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UNI EN ISO9001 certification

INSPECTION REPORT OF BONO ENERGIA WATER TUBE BOILER AT BADRA OIL FIELD CPF PHASE 1

Baghdad-Iraq
June 2013

PARTITA IVA E CODICE FISCALE IT 00757520150 – CCIAA MILANO 536507 – ISCR. REG. SOC. TRIB. MILANO 105598/2807/7


SPOTCHECK
SKL-SP2
Penetrant
SPOTCHECK
SKD-S2
Developer
SPOTCHECK
SKC-S
Cleaner/Remover
MAGNAFLUX
MAGNAFLUX

CONTENTS

I. INTRODUCTION

According to PETROFAC Purchase Order No. 2013C730014, BONO ENERGIA S.p.A. herein refer to as (BE) has set up its inspection team for performing Detailed Inspection Program (DIP) to the boiler which, due to mishandling, as been subject to a falling accident at Umm Qasr port in South Iraq. Purpose of the (DIP) was investigation of damages that might have occurred to the boiler.

The job was commenced on Wed. 29th of May 2013 and ended up on Sun. 2nd of June 2013. The boiler base frame structural elements external ends, the burner, the boiler feed water inlet nozzle (4" size) and the refractory covering furnace bottom showed a serious extent of damages, on the other hand the (DIP) revealed no significant indications of damages in the boiler Steam drum, Water drum, water walls, Wind box, and the boiler bank tubes and water preheater tubes.

II. APPLICABLE CODES & STANDARDS

1. ASME "I"
2. ASME "V"
3. ASME "VIII Div. 1"
4. ASTM "E-164, E-165, E-1444"

III. ISPECTION PERSONNEL

The (DIP) was implemented by:

1. SNT-TC-1A Level III NDE examiner-Team Leader.
2. SNT-TC-1A Level I NDE two examiners.
3. Surveying Engineer

IV. ISPECTION & NDE PERFORMED

1. Visual Examination (VT).
2. Dye Penetrant Examination (PT).
3. Magnetic Particles Examination (MT).
4. Dimensional Measurements.
5. Center link survey to the boiler steam and water drums and headers.

V. ISPECTION FINDINGS

1. Visual Examination (VT)

(VT) Examination to the boiler components and the following were observed:

A. Steam Drum

- **(Externally)**

Boiler feed water inlet nozzle (4”size) showed a severe damage in form of folds and tear in the nozzle connecting pipe body. In addition the structural frame I-Beams located at the top of the steam drum seemed to be severely damaged. (See photos no. 1, 2 & 3 below). On the other hand the rest of boiler steam drum nozzles and shell plates showed no indications of damage from outside.

photo no. 1

photo no. 2

photo no. 3

- **(Internally)**

Steam drum cyclones seemed to be displaced (disassembled) from their positions due to boiler tilting during the falling accident. On the other hand cyclones and the rest of drum internals showed no significant indications of damage. (See photo no. 4 below).

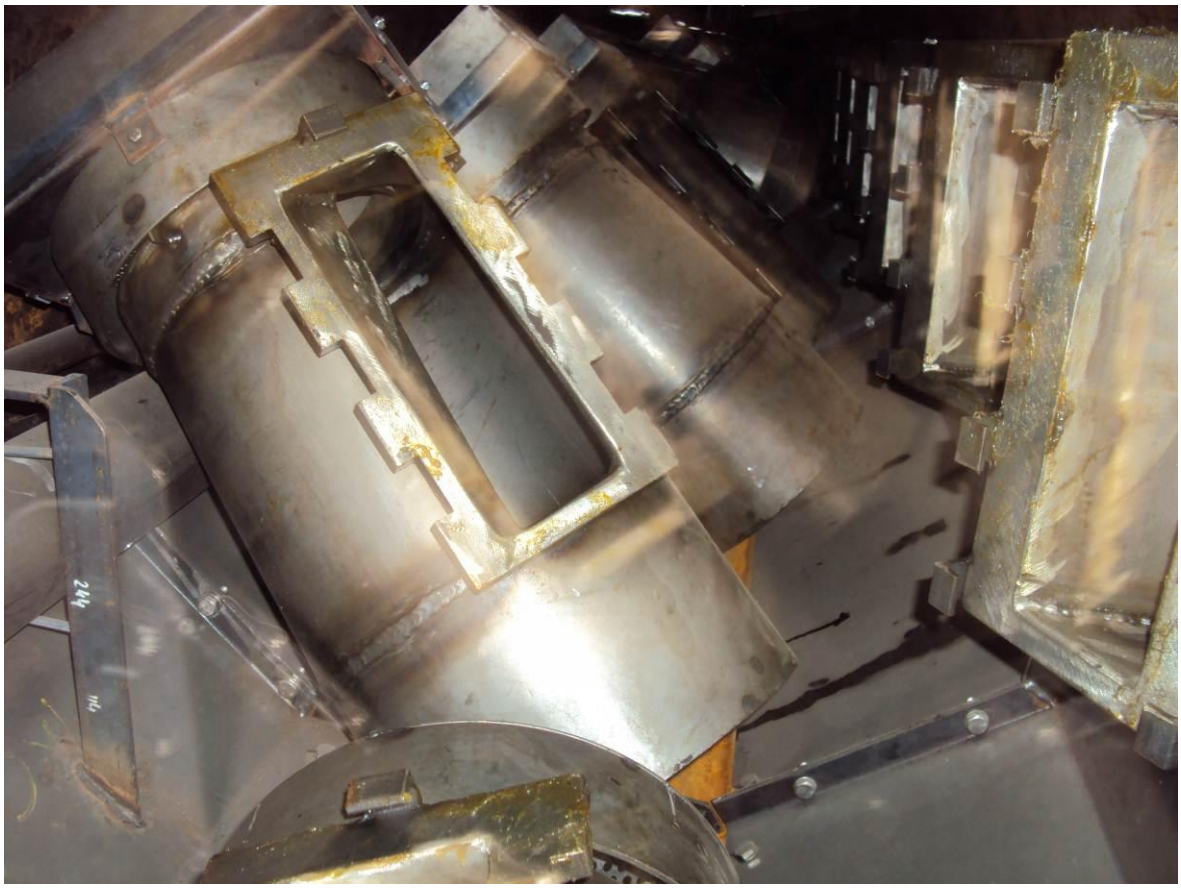


photo no.4

B. Water Drum

- **(Externally)**

Water drum shell plates, water preheater nozzles (4” size) and the drum drains (2” size) nozzles showed no indications of damage. (See photo no.5 below).

photo no.5

- **(Internally)**

Water drum internally showed no indications of damage. Water preheater pipe and its supports seemed not to be affected by the accident. (See photo no. 6).

photo no.6

C. Convective Bundle external side wall

Convective Bundle external side wall tubes showed no indications of damage due to the falling accident. Tubes straightness seemed to be in a satisfactory condition. Tubes membrane seal welds showed no indications of significant damages or holes due to the accident. Wall inspection door seemed be serviceable, while the supporting arm is damaged.
(See photos no. 7, 8 & 9).

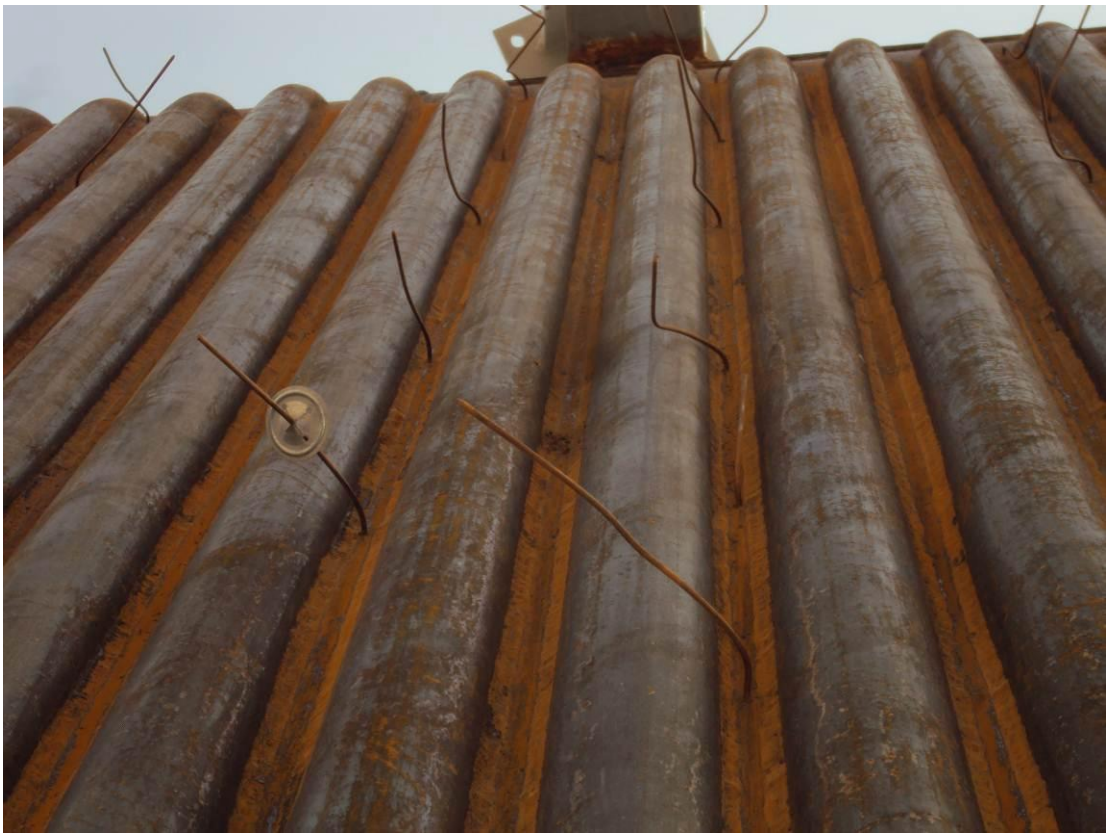


photo no.7

photo no.8

photo no.9

D. D-Shape wall tubes

D-Shape wall components (Roof tubes, Left side tubes) externally seemed not to be affected by the accident, no indications of damage observed. Tubes straightness seemed to be in a satisfactory condition. Tubes membrane seal welds showed no indications of significant damages or holes due to the accident. (See photos no. 10 & 11).

photo no.10

photo no.11

E. Rear wall tubes

Rear wall tubes externally seemed not to be affected by the accident, no indications of damage observed. Tubes straightness seemed to be in a satisfactory condition. Tubes membrane seal welds showed no indications of significant damages or holes due to the accident. Wall inspection wall seemed be serviceable. (See Photo no. 12).

Photo no. 12

F. Boiler Base-frame

Boiler-base frame structural elements (I-Beams) right side ends underneath the right side wall tubes showed sever extent of damage in form of warps and tears due to the accident. In addition most of the boiler sliding support guides tack welds seemed to be cracked or broken. On the other hand the rest of parts the base frame seemed not to be affected by the accident.
(See photos no. 13 & 14).

Photo no.13

Photo no.14

G. Boiler Radiation and Convection sides

- **Combustion Chamber Internal**

Furnace bottom refractory tiles seemed to be completely displaced and most of them seemed to be deteriorated (broken) due to the boiler tilting during the accident. (See Photo no. 15).

Photo no.15

The burner throat refractory seemed not to be affected by the accident. (See photo no. 16).

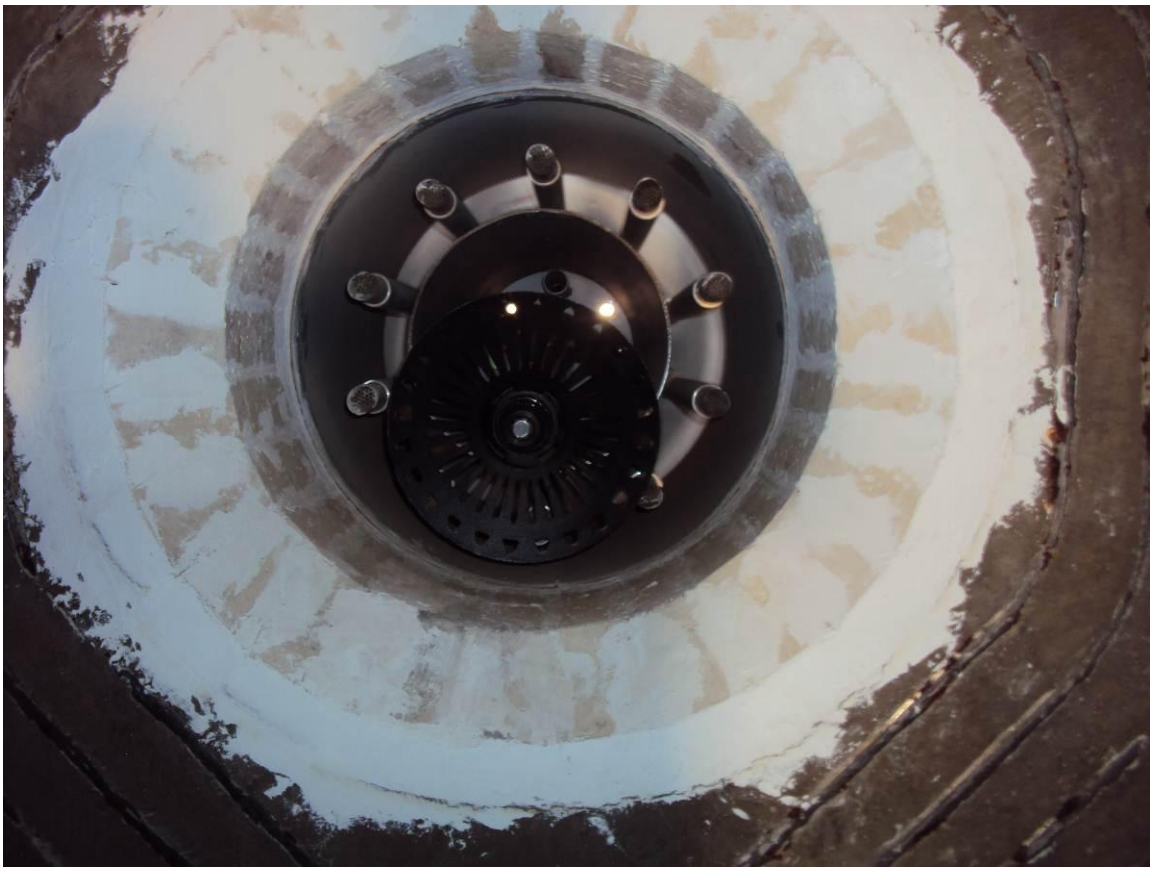


Photo no.16

On the other hand in Photo no. 16 above it’s clear that a damage has occurred to burner central diesel oil gun (it is not in center correct position).

On the other hand the “D” shaped membraned tubes, the Front wall, and the rear wall of the furnace showed no significant indications of damage due to the accident.
(See photos no. 17, 18 & 19).

Photo no.17

Photo no.18

Photo no.19

- **Convection (boiler) side**

Boiler convective bundle tubes showed no visible indication of damage. Tubes rows seemed to be straight and no visible indication of tubes pull out from the water drum holes was present. (See photos no. 20 & 21).

Photo no.20

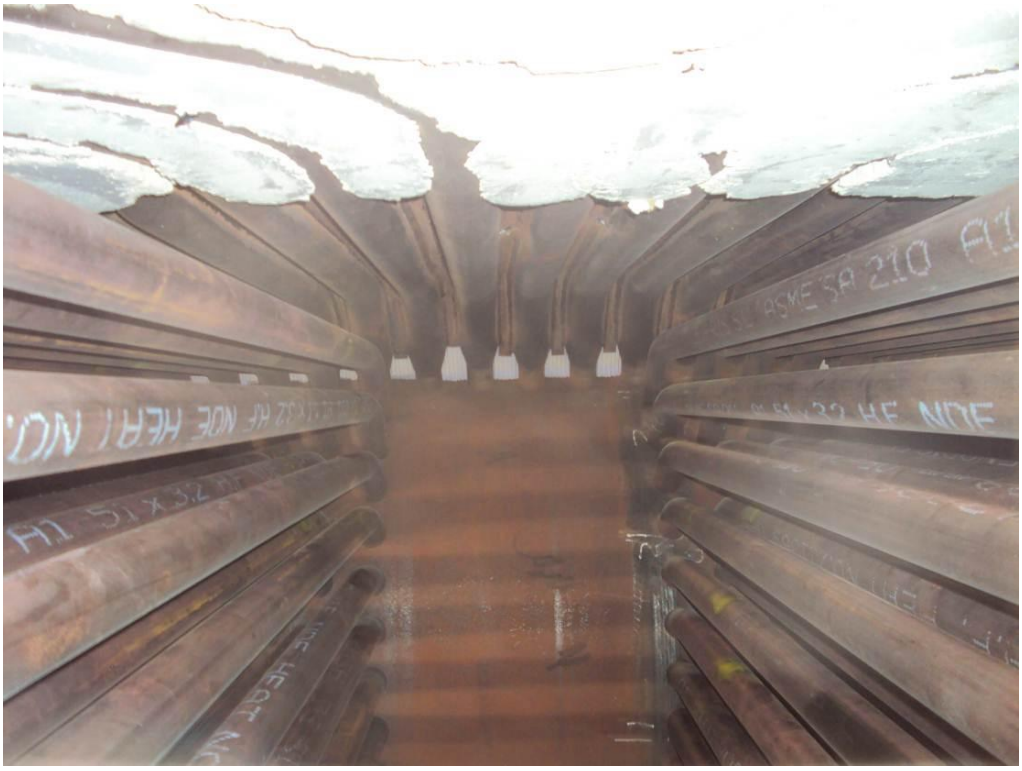


Photo no.21

H. Wind box and burner

Wind box and burner associated parts showed no visible indications of damage due to the accident. Burner air register seemed not to be affected by the accident. (See photos no. 22).

Photo no.22

2. Nondestructive Examinations (NDE)

The following NDE methods were performed:

A. Dye Penetrant Examination (PT)/ Type II method A (visible red dye)

The following boiler welds were (PT) examined and showed no significant indications of defects:

- Rear wall tubes to the lower header welds.
- Rear wall tubes to the upper header welds.
- Rear wall lower header to the end cap weld.
- Rear wall lower header to feeding tubes welds.
- Front wall lower header to feeding tubes welds.
- Rear wall upper header to the feeding tubes welds.
- Rear wall upper header to the end cap weld.
- Front wall upper header to the feeding tubes welds.
- Steam drum upper nozzles to the drum welds.
- Water drum preheater nozzles to the drum welds.

(See photos no. 23, 24, 25 & 26).

Photo no.23

Photo no. 24

Photo no. 25

Photo no. 26

B. Magnetic Particles Examination (MT)/Black visible particles with AC Yoke

The following boiler welds were (MT) examined and showed no significant indications of defects:

- Boiler Base frame fillet welds.
- Rear wall tubes to the lower header welds.
- Rear wall tubes lower header to supports welds.
- Rear wall tubes to the upper header welds.
- Rear wall lower header to the end cap weld.
- Rear wall lower header to feeding tubes welds.
- Front wall lower header to feeding tubes welds.
- Rear wall upper header to the feeding tubes welds.
- Rear wall upper header to the end cap weld.
- Front wall upper header to the feeding tubes welds.
- Steam drum upper nozzles to the drum welds.
- Water drum water preheater nozzles to the drum welds.
- Water drum fixed support to the base frame fillet weld.

(See photos no. 27, 28, 29, & 30).

Photo no. 27

Photo no. 28

Photo no. 29

Photo no. 30

C. Ultrasonic Examination (UT)/A-Scan with angle probe of 45 degrees.

The following nozzles were (UT) examined and showed no significant indications of defects:

- Water drum preheater nozzles to the drum welds.
- Steam drum upper nozzles to the drum welds.
- Boiler feed water nozzle to the drum weld.

(See photos no. 31, 32, & 33).

Photo no. 31

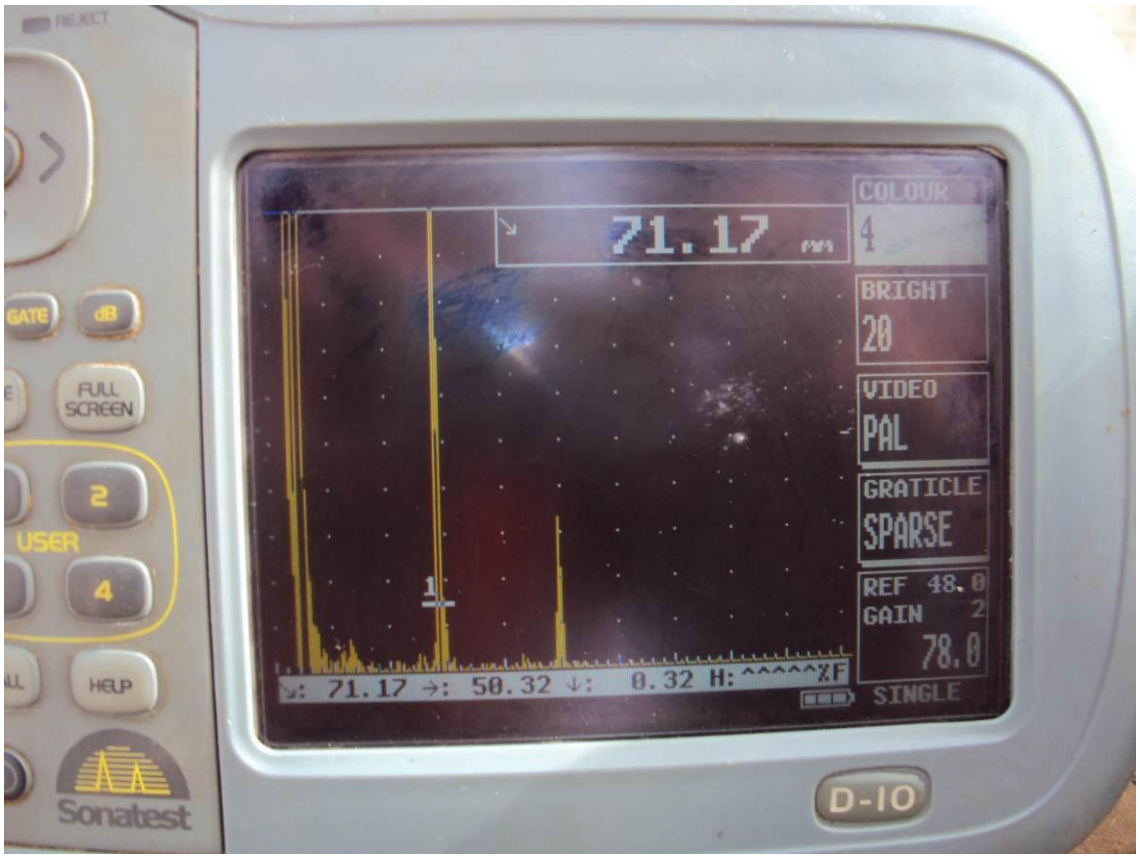


Photo no. 32

Photo no. 33

3. Dimensional Measurements

Dimensional measurements were taken to the boiler steam and water drums associated nozzles for the purpose of checking straightness and alignment. Excluded the steam drum feed water nozzle, the rest nozzles straightness and alignment seemed to be in a satisfactory condition.
(See photos no. 34, 35, 36, & 37).

Photo no. 34

Photo no. 35

Photo no. 36

Photo no. 37

4. Center link survey to the boiler steam and water drums and headers

A theodolite type Leica CTB 101 having serial no. (0726839) of R300 M was used for checking the boiler steam and water drums center link (concentricity) after the accident. Survey revealed no displacement in the steam drum and water drum centers with respect to each other on both vertical and horizontal axis. (See photos no. 38 & 39).

Photo no. 38

Photo no. 39

VI. ANALYSIS

The (DIP) revealed the following:

1. No visible mechanical damages were observed in the boiler components due to the boiler tilting during the falling accident, excluded the boiler feed water nozzle at the steam drum and the upper steel structure elements and the boiler base frame ends underneath the right side wall which had their bodies severely damaged and deteriorated.
2. NDE performed gave an indication that no unforeseen defects were induced or formed in the examined welds of the boiler components.
3. Theodolite survey gave an indication that no measurable offset occurred between the boiler drums centers.
4. Furnace bottom refractory tiles were displaced and severely deteriorated due to the accident.
5. Steam drum cyclones were displaced without damages.

VII. RECOMMENDATIONS

1. Boiler site hydrostatic test must be performed before starting of the re-work activities.
2. Boiler bubble test has to be preformed after hydrostatic test.
3. Boiler feed water nozzle damaged connecting pipe must be replaced from the portion beyond the reducer before the site hydrostatic test.
4. Damaged steel structure elements on the steam drum must be replaced.
5. All re-work welds must be re-examined according to the weld type and ASME “I” requirements.
6. Furnace bottom refractory tiles must be replaced and rebuilt after the site hydrostatic test.
7. Steam drum cyclones must be evacuated from the drum and reassembled after the site hydrostatic test.
8. The burner diesel fuel gun has to be replaced.
9. Supporting arm of convective bundle inspection door has to be replaced.

VIII. CONCLUSIONS

On the basis of the inspection results, the boiler can be mechanically repaired.

An hydrostatic test is required in order to define in detail and optimize any further repairing activity.

The following activities have to be concluded before the hydrostatic test:

1. Remove the nozzle “A1” (ref. Attachment 1 & Photo no.1).
2. Prefabricate a new nozzle “A1” (ref. Attachment 1).
3. Weld the prefabricated new nozzle following proper WPS.
4. Remove the cyclones from the Steam drum (ref. Photo no.4).
5. Remove the internal plates from the Steam drum (ref. Photo no.4).
6. Remove the demisters from the Steam drum.
7. Close with blind flange and gaskets all the nozzles.

Following the result of the hydrostatic test (BE) will study and plan the further activities and the procedures to complete the reparation of the boiler.

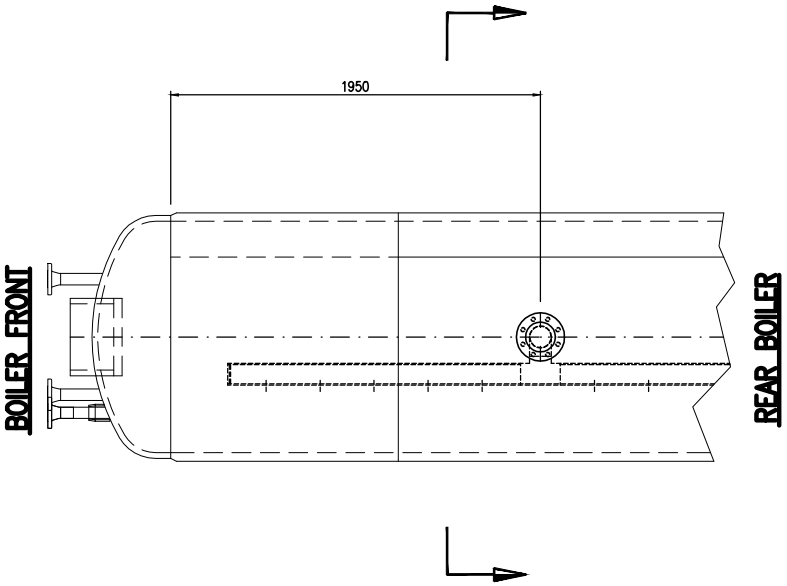
At the end of the repair works also bubble test shall be carried out in order to check tightness to flue gases.

IX. ATTACHMENTS

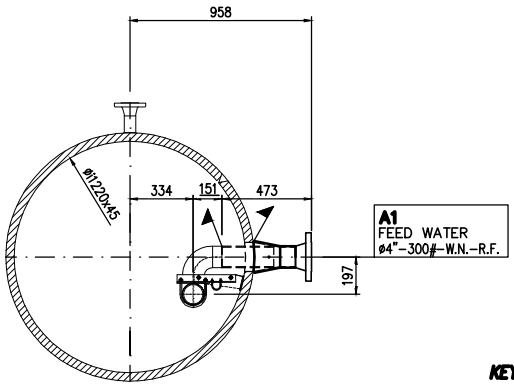
ATTACHMENT 1 – “A1” feed water nozzle details
ATTACHMENT 2 – Materials for hydrostatic test

ATTACHMENT 1 – PHOTO 1

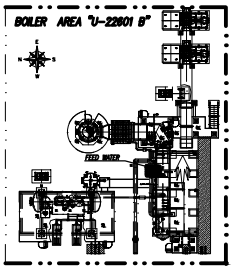
UPPER DRUM



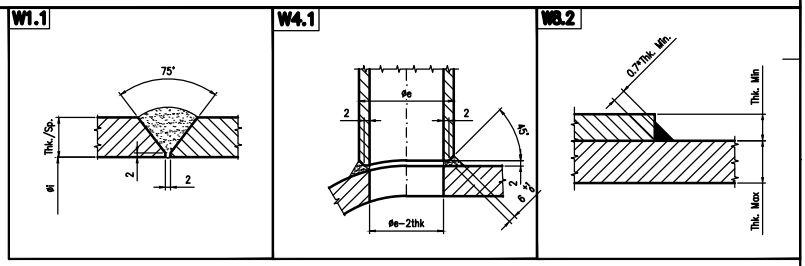
BOILER FRONT

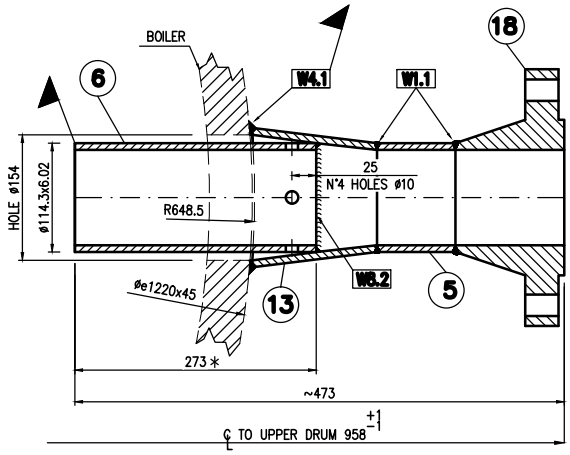


KEY–PLAN



NR°1 PIECE





WELD ON SITE

* ADJUSTMENT +100

TOT. WEIGHT KG. 7.5~

POS.	DESCRIPTION	U.m.	DIMENSION	MATERIAL	Q.TY	WEIGHT
18	FLANGE 4"–300#–WN–RF	n	Thk. 6.02	SA 105	1	–
13	RED.CONC. ø6"x4" BW	n	Thk. 7.11 / Thk. 6.02	SA 234 WPB	1	–
6	TUBE ø114.3x6.02	mm	Lgh. 373 *	SA 106 GR.B	1	6
5	TUBE ø114.3x6.02	mm	Lgh. 80	SA 106 GR.B	1	1.5

ATTACHMENT 2

MATERIAL FOR HYDROSTATIC TEST

DESCRIPTION	U.m.	DIMENSION	MATERIAL	Q.TY
GASKET 350x450 INT. (MANHOLE)	n°	THK.6.5	AISI316+GRAPHITE	4
STUD BOLT+2NUTS (FLG. ø4"300#)	n°	3/4"x120	SA193 B7/194 2H BI-CHROMATE	24
STUD BOLT+2NUTS (FLG. ø3"300#)	n°	3/4"x115	SA193 B7/194 2H BI-CHROMATE	16
STUD BOLT+2NUTS (FLG. ø2"300#)	n°	5/8"x100	SA193 B7/194 2H BI-CHROMATE	120
STUD BOLT+2NUTS (FLG. ø8"300#)	n°	7/8"x150	SA193 B7/194 2H BI-CHROMATE	36
SPIR. GASKET WITH INT. AN EXT. RING 4"-300#-RF	n°	Thk. 4.5	AISI316+GRAPHITE	3
SPIR. GASKET WITH INT. AN EXT. RING 3"-300#-RF	n°	Thk. 4.5	AISI316+GRAPHITE	2
SPIR. GASKET WITH INT. AN EXT. RING 2"-300#-RF	n°	Thk. 4.5	AISI316+GRAPHITE	15
SPIR. GASKET WITH INT. AN EXT. RING 8"-300#-RF	n°	Thk. 4.5	AISI316+GRAPHITE	3
BLINDE FLANGE 4"-300#-RF	n°	/	SA 105	3
BLINDE FLANGE 3"-300#-RF	n°	/	SA 105	2
BLINDE FLANGE 2"-300#-RF	n°	/	SA 105	15
BLINDE FLANGE 8-300#-RF	n°	/	SA 105	3