Heat Exchanger Tube Bundle Sample Extraction

Project Report

- **Client:** Chevron Nigerian Limited (Star Deep Water Petroleum Limited)
- **Contractor:** Ultimate Design consortium Limited (UDCL)
- **Location:** Port Harcourt Nigeria
- **Start Date:** 7th August 2019
- **Completion Date:** 27th September 2019
- **Duration:** Eight (8) Weeks
- **Prepared by:** Udechukwu Azubike Ifeanyi
- **Reviewed by:** Engr. Unachukwu Sopulu

Introduction

This project was executed by Ultimate Design Consortium Limited in response to a request from Chevron to provide Heat Exchanger (HEX) Tube Bundle Cutting and Sample Extraction Service at Onne Port Harcourt.

Scope of work – 5 Heat Exchangers

- Sites visit and assessment of the heat HEX.
- Haulage of heat HEX from Chevron Warehouse Onne, to UDCL fabrication Workshop Abuloma.
- Cutting & opening of heat exchanger shell for visual inspection of tubes.
- Extraction of selected tubes samples.
- Cutting and exposure of tube sheet for visual inspection.
- Cutting and extraction of tubesheet samples.
- Packaging and delivery of extracted samples to Chevron facility Onne.
- Evacuation of the heat HEX scraps back to Onne.

Equipment & Facilities

- Fabrication Workshop
- Cutting tools & Scaffolds
- Forklift
- Flatbed trucks & Crane

EWTL-UDCL Fabrication Workshop

Project Activity Report

1. Site visit and assessment of the HEX.

- On-site assessment of the HEX and Fabrication Workshop.
- kickoff meeting.

Assessing the HEX - Chevron Warehouse Onne

UDCL-EWTL Fabrication Workshop

UDCL-EWTL Fabrication Workshop

2. Haulage of HEX from Chevron Warehouse Onne to UDCL fabrication Warehouse Abuloma.

- Truck inspection and pre-mob.
- Truck, driver and personnel bookings with Chevron.
- Lifting and haulage of HEX to UDCL fabrication workshop.
- Offloading of the HEX at UDCL workshop.

Heat Exchanger Offloading

3. Cutting and Opening of HEX shell for visual inspection.

- Marking out portions of exchanger shell for cutting.
- Cutting and opening of the HEX shell, exposing the tubes for visual inspection.
- Marking of tubes for sample extraction

Exposed tubes for Visual Inspection

Selecting tubes for Sample Extraction

4. Extraction of selected tubes as samples.

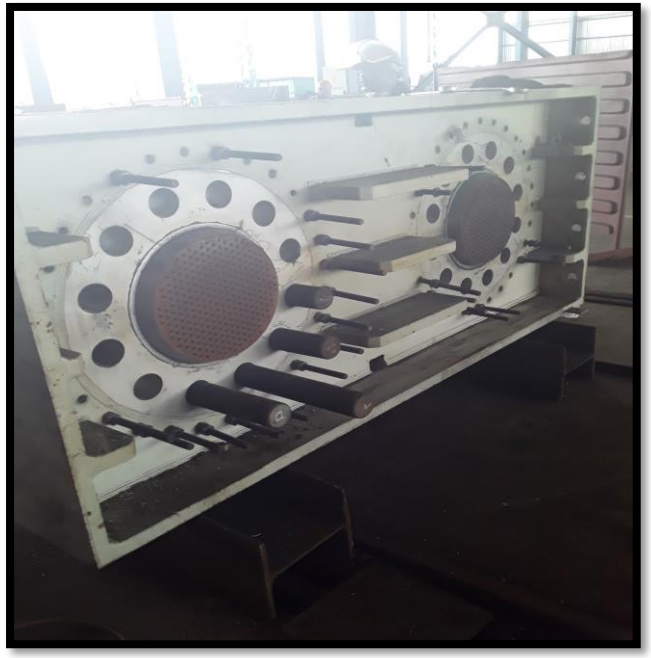
- Extraction of selected tubes.
- Cutting and tagging of selected sample tubes.

Marked Tubes Extraction

Extracted Sample Tubes

5. Cutting & exposure of tubesheet for visual inspection

- Removal of the flanges on the tube sheet, exposing the tubesheet for visual inspection.



Exposed Tubesheet for Visual Inspection

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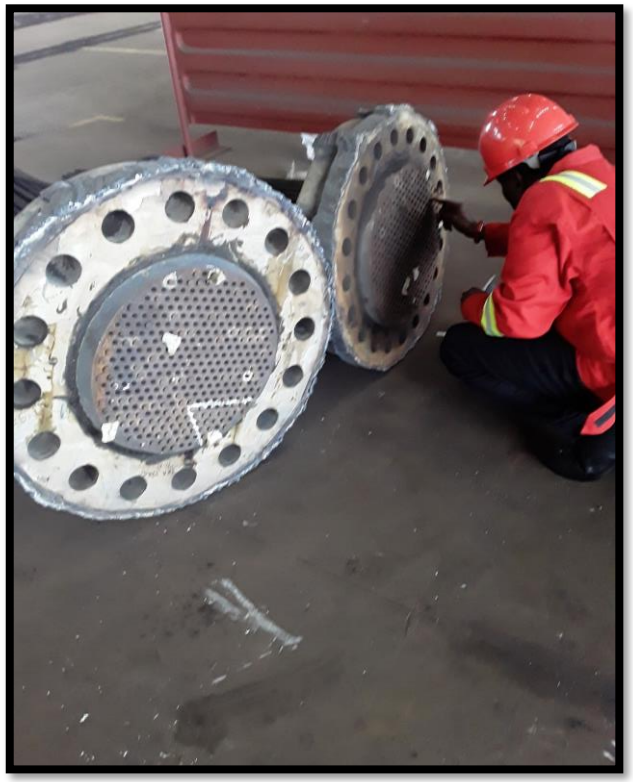
6. Cutting and extraction of marked out piece of each tube sheet for sample.

- Detaching the tube sheet from the base support.
- Marking-out tubesheet sections for cutting.
- Cutting of marked-out tubesheet sections.

Tube sheet detached from the base support



Marking out piece of tube sheet

Tube sheet cutting

7. Packaging and delivery of extracted sample to Chevron Warehouse Onne.

- Packaging into boxes tagged tubes samples and the cut-out samples from the tube sheet.
- Delivery of the boxed samples to Chevron Warehouse Onne.

Extracted Sample Packaging

Samples ready to be delivered

8. Evacuation of the heat HEX scraps back to Chevron Warehouse.

- Truck inspection and pre-mob.
- Truck, driver and personnel bookings with Chevron.
- Lifting and haulage of HEX scraps back to Chevron Warehouse.
- Offloading of the HEX scraps at Chevron Warehouse Onne.

Delivering the HEX scraps back to Chevron Warehouse

9. Demobilization of equipment and personnel.

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Summary Statement

- This project was executed safely in compliance with HSE and Quality Standards, within Planned Budget & Schedule, Meeting and Exceeding Client Expectation with 100% Compliance to Nigerian Content Development Policy.

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Procurement and Installation of Inductosense Probes to Automate Agbami Topside Riser Elbow Wall Thickness Measurements

- **Client:** Chevron Nigerian Limited (Star Deep Water Petroleum Limited)
- **Contractor:** Ultimate Design consortium Limited (UDCL)
- **Location:** Agbami FPSO
- **Start Date:** 14th December 2021
- **Completion Date:** 11th June 2022 v

EXECUTIVE SUMMARY

This project was executed by Ultimate Design Consortium Limited (UDCL) in response to a request from Chevron Nigeria Limited, on Dec 2021, to provide a service of procurement, installation and commissioning of hundred (100) units of UT probes from partner Inductosense to automate wall thickness measurements on Agbami topside riser elbow: PMF-1, PMF-2, PMG-1, PMG-2, PMD-1, PMD-2, PMA-1 and PMA-2.

SCOPE OF WORK

- Procurement and supply of Inductosense UT probes and all required accessories to Chevron Nigeria Limited
- Installation and commissioning of the procured Inductosense UT probes on Agbami topside riser elbows (PMF-1, PMF-2, PMG-1, PMG-2, PMD-1, PMD-2, PMA-1 & PMA-2).
- Training of Agbami FPSO Operations & Maintenance personnel on how to use and operate the system after commissioning and start-up.
- Provision of all operations and maintenance manuals for the system to Agbami Operations & Maintenance personnel on the FPSO.

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PROJECT ACTIVITY REPORT

1. Procurement and supply of Inductosense UT probes and all required accessories to Chevron Nigeria Limited

Inductosense UT probes and accessories procured by UDCL

Inductosense UT probes and accessories supplied to Chevron yard Warri (Nigeria) by UDCL

2. Installation and commissioning of the procured Inductosense UT probes on Agbami topside riser elbows (PMF-1, PMF-2, PMG-1, PMG-2, PMD-1, PMD-2, PMA-1 & PMA-2) by UDCL field service representatives (FSRs).

Installation Steps

- Planning
- Surface preparation
- Attaching the Sensor and RFID
- Protective Coating / Coating touch-ups

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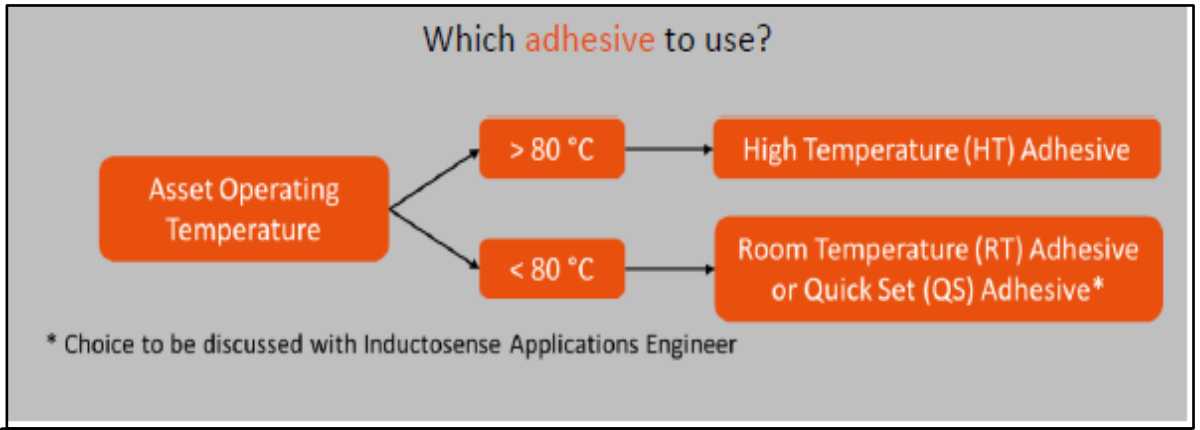
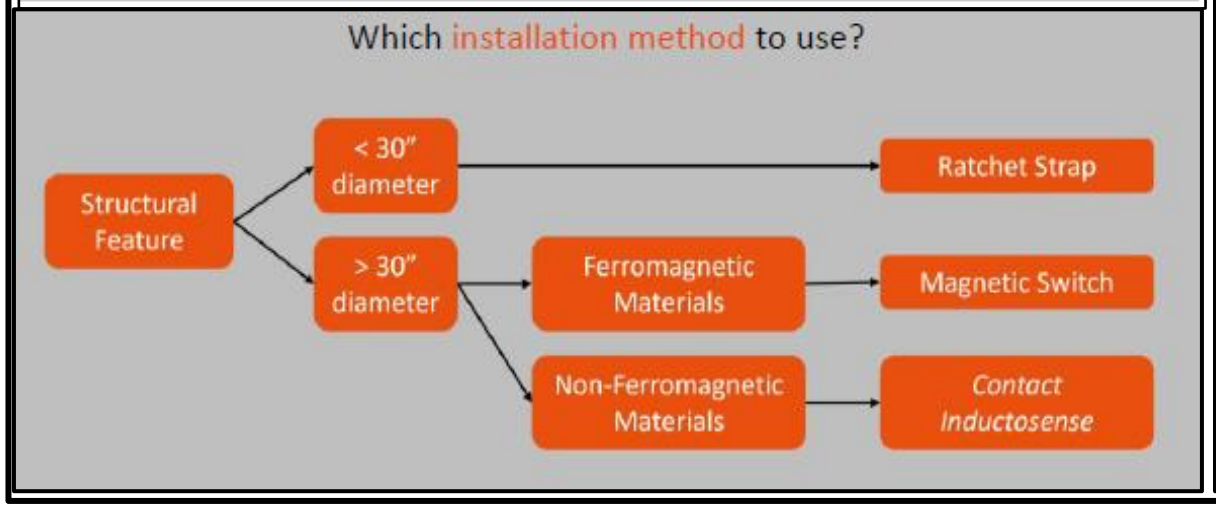
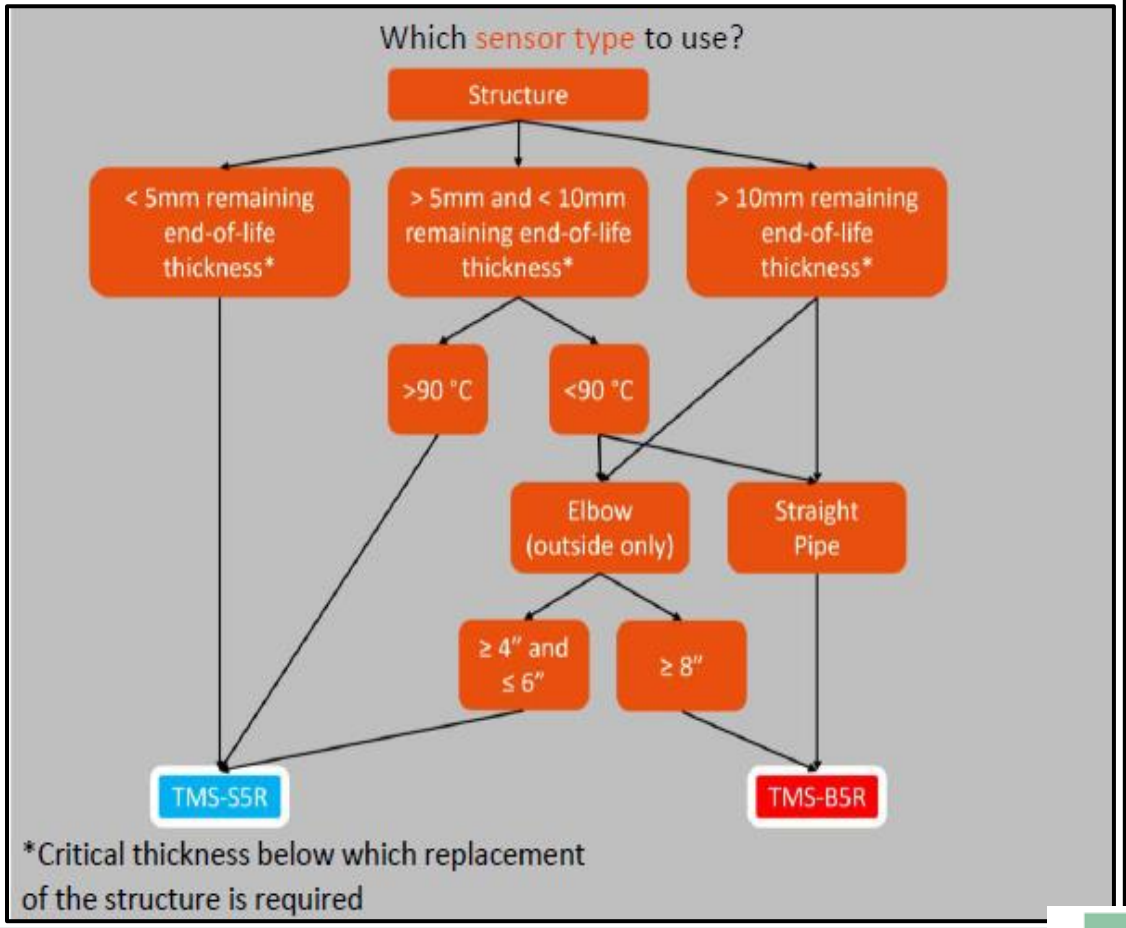
Planning

- Planning stage was conducted by Inductosense to ensure that the appropriate sensor type, adhesive and installation method are used. Below decision trees were used.







Structure Parameters

Diameter of structure	323.90mm
Ambient temperature (°C)	37.6
Operating temperature (°C)	77
Nominal thickness	44.50mm
End-of-life wall thickness	29.99mm
	25.30mm (for PMF-1 elbow)

Surface Preparation

1. **Marking of installation location on the Structure**

The monitoring locations (minimum thickness location and other seven locations) on the pipe elbow where the sensors will be installed, were marked out after being located using manual UT scan.

Marked out location for Sensor Installation

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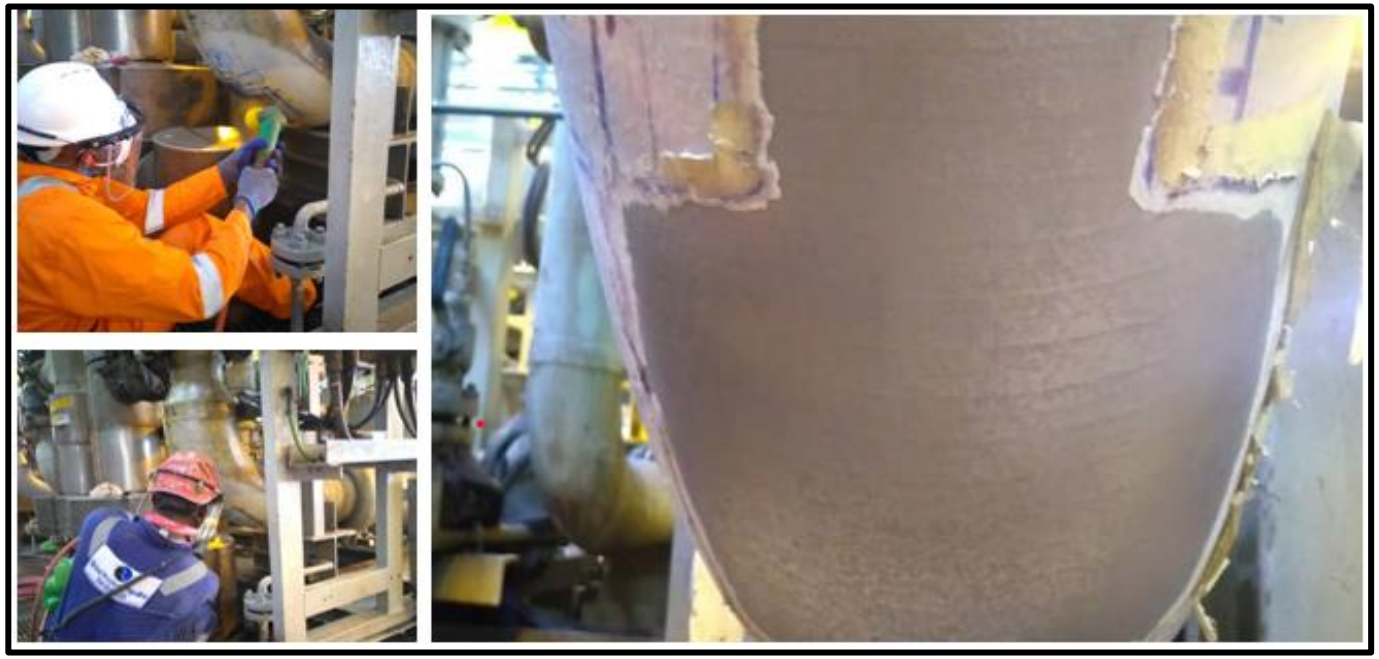
2. Preparing the surface of the structure

a) Structure surface prepared by the removal of coatings exposing the bare metal around the marked-out area using power brush/ grit blaster

b) Further preparation was done on the area directly beneath where the piezo will be bonded to the surface with finer sandpaper (P120-grit) to achieve a smooth and bright finish.



Preparing the surface of the structure

3. Chloride test on the Structure

Chloride test was essential because the location is offshore, therefore salt contamination is of great concern.
Elcometer 134 CSN - Chlorides, Sulphates & Nitrates Kit was used in place of recommended Bresle chloride test kit.
The maximum salt contamination must be less than 50 mg/m2 (for carbon steel materials)

Elcometer 134 CSN Kit

Conducting Chloride test

Risk and Risk Management

Prior to mobilization of Ultimate Design Consortium limited (UDCL) personnel to Agbami FPSO, a risk assessment session was conducted and facilitated by Agbami HSE Specialist (Okafor Kingsley) online. Hazards were identified, preventive measures stated, and recommendations were made on right PPEs to use. (see risk assessment report). UDCL personnel were mobilized to Agbami FPSO with all HSE requirements at heart.

Activities that helped in the good risk management practice are.

- Daily toolbox meeting.
- Daily assessment of site during raising of work permit.
- Regular use of right PPE
- Effective communication with onshore team.
- Regular analysis of project activities by all stakeholders.

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4. Condensation Risk Measurement

The sensor can only be installed when both the air and structure surface temperature are >3 °C higher than the dew point temperature. Condensing water on the structure surface or the sensor can disrupt the quality of the installation. Before starting installation during a shift, with the dew point monitor and thermometer measurements of the air temperature, structure temperature and dew point were taken.

Installation will not progress if the surface or air temperature minus the dew point temperature is less than 3°C.

Attaching Sensor and RFID

Sensor and RFID attachment was done in accordance with the approved installation manual.

Attached Sensors with RFID

Testing for good signal after attaching the Sensors

Protective Coating / Coating touch-ups

Protective Coating was done immediately RFIDs are placed and signals confirmed okay. This is to prevent significant oxidation or change in conditions before the final coating is applied

Coating Steps

- Sanding tape removed/ replaced with tape for coating.
- Coating paste mixed and ready and be applied.
- Mixed paste applied and allowed to cure.
- Touch-ups done on the surface to ensure the area is properly cover with the ceramics coating paste.

Coating of Installation area

Project Commissioning

- Demonstration using HoloLens during project commissioning.

Presentation during Project Commissioning

3. Training

Training of Agbami FPSO Operations & Maintenance personnel on how to use and operate the system after commissioning and start-up.

The Training of Agbami FPSO Operations and Maintenance personnel was conducted by UDCL / Inductosense.
Training was done in two (2) sessions

- Online e-learning classroom (theory) - Facilitated by Inductosense
- Practical field demonstrations – Facilitated by UDCL

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4. Provision of all operations and maintenance manuals for the system to Agbami Operations & Maintenance personnel on the FPSO

- On completion of sensor installation on the eight (8) Top side Agbami riser elbows: PMF-1, PMF-2, PMG-1, PMG-2, PMD-1, PMD-2, PMA-1 and PMA-2 by Ultimate Consortium limited (UDCL), the items listed in the table were handed over to the Chevron rep on-board the FPSO

Tablet	➢ **Windows based tablet with pre-installed IDM and IDOT software,** ➢ **Bluetooth keyboard** ➢ **Mouse, charger cable,** ➢ **USB-C adaptor** ➢ **International plug adaptor**	
WAND - DC	➢ **WAND Handheld data collector** ➢ **USB data cable** ➢ **Charger unit with international adaptors** ➢ **Test block with pre-installed TMS-B5R sensor & UHF RFID tag** ➢ **USB flash drive with IDM and IDOT software, software manuals and license key** ➢ **Protective Peli-case** ➢ **User manual**	
Other remaining items	**Remnants of** ➢ **Installation and coating Kit,** ➢ **Inductosense TMS-B5R 5MHz Sensor with UHF RFID Tag** ➢ **ECHO-45**	

Summary Statement

- This project was executed safely in compliance with HSE and Quality Standards; with no recordable incidence or near miss, within Planned Budget and Schedule, Meeting and Exceeding Client Expectation with 100% Compliance to Nigerian Content Development Policy.

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