# FRP PIPING CHALLENGES AND RELIABILITY IMPROVEMENT JOURNEY IN TASNEE

# TASNEE INTRODUCTION

التصنيع TASNEE

التصنيع TASNEE was established in 1985, as Saudi Arabia's first private sector, fully owned joint stock industrial company, with the aim of advancing the economic diversification in Saudi Arabia.

## VISION

To expand our global reach by seizing industrial opportunities that thoughtfully challenge the status quo.

## MISSION

To create versatile solutions in petrochemical and beyond that make a strong and sustainable future for our company and the wider world.

## VALUES

**Excellence**

**Integrity**

**Seeking Knowledge**

**Team Work**

**Investors: 30K**

**Products: 38**

**Affiliates: 35**

# TASNEE INTRODUCTION (cont.)

## Strategic Business Units (SBUs)

البتروكيماويات
**Petrochemicals**

الصناعات التحويلية
**Downstream**

المعادن المتطورة
**Advanced Metals**

### Petrochemicals SBU

Petrochemicals SBU is the largest business unit in Tasnee.

Petrochemicals SBU manages the production and marketing processes of petrochemical products

**Products:** PP | HDPE | LDPE | Super Absorbent Polymer – SAP | Butyl Acrylate BA | n-Butanol & i-Butanol

**Certifications:** ISO 4501 | ISO 9001 | ISO 14001 | RC 14001 | OHSAS 18001 | 50001 | 55001

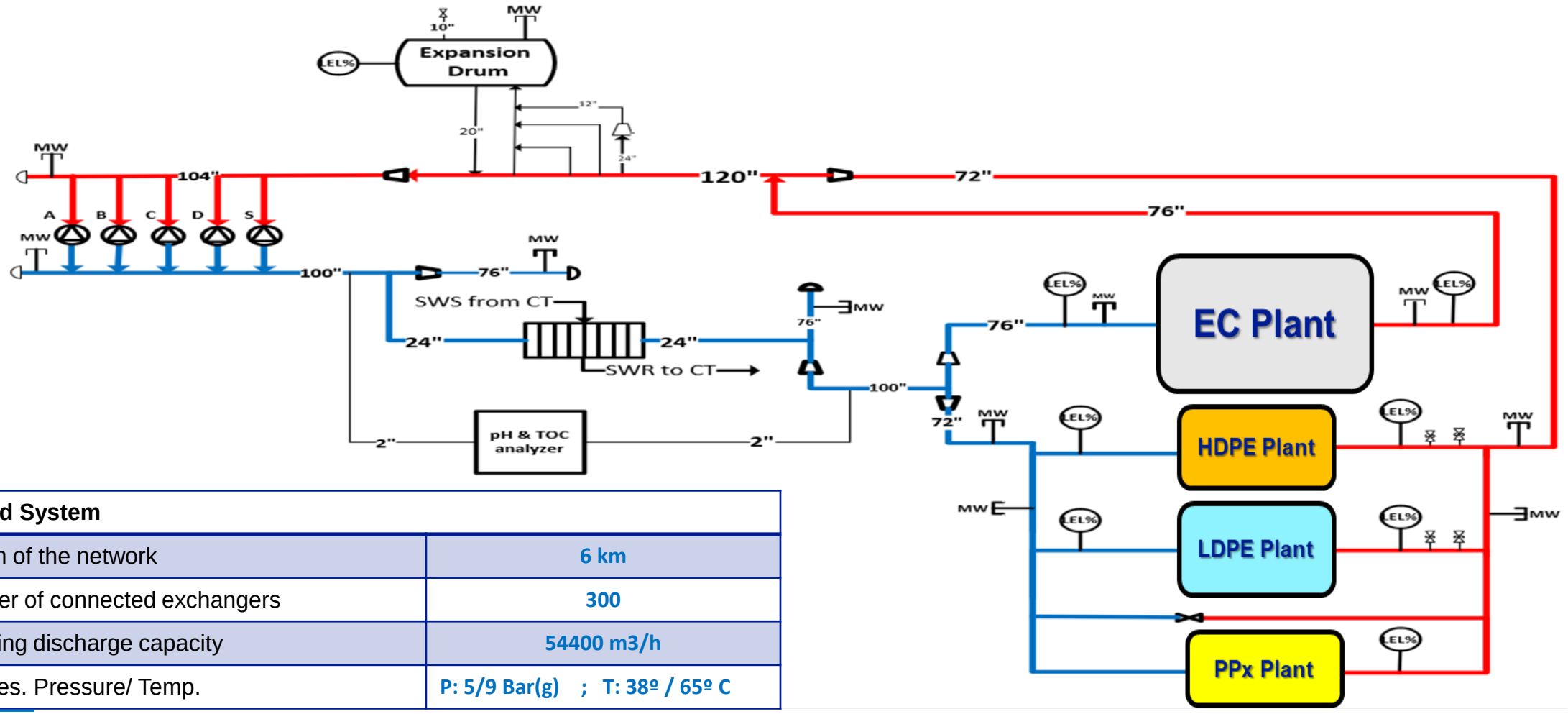
**Memberships:** Member of the Gulf Petrochemicals & Chemicals Association (GPCA) | Jubail Area Mutual Aid Association (JAMA'A)

# TASNEE FRP/ GRP PIPING AND FAILURE HISTORY

- **GRP Piping**
  - **Utility system**
    - **Cooling Water system (CW)** — **14 Failures**
    - **Sea Water system (SW)** — **1** Failure
  - **Process system**
    - **Waste Water (WW)** — **0** Failure
    - **Chemical** — **0** Failure

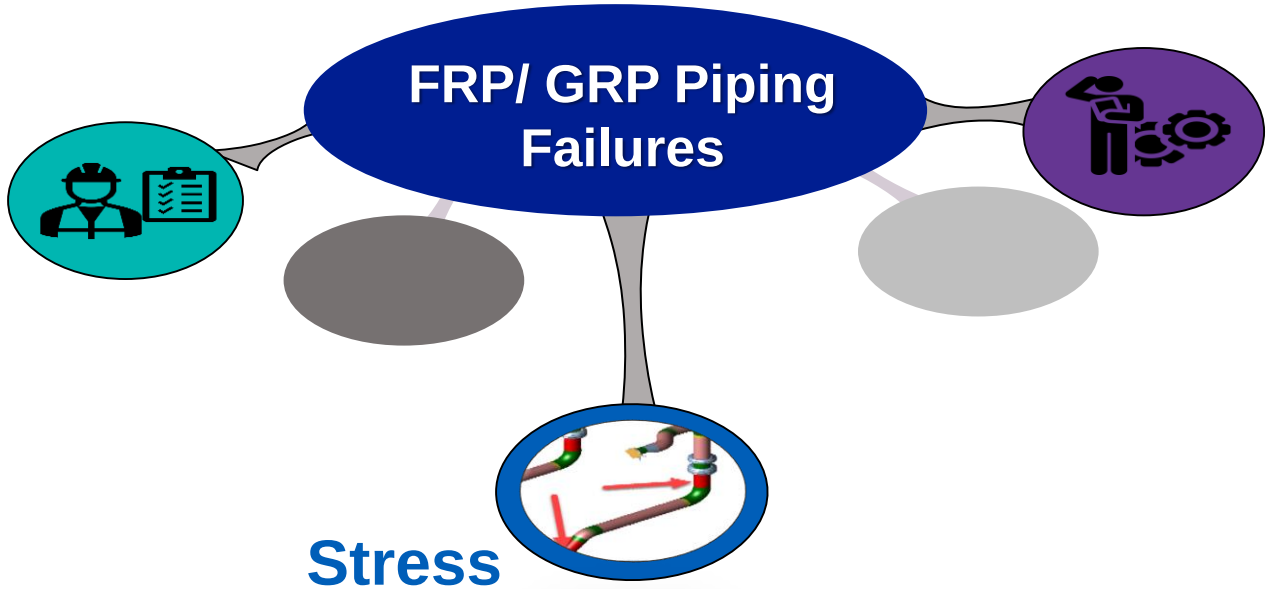
**Our focus in coming slides for High failure recorded CW**

# CW NETWORK OVERVIEW ( GRP PIPING)




| Closed System | |
|---|---|
| Length of the network | 6 km |
| Number of connected exchangers | 300 |
| Pumping discharge capacity | 54400 m3/h |
| Op./Des. Pressure/ Temp. | P: 5/9 Bar(g) ; T: 38º / 65º C |

# TASNEE FRP/ GRP PIPING FAILURE HISTORY (cont.)




## Poor Workmanship

- Installation & Repair work
- Pipe Manufacturing issues

## GRP Design Issues

- Material spec selection
- Flange joint selection (Non integral type)
- Branches Tie in Joints geometry (High Stress)

## Stress

- **Soil settlement**
  - Backfilling issue / compaction
  - Ground water
- **Gas Ingress from Process**
  - Dead Zone
  - Ventilation system failure
  - Process heat exchanger leakage
- **Exceed IOW limits**
  - Design Flow , Pressure &Temp.
  - Treatment & Analyzer monitoring
  - Two phase flow. (Gas & Liquid)

# 1st CHALLENGE PERIOD

TASNEE التصنيع

## Root cause:

**Soil Settlement**

## Due to:

- Lack of sufficient compaction & backfilling.
- Top soil movement due to Raining.
- Presence of underground water <2.5m depth.

## Mitigations done

- ✓ Removed soil & re-compacted.
- ✓ Developed routine PM Inspection program.
- ✓ Routine survey after heavy raining.
- ✓ Regular soil settlement survey (monthly).
- ✓ Develop QA/QC system for Backfilling work




# 2nd CHALLENGE PERIOD

## Root cause:

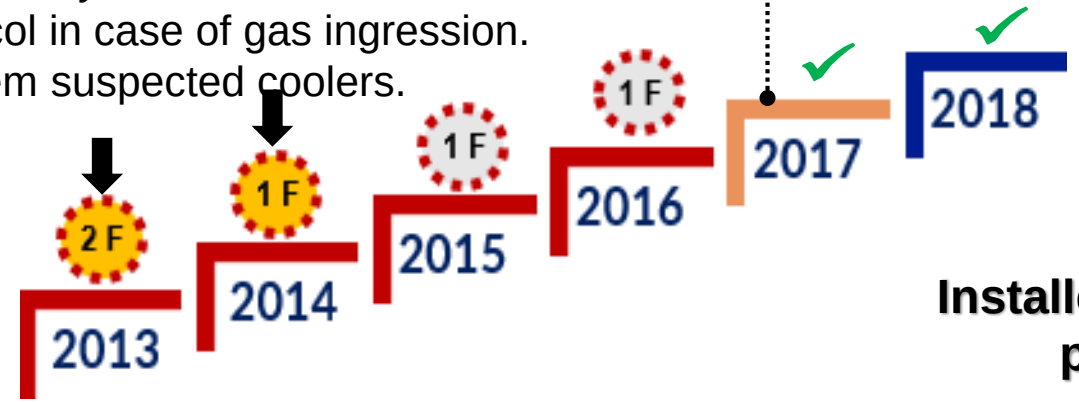
- **Gas ingress – from connected process coolers**
- **Design weakness point - Branches Tie in Joints geometry**

## Due to:

- Plant gasses ingression through heat exchangers tubes failure.
- GRP not designed for dual phase flow.
- Gas in system create stress in pipes weak points (at PHE 24'' Branches)

## Mitigations done

- ✓ Expansion pots/vessel.(To vent the entrapped Gases)
- ✓ Enhance operation procedure and venting control.
- ✓ Monitoring for gas ingression by analyzer.
- ✓ Develop venting response protocol in case of gas ingression.
- ✓ Inspection program for CW system suspected coolers.

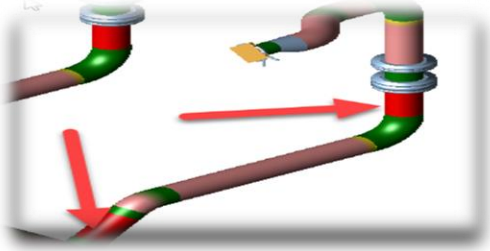




**Installed in CW loops (highest point) in each plant**

# 2nd CHALLENGE PERIOD (cont.)

## Root cause:

- **Gas ingress – from connected process coolers**
- **Design weakness point - Branches Tie in Joints geometry**



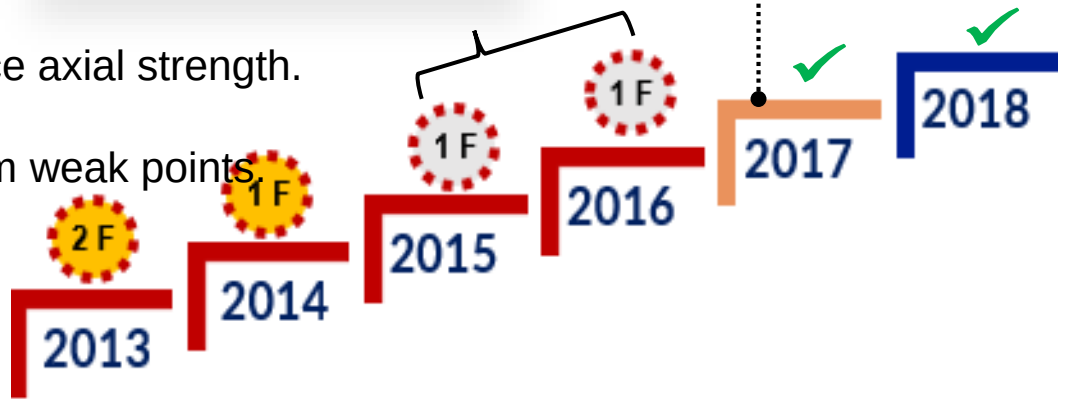
## Due to:

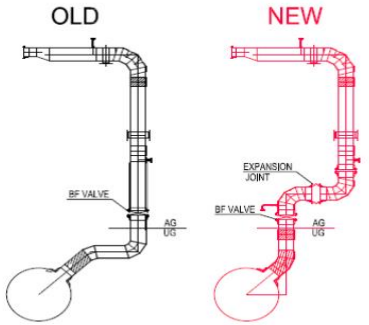
- Stress coming from Piping Support design.
- Branch geometry have weak points easy to fail with external stress factor.
- Piping Lower axial tensile strength.


**Stress issue Enhancement Project**

## Mitigations done

- ✓ Upgrade the pipe to GRV.
- ✓ Additional lamination done to enhance axial strength.
- ✓ Re-routed of highly stressed lines.
- ✓ Add exp. bellow to absorb stress from weak points.
- ✓ Flow velocity < 3 m/sec as IOW limit



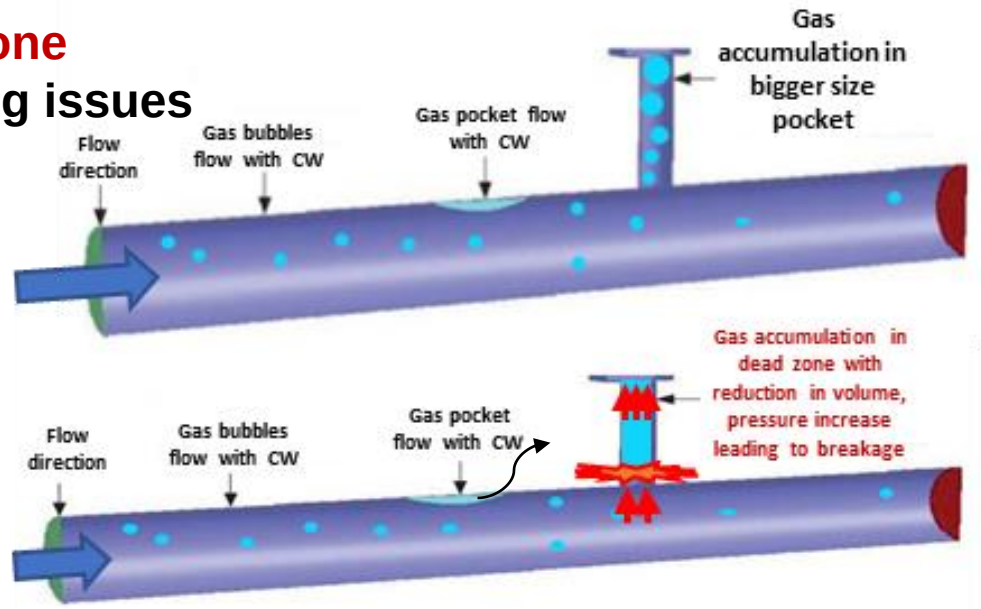
# 3rd CHALLENGE PERIOD (ST)

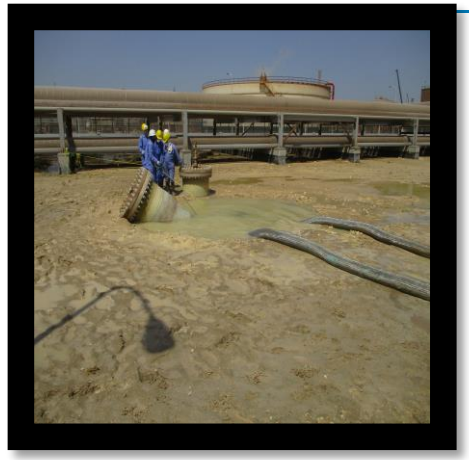
## Root cause:

- **Gas ingress and accumulation in dead zone**
- **High Material degradation - Manufacturing issues**

## Due to:

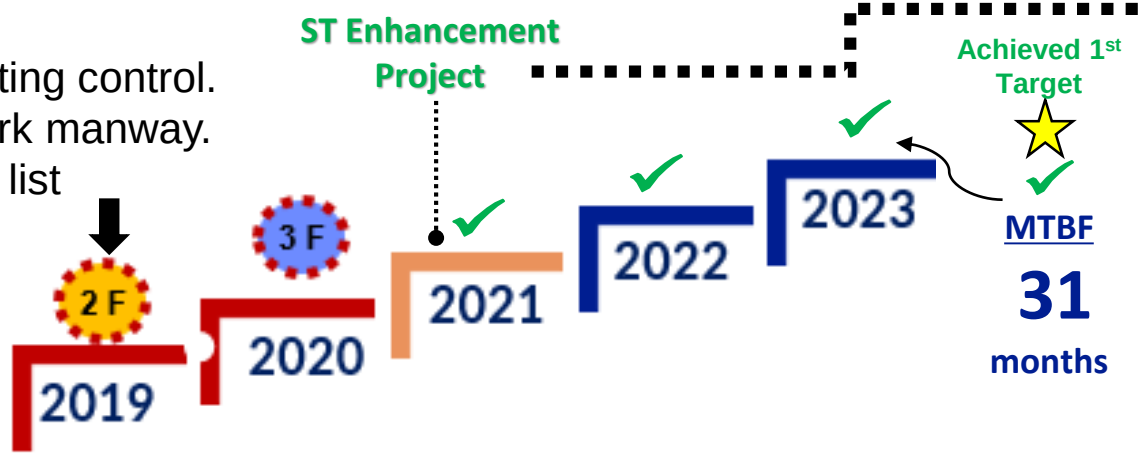
- Plant gasses ingression through heat exchangers tubes failure.
- GRP not designed for dual phase flow.
- No auto-venting system in piping dead zone (manway & isolated valve).



## Mitigations done

- ✓ Enhance operation procedure and venting control.
- ✓ Provide Auto-vent system for all network manway.
- ✓ Include isolated valve in venting check list
- ✓ Develop guideline



# 3rd CHALLENGE PERIOD (cont.)(ST)

## Root cause:

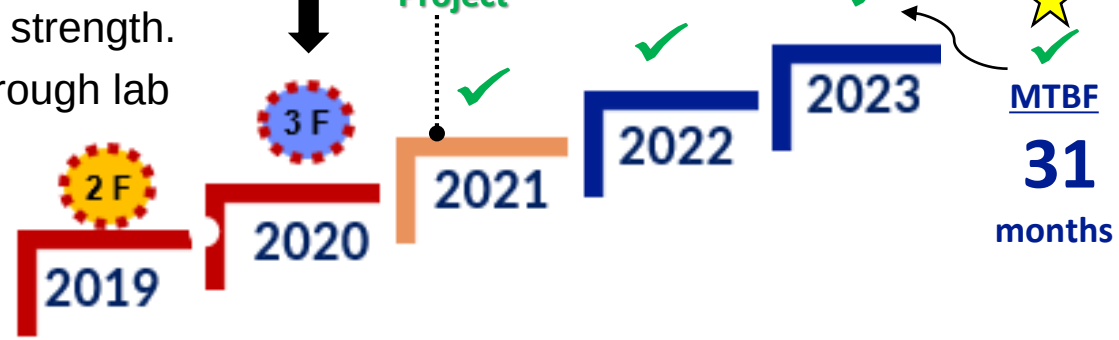
- **Gas ingress and accumulation in dead zone**
- **High Material degradation - Manufacturing issues**

## Due to:

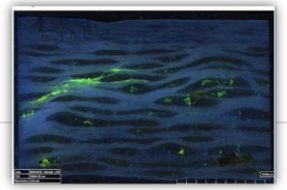
- Axial & Bending Strength < min. required values.
- Internal corrosion barriers damage
- Air bubbles converts to blisters during in service.
- Blister presences accelerate further deterioration of piping strength & leads to crack.
- External UV Protection barriers damage.
- Consider only long-term safety factor in calculation.

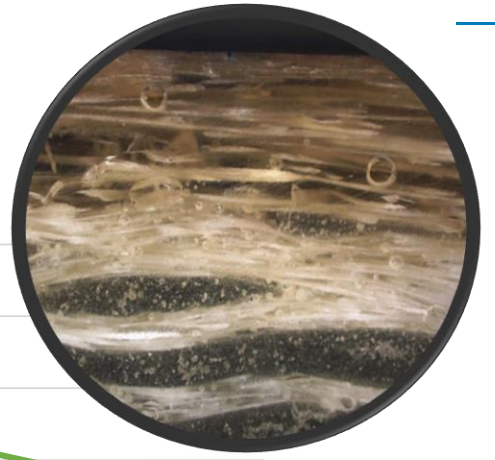
## Mitigations done

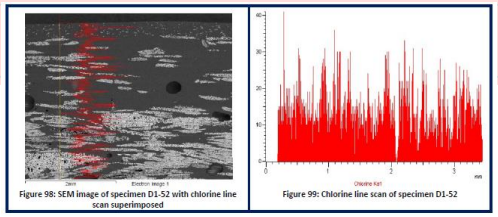
- ✓ Replaced with upgraded materials (GRV/GRE/CS).
- ✓ Additional lamination done to enhance strength.
- ✓ Deep assessment for GRP network through lab analysis.

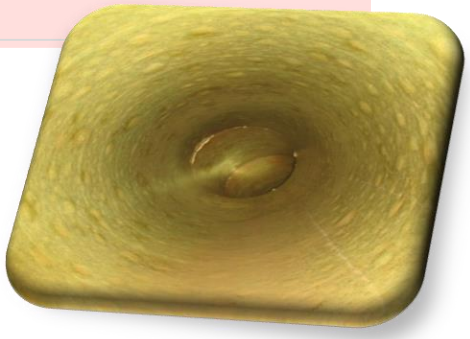


# LAB ANALYSIS AND LIFE ASSESSMENT OUTCOME







GRP PIPING STRENGTH (YEARS)

100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%

UG replaced GRV

Normal GRP life

Start failure risk zone

Actual remaining piping (≥ 52")

eliminated UG lower size (32"≤) risk

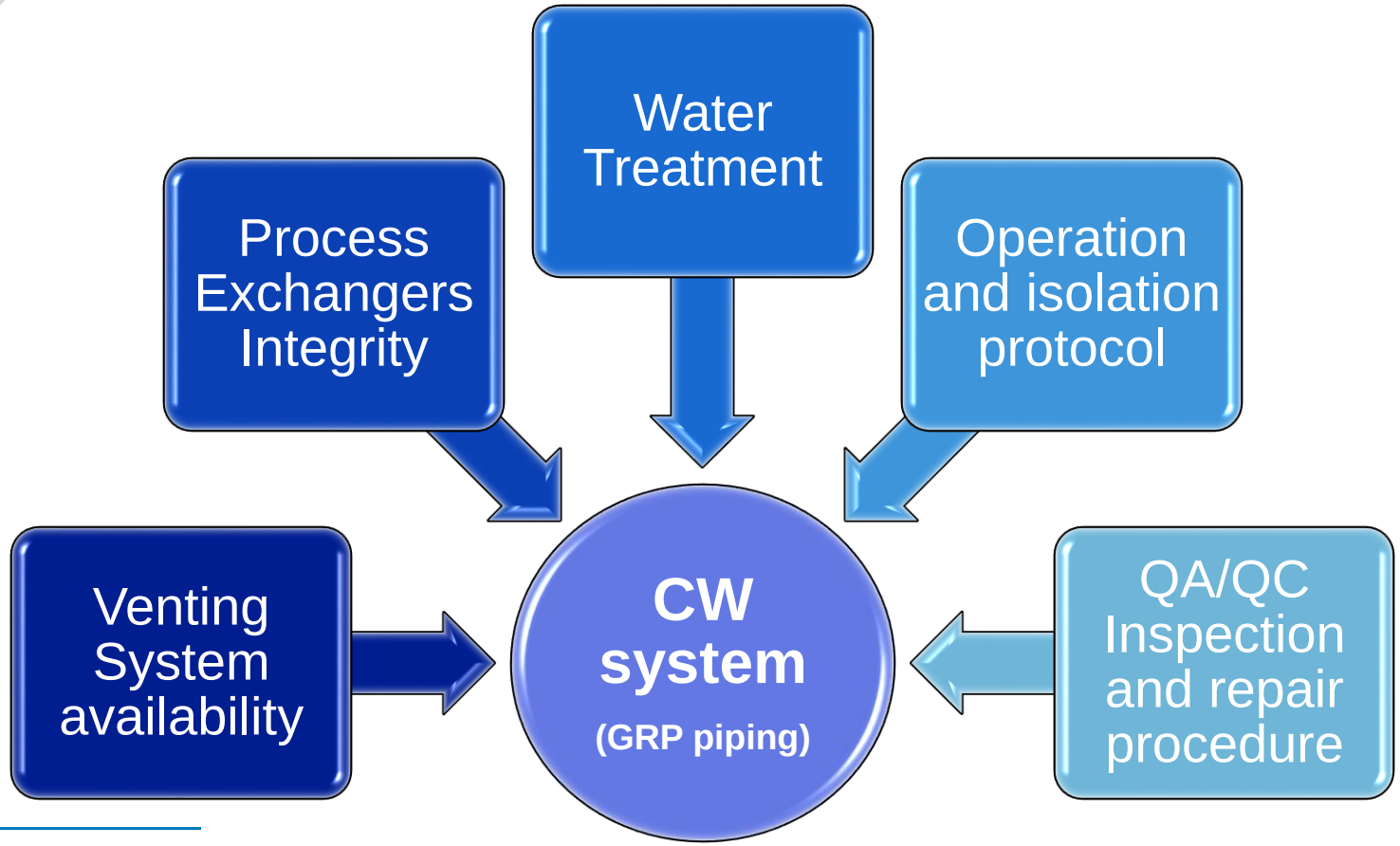
Failure zone (expected)

Scoped in Short Term Enhancement project

Under inspection plan and required Enhancement scope based assessment report

# SYSTEMS CONNECTED TO CW NETWORK

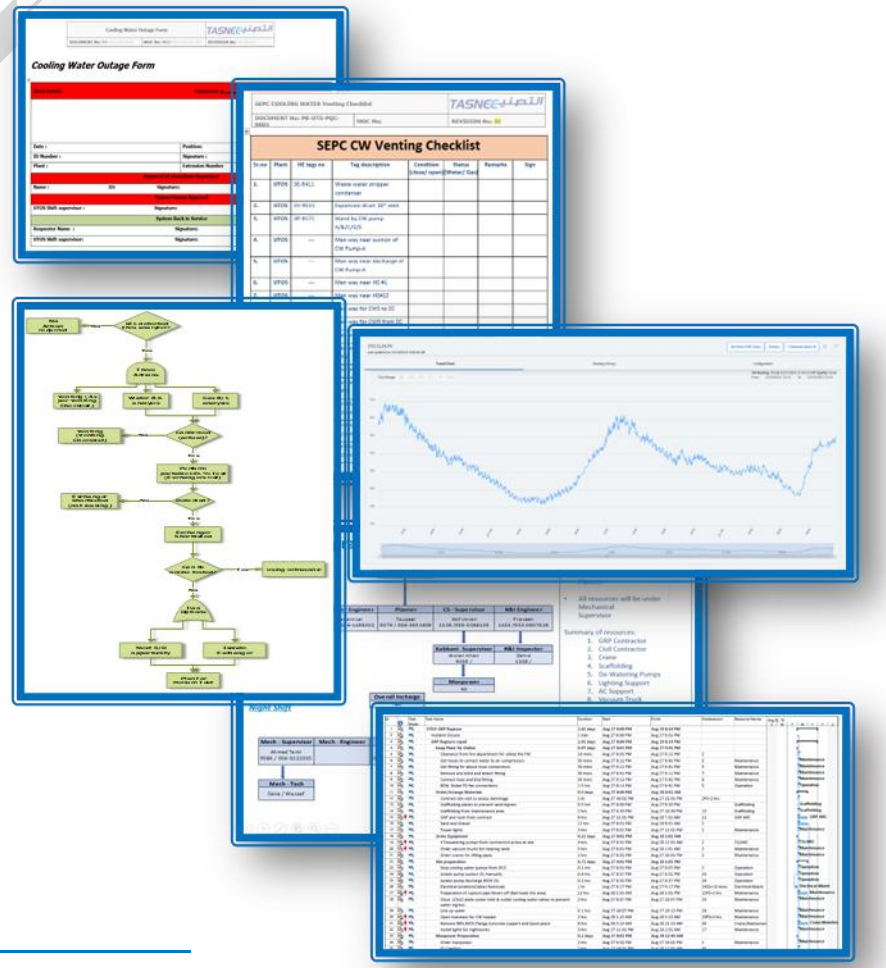
**System may direct or indirect impact CW GRP network risk of failure level:**




**All GRP systems controlled under the developed TASNEE standard :**

- **Engineering & Design**
- **Material Specifications**
- **Piping Manufacturing**
- **Inspection program**
- **Damage mechanism & acceptance criteria**
- **Operation practices**
- **Repair procedure and required QA/QC**
- **IOW limits and monitoring system**

# CW GRP CONTROL MEASURE PROGRAM




**Gas ingression/ Pressure Surge event**

- ☑ Enhance operation procedure and venting control
- ☑ Continuous monitoring for gas ingression by analyzer
- ☑ Auto venting system for all dead zones
- ☑ Continuous venting incase of gas ingression
- ☑ Inspection program for CW system suspected coolers

**High Stress Area**

- ☑ Replaced with CS piping
- ☑ Rerouted to above ground in process area
- ☑ Replaced with GRV for high affected underground piping

**Soil Settlement**

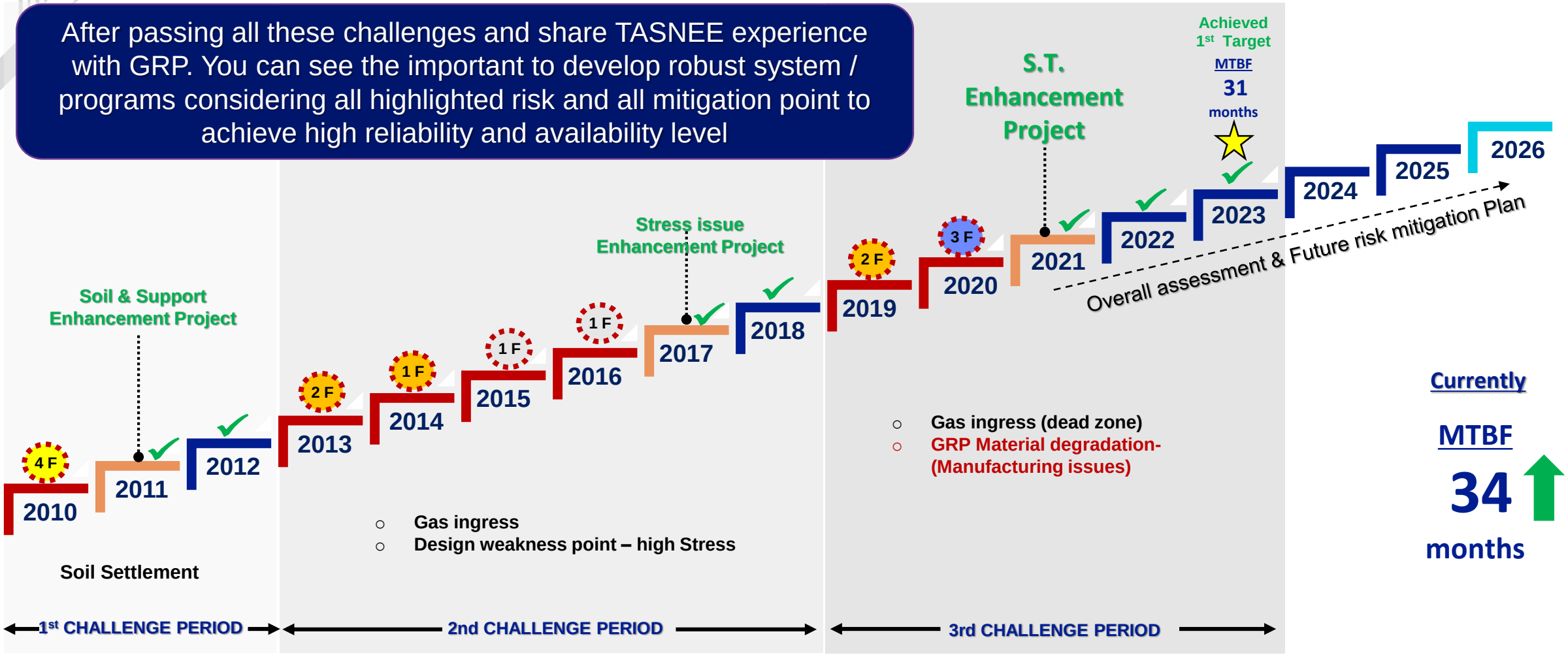
- ☑ Regular soil settlement survey (monthly)
- ☑ Additional monitoring points in CW GRP network

**Material properties degradation**

- ☑ Developed Tasnee standard for GRP piping design, manufacturing, installation and maintenance
- ☑ Regular external survey as PM
- ☑ Knowledge of overall system health through internal inspection
- ☑ Maintain operating limits in monitoring alarming system
- ☑ **Develop mitigation plan based on future risk**

# FRP/ GRP ENHANCEMENT HISTORY IN TASNEE

After passing all these challenges and share TASNEE experience with GRP. You can see the important to develop robust system / programs considering all highlighted risk and all mitigation point to achieve high reliability and availability level




Currently

MTBF

34

months

# CW GRP NETWORK AUTOMATION MONITORING SYSTEM

**All invited to attend tomorrow technical session:**

**Title**

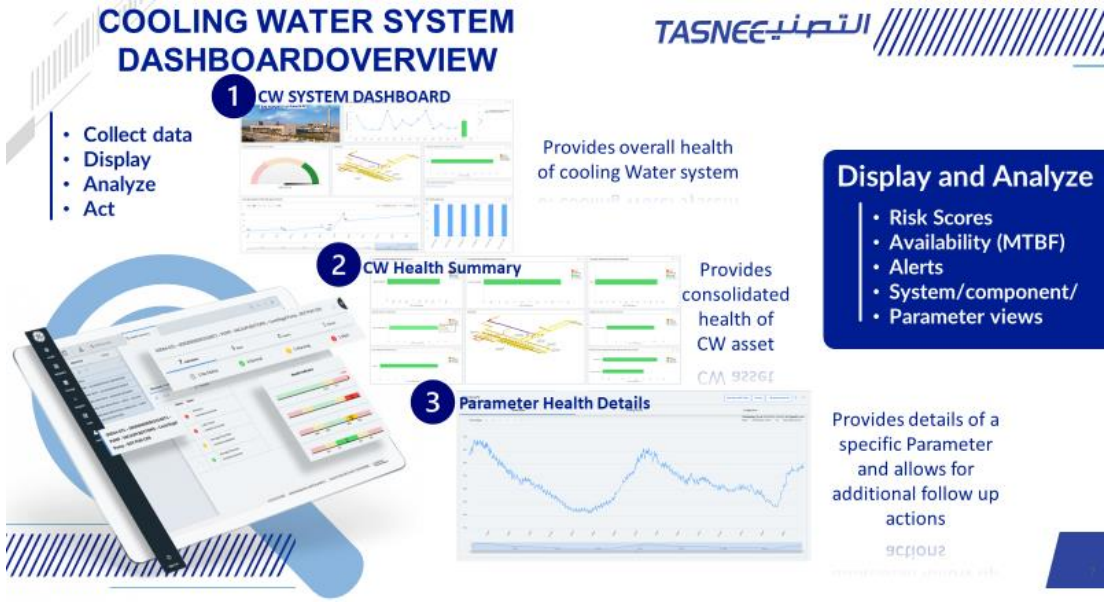
**360° HEALTH LIVE MONITORING for FRP COOLING WATER SYSTEM**

**Time**

**9:30 – 10:00 AM**

**Speaker**

**Engr. Sultan Al Hazmi ( TASNEE)**



THANK YOU

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