Modified RIL-NORSOK M-506

- Developed for Theoretical Internal Corrosion rate estimate due to CO2

- Concepts from Reservoir engineering, GMS are taken and different pH calculation methods are incorporated into the model

- Corrosion inhibition due to MEG presence also considered

- In-situ Process conditions at individual flow line were estimated and corresponding corrosion rate and metal loss were calculated

- Metal loss is estimated quarterly
Internal Corrosion Direct Assessment (ICDA)

ICDA executed by third party BV and JEE (UK)

Objective:

This assessment is executed as part of the overall fitness for purpose for the D1D3 and MA subsea pipeline systems.

Internal corrosion assessment in accordance with the methodology presented in NACE Standard Practice SP0110-2010

The objectives of this assessment were:

1. Establish a sample of flow lines that are representative of worst scenario

2. Determine the anticipated flow and corrosion regimes and identify the locations of maximum corrosion

3. Expected internal corrosion based on production and operating history
Conclusions and Recommendations

As a result of this ICDA assessment, it is concluded that:

- Cumulative corrosion in all pipelines is acceptable, being less than criteria defined by the corrosion KPI (0.1mm/yr).

- KPI criteria derived from BOD

- It is recommended that this ICDA approach is revisited at the time of the next full FFP audit at the end of 5 calendar years
External Corrosion Control - Design

- Offshore installation and commissioning witnessed and certified by DNV
- Pipelines are covered with 3LPE, PU and Concrete Coatings
- Cathodic Protection through sacrificial anodes
- Protection of pipe lines at Crossings with mattresses
- Bend restrictors at Flexible lines and Umbilicals
- Shallow water sections buried 7 meters deep with gravel cover
- Onshore sections buried at a depth of 2 m
- Pipelines protected in ROW through fencing
GVI - General Visual Inspection

- Coating damage
- Anode Consumption
- Flow line burial and profile survey
- Cathodic Potential Measurement
- Free span and Scour survey

CPFG – Cathodic Protection Field Gradient survey

- Trailing wire method for shallow water
- Twin cell method for deep water

UT Survey

- CYGNUS UT gauge with ROV at Deep water by Multi echo method through coating
Corrosion Control @ Topsides, LFP

- Corrosion ER Probes on Platform CRP
- Corrosion rate is monitored monthly for GTLs
- UT and LRUT measurements taken at Landfall point
- UT and LRUT measurements performed at Block valve station at Landfall point
- Corrosion coupons are located at OT Slug catchers
- Corrosion coupons metal loss data will be available when shutdown is offered of the trunk line

Piping @ Control Riser Platform

Block Valve Station at Landfall Point
Sand monitoring

Design
- Wells are completed with down hole sand control devices to mitigate sand production from the reservoir
- Acoustic Sand detection system is provided at each well head (Clampon)
- AMC with Vendor for data analysis

Monitoring
- Acoustic Data Vendor analysis review and reporting
- Development and updating of Sand Management Plan
- Daily and Monthly analysis of ASD
Erosion monitoring

Design

- Well completion – Sand screens & Gravel packs
- Material selection
- Process simulation (PSS) – Maintain gas velocity control
- Erosion monitors installed in all wells

Monitoring

- Control system healthiness check
- Daily monitoring & Monthly analysis by Integrity Team
- Solids trending across system
CRP Risers Inspection was carried out as per OISD and IM Plan:

Above Splash Zone
UT, LRUT inspections were carried out latest in 2017

Splash zone
GVI, LRUT inspections were carried out latest in 2017

Below Splash Zone
GVI was done with ROV latest in 2016
UT inspections were carried out thru rope access according to IRATA guidelines
Riser Monitoring

- Jacket, Riser, J-tube GVI performed from (-)14m to seabed
- Riser above water UTM program is in place.
- Topside piping internal corrosion probe status
- Topside Piping GVI performed
  - Performed coating Repairs
  - Flange protection mitigation is in place.
- Splash zone inspection/LRUT/FMD/LFJ/MG Removal

Very important for structural safety of platform
CRP Jacket Inspection was carried out as per OISD and IM Plan:

**Splash zone**
Jacket Inspection was done by using Air diving Services latest in 2016

**Below Splash Zone**
Jacket inspection was done by ROV and Air diving Services latest in 2016
Least Fatigue Joint inspection was done using ACFM (Alternating Current Field Measurement. Thickness Survey was conducted for Fire & Utility water pump Caissons, J tubes.
Shallow water and Onshore pipelines inspection

- Shallow water pipelines GVI and CPFG survey carried out.

- Onshore Pipeline CP Survey performed every three months and shows adequate protection along onshore ROW.

- UT survey performed on onshore pipelines above ground piping once in two years.

Shallow water and onshore pipelines pose high risk of third party damage.
Initiatives for CP improvement

Onshore
- CP survey quarterly for Onshore pipelines
- GVI annually for Onshore Pipelines

Offshore
- GVI as per IM Plan
- Low CP was noticed on FCMs of XMT
- Rectified by installing Retrofit Anodes
- Improved by installing CP clamps with continuity Cables
- HPEN: Designed, Fabricated the Clamps In-house and installed
Engineering Assessments Reports

- Record status against each inspection criteria
- Identify further actions and prioritise according to threat level
- Assess change in risk
- Update damage register
- Update Action Tracker

Proper review, analysis and reporting critical for AIM.

OISD Work shop 4 – 5th Dec ’17, New Delhi.
Asset Integrity Management

Highlights

- FFP - Fit for purpose certifications by third party agencies are in place for CRP and Subsea assets
- Bi-Monthly reports are issued to depict the Assets integrity status
- FARs – Field Anomaly reports are initiated to address the observations
- SAP – PTW is followed for the execution of Integrity Management Plan
- Historical data is maintained in Visual Soft based Server system to archive, review and report “digital video inspection” data
- Commitment of Site management for the adherence of Inspection Management Plan
Contd…

- Inspections are regularly performed, Engineering assessments are prepared.

- MSV with a work class ROV is available for quality inspections.

- Dedicated resources are available to ensure Asset Integrity.

- Well integrity testing is being carried out as per the plan.

- SSIVs integrity test and inspection is being carried out annually.

- Developed app for Internal Corrosion monitoring with our big data analytics team.
Lessons Learnt

- Sand management plan has been revised considering Field Operational experience

- GVI (General Visual Inspection) procedures revised with inclusion of learnings from previous inspections cycles which is based upon Risk Based Inspection approach

- FAR (Field Anomaly Register) maintenance and monitoring to close out anomalies. Etc.
RIL believe that independent and third party validation leads to continuous improvement as well as providing assurance; the following are examples:

- 2H Offshore Audit of Integrity management System
- Lloyds Register Validation of complete Subsea Manual
- DNV Validation of Subsea Manual (Book 5 - Integrity Management)
- NALCO corrosion and scale inhibitor program reviews
- Certification of CRP FFP done in 2015 by BV and annual audits follows
- Certification of Subsea System FFP in 2016 and periodic audits follows
- Insurance survey audit by ACE & Marsh in 2017

2H Offshore audit reported as “Reliance IM system is amongst the best currently in operation by any operator around the world”
Recognition & Awards

Project Phase:
- Best Project Management Award from PMI India -2010
- Marico Innovation Award (KGD6 Project) – 2010
- Petrotech Award by MOPNG– Best Project Management (Joint Winner ) - 2010

Operations Phase:
- BSC 5 Star Award- Occupational Health & Safety System & Sword of Honour-2011
- BSC 4 Star Award for Environment Management System -2012
- BSC International Safety Award-2012
- OISD award : Best Platform award for CRP (2010-11)
  - Best Rig for DWF (Deep Water Frontier ) (2010-11)
  - Best Onshore Processing Plant (2011-12)
- Economic Times –Indian manufacturing Excellence “Super Platinum” Award-2011
- Corporate Social Responsibility Company of the year- Asia Oil & Gas Awards 2013 by Oliver Kinross
- Ramakrishna Bajaj National Quality Award( RBNQA)- Certification of Merit - 2010
- Gold Medal from Red cross society presented by Hon’ble Governor of AP- 5th Consecutive Year in ‘13
- 4 star rating EHS award in southern region by CII in 2014

Excellence in excellence
Recognition & Awards

Shri G. Sreeramamurthy receiving Sword of Honour Award from Mr. Alex Bortha, CEO, British Safety Council
CERTIFICATE OF FITNESS

Operator: RELIANCE INDUSTRIES LIMITED, INDIA (RIL).
Block No: KG-DWN-98/5(KG-D6)
Field: D6
Certification Object: CRP Topside Facilities & underwater jacket structure including appurtenances, riser from -60m from mean sea level till tube-turn and pipeline till 50 mtrs from riser tube-turn.

The undersigned acting within the scope of BUREAU VERITAS General Conditions of Service certifies that at the request of RIL Ltd., A Review of maintenance documentation and records Review from 12th March 2015, through to 14th March 2015, and an offshore physical examination between 24th July 2014 through 25th July 2014 and 20th October 2014 through 22nd October 2014 was carried out to verify compliance of the above units as per applicable international Standards.

Based on the results of the review and examination the CRP Topside Facilities & underwater jacket structure including appurtenances riser from -60m from mean sea level till tube-turn and pipeline till 50 mtrs from riser tube-turn are considered to be fit for operations, subject to the requirements of the following to be verified during annual surveillance audits.

3. Appendix-3- Log of Compliance Verification for Findings during Follow Up Audit Survey 2014

This Certificate is valid until Feb 2020 subject to the conditions set forth in BUREAU VERITAS Initial audit survey report No. IND.H.4.14.0073-2014/01 and four consecutive satisfactory annual surveys by Bureau Veritas.

Issued at Mumbai-India
On 21st March’ 2015.

For BUREAU VERITAS Mumbai

V. RAVI KUMAR
OIL & GAS MANAGER

KG D6
Exploration & Production

OISD Work shop 4 – 5th Dec ‘17, New Delhi.
Subsea Assets FFP certified BV- JEE
Thank You

We have also supported Coast Guard and Navy during SAR (Search and Recovery operations). MSV / ROV was used for Recovery of Coast Guard aircraft from 1200 meters and Navy helicopter from 90 meters from East Coast deep sea.