ENGINEERING REPORT

For:	Transnet Port Terminals (TPT), Saldanha
Project Name:	FEL3 - Saldanha Bulk Terminal Equipment Refit: Stacker Reclaimers, Ship Loaders and Tippler 2. (Phase-4: Stacker Reclaimer 3)
Project Number:	Z.5200160
Author:	World Crane Services
Owner:	Louis Du Toit (Terminal Manager)
Client:	Transnet Port Terminals (TPT)
Project Sponsor:	Andiswa Dlanga (Managing Executive)
Project Manager:	Graham Handley
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SIGNATORIES:

Prepared by: Samuel BEMA — 2021.07.05th
World Crane Services
TPT Consultant
Date

Prepared by: — 30/06/2021
Graham Handley
Snr. Project Manager
Date

Reviewed by: — 30/06/2021
Ebrahim Jacobs
Engineering Manager
Date

Reviewed by: — 30/06/2021
Kallie Niemand
Engineering Manager
Date

Approved by: — 02/07/2021
Carols Engelsman
Senior Engineering Manager
Date

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1 PROJECT BACKGROUND

The Saldanha Terminal on South Africa's West Coast is the country's only dedicated iron-ore terminal. The Saldanha port is linked by rail to key iron-ore mines in the Northern Cape, making it the ideal gateway for the export of seaborne iron-ore.

The Saldanha Terminal is comprised of two operational terminals, namely the Bulk Terminal (BTS) and the Multi-purpose Terminal (MPT) (refer Figure 1 below).

Figure 1. Saldanha Terminal - BTS in the foreground and MPT top right

The MPT is currently a four (4) berth facility that handles a mix of commodities including dry bulk and break bulk cargo for both import and export. The BTS is a specialized iron ore export facility with dedicated equipment for offloading (from rail), storing and exporting (loading onto ships) different grades of iron ore. The iron ore capacity at the BTS is sixty (60) million tons per annum (mtpa).

The BTS's bulk handling equipment includes:

- Two (2) Tandem rotary tipplers;
- Four (4) Stacker-reclaimers (SR) (Figure 2);
- Two (2) Ship Loaders (SL) (Figure 3); and
- Twenty five (25) inter-connected conveying belts.

Figure 2. Stacker-reclaimer at BTS

Figure 3. Ship loaders at the BTS

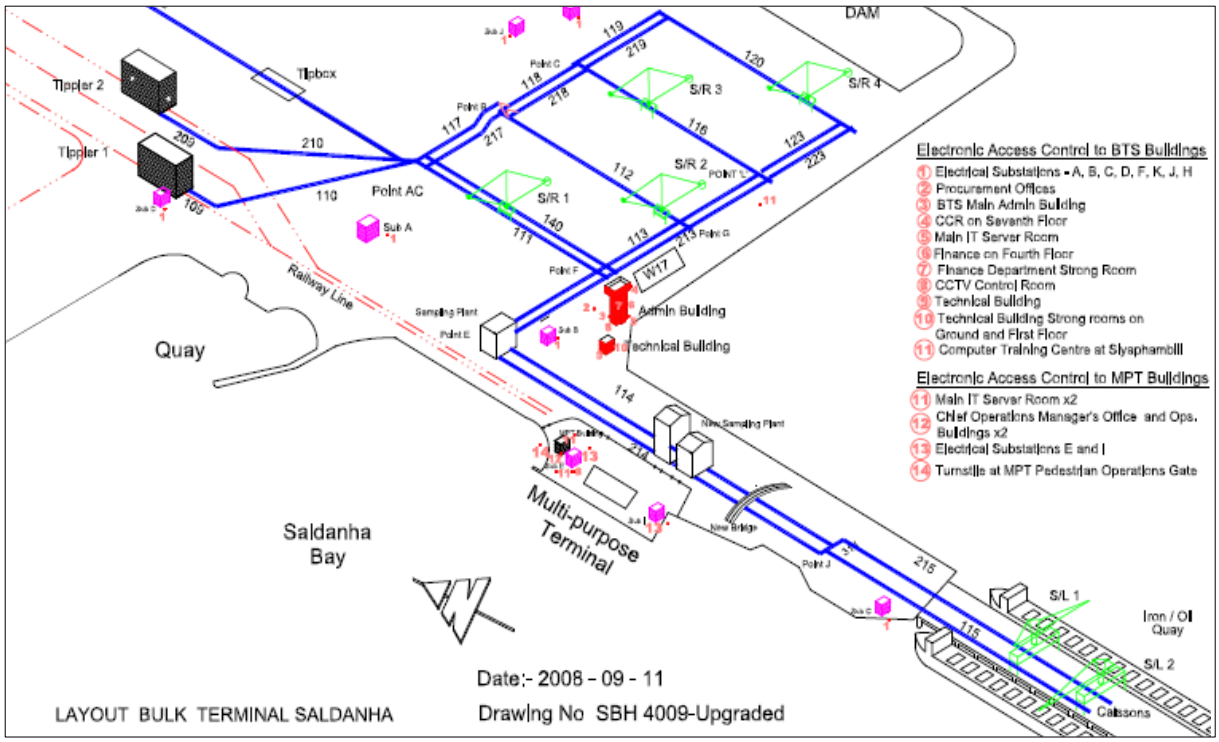

Figure 4. Schematic layout of the Saldanha Bulk Terminal

A refurbishment is required to ensure that machinery remains safe for operation for the remainder of the operational period. Although regular maintenance has been undertaken over the years, critical mechanical, electrical and structural works are required to ensure continued operation of the plant. Table 1 provides a summary of the major BMH equipment at BTS, as well as the key age-related milestones.

Asset	Year built	Midlife	End of life	Upgrade	Refurbishment
Stacker Reclaimer 1	2005	2015	2025	-	2021
Stacker Reclaimer 2	2006	2016	2026	-	2018
Stacker Reclaimer 3	2005	2015	2033***	-	2022/23
Stacker Reclaimer 4	2009	2019	2029	-	2019
Ship loader 1	2005	2015	2025	2008**	2019
Ship loader 2	2004	2014	2024	2008**	2018
Tippler 1	1996	2006*	2016	2000	
Tippler 2	2006	2016	2026	-	

Table 1: Equipment list and key age related milestones

* Refurbished in 2006

** Tripper Cars rebuilt after structural design failure at the expense of the supplier. No work completed on the SL's

*** Additional 10years to End of Life from date of refurbishment

Note - Refurbishments are spread over a number of years to mitigate volume loss, taking into critical scope and long lead items

Transnet Port Terminals has conducted a FEL3 study for the refurbishment of the Bulk Material Handling Equipment at the Bulk Terminal Saldanha.

2 PROJECT SCOPE STATEMENT

The refurbishment is required to ensure that the Bulk Material Handling equipment reaches end of life and to ensure that machinery is safe for operation for the remainder of the operational period. It is expected that with continued maintenance according to the manufacturer's procedures and schedules that a minimum of 10 years would be gained from the date of this refurbishment.

Although regular maintenance has been undertaken over the years, critical mechanical, electrical and structural works are required to ensure continued operation of the plant.

This project scope is limited to the refurbishment of Stacker Reclaimer 3 and Tripper Car 3

The scope can be categorized into three aspects, namely:

- Mechanical - includes components or systems such as the open gear systems, gearboxes, hydraulic systems, and rotating and moving parts (e.g. trunnions, car-clamps);
- Structural - includes wear liners, supporting structures (if required) and areas of possible structural damage (cracking deformation wear). Additionally, includes maintenance detection (e.g. non-destructive testing for fatigue fracturing) of areas where access to certain structures that is not normally possible while equipment is in service;
- Electrical, control and instrumentation - includes panels and drives that are approaching the end of their useful life or have become obsolete or, where newer technologies can be incorporated.

High level assessments have been conducted on all equipment to validate the sequence of refurbishment. The overall project is to be broken down into 4 distinct phases:

- Phase 1: SR2, SL2 (Business Case approved)
- Phase 2: SR4, SL1 (Business Case Approved)
- Phase 3: SR1 (Business Case Approved)
- Phase 4: SR3 (This Submission)
  TP2 (Included in phase 4 but will be executed via its own submission after the completion of Tippler 3)

All execution phases will be centred around the Sept/Oct Annual Industry Iron Ore shut period to mitigate against volume loss.

The high-level deliverables of the FEL4 execution (Phase 4 refit – SR3) includes:

1. Execute agreed volume mitigation plan
2. Procurement and contract award
3. Manage execution of the work & ensure adherence to Transnet's standards & procedures
4. Test, commission and certify completion of the works
5. Draw up project close-out documentation

The refurbishment project is required to ensure the optimal operational use and availability of the existing BMH equipment at the BTS.

The refurbishment project is not an equipment upgrade and no increase in throughput will therefore be realised.

This scope is related to **Phase 4**. This includes the refurbishment of the following equipment only:

- **Stacker Reclaimer 3 and Tripper Car 3**

It has been determined that an eight (8) week refurbishment outage for Stacker Reclaimer 3 is required based around the following milestones:

Key Milestones/Financial year	Date
2021/22 Milestones:	
Gate Review	12 July 2021
Business Case Approval by	16 August 2021
Contract Award by (Principal Contractor & CMC)	08 March 2022
2022/23 Milestones:	
Site Establishment Start	23 August 2022
Execution Start	06 September 2022
Cold Commissioning Complete	20 October 2022
Hot Commissioning Complete	24 October 2022
Sectional Close Out 2022 Complete	31 October 2022
2023/24 Milestones:	
Deliver of Spares/Refurbished Components	10 August 2023
Site Establishment Start	20 September 2023
Execution Start	27 September 2023
Cold Commissioning Complete	03 October 2023
Hot Commissioning Complete	04 October 2023
Sectional Close Out 2023 Complete	11 October 2023
2024/25 Milestones:	
Retention Release Complete	15 October 2024
Final Close Out Complete	29 November 2024

Table 2 - Milestones

Due to the availability of long lead items the execution period will be split:

- 7 weeks – Sept/Oct 2022
- 1 week – Sept/Oct 2023 (Installation of Refurbished Components within Industry shut)

The execution period is centred around the Sept/Oct annual Iron Ore Industry shut period. Proposed from 28th Sept – 7th Oct 2022

Below is the status regarding previous phases of the Program:

Phase 1 Status:

SR2 and SL2 execution commenced in Sept/Oct 2018.

Phase 1 will be 100% complete at the start of Phase 4

Phase 2 Status:

SR4 and SL1 execution commenced in Sept/Oct 2019.

Phase 2 will be 100% complete at the start of Phase 4

Phase 3 Status:

Execution will commence in October 2021.

90% of Phase 3 works are planned to be complete in 2021. The remaining works are planned to be executed within the Annual 2022 Industry Shut and thus do not impact the execution schedule for Phase 4.

Phase 3 & 4 will be managed by different team in different areas and scheduled according to the result of the simulation model.

3 CONDITION ASSESSMENT REPORTS

On-site condition assessments were carried out by WCS in May 2021. Mechanical, Electrical and E C & I condition assessment reports were compiled from their findings:

SR3 E, C & I Condition Assessment report	Appendix A
SR3 Mechanical Condition Assessment report	Appendix B
SR3 Structural Condition Assessment report	Appendix C

4 SCOPE DEVELOPMENT

Scope development as follows:

- SR1, SR2 and SR3 are identical machines, with problems of a similar nature. The detailed scope for SR2 (Phase 1 of the Refit Project) as supplied by the OEM was analysed along with the scope for SR1 (Phase 2 of the Refit project).

- Additional scope from the refurbishment of SR2 & SR1 highlighted potential areas of concern which have been taken into account during SR3's scope development. Lessons Learnt incorporate all applicable Compensation events raised in Phase 1 & 2.
- BTS Engineers via maintenance experience and visual inspections also provided input into the scope for SR3
- Condition assessments carried out by the Bulk Material Handling specialist in May 2021 along with the above inputs provided the final Scope of Works for SR3

5 TECHNICAL LESSONS LEARNT

Category	Lessons Learnt: (Phase 1 – SL2 and SR2)	Mitigations for future phase(s)	Lessons Learnt: (Phase 2 – SL1 & SR4)	Mitigations for future phase(s)
Technical and Construction Management	Dedicated roles for Contractors personnel not defined (e.g. construction, commissioning and quality managers.)	Contractors project organogram with clear reporting lines to be approved by TPT Project Team, prior to execution. .		
	Existing status/faults on equipment not defined prior to execution.	Pre-inspection of equipment to be done by Contractors prior to commencement of construction activities. Inspection to include inter alia operational, limits, electrical, functional, IO and the loop tests. Pre-inspection allowance to be included in the execution schedule.		
	Boom tip repair underestimated due to lack of access during condition assessment	Remeasured after completion of activity. Scope updated for Phase 3 (SR1) and phase 4 (SR3). Budget cost as per Phase 1 CE	The Field DB's were not rated for the extensive welding repairs done on the Boom of SL1	1x Field DB with extensions must be rated to handle heavy welding repairs if needed.
	Bolt replacement originally anticipated to be covered under structural repairs. After cleaning – excessive bolts were found to be missing or corroded.	Remeasured after completion of activity. Scope updated for Phase 3 (SR1) and phase 4 (SR3). 200 bolts to be allowed. Budget cost as per Phase 1 CE.	Availability of Tools and Consumables. Tools being taken out of the stores without a record during night shift. Consumables were only ordered when stock was depleted.	•Storemen to be available 24/7 in the stores and all tools to be recorded before leaving the stores. • All required tools to be available at all times. • Consumables must be checked and ordered well in advance. • Faulty equipment must be reported immediately and replaced. • Both Day & Night Shift Storeman must know what is in their store to prevent confusion.
	NDT's not included in original scope. CE approved for inspection during execution	Scope amended for all future phases	Client Forklift not always available. It was assumed the client forklift would be available when necessary. This was not the case.	Having a small forklift on site permanently would have helped a lot with Bogies and general parts movement. This should be added to the site equipment resources for next year
	Conveyor support frames on the incline and tripper missed out in original scope. Only included for Boom. CE to correct in phase 1	Scope amended for all future phases	Locking mechanism from Tripper to SR4 found to be inadequate. CE to correct.	Investigated on Metso stackers but found to be working as required
	Obsolete Simmacodes found in Gantry E-House. CE to correct in phase 1	Scope amended for all future phases	Dust suppression system included in Scope via CE. Originally anticipated would be part of maintenance activities but full refurbishment required	Also found to be inoperable on Metso stackers so included in future scope
	Air conditioning system found to be underspecified and not working in E-House. CE to correct in phase 1.	Scope amended for all future phases. Conditioning system designed for new VSD's with redundancy included	Hose reel configuration changed. CE to notify of change.	Investigated on Metso machines and included in scope
	Cable for festoons underestimated. CE to correct as not possible to be seen during condition assessments.	Scope amended for future phases	Luffing cylinder replacement did not include for replacement motor/pump. Included via CE	Reviewed but not applicable to Metso Stacker/Reclaimers
	Hose reel configuration changed. CE to notify of change.	Scope amended for future phases	UPS replaced in SR4	Reviewed but not required for Metso Stacker/Reclaimers

	Dust suppression system included in Scope via CE. Originally anticipated would be part of maintenance activities but full refurbishment required	Scope amended for future phases		
	Safety request to install a fire escape davit system at the operators cabin. CE to include	Scope amended for future phases		
	Mid point sump system found to be not working. Originally a maintenance activity by found to be compromising installed scope (i,.e Hose reel) CE to rectify.	Scope amended for future phases		
	Guards missing on various drives. CE raised to correct.	Scope to include for guard where found missing,		

6 CONDITION ASSESSMENT METHODOLOGY AND FLOWCHART SCOPE OF WORKS

The flowchart below represents the methodology/process, used during the FEL3 stage, including the condition assessments, used to produce the outputs required to move to FEL4.

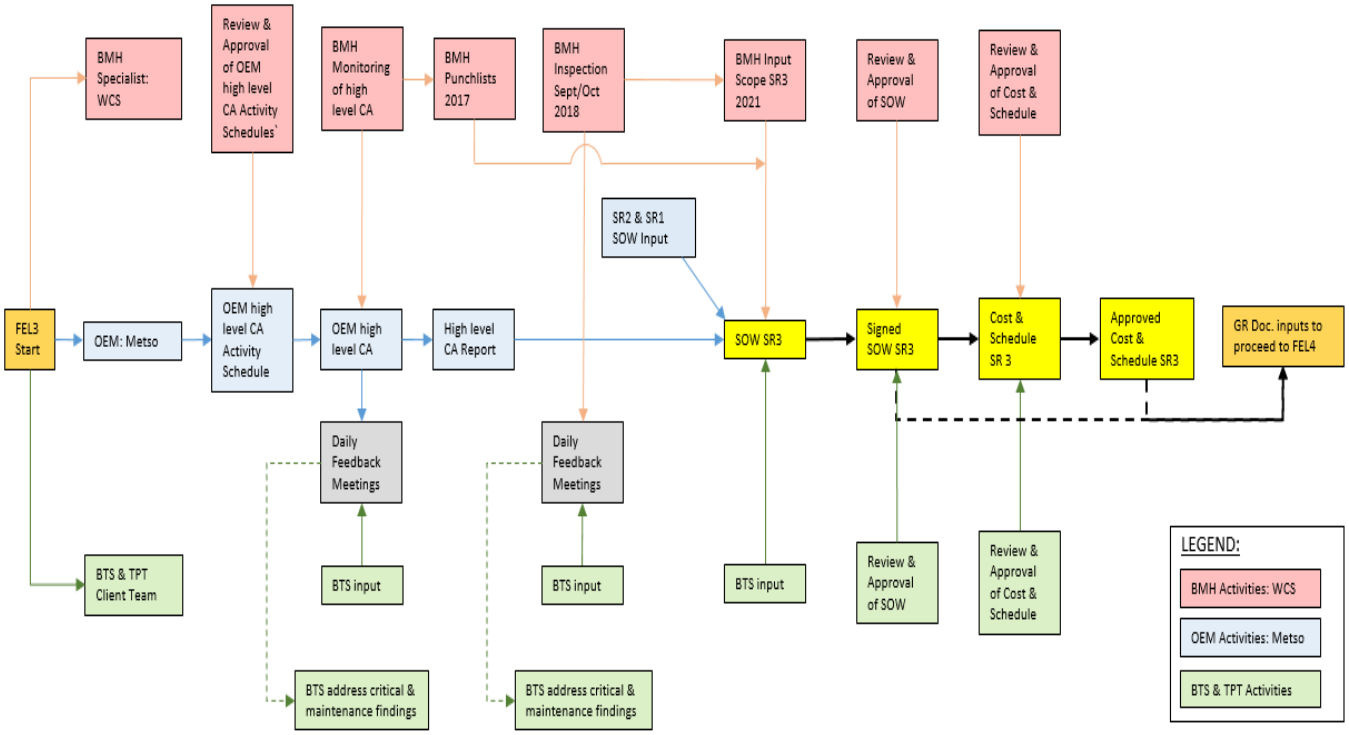

Figure 5- Process Flow Chart

7 SCOPE OF WORKS

The scope of works is presented in table 3. Refer to Appendix D for the detailed scope document.

STACKER RECLAIMER 3– Scope of Work:

EQUIPMENT REFIT PROJECT (PHASE 4)					
STACKER RECLAIMER 3					
SOW No	**DESCRIPTION**	**Sum/No**	**QTY**	**WCS Report**	**Report Item No.**
1	Preliminary and General, project management and overhead costs, all labour, cranage, equipment, vehicles, tools, access requirements, assessing free issue equipment, civils works for site establishment and execution of works, also including meeting the requirements of Health & Safety, Environmental, Quality, Construction Management, Execution and Commissioning, as stipulated in the Scope of Work Includes for any training/familiarization of installed equipment. Contractor to provide a detailed cost breakdown for this item.	Sum	1		
2	SR3 & TC3 high pressure Cleaning	Sum	1	Structural	Note 2
3	Boom tip repair (Including replacement of Wear Bars)	Sum	1	Structural Mechanical	Item no. 7 Item no. 31
4	Replace Wear bars on Boom Tip	Sum	1	Structural Mechanical	Item no. 7 Item no. 31
5	Drive/Idle wheel assemblies (New)	No.	8	Mechanical Electrical	Item no. 1, 2, 3, 4 Item no. 9, 14, 15
6	Drive/Idle wheel assemblies (Refurb)	No.	8	Mechanical Electrical	Item no. 1, 2, 3, 4 Item no. 9, 14, 15
7	Single Idle Wheel assemblies for tripper car (New)	No.	4	Mechanical	Item no. 1, 2, 3, 4
8	Single Idle Wheel assemblies for tripper car (Refurb)	No.	4	Mechanical	Item no. 1, 2, 3, 4
9	Double Idle Wheel assemblies for tripper car (New)	No.	5	Mechanical	Item no. 1, 2, 3, 4
10	Double Idle Wheel assemblies for tripper car (Refurb)	No.	5	Mechanical	Item no. 1, 2, 3, 4
11	Wheels for SR. All remaining wheels to be replaced	No.	64	Mechanical	Item no. 1, 2, 33
12	Centralised Automatic Lube System - refurbish	Sum	1	Mechanical	Item no. 9, 27
13	Travel Brakes. Supply and install (supply 32. i.e 48 less the 16 supplied with the wheel assemblies)	Sum	1	Electrical	Item no. 13, 14
14	Slew Drive Reducers (set of 3)	Sum	1	Structural Mechanical Electrical	Item no. 1, 3 Item no. 21-29 Item no. 7
15	Slew drive reducers - 3 x spare	Sum	1	Mechanical	Item no. 21
16	Bucket Wheel Installation. Contractor to install complete bucket wheel system. Components free issue from terminal.	Sum	1	Structural Mechanical	Item no. 6 Item no. 19, 20
17	Refurb old Bucket Wheel & Receiving chute	Sum	1	Structural Mechanical	Item no. 6 Item no. 19, 20
18	Hose reel.	No.	1	Mechanical	Item no. 37
19	Rail Clamps.	No.	2	Mechanical	Item no. 3

20	Operator Cab (Stainless steel Cab)	No.	1	Structural Electrical	Item no. 1 Item no. 11,
21	Operators Chair	No.	1	Electrical	Item no. 11,
22	S/R T Bar Festoon	No.	1	Electrical	Item no. 19-23
23	Slew Cable Carrier	No.	1	Electrical	Item no. 41
24	Main Power Cable Reel	No.	1	Electrical Mechanical	Item no. 24-27 Item no. 36
25	Slew Drive VFD's (1 x Set)	Sum	1	Electrical	Item no. 4, 5, 6, 34-36
26	Travel Drive VFD's (1 x Set)	Sum	1	Electrical	Item no. 4, 5, 6
27	Bucket wheel VFD Only (1 x Set)	Sum	1	Electrical	Item no. 4, 5, 6
28	VFD spares	Sum	1	Electrical	Item no. 4, 5, 6, 34-36
29	Main PLC Enclosure	No.	1	Electrical	Item no. 37-40
30	3D scan	No.	1	Structural	Note 4
31	Boom/incline/Tripper idlers support frames - replace all. 1 x set as spare	Sum	2	Structural Mechanical	Item no. 16 Item no. 10
32	Corrosion Protection (SR and Tripper car)	Sum	1	Structural	Items no. 1, 2, 9, 11
33	Pr Eng Signoff of support trestles	sum	1	Mechanical	Items no. 19
34	Containers for storage of long lead items on site (will become BTS property)	No.	6	Mechanical	Items no. 41
35	Luffing cylinder, manifold. Replace with new. Supply x 1 spare with stand and test pack.	No.	2	Mechanical Structural	Item no. 14-17 Item no. 1, 2, 4
36	Structural/weld repairs/NDT's of critical areas/Bolt replacement	Sum	1	Structural	Item no. 1, 2, 3, 4, 5, 8, 9, 10, 13, 14, 15. Note 1 & 3
37	Boom Conveyor Drive Train. Supply and install 1 x set. Supply 2 x spare	No.	3	Mechanical Electrical	Item no. 5-8 Item no. 8
38	Incline Conveyor Drive Train. Supply and install 1 x set. Supply 2 x spare	No.	3	Mechanical Electrical	Item no. 5-8, 35 Item no. 8
39	Boom and Incline Conveyor Pulleys. Supply and install 1 x set. Supply 2 x spare	No.	3	Mechanical	Item no. 11
40	Supply and replace Obsolete Simmocode Modules in the Gantry MCC	Sum	1	Electrical	Item no. 37-40
41	Fire Escape point to Operators Cabin	Sum	1	Mechanical	Item no. 42
42	Replace Air conditioning within Gantry E-House & Extend/Seal Roof	Sum	1	Electrical	Item no. 4, 5, 6
43	Refurbish Dust Suppression System	Sum	1	Mechanical	Item no. 40
44	Replacement of local maintenance stations (all)	Sum	1	Electrical	Item no. 32 & 33
45	HT Switchgear - Replace worn power relays.	Sum	1	Electrical	Item no. 12
46	HT Switchgear - spare power relays	Sum	2	Electrical	Item no. 12

Table 3: SR3 Scope of Works

8 LIFE OF MACHINE

- **Mechanical**

Provided that all mechanical concerns are addressed as per the scope of work, it is expected that SR3 would be able to be operated to a minimum of 10 years beyond the date of this refurbishment. It is strongly recommended that all plant and equipment within SR3 be maintained properly and effectively according to manufacturer's procedures and schedules.

- **E, C & I**

The following main items are critical and should be replaced with UP-TO-DATE equipment. The definition of UP-TO-DATE equipment is the following:

Equipment that is currently in the market and equipment that isn't at the end of its production life span. Such equipment that is still within its active Production life will be maintainable and spares available thereafter for a further 10 years.

The equipment seen as CRITICAL and require replacing as per the SOW are:

- All the VFDs Panels (Scope item 25, 26, 27)
- PLC panel (Scope item 29)
- Slew Drag chain (Scope item 23)
- Tripper travel Catenary cables and carriers (Scope item 22)
- Cabin controls and Intelligent Chair controls (Scope item 20)
- Simocodes (Scope item 29 & 40)

If all the above is met, there is no reason to doubt the equipment installed during refurbishment will not last 10 years as a minimum life span. BTS should maintain the equipment regularly according to the O.E.M.s recommendations as stipulated in the O.E.M.s manuals.

- **Structural**

The areas of greatest concern are listed below and these have been included in the scope of works to be completed during the 2022 midlife refurbishment:

- Corrosion of steel structure
- Corroded/disintegrated/missing bolts
- Damage to the boom tip structure
- Possible failure of welds in the Boom high-stress areas

Certain high stress areas were previously identified on SR2 and SR1 - cracking of certain welds on the boom structure. SR1, SR2 and SR3 are identical and although no cracks were observed in these areas during the recent visual inspection of SR3, allowance has been made in the scope of works for NDT testing of the welds on the boom structure, as well as associated repairs, if required.

Once the equipment has undergone the refurbishment, it is expected that the end of life of the structural elements may be extended by a minimum of 10 years from date of refurbishment, given regular ongoing maintenance of the structure. It is furthermore recommended that structural condition assessments are conducted at least every two years after the equipment's end of life, inclusive of NDT testing of the welds on the boom structure and that any observed structural defects be rectified shortly after.

9 APPENDIX

Appendix A: SR3 E, C & I Condition Assessment

Appendix B: SR3 Mechanical Condition Assessment

Appendix C: SR3 Structural Condition Assessment

Appendix D: SR3 Detailed Scope Document Z.5200160-DS