
71	REJ	WM	WB	B	WB	WB	B
72	REJ	WM	WE	B	B	WB	B
73	REJ	WM	WB	B	B	ACC	B
74	REJ	WM	WB	B	B	ACC	B
75	REJ	WM	WB	B	B	ACC	B
76	REJ	WM	WB	B	B	ACC	B
77	REJ	WM	WB	B	B	ACC	B
78	REJ	WM	WB	B	B	ACC	B
79	REJ	WM	WB	B	B	ACC	B
80	REJ	WM	WB	B	B	ACC	B
81	REJ	WM	WB	B	B	ACC	B
82	REJ	WM	WB	B	B	ACC	B
83	REJ	WM	WB	B	B	ACC	B
84	REJ	WM	WB	B	B	ACC	B
85	REJ	WM	WB	B	B	ACC	B
86	REJ	WM	WB	B	B	ACC	B
87	REJ	WM	WB	B	B	ACC	B
88	REJ	WM	WB	B	B	ACC	B
89	REJ	WM	WB	B	B	ACC	B



INCOMING INSPECTION REPORT

90	REJ	WM	WB	B	B	ACC	B
91	REJ	WM	WB	B	B	ACC	B
92	REJ	WM	WB	B	B	ACC	B

Record totals. Column totals: seal fin height REJ 92 of 92; seal fin/cutter teeth WM 92 of 92; Z-notch/shroud WB 92 of 92 (WE at Item 72); angel wing WB 36 of 92 with B on the remaining 56; location pin slot WB 40 of 92 with B on the remaining 52; leading edge WB 7 of 92 with ACC on the remaining 85; airfoil blend routing 92 of 92. These totals reproduce exactly the quantities used in Sections 5, 6, and 7.

16.0 PHOTOGRAPHS

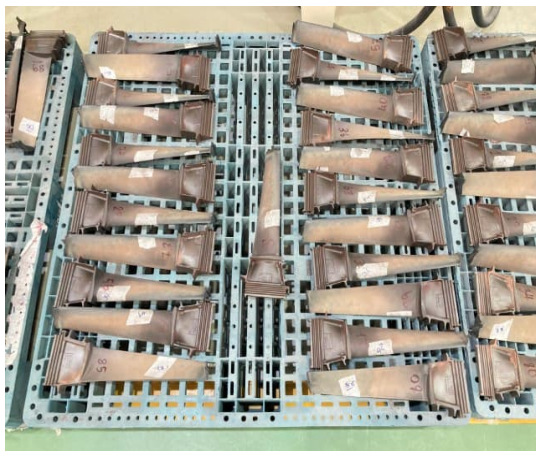


Figure 1. As-received condition.



Figure 2. As-received condition.



Figure 3. As-received condition.



Figure 4. As-received condition.



Figure 5. As-received condition.



Figure 6. As-received condition.

16.0 PHOTOGRAPHS (CONTINUE)



Figure 7. Condition after incoming inspection.



Figure 8. Condition after incoming inspection.



Figure 9. Condition after incoming inspection.



Figure 10. Condition after incoming inspection.



Figure 11. Condition after incoming inspection.



Figure 12. Condition after incoming inspection.

16.0 PHOTOGRAPHS (CONTINUE)



Figure 13. Fretage on seal fin.



Figure 14. Fretage on cutter teeth.

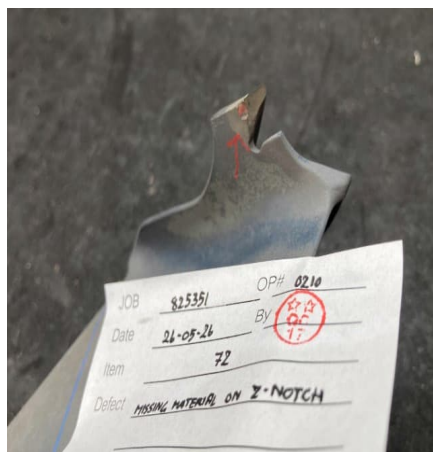


Figure 15. Dent or missing mat. on Z-notch.



Figure 16. Cut sample on shroud.

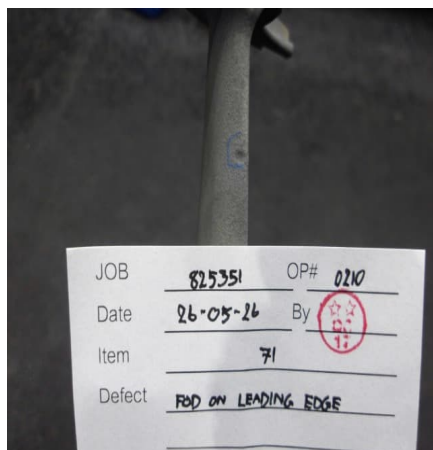


Figure 17. FOD on leading edge.



Figure 18. Corrosion on airfoil.

16.0 PHOTOGRAPHS (CONTINUE)



Figure 19. Corrosion on airfoil.



Figure 20. Corrosion on airfoil.



Figure 21. FOD on angel wing.



Figure 22. Fretage on angel wing.

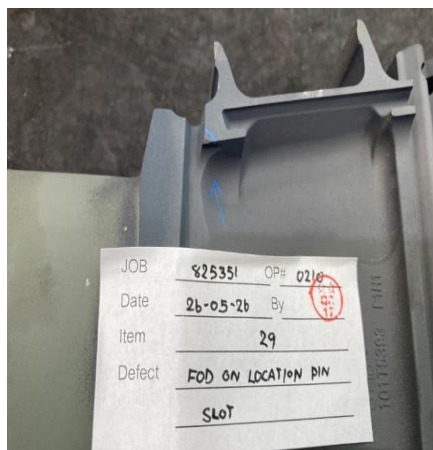


Figure 23. FOD on location pin slot.

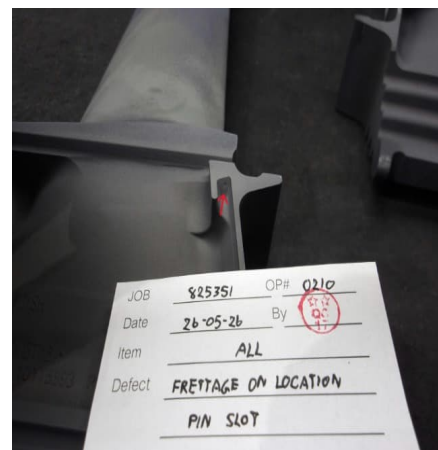
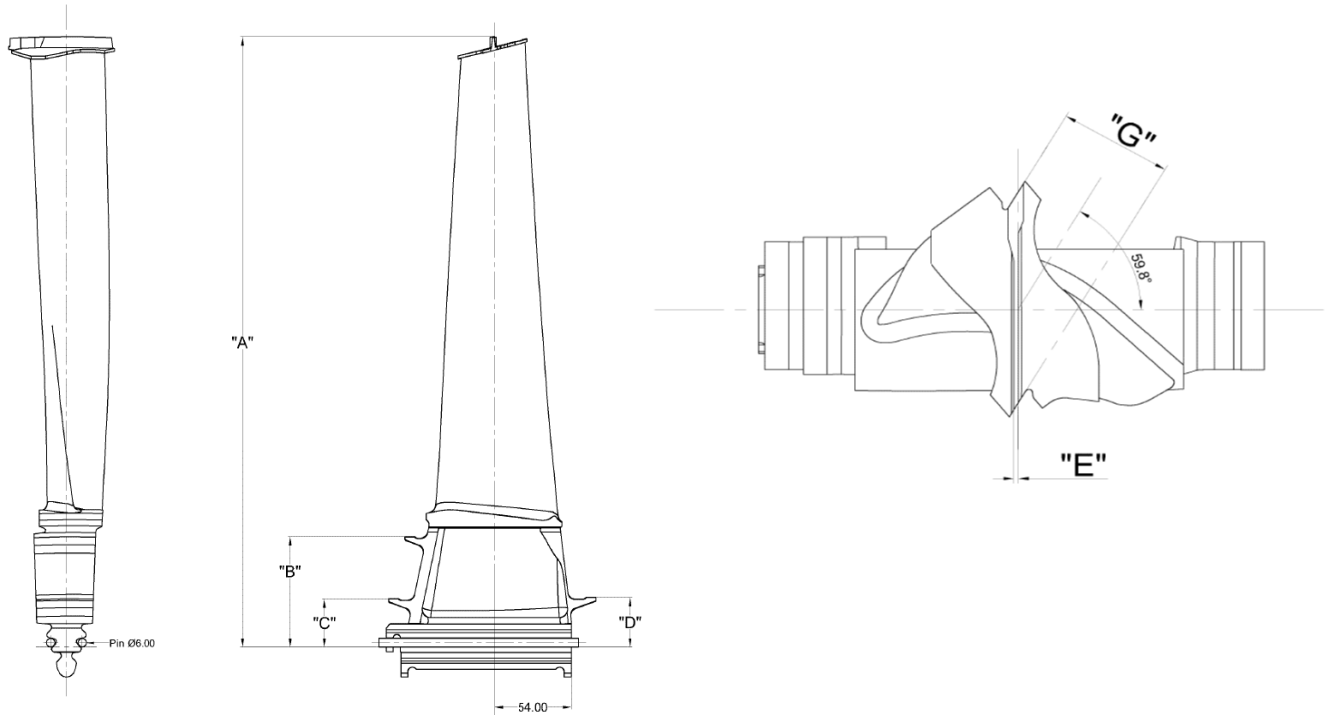


Figure 24. Fretage on location pin slot.

17.0 GENERAL DIMENSION



ANNEX A - QUANTIFIED HEAVY REPAIR WORK SCOPE

3RD STAGE BUCKET

Annex to Incoming Inspection Report, WO-1004061634 / WO-1004061642

Customer	Nghi Son Refinery & Petrochemical LLC	Report Date	27 April 2026
Customer P.O. No.	WO-1004061634 / WO-1004061642	UNEW Work Order	825351
Engine Type	MS6001FA (GE Frame 6FA)	Component	3rd Stage Bucket
Component Part No.	101T5421 G001 and G002	Qty. Received	92 pieces (1 complete set)
Repair Classification	HEAVY REPAIR	UNEW Repair Severity	Level 9 (Severe)

A1. PURPOSE AND SCOPE

This Annex records the work quantity of the repair route required by the recorded incoming condition of this set: how many times each process is performed, at which feature, on how many units, and against which recorded finding.

The repair classification of this set is HEAVY REPAIR, UNEW Repair Severity Level 9 (Severe), as recorded in the incoming inspection report. All quantities in this Annex are taken from the recorded findings, dimensional results, per item dispositions and part quantities of that report. One controlled operation is one process action applied at one feature location on one bucket, or to the complete set where the process is a set level process.

A2. COMPONENT FEATURE COUNT

A process step is one line of the repair route, but it is not one job: it is performed at every affected feature on every bucket. The feature counts below establish the multiplier applied throughout this Annex.

Feature	Per bucket	Complete set	Source in the incoming inspection report
Bucket	1	92	Section 17, serial correlation, 92 buckets received
Seal fin and cutter tooth	1	92	Section 12, repair code WM, 92 of 92 affected
Z notch and shroud	1	92	Section 12, repair code WB, 92 of 92 affected

ANNEX A - QUANTIFIED HEAVY REPAIR WORK SCOPE

Feature	Per bucket	Complete set	Source in the incoming inspection report
Angel wing	1	92	Section 12, 92 of 92 restoration, weld on minimum 36 of 92
Location pin slot	1	92	Section 5, FOD recorded on 40 of 92
Leading edge	1	92	Section 5, FOD recorded on 7 of 92
Fir tree root	1	92	Section 12, shot peen of the fir tree root

A3. RECORDED FINDINGS AND REQUIRED RESTORATION

Finding	Recorded extent	Restoration required	Locations
Seal fin and cutter tooth	Fretage on 92 of 92; dimension E rejected on 92 of 92	Weld build up and restoration, repair code WM	92
Z notch and shroud	Fretage on 92 of 92; missing material at Item 72	Weld build up and restoration, repair codes WB and WE	93
Angel wing	Fretage on 92 of 92; FOD on 36 of 92 with depth beyond the blend limit	Weld build up where defect depth exceeds the blend limit	36
Location pin slot	FOD recorded on 40 of 92	Blend repair and defect removal	40
Leading edge	FOD recorded on 7 of 92, depths to 0.6 mm against a 0.3 mm blend limit	Blend repair and defect removal	7
TOTAL WELD AND DEFECT REMOVAL LOCATIONS			268

ANNEX A - QUANTIFIED HEAVY REPAIR WORK SCOPE

A4. DIMENSIONAL REJECTIONS AND GEOMETRY RESTORATION

The features below are recorded as REJECT or out of limit against fixed acceptance criteria. Each requires physical restoration, not measurement.

Feature	Recorded result	Restoration required	Ops.
Seal fin height, dimension E	REJECT on 92 of 92. Measured range 1.36 to 1.67 mm against a 2.00 mm minimum. Mean 1.528 mm, a mean shortfall of 23.6 percent. The best measured bucket is 16.5 percent below the minimum.	Machining and EDM to restore the seal fin and cutter tooth configuration	92
Z notch and shroud profile	Fretage and rejection recorded on 92 of 92	EDM to recreate the Z notch and shroud profiles	92
Angel wing dimensions	Restoration required on 92 of 92	Machining to recreate the angel wing dimensions	92
TOTAL GEOMETRY RESTORATION OPERATIONS			276

ANNEX A - QUANTIFIED HEAVY REPAIR WORK SCOPE

A5. REPAIR ROUTE WITH WORK QUANTITY

Step	Process, applies to all 92 buckets	Work quantity across the set	Ops.
1	Receipt inspection and serial number recording	92 buckets under serial control	92
1a	Incoming visual inspection	92 buckets	92
2	Grit blast cleaning	92 buckets	92
3	Removal of oxidation corrosion and affected surface material to a defined depth	92 airfoils	92
4	Feature by feature defect mapping against the defect legend record	92 buckets	92
5	Incoming dimensional and CMM measurement	92 dimensional inspections and 92 CMM verifications	184
6	Incoming FPI and NDT, control point 1	92 buckets	92
7	Incoming solution heat treatment	92 furnace exposures, cycle 1 of 3	92
8	Defect preparation at the affected features	92 buckets	92
9	FPI and NDT after defect preparation, control point 2	92 buckets	92
10	Weld build up and restoration of the seal fin and cutter tooth areas, repair code WM	92 buckets	92
11	Weld build up and restoration of the Z notch and shroud areas, repair codes WB and WE	92 buckets plus missing material reconstruction at Item 72	93
12	Weld build up and restoration of the angel wing areas where defect depth exceeds the blend limit	Minimum 36 buckets	36
13	Blend repair and removal of defects at the location pin slot and the leading edge	40 pin slots and 7 leading edges	47
14	FPI and NDT after weld and profile restoration, control point 3	92 buckets	92
15	Post repair solution heat treatment	92 furnace exposures, cycle 2 of 3	92
16	FPI and NDT after post repair solution heat treatment, control point 4	92 buckets	92

ANNEX A - QUANTIFIED HEAVY REPAIR WORK SCOPE

Step	Process, applies to all 92 buckets	Work quantity across the set	Ops.
17	Machining and EDM to restore the seal fin and cutter tooth configuration	92 buckets	92
18	EDM to recreate the Z notch and shroud profiles	92 buckets	92
19	Machining to recreate the angel wing dimensions	92 buckets	92
20	Blend of all restored features to profile	268 restored feature locations	268
21	Dimensional and CMM verification after restoration	92 dimensional inspections and 92 CMM verifications	184
22	Final age heat treatment	92 furnace exposures, cycle 3 of 3	92
23	FPI and NDT after final age heat treatment, control point 5	92 buckets	92
24	Shot peen of the fir tree root	92 buckets	92
25	Moment weighing of all buckets	92 buckets	92
26	Balance chart for the complete stage	1 balance chart	1
27	Blade location labeling and wheel position assignment	92 buckets	92
28	Final visual inspection	92 buckets	92
29	Final report, serial control record and controlled packing	92 buckets, 1 set documentation package	93

ANNEX A - QUANTIFIED HEAVY REPAIR WORK SCOPE

A6. INSPECTION AND HOLD POINT SCHEDULE

Each event below is a hold point. The set does not advance to the next stage until the event is passed and recorded, and a failure at any gate returns the affected part to the repair loop.

Gate	Inspection event	Route step	Events
1	Incoming visual inspection	1a	92
2	Incoming dimensional and CMM measurement	5	184
3	Incoming FPI and NDT, control point 1	6	92
4	FPI and NDT after defect preparation, control point 2	9	92
5	FPI and NDT after weld and profile restoration, control point 3	14	92
6	FPI and NDT after post repair solution heat treatment, control point 4	16	92
7	Dimensional and CMM verification after restoration	21	184
8	FPI and NDT after final age heat treatment, control point 5	23	92
9	Final visual inspection	28	92
TOTAL INSPECTION AND VERIFICATION EVENTS			1,012

ANNEX A - QUANTIFIED HEAVY REPAIR WORK SCOPE

A7. HARDWARE AND RESTORATION CENSUS

Disposition	Quantity	Detail
Restored by weld build up	220 weld operations minimum	184 full set weld reconstructions on the seal fin and cutter tooth (WM) and Z notch and shroud (WB) features, plus angel wing weld build up on a minimum of 36 buckets
Restored by blend repair	47 locations	40 location pin slots and 7 leading edges with FOD beyond the blend limit
Geometry recovered by machining and EDM	276 operations	Seal fin and cutter tooth, Z notch and shroud, and angel wing dimensions on every bucket
TOTAL RESTORATION LOCATIONS ACROSS THE SET	543	

A8. WORK VOLUME OF THE REQUIRED REPAIR SCOPE

Work category	Controlled operations
Cleaning, coating removal and material preparation	460
Structural weld repair, weld build up and profile restoration	268
Geometry restoration, machining and mechanical correction	544
Heat treatment, furnace cycles	276
Inspection, verification and hold point control	1,012
Coating application and acceptance	92
Receipt, assembly, documentation and release control	278
TOTAL CONTROLLED OPERATIONS	2,930

The Heavy Repair scope required by this set consists of 2,930 controlled operations across 92 buckets. It includes a minimum of 220 weld operations across the seal fin and cutter tooth, Z notch and shroud, and angel wing features, 276 machining and EDM geometry recoveries, 276 furnace exposures across three mandatory heat treatment cycles, 737 mandatory inspection events across five FPI and NDT control points, and set level moment weighing and balance charting of the complete rotating stage.

ANNEX A - QUANTIFIED HEAVY REPAIR WORK SCOPE

A9. HEAVY REPAIR - WORK PERFORMED, AND COMPARISON WITH A MEDIUM REPAIR

This set received a **HEAVY REPAIR**. We performed 2,930 controlled operations on 92 MS6001FA 3rd stage buckets. Every line below is work we carried out and recorded.

The **HEAVY REPAIR** work we performed

What we did	Controlled operations	Recorded detail
We stripped the coating and prepared every airfoil	460	All 92 3rd stage buckets, corrosion removed under laboratory control
We rebuilt the seal fin, cutter tooth, Z notch, shroud and angel wing by weld	268	220 weld operations minimum, 184 full set reconstructions
We recovered the geometry by machining and EDM	544	276 restorations, plus 47 locations beyond the blend limit
We ran three heat treatment cycles	276	276 furnace exposures across the set
We inspected and held the set at 9 gates	1,012	5 FPI and NDT control points, 368 CMM measurements
We rebuilt the coating system	92	On a fully restored substrate
We received, weighed, documented and released	278	93 3rd stage buckets weighed and balance charted
TOTAL CONTROLLED OPERATIONS	2,930	On 92 MS6001FA 3rd stage buckets

The measurements that required this work: 543 restoration locations found on incoming dimensional and CMM measurement, 47 locations beyond the location blend limit, corrosion present across the set, and 368 CMM measurements taken before and after restoration.

Repair work hours for the complete set - the same hours shown on the UNEW invoice

Major task	Standard / Medium repair (hours)	HEAVY REPAIR (hours)	Difference
1. Cleaning, surface preparation and defect mapping	129	193	1.5 times (+50%)
2. Airfoil corrosion removal and metallurgical acceptance	74	288	3.9 times (+289%)
3. Welding and material build up	184	695	3.8 times (+278%)
4. Geometry restoration by machining and EDM	129	563	4.4 times (+336%)
5. Heat treatment	0	180	Not performed at Medium
6. Moment weighing, balancing and set control	92	316	3.4 times (+243%)
TOTAL FOR THE SET, 92 PIECES	608	2,235	3.7 times (+268%)

A Standard or Medium repair on this set of 92 MS6001FA 3rd stage buckets is 608 working hours. The **HEAVY REPAIR** we performed is 2,235 working hours. That is 3.7 times more work, 268 percent more. These are the same hours shown on invoice WO-1004061634 / WO-1004061642.

Reviewed and approved
UNEW Engineering



Paul McGuire
Engineering Manager