SHAMS POWER COMPANY

ENGINEERING DIVISION

INSPECTION & CORROSION SECTION

SHAMS 1

LOCATION : R1HAF12-BC010

KKS : R1HAF12-BC010

GRADE & CLASSIFICATION : 2

CERTIFICATE OF INSPECTION

The equipment detailed below was examined in accordance with the SHAMS code of practice for plant inspection,

ITEM : **Super- heater (SGG-2)** **LOCATION :** **SHAMS Plant**

TYPE OF INSPECTION : **Major** **DATE OF INSPECTION :** **March, 2020**

PLACE OF INSPECTION : **IN-SITU** **DATE OF LAST INSPECTION :** **N/A**

REPORT :

1.0. SUMMARY

The above Super -heater (SGG-2) was taken off line, isolated, opened, vented & cleaned for major external & internal inspections.

2.0. SUBJECT

2.1. This is a horizontal carbon steel shell with carbon steel tube bundle.

Item	Shell Side	Tube side
Design pressure	25 bar	120 bar
Design temperature	398C	398 C
Operation pressure	-	-
Operation temperature	-	-
Hydro test pressure	43.6 bar	203.85 bar
Fluid	HTF	Steam
Material	A 516 Gr 70	A556 –B2
Tube Number		752 U
Tube diameter		5/8 inch
Tube thickness	25 mm	1.473 mm
Tube length		9309 mm

The above equipment is/ ~~is not~~ considered suitable for further service under the present operating conditions

NEXT MAJOR INSPECTION DUE : March 2024

INSPECTED: Osman Ismail

ENDORSEMENT: 48 MONTHS

REVIEWED: Ali Al Masabai

3.0 History

This Super-heater - (SGG-2) was commissioned in 2013. Periodical inspection records since Oct.'2014 are available.

4.0. Scope of Inspection

4.1Visual Inspection
4.2 Remote field Eddy Current (RFT)
4.3 Ultrasonic Thickness survey
4.4 Dye- penetrant
5.4 Borescope inspection

5.0. CONDITIONS FOUND

5.1. **External (Shell side)**

5.1.1 All painting and insulation found intact without any evidence of painting peel off or blistering and no evidence of any damage for insulation or insulation cover aluminum sheet.
5.1.2 All ladders, stairways and handrails found in satisfactory condition.
5.1.3 All concrete support found in satisfactory condition without evidence of cracking or spalling.
5.1.4 All external piping insulation found in satisfactory condition.
5.1.5 All earthling lugs found in satisfactory condition.

5.2. **Internal** (Tube side)

5.2.1 All tubes as could see internal surfaces found satisfactory condition without evidence of corrosion, apart from a considerable amounts of deposits which have cleaned by high pressure hydro jetting.
5.2.2 All tube to tube sheet welds found in satisfactory condition.
5.2.3 Diaphragm was cut out for tube inspection access and welded back and dye-penetrant tested successfully.
5.2.4 Scattered pitting (oxygen corrosion) were found in the lower part of channel (6:00 o'clock position). Evaluation was carried out according to API 510, Paragraph 7.4.3 found acceptable, see attached pitting evaluation report.

6.0 NDT

6.1 Ultrasonic thickness survey

Ultrasonic thickness measurement was carried out on accessible locations of channel found satisfactory. See attached thickness measurement report.

6.2 Dye – Penetrant test

Dye – Penetrant test was carried out on tube to tube sheet welds and new welds of diaphragm all found satisfactory. See attached thickness measurement report.

6.3 Remote field Eddy Current test (RFT)

Eddy current test was carried out on 118 tubes as sample, results was satisfactory as indicated in below table. More details in the attached RFT report.

Classifications	Total
No Defects Detected	118
0.1% - 10% Volume Loss	0
10%- 20% Volume Loss	0
20%- 30% Volume Loss	0
30%- 40% Volume Loss	0
40.0%- 50% Volume Loss	0
50.0 +Volume Loss	0
Restricted	0
Obstructed	0
Plugged	0

6.4 borescope Inspection

It was done internally from tube side end and externally of tubes from shell side end. It revealed a considerable amount of deposit inside tubes, while outside was satisfactory. After hydro jetting deposits was less but not removed completely, (see attached videos and photos)

6.7 Chemical Analysis

Chemical analysis was carried out through third party called GEO –CHEM MIDDLE EAST, results was normal.

7.0. Recommendations

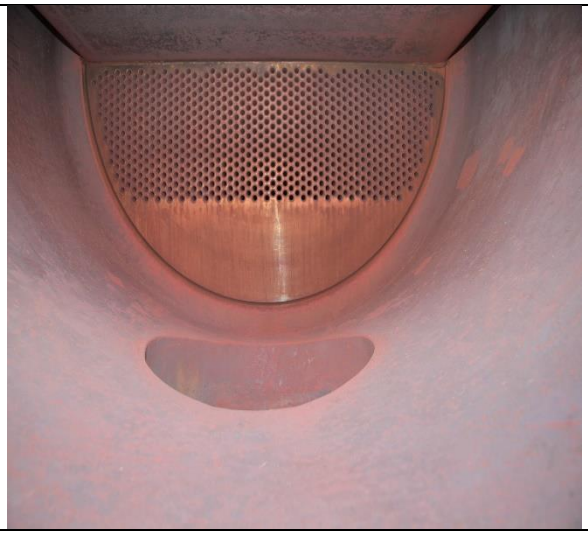
Super-heater- (SSG-2) to be open for inspection after four years as per SHAMS code of practice.

8.0 Inspection Grade and Interval

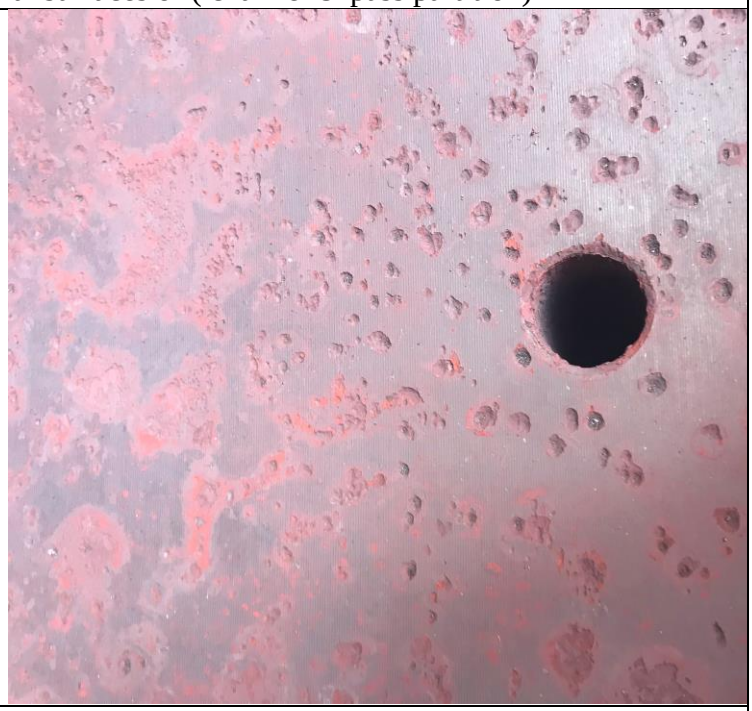
In accordance with the latest revision of SHAMS Code of Practice, this Super-Heater – (SGG-2) was endorsed for 48 months under class 2, for next Major Inspection.

FREQUENCY : 48 MONTHS.
ENDORSEMENT : 48 MONTHS,
GRADE : 2
Next Major Insp. due : March, 2024

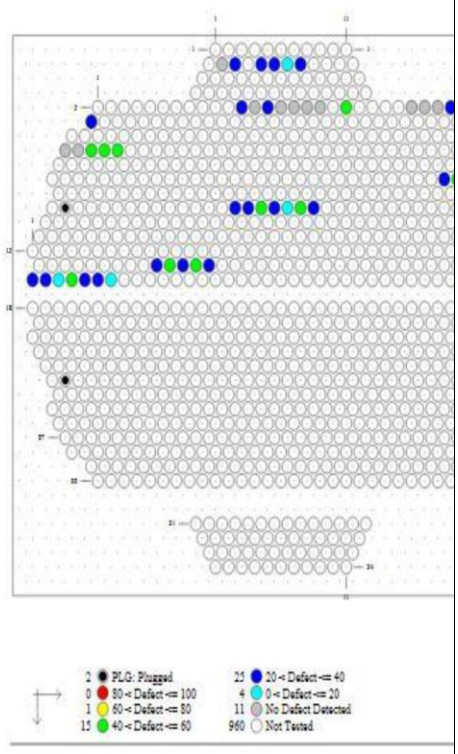
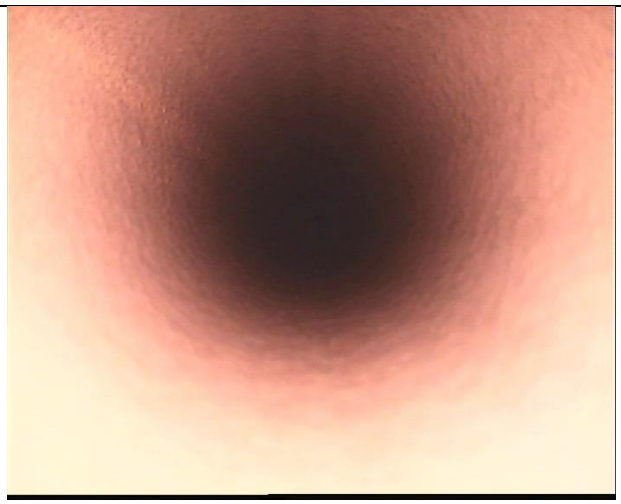
Photos



Tubes , welds and internal surfaces of (channel & pass partition)



Scattered pitting in channel internal surfaces

	
Eddy current results	Tube NO. R9 T34 – boroscope (good condition)

Form No.: IN-QSF-36 Rev. 05E Dtd.: 20-10-2018

ULTRASONIC THICKNESS GAUGING REPORT

Client:	SHAMS POWER COMPANY		
Date:	18.03.2020	Report No.:	AD / 486
Project:	SHAMS OUTAGE MARCH 2020	Job No. :	N/A
Location:	MADINAT ZAYED	Drawing No.:	N/A
Item ID:	SUPER HEATER-2	Material:	CS
Ref/ Procedure No:	INSPEC/UTG/001 Rev.10	Ref. Standard:	ASME SEC V
UTG Equipment Model/ Manufacturer:	USM 35 X DAC / GE	Serial No.:	7292a
Calibration Block No. :	STEP WEDGE, IIW V2 BLOCK	EQPT Calibration Certificate & Due Date:	INS/UT/CAL-043/19/AUH
Probe Type/ Size/Frequency:	WK TR 0° PROBE/ 10mm DIA / 5 MHz	Couplant Brand Name & Type:	POLYCELL + WATER
Connecting Cable Type & Length:	LEMO TO MICRODOT & 2 MTR	Special Attachment/ Equipment/ Block:	STEP WEDGE BLOCK (SL NO : AZB270)
Test Temperature:	AMBIENT	Surface Condition:	AS CLEANED
Inspection Date:	18.03.2020	Page: 1 of	2

Description:

 # ULTRASONIC THICKNESS GAUGING WAS CARRIED OUT ON THE FOLLOWING SUPER HEATER-2 (R1HAF12 BC010)

LOCATION	ORIENTATION	MEASURED THICKNESS (mm)
1	12 O'CLOCK	106.20
1	3 O'CLOCK	106.20
1	6 O'CLOCK	105.20
1	9 O'CLOCK	105.60
2	12 O'CLOCK	24.92
2	6 O'CLOCK	25.24

REPORT FORMAT APPLICABLE ONLY FOR AUH & FUJ FACILITY

LEVEL II TECHNICIAN	CLIENT REPRESENTATIVE	AI / TPI
Name : SIVANESAN	Name :	Name :
Sign :	Sign :	Sign :
Date : 18.03.2020	Date :	Date :

INSPEC Level II No. 660

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Sharjah Branch : P.O Box: 8130, Sharjah, U.A.E
Abu Dhabi Branch : P.O Box: 41227, Abu Dhabi, U.A.E
Fujairah Branch : P.O Box: 7307, Fujairah, U.A.E
Oman Branch : P.O Box: 193, P.C: 131, Sultanate of Oman
Registered Office :33-37 Athol Street, Douglas, IM1, 1LB, Isle of Man. Company Number 010728V.

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Tel : 02 6225820 Fax: 02 6225830 Email: inspec.adhcoor@intertek.com
Tel : 09 2238754 Fax: 09 2238754 Email: inspec.fujcoor@intertek.com
Tel : 00968 2448 3291 Fax: 00968 2448 5855 Email: inspec.muscat@intertek.com

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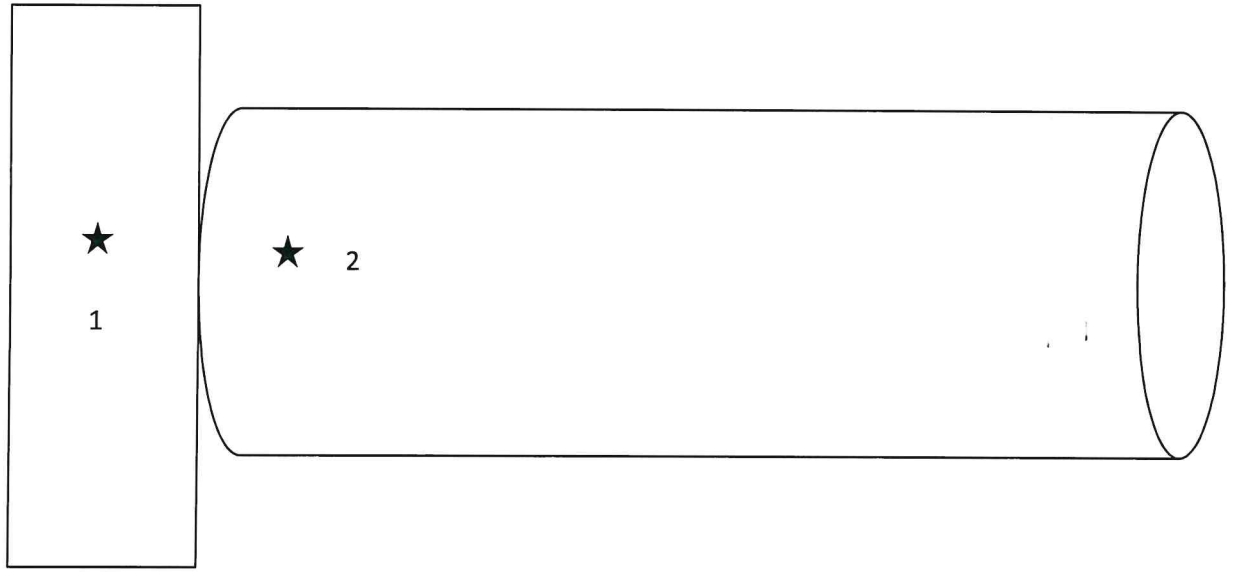
Date :- 18.03.2020
Report No.:- AD-486
Page No. :- 2 OF 2

ULTRASONIC THICKNESS SCANNING DRAWING SHEET

SUPER HEATER – 2



★ UTG LOCATION

LEVEL II TECHNICIAN

Name :- SIVANESAN & RAJESH KANNAN
Sign :-
Date :- 18.03.2020

Level II No. 660 Sign Date

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CALIBRATION SERVICES AND MECHANICAL & METALLURGICAL LAB SERVICES

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Form No.: IN-OPF-04 Rev. 13E Dtd. 20-03-2019

LIQUID PENETRANT EXAMINATION REPORT

Report No.:	AD / 53679	Date:	15.03.2020	Page:	1 Of 1
Client :	SHAMS POWER COMPANY	Job No. :	PROJECT :- SHAMS OUTAGE MARCH -2020		
Location :	MADINAT ZAYED	Item :	AS BELOW		
Material :	CS	Ref / Procedure No. :	INS/ASME/PT/001		
Thickness :	VARIOUS	Revision :	22		
Surface condition :	AS WELDED & CLEANED	Test Temp. :	AMBIENT (25°)		
Viewing condition :	DAY LIGHT (>1076 LUX)	Penetrant Type / Technique :	VISIBLE SOLVENT REMOVABLE		
Penetrant dwell time :	10 MIN	Dev. Time:	10 MIN		
Date of test :	15.03.2020	ACCP - Criteria :	ASME SEC VIII DIV-1		
Consumables Type & Batch	MAGNAFLUX - SPOTCHECK				

Penetrant Remover	Penetrant	Developer
SKC-S (BATCH NO-180108) JAN 2021	SKL-SP2 (BATCH NO-171201) DEC 2020	SKD-S2 (BATCH NO-180102) JAN 2021

Observation & Evaluation :

100% DPT WAS CARRIED OUT ON THE FOLLOWING ITEM

SUPER HEATER-2 (KKS-R1HAF12BC010)

PT WAS DONE ON TUBE END WELD JOINT

NO RELEVANT INDICATION WAS OBSERVED DURING THE TIME OF INSPECTION.

FOUND ACCEPTABLE AS PER THE SPECIFICATION.

	ACCEPT	REJECT
RESULT	☑	☐

REPORT FORMAT APPLICABLE ONLY FOR AUH & FUJ FACILITY

LEVEL II TECHNICIAN	CLIENT REP	AI / TPI
Name : AFZAL ANSARI & MURALI MANOJ	Name :	Name :
Sign :	Sign :	Sign :
Date : 15.03.2020	Date :	Date :

Level II No. 660

Dubai Branch : P O Box [illegible], Dubai, U.A.E Tel : 04 3241955 Fax: 04 3241957 Email: Inspec.dxbcoor@intertek.com
Sharjah Branch : P O Box: 6130, Sharjah, U.A.E Tel : 06 5061300 Fax: 06 5361173 Email: Inspec.shjcoor@intertek.com
Abu Dhabi Branch : P O Box: 41227, Abu Dhabi, U.A.E Tel : 02 6225820 Fax: 02 6225830 Email: Inspec.adhcoor@intertek.com
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Oman Branch : P O Box: 193, P.C. 131, Sultanate of Oman Tel : 00968 2448 2391 Fax: 00968 2448 5855 Email: Inspec.muscat@intertek.com
Registered Office :33-37 Athol Street, Douglas, IM1, 1LB, Isle of Man. Company Number 010728V.

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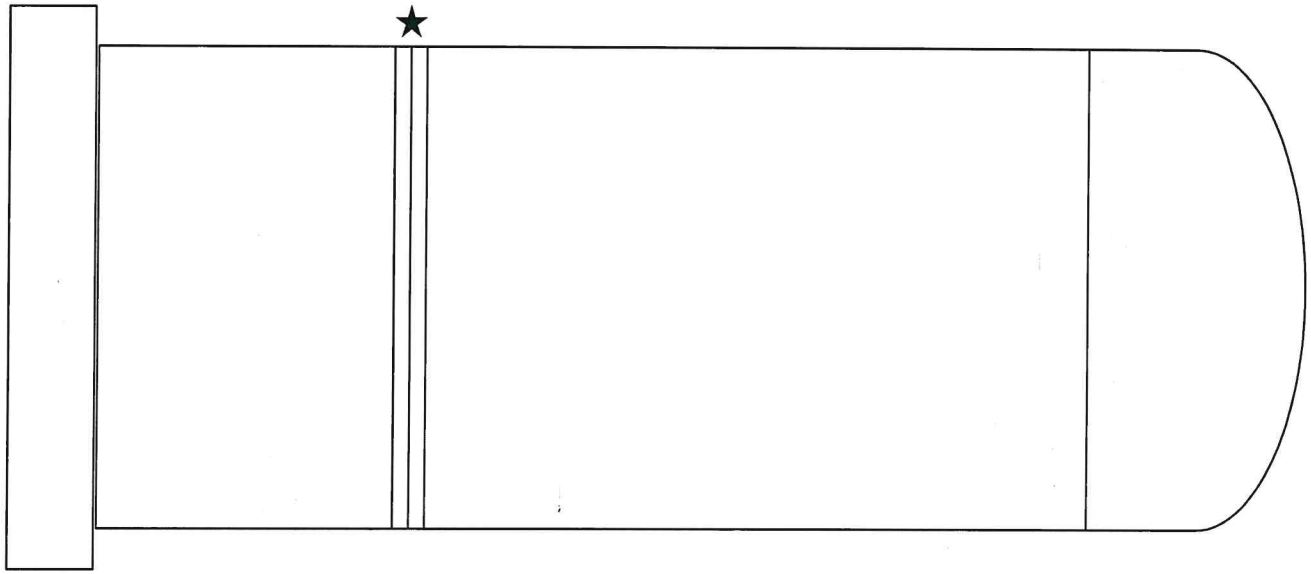
intertek INSPEC	International Inspection Services Ltd Intertek.com	Date :- 15.03.2020 Report No.:- AD-53679 Page No. :- 2 OF 2

LIQUID PENETRANT EXAMINATION - DRAWING SHEET

SUPER HEATER-2



★ PT DONE LOCATION

LEVEL II TECHNICIAN

Name :- AFZAL ANSARI & MURALI MANOJ

Sign :-

Date :- 15.03.2020

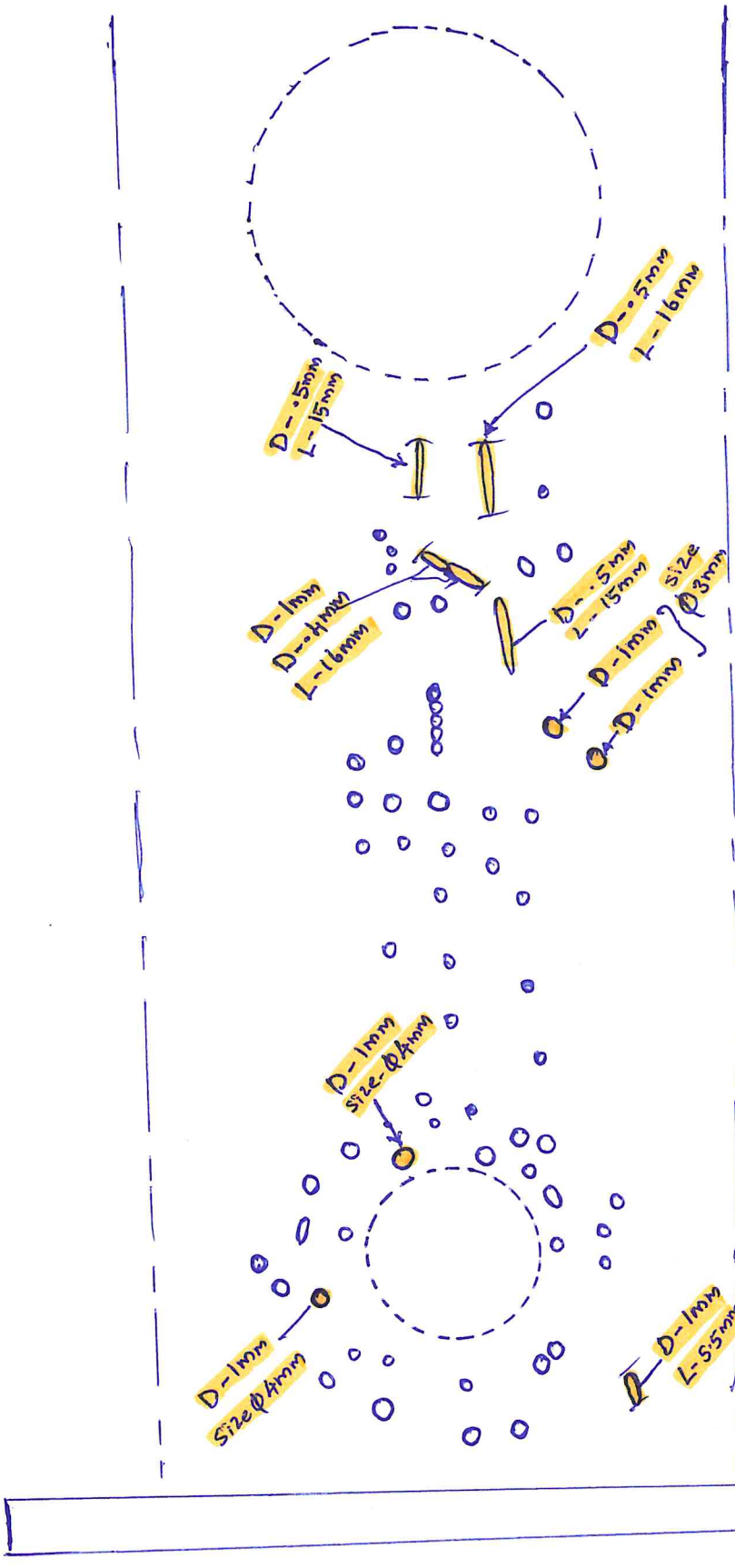
INSPEC Level II No. 380 Sign Date

SUPER HEATER – SGG 2

R1HAF12BC010

12/03/2020

Pitting Corrosion



Except highlight all location

D – .2mm to .7mm

Size – ϕ 2mm to 6mm

Acceptance Ref.

API-510

Para-7.4.3

Pitting measured by using equipment – Vernier caliper

7.4.3 Evaluation of Pitting

During the current inspection, widely scattered pits may be ignored as long as all of the following are true:

a) the remaining thickness below the pit is greater than one-half the required thickness ($^1/_2\ t_{required}$),

b) the total area of the pitting that is deeper than the corrosion allowance does not exceed 7 in.^{2} (45 cm^2) within any 8-in. (20-cm) diameter circle,

c) the sum of the pit dimensions that is deeper than the corrosion allowance along any straight 8-in. (20-cm) line does not exceed 2 in. (5 cm).

API 579-1/ASME FFS-1, Part 6 may be used to evaluate different pit growth modes, estimate pitting propagation rates, and evaluate the potential problems with pitting remediation versus component replacement. The maximum pit depth and the extent of pitting are related in the API 579-1/ASME FFS-1, Level 1 assessment pitting charts, which may be used to evaluate the extent of pitting allowed before the next inspection.

7.4.4 Alternative Evaluation Methods for Thinning

7.4.4.1 An alternative to the procedures in 7.4.2 and 7.4.3, components with thinning below the required thickness may be evaluated by employing the design by analysis methods of either ASME *Code*, Section VIII, Division 2, Appendix 4 or API 579-1/ASME FFS-1, Annex B-1. These methods may also be used to evaluate blend ground areas where defects have been removed. It is important to ensure that there are no sharp corners in blend ground areas to minimize stress concentration effects.

7.4.4.2 When using ASME *Code*, Section VIII, Division 2, Appendix 4, the stress value used in the original pressure vessel design shall be substituted for the maximum allowable stress (Sm) value of Division 2 if the design stress is less than or equal to two-thirds specified minimum yield strength at temperature. If the original design stress is greater than two-thirds specified minimum yield strength at temperature, then two-thirds specified minimum yield strength shall be substituted for Sm. When this approach is to be used, an engineer shall perform this analysis.

7.4.5 Joint Efficiency Adjustments

When the vessel surface away from a weld is corroded and the joint efficiency is less than 1.0, an independent calculation using the appropriate weld joint factor (typically 1.0) can be made. For this calculation, the surface at a weld includes 1 in. (2.5 cm) on either side of the weld (measured from the toe) or twice the required thickness on either side of the weld, whichever is greater.

7.4.6 Corroded Areas in Vessel Heads

7.4.6.1 The required thickness at corroded areas of ellipsoidal and torispherical heads can be determined as follows.

a) In the knuckle region of the head, use the appropriate head formula in the construction code.

b) In the central portion of the head, use the hemispherical head formula in the construction code. The central portion of the head is defined as the center of the head with a diameter equal to 80 % of the shell diameter.

7.4.6.2 For torispherical heads, the radius to use in the hemispherical head formula is the crown radius (equal to the outside diameter of the shell for standard torispherical heads, though other radii have been permitted).

7.4.6.3 For ellipsoidal heads, the radius to use in the hemispherical head formula shall be the equivalent spherical radius $K_1 \times D$, where D is the shell diameter (equal to the inside diameter) and K_1 is given in Table 7.1. In Table 7.1, h is one-half the length of the minor axis (equal to the inside depth of the ellipsoidal head measured from the tangent line). For many ellipsoidal heads, $D/2h = 2.0$.

GEO-CHEM MIDDLE EAST

GEO CHEM

جيو – كيم ميدل ايست

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Laboratory: E-mail: lab.dubai@geochemglobal.com, **Operation:** Email: operations.dubai@geochemglobal.com
ISO 9001:2015 CERTIFIED COMPANY
www.geochem.ae

LABORATORY REPORT

Date Reported: 24/03/2020
Date Received: 19/03/2020

Report No: GC/LR/829979/2020
Sample No.: GC/829979

To,

Shams Power Company PJSC
Masdar City, SAF-1
PO Box 54115,
Abu Dhabi, UAE
Tel : +971 561883624

For the Attention of	:	Mr. Rommel dela Pena Acda
Sample Received from	:	Shams Power Company PJSC
Sample(s) submitted as	:	Deposit Sample [1 X 500 gm Plastic Bag]
Description(s) on Label(s)	:	As per attached sheets
Seals on Sample(s)	:	Nil

The above sample(s) was/were examined as detailed below and the following results obtained:
Please refer attached sheets for analytical results. Total no. of pages : 03 (incl. cover page)

LABORATORY REPORT

Date Reported: 24/03/2020
Date Received: 19/03/2020

Report No: GC/LR/829979/2020
Sample No.: GC/829979

Description(s) on Label(s) : SSG-2 Super Heater Deposit
Dated: 18/03/2020

Test	Method	Unit	Result
Loss On Ignition:	Gravimetry	-	-
@550 °C		% wt	**0.22**
@750 °C		% wt	**0.03**
Sulphate	Gravimetry	mg/kg	**<10.0**
Silicon Dioxide	Gravimetry	% wt	**0.12**
Chloride	Titration	% wt	**0.09**
Phosphate	ICP-OES	% wt	**0.09**
Calcium Chloride		% wt	**0.07**
Moisture		% wt	**0.41**
Silver		% wt	**<0.01**
Aluminium Oxide		% wt	**0.03**
Titanium Dioxide		% wt	**<0.01**
Calcium Oxide		% wt	**0.04**
Magnesium Oxide		% wt	**0.01**
Sodium Oxide		% wt	**0.02**
Potassium Oxide		% wt	**<0.01**
Copper Oxide		% wt	**0.05**
Zinc Oxide		% wt	**0.04**
Manganese Oxide		% wt	**0.40**
Vanadium		% wt	**<0.01**
Molybdenum		% wt	**<0.01**
Antimony		% wt	**<0.01**
Tin		% wt	**<0.01**
Lithium		% wt	**<0.01**
Barium		% wt	**0.01**

جيو – كيم ميدل ايست

GEO-CHEM MIDDLE EAST

LABORATORY REPORT

Date Reported: 24/03/2020
Date Received: 19/03/2020

Report No: GC/LR/829979/2020
Sample No.: GC/829979

Test	Method	Unit	Result
Cadmium	ICP-OES	% wt	**<0.01**
Cobalt		% wt	**<0.01**
Chromium Oxide		% wt	**0.35**
Nickel		% wt	**0.42**
Phosphorous		% wt	**0.03**
Lead		% wt	**<0.01**
Selenium		% wt	**<0.01**
Beryllium		% wt	**<0.01**
Strontium		% wt	**<0.01**
Arsenic		% wt	**<0.01**
Iron Oxide:		-	-
FeO		% wt	**51.39**
Iron Oxide (Fe_2O3)		% wt	**46.36**

Test conducted on 19-23/03/2020
Test method deviation: None
Sampling method Sampled by Client
Test conducted by Emp: 877, 586
Report prepared by Emp: 432
The above test results are only applicable to the sample(s) referred above

REPORTED BY

PRADEESH PRADEEP
LABORATORY MANAGER

Samples retention period as per procedure QP/12, which shall be provided on request.

END OF REPORT

BOROSCOPE TESTING REPORT

CLIENT: SHAMS POWER COMPANY

SUPPER HEATER-2

EQUIPMENT NO: R1HAF12-BC010

REPORT No.: INS/BOR/SHAMS/003/2020

DATE: 13/03/2020

Prepared By:	Reviewed By:	Reviewed By:	Approved By:
INTERTEK INSPEC	INTERTEK INSPEC	CLIENT/TPI	CLIENT
Sibin V V Level II No. 858 Sign Date	Shabin N Level II No. 273 Date Sign		

TABLE OF CONTENTS

1.0 BOROSCOPY TESTING REPORT

a) SUPPER HEATER-2 (R1HAF12-BC010) TUBE BUNDLE

a) SUPPER HEATER-2 (R1HAF12-BC010) TUBE BUNDLE

International Inspection Services Ltd.

NON DESTRUCTIVE TESTING/HEAT TREATMENT/ADVANCED INSPECTION SERVICES,
CALIBRATION SERVICES AND MECHANICAL & METALLURGICAL LAB SERVICES

IB-054

Form No.: IN-OPF-41 Rev. 05 Dtd.: 20-03-2019

BOROSCOPE TESTING REPORT

Report No.:	INS/BOR/SHAMS/003/2020	Date:	13-Mar-20	Page:	1	Of	1
Client :	SHAMS POWER COMPANY	Equipment :	**R1HAF12-BC010**				
Location :	MADINAT ZAYED						
Item :	SUPPER HEATER-2 (R1HAF12-BC010)	Type of construction:	U TUBE				
Equipment :	OLYMPUS IPLEX FX	Specification :					
Serial No. :	Y104888	Photographs :	ATTACHED				

Description :-

Boroscope inspection was carried out on SUPPER HEATER-2 (R1HAF12-BC010)

Observations:-

Refer attachment for details.

Note:-

The above observations were as per the client who had witness the inspection.

TECHNICIAN / INSPECTOR	CLIENT REP.	AI / TPI
Name : SIBIN.V.V	Name :	Name :
Sign :	Sign :	Sign :
Date : 13-Mar-20	Date :	Date :

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Registered Office : 33-37 Athol Street, Douglas, IM1, 1LB, Isle of Man. Company Number 010728V.

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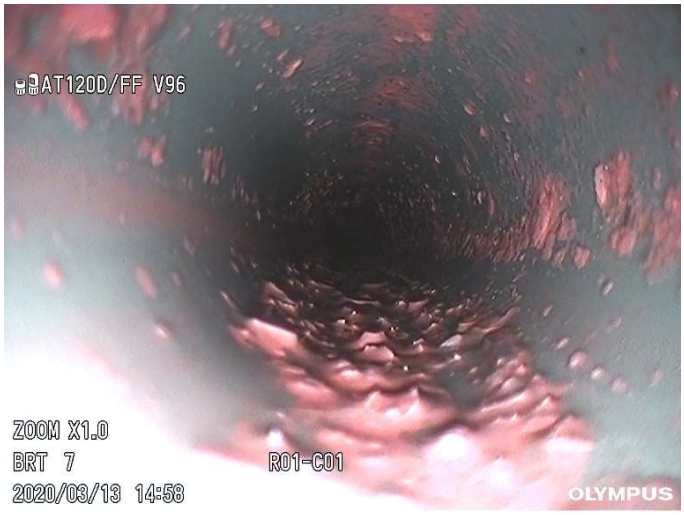
BOROSCOPE INSPECTION REPORT

ROW-1 TUBE-1		ROW-1 TUBE-16	
			
Observation:	Minor deposits fond in visual inspection	Observation:	Minor deposits fond in visual inspection

ROW-3 TUBE-1		ROW-2 TUBE-1	
			
Observation:	Minor deposits fond in visual inspection	Observation:	Minor deposits fond in visual inspection

2.0 CERTIFICATE

INTERNATIONAL INSPECTION SERVICES LTD
(INTERTEK – INSPEC)
P. O. BOX 96535, DUBAI, U.A.E.

CERTIFICATE

Date of Assignment : 02nd August 2016
Certificate No : INS/VT/16/858
Issue Date : 02nd August 2016
Expiry Date : 01st August 2021

This is to certify

Mr. SIBIN V.V

Has demonstrated his ability successfully in both written and Practical examinations following training in accordance with the INTERTEK-INSPEC written Practice Document No. INS/SNT/WP/01 Revision 00 which is based on ASNT SNT TC 1A – 2006 edition in the following method and level shown below:

Method : **Visual Testing.** (*Remote Visual Inspection by Fiber Optics*)

Level : **II (Two)**

RESULTS	GRADE
General Examination	85.0%
Specific Examination	85.0%
Practical Examination	86.0%
Total for Average	256.0
Composite	85.33%

This certificate is only valid whilst the above person is employed by INTERTEK-INSPEC.

ASNT LEVEL-III
SANTANU SAHA
E, ET, IR, LT, MT, PT, RT, UT, VT
Certificate No: 99511

Intertek- INSPEC Certifying Authority

NDT Level III

Prolongation of validity

Date of renewal	Reference Document	Date of expiry	Examiner	Employer