



## AUDIT REPORT

### BONGA MAINTENANCE STRATEGY & MATERIALS MANAGEMENT REVIEW

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<b>Auditee:</b>	Jillis van Duuren	Bonga Maintenance Manager
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<b>Team Members:</b>	David Ojako, Ikechukwu Nwaokweanwa, George Chukwumah	
<b>Product Type:</b>	LOD-2 Audit	
<b>Locations covered:</b>	Lagos, Bonga FPSO	
<b>Period of Fieldwork:</b>	17 <sup>th</sup> to 24 <sup>th</sup> June 2019	
<b>Date Issued:</b>	15 <sup>th</sup> July 2019	

### EXECUTIVE SUMMARY

The Shell Nigeria Exploration and Production Company Limited (SNEPCo) is a major contributor to the Shell Group's Upstream business with an average production of 166kbpd in Q1 2019. SNEPCo manages the Deepwater Assets and interests in Nigeria under Production Sharing contracts (PSC). First oil from the Bonga Main Asset was achieved on November 25, 2005.

This audit appraised the effectiveness of risk-based Maintenance Strategy and Materials Management control framework for the Bonga Asset. The effectiveness of the closure of relevant actions from a Safety Critical Elements (SCE) rationalization exercise conducted in 2016 was also assessed.

The Audit Team noted visible Leadership drive and commitment to address technical integrity and equipment reliability issues identified on the Bonga Asset after several years of production. This was evidenced by the Bonga Business Improvement Program (BBIP) launched in 2015 and subsequently, the BBIP Re-energize in 2018.

It is noteworthy that one of the four workstreams of the BBIP Re-energize is focused on end-to-end system fixes, with six key systems selected in the first phase. Implementation is monitored via regular cadence meetings and progress reported out on a monthly-basis on a visible dashboard.

Notwithstanding, the following gaps which resulted in findings (with ratings indicated) were observed:

#### Set-up, Implementation & Review of Equipment Maintenance Strategies and Plans (High)

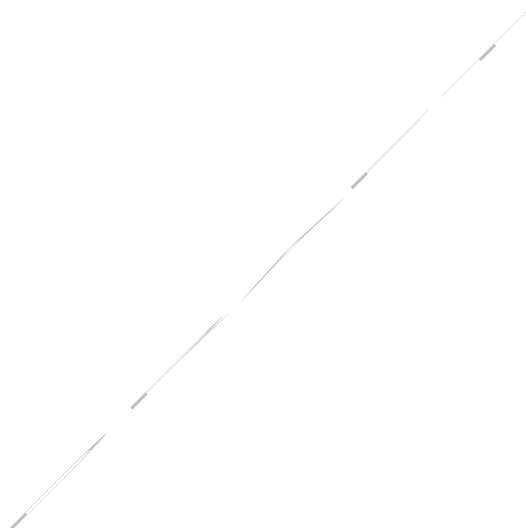
- Maintenance Plans developed and loaded in SAP following the Preventive Maintenance Library (PML) strategy localization workshop held in 2016, have largely not been implemented (i.e. PM work orders are not being called and scheduled). No PM work orders have been generated for 2,056 out of the 6,564 Maintenance Plans (active) in SAP (i.e. 31%).
- Some equipment (including some defined as SCEs) still have no Maintenance Plans at all in SAP.
- Equipment Maintenance Strategy reviews are not planned, resourced and documented as such in the Maintenance Reference Plan (MRP). The OE Standard indicates that over a five-year period (at most), all safety critical and production critical equipment maintenance strategies should be reviewed in a planned and structured manner documented in the MRP. As at the time of this audit, the MRP review and update (due since November 2018) was still not completed.

### **Effectiveness of Assurance Actions Closure Process (High)**

- Some of the actions from a Safety Critical Elements (SCE) rationalization exercise conducted in 2016 were found to have been closed out in Fountain even though the actions were not completed.

### **Materials Availability Processes (Medium)**

- Incomplete Bill of Materials (BOMs) in SAP. BOMs are largely not available in the Asset Register in SAP. Missing technical specifications hinder materials coding, ultimately impacting on the efficiency of the ordering process. However, the Audit Team acknowledges the work-in-progress with respect to initial (as-built) material data retrieval in conjunction with the OEM, Wood Group (AMEC).
- No Service Level Agreement (SLA) between the Bonga Asset Team and the Materials Procurement Team. Thus, clarity about the specific timelines for milestones in the Material Ordering Process, as well as responsibilities of the parties involved and possibly, penalties for breaches is lacking.



## AUDIT SCOPE

This audit was carried out as part of the approved 2019 Bonga Annual Assurance Plan. The Audit Team assessed the Maintenance Strategy and Materials Management control framework related to the business objectives of the Bonga Asset Team as set forth in Appendix I.

The Audit Scope included but was not restricted to:

- **Effectiveness of Assurance Actions Closure Process**
  - Tracking and Close-out of previous assurance actions
- **Risk and Reliability Management**
  - Asset Register Completeness
  - Risk Based Inspection
  - Equipment Maintenance Strategies and Tasks
  - Critical Spares
  - Strategy Review Results
- **SCEs and Performance Standards**
  - Hardware Barriers
  - Performance Standards aligned to GPST
  - Performance Standard Ownership
  - Assurance Activity Results
- **Work Preparation, Scheduling and Execution**
  - Job Request Quality
  - Job Request Process
  - Quality of Work Execution
- **Inspection and Condition Based Maintenance**
  - Scope
  - Degradation Rates
  - Integrity Operating Limits
- **Overall Equipment Condition**
  - HBA Compliance
- **Materials and Inventory Management**
  - Effectiveness
  - KPIs
  - Material Master Catalogues
  - BOM Availability
  - Materials Maintenance and Preservation

The audit covered the period from 1<sup>st</sup> January 2016 to 31<sup>st</sup> May 2019.

## AUDIT FINDINGS AND ACTIONS

<b>Finding Title</b>	<p><b>01</b></p> <p><b>Set-up, Implementation &amp; Review of Equipment Maintenance Strategies and Plans</b></p>
<b>Description</b>	<p>Risk and Reliability Management (RRM) covers the whole process of managing equipment maintenance strategies. It is a key process in sustaining any Maintenance and Integrity improvement effort. When properly implemented, the process ensures all equipment in the Asset Register is reviewed, utilizing a risk-based approach, to identify the inspection and maintenance actions required to retain an item in a specified condition.</p> <p>According to the Risk and Reliability Management Process Guide (EP 2007-9010), best in class Risk and Reliability Management standard requirements include the following:</p> <ul style="list-style-type: none"> <li>▪ <i>"A process is in place to ensure the Asset Register will remain current and accurate with all equipment having been assigned correct strategies, underpinned by the safety, production and no impact criticality and updated in the CMMS.</i></li> <li>▪ <i>An effective Strategy Review process that ensures all equipment within an Asset are reviewed every five years. The Strategy Review process will have a structured method of allowing adjustment of PM tasks based on the equipment criticality and performance history in the CMMS.</i></li> <li>▪ <i>An annual plan detailing how many reviews will be completed and implemented. This plan will be identified in the Asset's Business Plan and properly budgeted and resourced within the Maintenance Reference Plan. This plan will ensure that the target Strategy Review cycle of all equipment reviewed within 5 years is achievable. Tracking of the annual plan will be carried out at regular monthly review meetings".</i></li> </ul> <p><b>The Audit Team noted the following gaps with respect to Equipment Maintenance Strategies and Plans.</b></p> <ul style="list-style-type: none"> <li>▪ <b>Non-Implementation of Equipment Maintenance Plans</b> A Preventive Maintenance Library (PML) review exercise was conducted in 2016 with the active involvement of relevant TA's, Field Maintenance Practitioners and other stakeholders. Maintenance Strategies and Plans were developed or updated for several systems &amp; equipment groups. Subsequently, a substantial number of the Maintenance Plans were loaded in SAP. However, most of these Maintenance Plans have still not been implemented (i.e. the PM work orders are not being called and scheduled). PM work orders are presently not being generated for 2,056 out of 6,564 (active) Maintenance Plans in SAP (representing a non-implementation rate of 31%). Find Table 1 below indicating a breakdown of the non-implemented Maintenance Plans for some systems sampled by the audit team:</li> </ul>

Sampled Systems	# Maint Plans not scheduled (ACTIVE)	SCE Un-Sched.	PCE Un-Sched.	Non-Critical Un-Sched.
Water Flood System	186	22	75	89
Power Generation	60	29	10	21
Instrument Air System	52	18	34	0
HVAC System	32	23	2	7
Crude Oil Storage/Hydraulic Power System (Framo)	213	108	86	19
Produced Water System	34	20	13	1
Fuel Gas System	17	14	0	3

**Table 1: Breakdown of non-implemented Maint Plans for some sampled systems**

■ **No Maintenance Strategies and Plans for some equipment (including SCEs)**

Some equipment (including some categorized as SCEs) still have no defined Maintenance Strategy and no Maintenance Plans at all in SAP. Examples include:

- **Oil Mist Detectors 1 & 2 at solenoid valve cabinet room (SCEs)** Ref Functional Locations - NG.BON.8306-AT-A0A-010, NG.BON.8306-AT-A0A-010A)
- **Manual Valves (SCEs & non-SCEs)** Ref tags 40-CHV-205, 206, 207; 44-BLV-250,251....256)

■ **Equipment Maintenance Strategy Reviews are not driven by the Maintenance Reference Plan**

There is no structured process for Equipment Maintenance Strategy reviews over a period aligned with the Maintenance Reference Plan (MRP) as per requirement of the OE Standard. It is expected that over a five-year period (at most), all safety critical and production critical equipment maintenance strategies should be reviewed in a planned and structured manner documented in the MRP. As at the time of this audit, the MRP review and update (due since November 2018) was still not completed.

The Audit Team recognizes that the scope of the Bonga Business Improvement Program (BBIP) Re-energized does include update of Maintenance Strategies and Plans for some selected systems. However, the BBIP remains an intervention program and cannot replace the function of the substantive Maintenance Reference Plan with respect to documentation of a proactive and structured process for equipment maintenance strategy review for all safety critical and production critical equipment over a 5-year period as clearly stipulated in the OE Standard.

**Risk**

- Non or inadequate Maintenance of some equipment leading to equipment or system failure possibly resulting in plant outages and unscheduled deferment.

**Rating**

**High**

<b>Action</b>	<b>01.01</b>
<b>Action Description</b>	Complete upload in SAP and commence implementation of all Maintenance Plans developed or updated during the 2016 Preventive Maintenance Library (PML) Review.
<b>Action Party</b>	Chukwumah, George A SNEPCO-UPO/G/WBO
<b>Target Date</b>	October 31, 2019
<b>Action</b>	<b>01.02</b>
<b>Action Description</b>	Complete the review and update of the Bonga Asset Maintenance Reference Plan. Ensure it includes appropriate provision for a proactive and structured process for equipment maintenance strategies and plans review for all safety critical and production critical equipment over a 5-year period (at most).
<b>Action Party</b>	van Duuren, Jillis W SNEPCO-UPO/G/WBO
<b>Target Date</b>	December 31, 2019
<b>Action</b>	<b>01.03</b>
<b>Action Description</b>	Commencing with the 2020 Business Plan for the Bonga Asset (OP19), include in the Asset Business Plan, a properly budgeted and resourced annual plan (aligned with the Maintenance Reference Plan) detailing how many reviews of equipment maintenance strategies and plans will be completed and implemented. Subsequently, regularly track the implementation of this annual plan for equipment maintenance strategy/plans review in the Asset Business Performance Reviews.
<b>Action Party</b>	Jonathan, Amakiri R SNEPCO-UPO/G/WBO
<b>Target Date</b>	March 31, 2020

<b>Finding Title</b>	<b>02</b> <b>Non-compliance with Assurance Action Closure Process</b>
<b>Description</b>	<p>RDS has a mandatory and standardised assurance action tracking system that supports the Group Assurance and Risk Management processes. This system (presently Radar – previously Fountain, up until Feb 2018) provides:</p> <ul style="list-style-type: none"> <li>(i) auditable trail of the action closure, with appropriate supporting documentation;</li> <li>(ii) transparency to the responsible Auditee and Senior Management on the on the status of actions and confirmation when identified risks have been effectively mitigated.</li> </ul> <p>Ten out of twenty-seven relevant actions were sampled from the 2016 SCE Rationalization Exercise to verify both compliance to the Assurance Action Closure Process (AACP) and the effectiveness of the actions taken.</p> <p>The testing identified that the closure of three out of the ten actions sampled (30%) did not comply with the Assurance Action Closure Process and were “not effective” in addressing the identified gaps. It was found that the three actions, though closed out in Fountain, were actually not implemented in SAP as required.</p> <p>Further details are provided in Table 2 (see Appendix 2).</p>
<b>Risk</b>	<ul style="list-style-type: none"> <li>▪ Risk exposures continue to exist due to failure to address identified gaps.</li> <li>▪ False assurance to Management on the effectiveness of closed assurance actions and level of continuing risk exposure.</li> </ul>
<b>Rating</b>	<b>High</b>
<b>Action</b>	<b>02.01</b>
<b>Action Description</b>	Re-open the three closed actions from the 2016 SCE Rationalization Exercise identified as not properly completed (i.e. Fountain IDs 951724, 951990, 951746). Follow up to ensure that the actions are properly implemented in SAP. Review other closed actions from the same 2016 SCE Rationalization Exercise report and check to confirm effectiveness. Take appropriate steps to rectify any anomalies identified.
<b>Action Party</b>	Iheme, Nkemdirim J SNEPCO-UPO/G/WBO
<b>Target Date</b>	October 31, 2019
<b>Action</b>	<b>02.02</b>
<b>Action Description</b>	Monitor the progress of implementation of the actions from the 2019 Bonga Maintenance Strategy & Materials Management Review until close-out. Provide necessary support and oversight to ensure the associated controls/processes are embedded to address the risks and identified control weaknesses in a sustained manner.
<b>Action Party</b>	van Duuren, Jillis W SNEPCO-UPO/G/WBO
<b>Target Date</b>	December 31, 2020

**Finding  
Title****03  
Materials Availability Processes****Description**

Excellent Materials and Inventory Management can, and does, have a positive impact on an Asset's performance by supporting Work Preparation, Scheduling and Execution (WPSE), safeguarding technical integrity and reducing cost and deferment.

Material availability and delivery times have to be carefully managed as they can impact directly on the performance of the maintenance execution teams. Late arrival of materials on site directly threatens the ability of the maintenance team to deliver its schedules of work and, can, therefore, impact on extended downtime of equipment.

**The following gaps were observed:**

- **Incomplete Bill of Materials (BOMs) in SAP**  
BOMs are largely not available in the Asset Register in SAP. Missing technical specifications and price estimates for required materials and spares is quite usual. This often hinders materials coding and also causes significant delays in the materials ordering process as several iterations of clarifications with vendors and suppliers are common occurrences.

However, the Audit Team acknowledges the work-in-progress with respect to initial (as-built) material data retrieval in conjunction with the OEM, Wood Group (AMEC). This project is expected to address the missing BOMs.

- **Absence of Service Level Agreement**  
The Audit Team noted that there was no documented Service Level Agreement (SLA) between the Bonga Asset Team and the Materials Procurement Team. Thus, clarity about the specific timelines for stages in the Material Ordering Process, as well as responsibilities of the parties involved and possibly, penalties for breaches is lacking.

**Risk**

- Delayed material delivery beyond ROS dates resulting in maintenance backlogs and deviations which could severely impact on asset integrity.
- Missing or wrong technical specifications for materials could lead to supply of inappropriate spares; leading to unnecessary delays in execution of maintenance work and extended equipment downtime.
- Absence of Service Level Agreements between the Asset Team and Materials Procurement Team could lead to lack of clarity about roles and responsibilities of parties concerned, sub-optimal planning and unrealistic expectations; all which could negatively impact on material on time delivery and prompt execution of maintenance work.

**Rating**

**Medium**



<b>Action</b>	<b>03.01</b>
<b>Action Description</b>	Identify all equipment that require Bill of Materials (BOMs) update in SAP. Develop a phased and adequately resourced plan to complete update of BOMs in SAP. Obtain Asset Manager's approval for the plan.
<b>Action Party</b>	lheme, Nkemdirim J SNEPCO-UPO/G/WBO
<b>Target Date</b>	November 30, 2019
<b>Action</b>	<b>03.02</b>
<b>Action Description</b>	Implement the approved plan for equipment Bill of Materials (BOMs) update in SAP. Report out progress regularly in the Asset Business Performance Reviews.
<b>Action Party</b>	lheme, Nkemdirim J SNEPCO-UPO/G/WBO
<b>Target Date</b>	December 31, 2020
<b>Action</b>	<b>03.03</b>
<b>Action Description</b>	Develop, agree and communicate a Service Level Agreement (SLA) between the Bonga Asset Team and Procurement Team. The SLA should address the following as a minimum: <ul style="list-style-type: none"> <li>• Clear roles and responsibilities of the parties involved and their representatives</li> <li>• Specific timelines for various stages in the Material Ordering/Delivery Process</li> <li>• Process for escalation or complaints resolution mechanism in the event of default by a party.</li> </ul>
<b>Action Party</b>	Odiase, Arese T SPDC-PTC/OU <i>[Assigned action party to collaborate with the Bonga Asset Operations Manager or her delegate]</i>
<b>Target Date</b>	October 31, 2019

## APPENDIX 1: BUSINESS OBJECTIVES

### Description of Business Objectives

The objectives of the business or function form the basis for risk identification and assessment and will be used in rating the Audit Findings. These include long term and short term, implicit and explicit objectives (as relevant to the audit scope areas). Implicit objectives will usually include the effectiveness of basic processes and controls that form the foundations of the day-to-day business operations. These are rarely explicitly documented as "Objectives", but failures in this area would impact the overall business performance and the achievement of the business objectives.

The following explicit business objectives have been provided by the Auditee and agreed with the Audit Team for the purposes of this audit:

The business objective of the Bonga Asset Team is to produce hydrocarbons safely and cost effectively in commercial quantities from production units, assuring asset integrity whilst achieving top quartile production reliability and unit operating costs and contributing to the maximisation of the Shell Nigeria resource value.

With a vision is to be **"One Integrated SNEPCo Family, Achieving Goal Zero, Delivering TQ Operations and Competitive Growth"**, the team aspires to continuously improve the way it works, leveraging on close collaboration and integration with all business functions, SEPCiN's supply chain, contractors and stakeholders, to build and sustain a best in class performance culture, consistent with the Group's Make it Safe, Make it Work, Make it Grow and Goal Zero agendas.



## APPENDIX 2: TABLE 2, FINDING 2

Bonga SCE Rationalization								
S/N	Action Required	Action Closure Description	Audit Team Comments	Action Owner		Plan Finish Date	Actual Finish Date	Status
				Responsible	Accountable			
16	The blast wall was not assigned SCE in SAP under the expected SCE group PS002 – confirm it is contained in the asset register and update accordingly	Action completed before the publication of the assessment.	Blast wall not currently in the asset register; so cannot be assigned as SCE.	Azubuike Nwachukwu	Ogor Roland	30-May-17	30-May-17	Completed
26	Review the description of the KLV in the asset register and assign it under the SD007 SSIV SCE group	Action repeated as ID 951990 which has been closed.	KLV still assigned to SD006	Nkem Ifeme	Mbonu Obinna	31-Aug-17	5-Jul-17	Completed
27	Upload all the changes identified in the asset register spreadsheet APP3 into SAP	Action completed before the publication of the assessment.	IGG-A&B skid units still under PC001 instead of IC004 recommended. Recommended Air Receivers FLOC description change still not implemented	Azubuike Nwachukwu	Ogor Roland	Completed before self assessment audit	Dec-16	Completed

Table 2: Assurance Actions Testing Results