Report of the
Comptroller and Auditor General of India
on
Information Systems Audit of selected Central Public Sector Enterprises

SUPREME AUDIT INSTITUTION OF INDIA
लोकहितार्थ सत्यनिष्ठा
Dedicated to Truth in Public Interest

Union Government (Commercial)
Ministry of Petroleum and Natural Gas
No. 2 of 2024
(Compliance Audit Observations)

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PREFACE

1. This Report of the Comptroller and Auditor General of India has been prepared for submission to the Government under the provisions of Section 19-A of the Comptroller and Auditor General's (Duties, Powers and Conditions of Service) Act, 1971, as amended in 1984.

2. This Report contains the results of Compliance Audit of Information Systems of two Central Public Sector Enterprises under the administrative control of Ministry of Petroleum and Natural Gas as detailed below:

  a. Information Systems Audit of Enterprise Resource Planning implementation in Brahmaputra Cracker and Polymer Limited. (2016-17 to 2020-21)

  b. Information Systems Audit of the Plant Maintenance Module of SAP ERP in Oil and Natural Gas Corporation Limited. (2014-15 to 2020-21)

3. The audit has been conducted in conformity with the Auditing Standards issued by the Comptroller and Auditor General of India.

4. Audit wishes to acknowledge the cooperation received from the Managements of CPSEs and the Administrative Ministry at each stage of audit process.

Executive Summary

Executive Summary

I   Introduction

This Audit Report contains the results of Compliance Audit of Information Systems of two Central Public Sector Enterprises under the administrative control of Ministry of Petroleum and Natural Gas, as detailed below:

a. Information Systems Audit of Enterprise Resource Planning implementation in Brahmaputra Cracker and Polymer Limited.

b. Information Systems Audit of the Plant Maintenance Module of SAP ERP in Oil and Natural Gas Corporation Limited.

II   Highlights

Highlights of significant observations on the selected areas included in the Report are given below:

A. Information Systems Audit of Enterprise Resource Planning implementation in Brahmaputra Cracker and Polymer Limited.

Brahmaputra Cracker and Polymer Limited (Company/BCPL) was incorporated in January 2007 as a subsidiary of GAIL (India) Ltd (GAIL). GAIL is the major shareholder of the Company having 70 *per cent* shares and the balance is equally held by Oil India Limited, Numaligarh Refinery Limited and Government of Assam at 10 *per cent* each. The Company is engaged in production of polymers from natural gas procured from Oil India Limited and Oil and Natural Gas Corporation Limited whereas naphtha is procured from Numaligarh Refinery Limited. The Company entered (March 2016) into an agreement with GAIL for marketing of its products.

The objectives for audit were to assess:

i.   Adequacy of IT Governance framework and its implementation by the Company.

ii.   Adequacy and effectiveness of General and Application Controls in Enterprise Resource Planning.

iii. Efficiency in Business process re-engineering in SAP.

iv.   Adequacy of change management and business continuity plans and its implementation.

Significant audit findings are given below:

Planning and Organisation

The Company implemented SAP Enterprise Resource Planning Central Component as its Enterprise Resource Planning (ERP) with modules pertaining to Finance and Control, Materials Management, Quality Management, Sales and Distribution, Warehouse Management and Human Capital Management with India payroll & Enterprise portal. The Company was yet to implement modules pertaining to Production Planning and Plant maintenance.

(Para 1.6.1.1)

Despite acquiring SAP Solution Manager (sub-module of SAP Technical module), it was not activated which would have enabled identification and documentation of 'AS-IS' critical business processes, identification of business needs etc.

(Para 1.6.1.2)

Various matrices of Control Objectives for Information and Related Technologies (COBIT) such as Critical Success Factors (CSF), Key Performance Indicator (KPI), Key Goal Indicator (KGI) to determine the efficacy of all IT systems were not designed and measured by the Company.

(Para 1.6.1.3)

No IT strategy or Plan was prepared by the Company in contravention of the requirement of COBIT.

(Para 1.6.1.4)

There was no segregation of duties for personnel having access to Development, Quality & Assurance and Production servers of SAP which showed that the Company was unable to minimise reliance on a single individual performing a critical job function.

(Para 1.6.1.5)

Although the Company had decided in November 2012 to train its staff to gain sufficient expertise and experience in the operation and maintenance to handle operations independently once ERP was implemented, the Company was hiring multiple consultants for regular operation and maintenance even after expiry of six years since operationalisation of SAP. The Company is largely dependent on the external consultants for routine activities related to Operation & Maintenance in the absence of adequate SAP training for its employees and had to deploy multiple consultants at a higher cost of ₹6.46 crore during six years since implementation of SAP.

(Para 1.6.1.6)

Recommendation 1: The Management may develop criteria and matrices to assess the project outcome and performance of SAP Enterprise Resource Planning System.

Recommendation 2: The Management may ensure that the IT policy reflects the latest developments in IT Governance and Management.

Recommendation 3: IT organisation may be strengthened and segregation of roles ensured. The Company may develop in-house capabilities and reduce recurring dependencies on consultants.

Acquisition and Implementation

The Company has no Standard Operating Procedure to keep its software updated and authorise/monitor changes made on SAP which is in contravention of the requirement of COBIT. SAP table logging has not been activated, therefore, changes made to SAP tables are not traceable.

Recommendation 4: Table Logging may be implemented to record documentation of change management.

(Para 1.6.2.1)

IT Support System

The Company was yet to prepare a data management policy and prescribe a procedure to manage media library, backup and recovery of data, and proper disposal of media.

Recommendation 5: The Company may frame a 'data management policy' at the earliest.

(Para 1.6.3.1)

The Company's IT policy does not specifically address a business recovery plan. It has not prepared a business impact analysis, it has not identified roles, responsibilities, and communication process for disaster recovery.

(Para 1.6.3.2)

The Company does not have an IT security policy. Crisis Management Plan which was put in place to address natural disasters, man-made disasters, and cyber-attacks to the Company's IT Systems was reactive rather than proactive in nature and addressed post incident response.

(Para 1.6.3.3 A)

Several risks including three high risks were not mitigated which were identified during Vulnerability Assessment and Penetration Testing in August 2020 and then a re-audit in July 2021, both conducted by M/s Bharat Electronics Ltd.

(Para 1.6.3.3 B)

Audit examination of user's access controls on SAP revealed existence of incomplete address data, retention of default username with default password for 17 instances, existence of users with multiple critical roles and authorisation for 735 users, provision of critical authorisations to multiple users ranging from 10 to 731 users, assignment of duplicate user IDs to one user, non-deactivation of SAP user IDs who had not logged in for a specified time period, non-configuration of the requirement of the IT Policy of the Company to change password after every 60 days and absence of documented Standard Operating Procedure in respect of source data preparation and authorisation.

Recommendation 6: The Company may define roles and provide access to SAP based on SAP standard roles or custom roles. Segregation of duties may be enforced when defining roles. Password policy may be enforced without compromise.

(Para 1.6.3.4)

Users should not be able to edit the field named "GR-Bsd IV" i.e. "Goods Receipt based Invoice" in standard (domestic) Purchase Orders so that unauthorised acceptance or payment is not done. There were 86,358 documents pertaining to standard (domestic) purchases where creation of invoices without Good Received Number was editable.

(Para 1.6.3.5 B)

In BSIK table (a standard table in SAP containing open items pertaining to vendors) 4,958 entries aggregating to ₹1,136.10 crore out of 5,960 entries were kept eligible for payment with blank entry in the payment block key indicating ineffective controls on account payables and entailed a risk of unauthorised payment.

(Para 1.6.3.5 C-I)

Scrutiny of LFA1 table (a standard SAP vendor master table) and LFBK (a standard SAP table containing the banking data for the vendors) revealed that table LFA1 had 6,252 vendor records and table LFBK had 4,101 banking records of vendors. Out of 6,252 vendors shown in LFA1 table, banking data was not available for 2,306 vendors, bank account holder's name was not noted for 1,104 vendors, invalid bank account number was recorded against 129 vendors, 2,509 vendor ID did not contain Permanent Account Number (PAN) and 228 Vendor ID consists invalid Permanent Account Number.

(Para 1.6.3.5 C-II)

Non-integration of Distributed Control System and SAP resulted in manual intervention for recording the stock of hydrocarbons related data in SAP as well as different production data of polymers recorded in Distributed Control System and data generated by SAP.

Recommendation 7: The Company may ensure that the loaded quantity of hydrocarbons should pass to the SAP automatically through an interface between SAP and Terminal Automation System.

(Para 1.6.3.5 E)

Similarly, non-integration of Terminal Automation System (records the quantity of hydrocarbon delivered to a tanker) and SAP resulted in manual intervention for recording delivered hydrocarbon related data in SAP as well as different Delivery Order data shown in Terminal Automation System and SAP. Key internal controls including delegation of powers applicable to the Company's operations were not configured in SAP. As a result, the necessary approvals were taken in files on paper trails and note sheets.

Recommendation 8: The Company may implement Production Planning and Plant Maintenance module. Automatic input of source data may be prioritised to create single source of data.

(Para 1.6.3.5 I)

Monitoring and Evaluation

The Company did not have a documented policy, procedure or method of evaluation of changes made to master tables. The Company did not comply with own IT policy that required SAP functional audit and technical audit covering the entire IT infrastructure at least once in every two years.

Recommendation 9: Internal control may be mapped in SAP itself and SAP functional and technical audit may be carried out at the earliest.

(Paras 1.6.4.1 & 1.6.4.2)

B. Information Systems Audit of the Plant Maintenance Module of SAP ERP in ONGC

Oil and Natural Gas Corporation Limited (ONGC) is an Oil and Gas Public Sector Undertaking (PSU) engaged in exploration and production of oil and gas. ONGC implemented SAP ERP in October 2003 with 10 modules. The Plant Maintenance (PM) Module is one of the ten modules implemented in the Company. The PM Module is used to maintain the master data of Equipment/Technical systems, map the maintenance processes and provide information for analysis and decision making at unit as well as organisation level.

An IS Audit was conducted to review the implementation and utilisation of the Plant Maintenance module of SAP in ONGC to assess the:

i)   correct mapping of business rules and requirements of the Company;

ii)   controls in place to ensure reliability and integrity of data; and

iii)   effectiveness of Plant Maintenance Module as implemented in the Company.

Significant audit findings are given below:

Mapping of business rules and requirements of the Company

Master Data deficiencies were noticed like not capturing details pertaining to manufacturer, warranty, Asset numbers, cost centres, start-up date and business area. In the absence of relevant data, the controls mapped with the Master data were less effective or the linkage with other modules was limited to that extent. Measuring points were not created for pressure, temperature, vibration values and particle count. Thus, these parameters could not be captured as envisaged in the Business blueprint diminishing the utility of the SAP system especially from preventive maintenance perspective.

Recommendation 1: It is recommended that along with the cleaning of equipment master data which should be done in a time bound manner, all fields in master data like manufacturer details, startup date, Asset numbers and warranty etc. may be filled up mandatorily.

Recommendation 2: The Company should consider developing measuring points and start recording the parameters like vibration levels, pressure and temperature in the SAP PM Module daily to effectively utilise the ERP system from preventive and predictive maintenance perspective and better monitoring of maintenance activities.

(Paras 2.5.1.1 & 2.5.1.2)

Major equipment like Compressors, Vacuum Pumps, Draw works, Blow out preventers were regularly retired from active use/scrapped as per the Asset Retired Report of the Finance Module. The same were, however, not updated in the PM Module by way of changing the user status leading to incorrect depiction of available equipment, continuance of redundant reports/data and incorrect reporting.

Recommendation 3: The Management may ensure that there is time bound verification/cleaning of equipment data and necessary controls are built so that the dismantling procedure is adhered to. Feasibility of integration of Asset accounting with equipment master may also be explored.

(Para 2.5.1.3)

Transactional data-Correctness and Completeness

With regard to transaction data pertaining to measuring documents and daily progress reports, there was continuing reliance on manual records for daily reports which form the basis for PM processes and failure to enforce timely entering of daily transaction data with

gaps of more than a month. Maintenance orders essential for planning of maintenance jobs were having incorrect order types and business closure of transactions were found incomplete (as of March 2022) for even orders which were technically completed during the period January 2014 to August 2021.

Recommendation 4: Adherence to daily reporting within the window made available through the SAP system must be ensured for control purpose and to avail the benefits of the PM Module across the organisation. Interface with equipment controls/SCADA[1] may be considered wherever feasible to minimise manual interventions in capturing performance parameters/exception events. Responsibility may be fixed in case of delay in daily reporting.

Recommendation 5: To ensure reduction in unplanned orders, the desirable ratio of planned/unplanned orders may be notified for work centres and monitored through the PM Module. Responsibility may be fixed in case of non-adherence to maintenance plan.

(Paras 2.5.2.1, 2.5.2.2 & 2.5.2.3)

Root cause analysis of equipment failure were not maintained in PM Module. Logbooks feature was not enabled in 50 plants and therefore continued with manual records.

Recommendation 6: The Management should clearly fix the criteria for conducting a Root Cause Analysis and ensure that Root Cause Analysis reports are recorded in suitable reporting structure in the PM Module.

Recommendation 7: The Company may ensure that the primary source of information like log books is maintained through PM Module for reliability, easy availability and from the perspective of preventive maintenance.

(Paras 2.5.2.4 & 2.5.2.5)

In the absence of regular maintenance/inspection data in the system, the timely maintenance of the equipment could not be ensured. Even in the monthly maintenance reports, the static equipment were not covered. The time-based maintenance schedule was not available in the PM Module for the equipment.

Recommendation 8: The Management may conduct a review of static equipment which are critical from operational/process perspective and map them with maintenance plans accordingly.

(Para 2.5.2.6)

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[1] *Supervisory Control and Data Acquisition*

Manpower Issues

Segregation of duties were not adhered to and maintenance in-charge roles were clubbed with other authorisations. As many as 30 roles were authorised to same person in three locations.

Recommendation 9: (a) The Management may conduct a systematic and complete review of role authorisations so that the inbuilt controls of segregation of duties are maintained.

(b)   The Management, through proper training for officials and staff, may ensure that maintenance work processes are carried out through PM Module only.

(c)   The Management may consider revisiting Maintenance SOPs to ensure that the maintenance work is carried out obligatorily through the SAP System.

(Para 2.5.3.3)

Use of Key Performance Indicators for effective utilisation of PM Module and Management oversight

The Key Performance Indicators for measuring the performance of the maintenance teams were not flowing from the PM Module but maintained outside the ERP system. The monthly reports maintained outside the system were found susceptible to change and unreliable. There were instances of equipment being denoted on standby even when under repair and availability hours were incorrectly denoted.

Recommendation 10: The Management may ensure that the Key Performance Indicators are transmitted to the work centres who are ultimately responsible for maintaining the equipment/releasing the production equipment for maintenance purpose. The Management may also ensure that Key Performance Indicators flow from verifiable and standard data of the Plant Maintenance Module.

(Para 2.5.4.2)

PM Module reports were not used by the Management to aid their decision making like repair versus replacement. This could be attributed partially to the deficiencies in data and reports. Backlog monitoring was also not effective. Reasons for backlogs were blank fields and incorrect dates found in the last allowed finish date field. After excluding the incorrect dates, backlog days ranged from 1 day to 2 years. The quarterly maintenance review dashboard containing major reasons for backlogs, equipment availability of critical equipment, spares procurement lead times, maintenance costs were discontinued.

Recommendation 11: Reports in PM Module that could aid in the Management decision making for repairs/replacements and for comparative analysis may be made available and suitably used.

Recommendation 12: The Management may ensure that the escalation matrix is adhered to, through the system, for reporting the backlogs so that timely maintenance action is taken. Cleaning of old backlogs must be taken up on time bound basis, so that monitoring of maintenance efforts could be effective.

Recommendation 13: The Top Management may utilise the Maintenance Dashboard for effective monitoring.

(Paras 2.5.4.3 and 2.5.4.4)

Chapter I

Information Systems Audit of Enterprise Resource Planning implementation in Brahmaputra Cracker and Polymer Limited

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Information Systems Audit of Enterprise Resource Planning implementation in Brahmaputra Cracker and Polymer

1.1   Introduction

Brahmaputra Cracker and Polymer Limited (Company/BCPL) was incorporated (January 2007) in Lepetkata, Dibrugarh as a subsidiary[1] of GAIL (India) Ltd (GAIL). GAIL is the major shareholder of the Company having 70 *per cent* shares and the balance is equally held by Oil India Limited, Numaligarh Refinery Limited and Government of Assam at 10 *per cent* each. The Company is engaged in production of polymers from natural gas procured from Oil India Limited and Oil and Natural Gas Corporation Limited whereas naphtha is procured from Numaligarh Refinery Limited. The Company has entered (March 2016) into an agreement with GAIL for marketing of its products.

The IT department of the Company is headed by the Chief Operating Officer under the general supervision of the Managing Director. The Chief Operating Officer is assisted by Deputy General Manager.

1.2   Enterprise Resource Planning in the Company

The Company awarded (December 2014) a contract to M/s Wipro for implementation of Systems, Applications & Products in Data Processing (SAP) Enterprise Resource Planning, and setting up of IT infrastructure and construction of Data Centre along with Annual Maintenance Contract for three years at a value of ₹23.72 crore. The project was ultimately completed at a cost of ₹24.69 crore. The scheduled date for going live for the SAP Enterprise Resource Planning system was September 2015 but it went live from 1 April 2016.

The Company implemented SAP Enterprise Resource Planning Central Component as its Enterprise Resource Planning (ERP) with modules pertaining to Finance and Control, Materials Management, Quality Management, Sales and Distribution, Warehouse Management and Human Capital Management with India payroll & Enterprise portal.

The Company uses SAP Enterprise Resource Planning with SAP Graphic User Interface (GUI) as the presentation layer or front end, SAP NETWEAVER7.4 as in-between application server and Oracle 11.2.0.4.0 database at back end with Windows Server 2012 R2 as operating system. There are 208 SAP users and 542 Employee Self Service (ESS) users in the Company.

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[1]   *Formation of Brahmaputra Cracker and Polymer Limited was a part of implementation of Assam accord (August 1985)*

The Company uses NetVault Backup Plug-in for SAP on Oracle and its disaster recovery server is located within GAIL's data centre at Noida. The Company also maintains a near recovery centre at Plant's central control room. The Company deploys CISCO ASA 2400 NGFW as external and Juniper SRX 550M as internal Firewall.

The Company adopted an IT Policy in September 2018 based on COBIT 4.1 framework much after award of contract for implementation of Systems, Applications & Products in Data Processing (SAP) Enterprise Resource Planning in December 2014.

1.3   Audit Scope and Methodology

The Information System audit of the Company covered the period from April 2016 to March 2021 and assessed the adequacy of IT Governance framework of the Company and its implementation regarding the SAP-Enterprise Resource Planning. However, matters relating to earlier period as well as subsequent period are also included wherever pertinent.

The audit process commenced with an entry meeting in August 2021 where the modalities of the audit were discussed. The IS audit was conducted between September 2021 and December 2021.

Audit methodology included scrutiny of relevant records, test check of controls on SAP, exporting data from SAP and analysis of data using Computer Assisted Audit Tool, generating reports from SAP and inspection of the Data Centre and physical infrastructure. It also involved discussion with the Management and soliciting their response to audit observations.

The audit observations were issued to the Management on 19 January 2022 and response received on 30 March 2022. An Exit Conference was held with the Management on 15 December 2021. The report incorporating Management responses was issued to Ministry of Petroleum and Natural Gas in March 2022 and the response of the Ministry was received in June 2022. The responses of the Management/Ministry have been considered and incorporated in the report.

1.4   Audit objectives

The objectives for the audit were to assess:

   i.   Adequacy of IT Governance framework and its implementation by the Company.

   ii.   Adequacy and effectiveness of General and Application Controls in Enterprise Resource Planning.

   iii. Efficiency in Business process re-engineering in SAP.

iv.   Adequacy of change management and business continuity plans and its implementation.

1.5   Audit Criteria

The criteria applied to assess the audit objectives were:

❖ Control Objectives for Information and related Technology (COBIT[2])

❖ Company's Business Plan and objectives enshrined in its IT policy

1.6   Audit Findings

1.6.1   Planning and Organisation

1.6.1.1 Status of Implementation of Enterprise Resource Planning

The Company implemented Finance and Control, Materials Management, Sales and Distribution, Warehouse Management, Quality Management and Human Capital Management with India payroll and Enterprise portal. The Company is yet to implement modules pertaining to Production Planning and Plant maintenance.

The Management, however, communicated (March 2022) that they were considering implementing the Production Planning module.

1.6.1.2 Non-activation of SAP solution manager

Among the modules implemented by the Company, SAP Technical module has sub module SAP Solution Manager which would enable identification and documentation of AS-IS[3] critical business processes, identification of business needs etc.
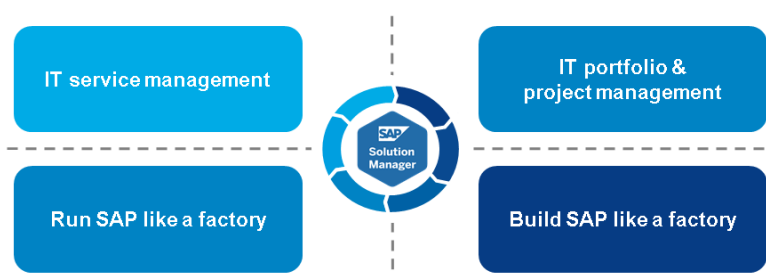

Figure 1: Key Functional Building Blocks of SAP Solution Manager

Audit observed that though the Company acquired the SAP Solution Manager as part of the SAP Enterprise Resource Planning, yet it had not reaped the above benefits due to non-activation. While accepting the audit observation, the Ministry (June 2022)/Management (March 2022) assured to implement the SAP Solution Manager after migration to newer version of SAP.

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[2]   *BCPL has adopted COBIT 4.1 framework as per their IT policy*
[3]   *AS-IS refers to the mapping of the existing business processes in place and keep it documented for customising the SAP as per business requirements.*

1.6.1.3 IT processes, organisation and relationships

As per COBIT, the Company is required to determine various matrices such as Critical Success Factors (CSF), Key Performance Indicator (KPI) and Key Goal Indicator (KGI) to measure the efficacy of all IT systems. The project was completed by M/s Wipro and Enterprise Resource Planning and went live from April 2016. Audit observed that none of the afore-mentioned matrices were designed and measured by the Management as on December 2021. It was also observed that the Company's Board played limited role in IT Governance of the Company as the Management did not place any data on the performance of the Enterprise Resource Planning before the Board in order to determine if the project was ultimately beneficial to the Company.

The Ministry (June 2022)/Management (March 2022) accepted the observation and assured to prepare appropriate matrices to measure the efficacy of all IT systems.

1.6.1.4 Strategic Plan

COBIT requires that the Management should prepare Strategic IT plan to manage and direct all IT resources in line with business strategy and priorities. It also necessitates setting and tracking IT budgets in line with IT strategy. Audit observed that the Company does not prepare IT strategy or Plan.

The Ministry stated (June 2022) that a draft IT strategy had been developed and the same was under review before implementation.

1.6.1.5 IT Organisation

COBIT requires establishment of an IT organisational structure that reflects business needs, to define and identify key IT personnel and minimise reliance on a single individual performing a critical job function and Chief Information Officer being an individual responsible for IT group within an organisation. Further, the Responsible, Accountable, Consulted and Informed chart within COBIT includes the role of Chief Information Officer for each COBIT objective. COBIT also requires segregation of duties i.e., a division of roles and responsibilities which will reduce the possibility of a single individual compromising a critical process.

There is no designated Chief Information Officer in the Company. However, the Chief Operating Officer is overall incharge of the IT functions alongside the chairperson of the IT Security Steering Committee. Thus, the Company is unable to minimise reliance on a single individual performing a critical job function. Further, the Company has not designated and separated the role of System Administrator, Database Administrator and Information Security Officer as on December 2021. It was also observed that there was no segregation of duties for personnel having access to Development, Quality and Assurance and Production servers of SAP.

The Company developed (January 2020) a Crisis Management Plan in which it had designated a Chief Information Security Officer and Deputy Chief Information Security Officer along with other personnel as members of the Crisis Management Cell. It was seen that there had been a change in personnel of that Crisis Management Cell due to promotion and retirement/termination. But the list of members of the Crisis Management Cell was not revised. Hence, in absence of the revised list of the members of such Cell, the objectives of the Crisis Management Plan would be defeated.

The Ministry/Management accepted the audit observation and stated (June 2022/March 2022) that necessary remedial measures regarding IT organogram and the Crisis Management Plan have been taken.

1.6.1.6 Management of Human Resources

The Company should define the target groups, appoint trainers and organise timely training sessions so that officials become independent in operating the SAP system. A training curriculum for each group of employees should be established and training alternatives should also be explored (internal or external site, in-house trainers or third-party trainers etc.).

The Company has 619 employees out of which 208 are designated as SAP professional

Picture 1: SAP training conducted at BCPL

users for whom the Company has acquired 208 SAP professional user licenses. The Company has also acquired 542 Employee Self Service (ESS) users' licenses for its employees. The IT department of the Company is responsible for training of the Company's employees for using SAP. In this regard, the Company awarded (November 2014) a contract of ₹40.59 lakh to SAP India Limited for training of 11 employees across all the eight modules. 10 employees were ultimately trained (between November 2014 and January 2015) in seven modules. Further, the Company conducted (between April 2016 and March 2021) three training programs on SAP at an additional cost of ₹3.36 lakh to train 32 employees in SAP Finance and Control, Warehouse Management, Quality Management and Human Resource modules against 208 SAP professional users in the Company.

In this regard, Audit observed the following:

- The Company did not have a formal documented, detailed training plan for its employees. As a result, the capabilities and familiarity with the new system varied widely.

- Even after completion of five years since "Go-Live" of SAP in April 2016, only 18 *per cent* of SAP professional users presently employed by the Company were given training. The remaining employees were not imparted any kind of training on SAP modules deployed by the Company.

- Out of the 42 trained employees, four had left the Company. Further, out of remaining 38 employees, one was SAP process owner for Quality Management module and five others were core team members in Human Resource, Material Management, Sales and Distribution, Quality Management and Warehouse Management modules. In case of remaining 32 employees, roles were not documented.

- The Company had decided in November 2012 to train its staffs to gain sufficient expertise and experience in the operation and maintenance to handle operations independently once ERP was implemented. Instead, in the absence of adequate SAP training for its employees the Company had to deploy multiple consultants at a higher cost of ₹6.46 crore even after six years since implementation of SAP.

The Management stated (March 2022) that services of external consultants were hired to get expert services to resolve time-to-time complex business/statutory issues on demand and pay-for-use basis only. The Management also assured that end user level training to the untrained SAP professional users would be provided in future on need basis.

Reply of the Management is to be viewed against the fact that the Company was hiring multiple consultants for regular operation and maintenance even after expiry of six years since operationalisation of SAP.

The Ministry, in their reply (June 2022), stated that it was planned to further strengthen the existing SAP core team of the Company and accordingly, necessary action had already been taken to provide advanced training to 11 new core team members. Post SAP professional training to the core team members, the requirement of an external SAP consultant would be reviewed and decision would be taken accordingly. The new core team members would train the end users of the Company SAP system from time to time.

Recommendation 1: The Management may develop criteria and matrices to assess the project outcome and performance of SAP Enterprise Resource Planning System.

Recommendation 2: The Management may ensure that the IT policy reflects the latest developments in IT Governance and Management.

> *Recommendation 3: IT organisation may be strengthened and segregation of roles ensured. The Company may develop in-house capabilities and reduce recurring dependencies on consultants.*

1.6.2   Acquisition and Implementation

1.6.2.1 Change Management

COBIT requires setting up of formal change management procedures to handle in a standardised manner all requests (including maintenance and patches) for changes to applications, procedures, processes, system and service parameters and the underlying platforms. However, the Company had no Standard Operating Procedure to keep its software updated and authorise/monitor changes made on SAP.

During audit, it was also observed that about 200 Notes were issued for system updation by SAP India Ltd during 2020-21 out of which only five Notes were implemented.

Audit observed that the Company had outsourced the maintenance activities for its Enterprise Resource Planning system to consultants who also modified/customised the Enterprise Resource Planning system to meet the evolving needs of the Company. However, changes to Enterprise Resource Planning system made by consultants were not documented in the SAP configuration documents and business blue-print documents.

The Ministry/Management stated (June 2022/March 2022) that a Standard Operating Procedure had been prepared to integrate all the activities from requisition of change to development to quality to production in SAP. The new version of design document was also being updated. However, the reply is silent about implementation of very low number of SAP Notes.

> *Recommendation 4: Table Logging may be implemented to record documentation of change management.*

1.6.3   IT Support System

1.6.3.1 Data Management

As per the IT policy of the Company, it shall establish procedures to manage media library, backup and recovery of data and proper disposal of media. The Company shall also implement an electronic and physical records retention schedule to maintain records for a period of eight years as per statutory requirements, to ensure that the Company adheres to existing record keeping regulations and requirements and does so consistently. The Company shall also formulate a process of systematically determining which records need to be captured and how long they need to be retained in the Company.

Audit observed the following:

- The Company did not prepare a data management policy and prescribe a procedure to manage media library, backup and recovery of data and proper disposal of media.

- Classification of data by information criteria such as confidentiality, integrity and availability was not done.

- Policies were yet to be established to store documents, data and source programmes in accordance with the organisation's activities, size and mission.

- Portability of data through pen drives and other means were not regulated and remote administration tools such as 'AnyDesk' and 'TeamViewer' were used to access remote desktops and transfer data. The Company did not have a policy for use of unauthorised remote administration tools.

Picture 2: AnyDesk and TeamViewer used by the Company as remote administration tool.

- Further, the contracts with consultants did not have any clause that enabled audit to access the records, processes and policies of the consultants having connection with their services provided to the Company. Consequently, audit was unable to vouchsafe that the access of the consultants to the Company's Enterprise Resource Planning system was limited to legitimate requirement of the consultants.

The Management stated (March 2022) that data management policy would be formulated along with the revision of IT policy.

> *Recommendation 5: The Company may frame a 'data management policy' at the earliest.*

1.6.3.2 Ensuring Continuous service

The Company prepared a Business Continuity Plan in January 2020 which provides that if it is assessed that the primary data centre cannot be made functional within 36 hours of a disaster, the Company will immediately switch over to the disaster recovery centre. The Company takes daily back-up which are stored in two sets. One is online backup of all systems and the other is on tape. There are two disaster recovery centres, one is located at

central control building within the factory complex at Lepetkata in Assam and the other is located at Noida within the premises of GAIL's data centre. The Company uses NETVAULT (a software used to routinely take back-up) to automatically take daily and weekly backup on tapes. Monitoring of the backup has been outsourced to contractual staff. The backup tapes are retained in a separate vault designated for that purpose. Business Continuity Plan for SAP systems requires testing as per data replication monitoring process of Procedure for Data Centre/Server Room Management of the Company's Quality Management System Procedural Manual. Moreover, the Business Continuity Plan requires the Company to have similar information security controls at its disaster recovery centres as it has for its data centre. The continuous availability of servers was ensured by use of cluster servers at data centre either of which can seamlessly take over tasks if the other server fails/is unavailable.

In this connection, Audit observed the following:

- Company's IT policy did not specifically address a business recovery plan. The Company has not prepared a business impact analysis and has not identified roles, responsibilities and communication process for disaster recovery.

- Test check of the Data Recovery Centre at Lepetkata (Assam) revealed that the room containing the servers did not have a gas-based fire suppressant system. Thus, the disaster recovery centre did not have fool proof protection from fire.

- The cluster servers are located adjacent to each other. So, in case of a disaster, there was high probability that it could affect the servers. As such, use of mirror servers[4] at different location would have obviated the risk.

- Test check of NETVAULT back-up logs between 1 August 2021 and 6 November 2021 revealed 158 instances when back-up had failed or had been aborted. 148 of these instances were subsequently restarted manually. Out of the remaining 10 instances, in 7 instances the personnel deputed by the contractor reported that

Picture 3: NETVAULT backup tapes are maintained in a vault

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[4] *Mirror Server is a replica server.*

backup was successful when it had failed or was aborted.

- Movement of the tapes between data centre and vault were not logged.

- Test check of NETVAULT back up logs revealed that a virtual hard disk was restored from NETVAULT backup tape on 25 September 2020 and attached to a new virtual machine. As per the log, the recovery of virtual hard disk had been completed within target recovery time. However, the reason for the recovery and the nature of data recovered were not on record.

- In absence of documentation, Audit could not vouchsafe that testing was done as per data replication monitoring process of Procedure for Data Centre/Server Room Management of the Company's Quality Management System Procedural Manual.

- A mock drill was undertaken by the Company in March 2019 to assess the disaster recovery capability. It was found that there was bandwidth constraint to recover data from Data Recovery Centre. To resolve this problem, the Company obtained (October 2019 and March 2020) 20 Mbps and 18 Mbps point to point leased line link bandwidth between the Company data centre at Lepetkata and Data Recovery Centre at Noida from M/s Bharti Airtel Ltd. and M/s BSNL respectively. However, after obtaining the increased bandwidth, no drills were carried out to assess the resolution of the problem and successful data recovery from Data Recovery Centre at Noida. No such drills were undertaken to assess the utility of Data Recovery Centre at Lepetkata.

- As per Emergency Response and Disaster Management Plan, testing and mock drills for onsite emergency plan should be carried once in three months and for offsite emergency plan once in twelve months. However, only one mock drill was conducted (February 2021) till date. But the same did not address the assessment of readiness for restoring full functionality of the Company's Enterprise Resource Planning capability after a disaster.

Thus, Audit observed that there were both policy and procedural shortcomings in the Company's business continuity and recovery plans which might have repercussions if the Company faces an actual disaster.

The Management, while accepting the audit observation, stated (March 2022) that business recovery plan would be executed as per the approved Business Continuity Plan of the Company and the same shall be reviewed to address the audit observations. It was also stated that inclusion of the business recovery plan in IT policy would be done during the review of IT policy. The Management further assured that either appropriate firefighting equipment would be installed or the server would be relocated to have the gas-based fire suppressant system at the near Data Recovery Centre. Moreover, mock drill of SAP will be

carried out in association with M/s SAP once the ORACLE, Net weaver and Solution Manager is upgraded to the latest version as advised by them.

While endorsing the Management's views, the Ministry stated (June 2022) that fire fighting equipment had been installed. The Ministry also stated that to mitigate any further lapse in complying with the Petroleum and Natural Gas Regulatory Board Regulations 2010, periodic re-certification of Emergency Response and Disaster Management Plan would be ensured based on the validity of the certificate awarded by the Petroleum and Natural Gas Regulatory Board approved Third Party Agency. The Ministry/Management is silent in their reply regarding conduct of drills to assess the utility of Data Recovery Centre at Lepetkata.

1.6.3.3 Ensuring Systems Security

The Company appointed a service provider for data centre infrastructure support with
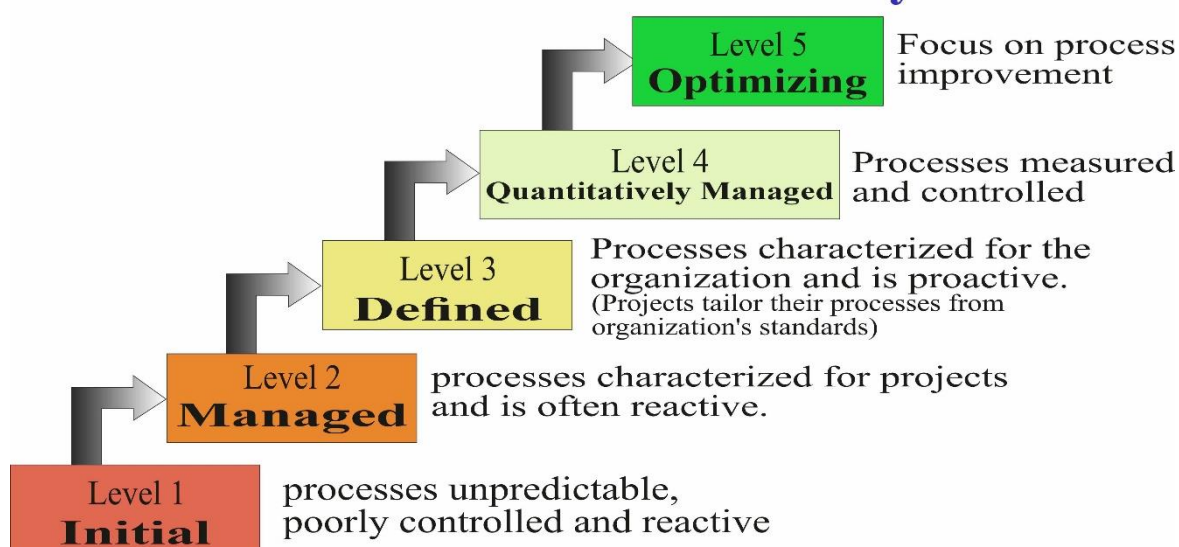

Figure 2: Capability Maturity Model Integration

Capability Maturity Model Integration level 3 certification[5]. During audit, the Management failed to furnish the Capability Maturity Model Integration appraisal report for two out of its three service providers for the data centre infrastructure support. Further, the certification of the third service provider which was furnished to Audit, was not found amongst the published certificates of Capability Maturity Model Integration certifying authority. Therefore, Audit was unable to independently vouchsafe such certification.

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[5] *The Capability Maturity Model Integration is a process and behavioural model that helps organisations streamline process improvement and encourage productive, efficient behaviours that decrease risks in software, product and service development. As per Capability Maturity Model Integration, at stage III, organisations are more proactive than reactive. There's a set of "organisation-wide standards" to "provide guidance across projects, programs and portfolios." Businesses understand their shortcomings, how to address them and what the goal is for improvement.*

The Ministry, while accepting the audit observation, stated (June 2022) that tender conditions for subsequent tenders had been revised to ensure Capability Maturity Model Integration certification agency.

(A) IT Security Policy

As per the Company's IT Policy, the Company shall establish and maintain IT security roles and responsibilities, policies, procedures and guidelines and perform continuous security monitoring. However, the Company does not have an IT security policy. Physical access security policy and a Standard Operating Procedure are yet to be prepared by the Company. In January 2020, a Crisis Management Plan was put in place to address natural disasters, man-made disasters and cyber-attacks to the Company's IT Systems. However, the said plan was reactive in nature and addressed post incident response. Proactive or continuous monitoring of IT environment for threats including timely updating of software to avoid IT security incidences were not addressed in that plan.

The Management, in its reply (March 2022), accepted the audit observation and assured that Policy/Standard Operating Procedure would be prepared by end of June 2022.

The Ministry, in their reply (June 2022), assured that those proactive roles and responsibilities would be incorporated in the IT security policy.

(B) Vulnerability Assessment and Penetration Testing

The Company had undertaken Vulnerability Assessment and Penetration Testing in August 2020 and then a re-audit in July 2021 both conducted by M/s Bharat Electronics Ltd. to test mitigation of the risks identified during audit of August 2020. Out of four high, ten medium and ten low category risks identified in August 2020, three high, seven medium and five low risks were found unmitigated during re-audit in July 2021.

Audit observed that three high, one medium and two low risks were yet to be mitigated as on December 2021. Audit further observed that the Management had no documented policy of addressing risks in a time bound manner.

The Ministry, while accepting the audit observation, stated (June 2022) that necessary action had already been initiated.

(C) Table logging and audit trail

Changes to general system settings as well as to data relevant for financial statements must always be transparent, plausible and traceable. These requirements are particularly necessary if the changes are done without change management procedures. For transactional data and sometimes even for configurations, elaborate change management procedures are not implemented. In such cases, logs are fundamental part of IT systems for accomplishing

the above-mentioned objective. The central log in the SAP system for documenting changes to data is the table logging function.

Audit observed that the Company had not implemented table logging yet and hence the change documentations were not available. In this connection, it is also stated that Companies (Accounts) Rules, 2014 recommends that there should be audit trail in the entity.

The Ministry/Management accepted the observation (June 2022/March 2022) and assured to enable table logging for selected tables. However, the reply of the Ministry/Management is not tenable as table logging should be enabled for all tables for complete audit trail.

1.6.3.4 Access and authorisation

The role and profile that a specific user will have on SAP would be defined by the role and job profile that employee has within the organisation, its authority and responsibility. Access to SAP should enable an employee to successfully undertake their tasks. However, access should also be restricted to such aspects where an employee is not expected to undertake any activity.

However, the Company did not implement workflow-based SAP Access Management System until October 2021. It also did not have a documentation defining the job profiles and roles of its employees. In absence of such documentation, the IT department of the Company relied on the requests it received from the respective Heads of the Departments and assigned SAP access, authorisation and roles based on such requests. IT department had not maintained any consolidated documentation of all such requests received from the Heads of the Departments. As a result, Audit observed conflicts in roles and authorisation of users which are discussed in the ensuing paragraphs.

Audit examination of user's access controls on SAP revealed the following: -

(A) Users with incomplete address data

The user master record which decides the level of access in the SAP system should be complete in all aspects. During audit, the existence of incomplete address data with default password was obtained by execution of built-in SAP report RSUSR007 in t-code SA 38 and SUIM. Analysis of the data revealed that users' identification data were missing in database. Further, users were provided with access to SAP without restricting the same up to their retirement date or date of completion of deputation.

The Ministry stated (June 2022) that action had already been taken and user authorisations been reviewed.

(B)   Changes made to security authorisations

Authorisations are the core of security in any Enterprise Resource Planning system. Authorisation objects, profiles and roles decide the level of access that will be available to a particular user. During audit, the changes made to security authorisation was prepared by execution of built-in SAP report RSUSR102 in t-code SA 38 and the same was analysed which revealed that there were 77,856 change documents. In absence of consolidated documentation, Audit could not vouchsafe if such changes to security authorisation were in consonance with the employee's roles within the Company's organisation.

The Management, while accepting the audit observation, stated (March 2022) that proper records would be maintained using the SAP Access Management System. The Ministry in their reply (June 2022) also endorsed the views of the Management.

(C)   Changes made to security profile

Profiles are used to assign security rights to users in SAP. Changes to security profiles should be closely monitored. During audit, the existence of changes made to security profile was obtained by execution of built-in SAP report RSUSR101 in t-code SA 38 and the same was analysed which revealed that there were 7,104 profile change documents. In absence of consolidated documentation, Audit could not vouchsafe if such changes to security profile were in consonance with employee's roles within the Company's organisation.

The Management, in its reply (March 2022), accepted the observation and assured to maintain proper records using the SAP Access Management System. The Ministry in their reply (June 2022) also endorsed the views of the Management.

(D)   Default passwords for default SAP users

During installation of SAP system, default users are created with default passwords. These default passwords are well known and if not properly secured, it could pose a security threat. During audit, the existence of default username with default password was observed by execution of built-in SAP report RSUSR003 in t-code SA 38 and the same was analysed which revealed 17 instances where default passwords were retained.

The Management/Ministry, while accepting the audit observation, stated (June 2022) that default/initial passwords of all the default users had been changed.

(E)   Changes made to users' security

The master record contains the roles and profiles assigned to user. Roles and profiles decide the level of access of a user in the SAP system. Changes to Master data record should be closely monitored. During audit, 32,653 changes made in users' security were obtained by

execution of built-in SAP report RSUSR100N in t-code SA 38. In absence of documentation, Audit could not vouchsafe reasons for such changes.

The Management, while accepting the audit observation, stated (March 2022) that proper records would be maintained using the SAP Access Management System. The Ministry, in their reply (June 2022), also endorsed the views of the Management.

(F) Users with multiple critical roles

During IT audit, the existence of users with multiple critical roles was obtained from t-code SUIM and the same was analysed. The analysis revealed that 735 users[6] had access to critical roles and authorisation which allowed the users to make changes on SAP. Out of these 735 users, 485 users had seven roles each pertaining to Employee Self Service. Out of the remaining 250 users, it was observed by Audit that between 10 and 67 roles were assigned to individual users. Since the Company did not document the roles and responsibilities of its employees within the Company, Audit could not vouchsafe that the roles assigned to the users on SAP were appropriate and commensurate with the roles of the said user within the Company.

In this connection, Audit also observed that providing SAP access to employees in excess of their Delegation of Powers may expose the Company to the risk of frauds. Thus, there was urgent need to periodically review the delegated roles assigned to the user. However, the Company did not have any documented policy for periodic review of user roles to ensure that it was commensurate with their Delegation of Power.

The Management/Ministry, while accepting the audit observation, stated (June 2022) that SAP roles had been reviewed and suitable access/authorisation have been granted.

(G) Users with critical combination of authorisation

Access to SAP system is controlled through authorisations. It is necessary to review users with critical combination of authorisations to assess so that only appropriate role specific authorisations are provided to the users to enable them to perform their official duty. The list of users with critical combination of authorisations was obtained by using SAP report RSUSR008_009_NEW in t-code SA 38 and analysed. The analysis revealed that critical authorisations were provided to multiple users ranging from 10 to 731 users.

Audit observed that the Company did not practice periodic review of users to assess the appropriateness of the authorisations available to the users. There was no documented policy

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[6] *735 users include present employees/retired/resigned/terminated employees, consignment stockist, audtors etc.*

to guide the SAP BASIS administrators[7] to determine the appropriate authorisations and roles and assign the same to the user.

The Management/Ministry, while accepting the audit observation, stated (June 2022) that SAP users' roles had been reviewed and multiple authorisations had already been revoked. It was also stated that proper records were maintained using the SAP Access Management System. The Ministry further stated that periodic review of authorisation given to the users would be carried out.

(H)   Same name with multiple user ID

In SAP, one user should be assigned only one user ID and given authorisation and roles commensurate with Delegation of Powers.

Audit noticed that one person was assigned two user IDs. These user IDs were created in October 2019 and November 2019 and both were active at the time of audit (December 2021) and could be used to log in to SAP although the user ID created in November 2019 had not been used to log into SAP since its creation. Audit observed that user IDs assigned to various users were not reviewed from time to time to weed out duplicate user IDs.

The Ministry/Management, in its reply, stated (June/March 2022) that the duplicate user ID had been deleted and periodic review will be done to identify and resolve such incidents.

(I)   User not logged in for last two months

Scrutiny (December 2021) revealed that 79 users including 15 consignment agents had not logged in to SAP since October 2021. It included users who had not logged in since November 2015. Such user IDs have not been blocked as on December 2021. Audit observed that periodic review of user IDs and their activity on SAP were not done by the Company.

The Management stated (March 2022) that locking an idle user after a short duration will increase operation & maintenance tasks on the SAP BASIS team.

The Management's reply may be seen in light of the fact that de-activation of SAP user IDs which were not logged in for a specified time period is essential in order to safeguard the Enterprise Resource Planning system.

The Management/Ministry, while accepting the audit observation, stated (June 2022) that a system would be developed to review dormant SAP users which would be locked after 60 days of inactivity/absence of login into the SAP system.

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[7]   *SAP BASIS administrators are responsible for managing a SAP environment on day-to-day basis.*

(J)   Change of password

As per the IT policy of the Company, the password to authenticate access to SAP should be changed after every 60 days. However, this requirement has not been configured in SAP. As a result, password of all users in SAP were more than 60 days old.

The Management/Ministry, while accepting the audit observation, stated (June 2022) that the policy for mandatory change of password had already been implemented by the Company.

(K)   Source data preparation and authorisation

An entity should document procedure for source data preparation and ensure that they are effectively and properly communicated to appropriate and qualified personnel. These procedures should establish and communicate required authorisation levels (input, editing, authorising, accepting and rejecting source documents). The procedures should also identify the acceptable source media for each type of transaction. Further, entities should also define and communicate criteria for timeliness, completeness and accuracy of source documents and also establish mechanisms to ensure that data input is performed in accordance with the timeliness, accuracy and completeness criteria.

However, no such Standard Operating Procedure in respect of source data preparation and authorisation was documented by the Management. The Ministry/Management, while accepting the audit observation, stated (June/March 2022) that necessary Standard Operating Procedure would be prepared.

Recommendation 6: The Company may define roles and provide access to SAP based on SAP standard roles or custom roles. Segregation of duties may be enforced when defining roles. Password policy may be enforced without compromise.

1.6.3.5 Management of Operations

(A)   SAP Procure to Pay Cycle

In the accounting and book-keeping area of accounts payable, the three-way match refers to a procedure used when processing an invoice received from a vendor or supplier. The vendor's invoice, prior to its paying is matched with the purchase order prepared and issued to the vendor and the goods received report or Goods Received Number (GRN) that was prepared upon receipt of the goods. These three

Figure 3: SAP Procure to Pay Cycle

documents are matched by comparing the quantities, price per unit, terms and other

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information appearing on the three documents. The purpose of the three-way match is to avoid paying an incorrect and perhaps fraudulent invoice.

In this regard, Audit undertook substantive analysis which revealed the following:

(B)   Invoice with editable Goods Received Number

At the time of raising purchase order in SAP, there is an important data field named "GR-Bsd IV", i.e., "Goods Receipt based Invoice" which is editable at the time of issuing Purchase Order. However, data field "GR-Bsd IV" should not be editable at the time of receipt or payment so that unauthorised acceptance or payment is not done. This is a cause for concern because this enables subsequent users to create an invoice with edited Goods Received Number.

An analysis of 1,54,695 purchasing document items, however, revealed that data field "GR-Bsd IV" related to 1,06,336 purchasing documents items was editable at the time of receipt or payment purchase order. Out of these 1,06,336 purchasing documents, 86,358 documents[8] pertained to standard (domestic) purchases where creation of invoices with editable Good Received Number should not have been enabled.

The Ministry/Management stated (June/March 2022) that "GR Bsd IV" indicator had not been kept mandatory for foreign vendor code in SAP.

Replies of the Ministry/Management are not relevant as audit observation is related to domestic vendors.

(C)   Internal control deficiencies in vendor management

A robust internal control over vendor management is necessary to ensure that frauds and misappropriations are avoided. Analysis of the tables associated with vendors and vendor payment data revealed the following deficiencies:

I.   BSIK[9] is a standard table in SAP containing open items pertaining to vendors. In this table, payment block keys denote the reasons for which the payment is kept pending/being an open item. Similarly, blank entry in the payment block key means those items which are eligible for payment. Scrutiny of the BSIK table revealed that it contained 5,960 entries out of which, 4,958 entries aggregating to ₹1,136.10 crore were kept eligible for payment with blank entry in the payment block key. Analysis of these 4,958 entries revealed that these pertain to the fiscal years 2016-17 to 2020-21 as shown in the table below:

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⁸   *19,978 documents pertain to Consignment, Subcontracting, Stock transfer and Service.*
⁹   *BSIK is a standard Financial Accounting Transparent Table in SAP.*

Table: 1.1 Year-wise statement showing blank entries in the payment block key

Financial year of posting of payment	No. of records	Amount left for payment (₹ in crore)
2016-17	1,735	177.15
2017-18	611	357.83
2018-19	640	175.40
2019-20	1,128	157.35
2020-21	844	268.37

Audit observed that considerable numbers of items lying as eligible for payment for five years was an indicator of ineffective controls on account payables. Further, it was also not clear whether they were actually eligible for payment or not.

The Management, in their reply (March 2022), stated that as per the Company's bill process and payment procedure, payment was processed for only those selected Journal Vouchers whose physical authorisation were received and was due for payment. Since the Company configured SAP automatic payment t-code with mandatory selection of vendor code and respective Journal Voucher numbers along with physical authorisation, additional payment block check was not maintained in SAP. The Management further assured that based on the advice of Audit, additional payment block would be implemented for future transactions.

II. LFA1 is standard SAP vendor master table and LFBK is a standard SAP table containing the banking data for the vendors. In the Company, the table LFA1 had 6,252 vendor records and table LFBK had 4,101 banking records of vendors. Scrutiny of banking data for the 6,252 vendors in table LFBK revealed that out of the 6,252 vendors, the banking data of 2,306 vendors was not with the Company. Further, out of 6,252 vendors, bank account holder's name was not noted for 1,104 vendors and invalid bank account number was recorded against 129 vendors.

Additionally, scrutiny of the table LFBK revealed that out of 4,101 banking records, 1,397 records had invalid bank key. In table LFA1, out of 6,252 records, 2 vendor IDs had no name, 6 vendors had 2 vendor IDs assigned to them and one vendor with name "NIL" had 14 IDs assigned. Moreover, it was noticed in audit that the address fields, nature of business, industry type and other details were not recorded in the table LFA1. It was also noticed that out of 6,252 vendor master records, 2,509 vendor IDs did not contain Permanent Account Numbers and 228 vendor IDs consisted invalid Permanent Account Numbers.

The Management clarified (March 2022) that the audit observations emanated from earlier practices which the Company had discontinued and corrective steps were being undertaken.

The Ministry, in their reply, stated (June 2022) that as advised by Audit, all the open items were being reviewed on a regular basis and clearing of the same was being carried out individual vendor wise.

(D)   Reliance on manual systems for stock keeping of hydrocarbons[10]

As per the Company's configuration document for silo[11] management module, tank level of liquid and vapor data is captured from Distributed Control System by plant personnel and data can be entered manually into SAP System. However, if interface specification for connectivity between Distributed Control System and SAP is provided and a connection is established, tank level data can be captured automatically into SAP System from Distributed Control System. System will calculate the volume and various process parameters with the given inputs from Distributed Control System. Such automatic recording of data in Enterprise Resource Planning System obviates human mistakes in manual entry and provides real time data for decision making.

During audit, it was observed that the calibration data was duly loaded in SAP. However, the stock of hydrocarbons produced by the Company was obtained manually by the shift-in-charge from Distributed Control System on daily basis. The shift-in-charge collated the data for each type of hydrocarbon and determined the quantum based on parameters recorded in Distributed Control System in an excel sheet. Subsequently, the data was manually entered into SAP by the site-in-charge using t-codes YSI04, YSI05, YSI06 and MIGO. Thus, automatic recording of stock for hydrocarbons was not functional.

Further, at the Company's plants at Lakwa and Duliajan[12] (both located in Assam), the recording of natural gas consumption which constitutes the principal raw material for the Company was also not recorded automatically in SAP but by manual MIGO entry based on periodic bills raised by Oil and Natural Gas Corporation and Oil India Ltd respectively.

The Management (March 2022) stated that Distributed Control System was not integrated with SAP due to vulnerable exposure of process safety which may lead to disastrous consequences. However, the Company would review the risk and explore future possibilities of Integrating Distributed Control System with SAP.

The Ministry stated (June 2022) that the Company would review the risk and explore future possibilities of Integrating Distributed Control System with SAP.

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[10]   *Hydrocarbons means HPG and CBFS. HPG means Hydrogenated Pyrolysis Gasoline and CBFS means Carbon black feed stock.*
[11]   *Silo is a storage container.*
[12]   *BCPL receives natural gas from OIL India Ltd at Duliajan (Assam) and from ONGC Ltd at Lakwa (Assam).*
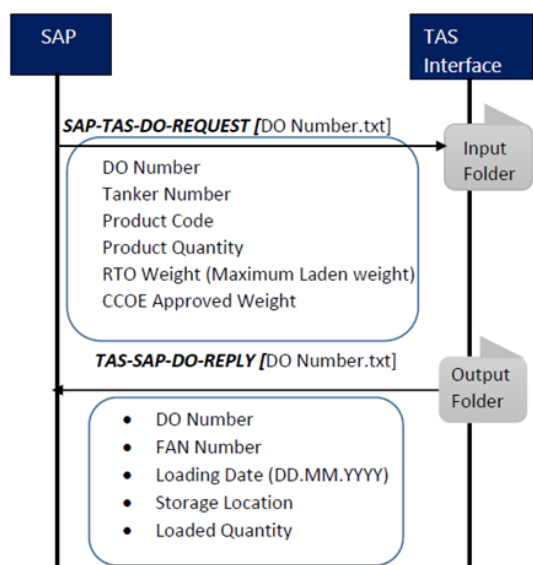
(E)   Reliance on manual recording of sale of hydrocarbons

Figure 4: Proposed interface between Terminal Automation System and SAP

Terminal Automation System records[13] the quantity of hydrocarbon delivered to a tanker by capturing data from batch controller[14] at each hydrocarbon loading bay[15]. Batch controllers ensure that the correct quantum of hydrocarbons as per Filling Advise Note[16] is delivered.

Audit observed that contrary to the proposed interface between SAP and Terminal Automation System (*Figure 4*) the data regarding quantity delivered from Terminal Automation System was not automatically transferred and recorded in SAP. Instead, the weight of both empty tankers[17] and loaded tankers[18] were captured from the weigh bridge by Terminal Automation System. The difference of weight between the empty tanker and loaded tanker was recorded manually and the same was entered in SAP through the t-code VL02N as the final delivered quantity. The invoices were then raised based on delivery quantity recorded in SAP.

The Management provided Terminal Automation System data from batch controllers to Audit but mentioned that it did not record the data pertaining to the mass flow meter[19]. Scrutiny of the data provided by the Management revealed that it was inconsistent and therefore unreliable. In absence of reliable records from the Management, hydrocarbon production data from the internal vigilance department of the Company for the period April 2018 to March 2019 was analysed which revealed that the Company had under billed its customers to the extent of 244.01 metric tonnes of HPG[20] valuing ₹0.89 crore (*Annexure I*) by relying on weighment of trucks instead of relying on data from batch controllers.

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[13] *Terminal Automation System is an IT system that is used by BCPL to monitor loading of hydrocarbons in tankers.*
[14] *As per Terminal Automation System Functional Design Specifications document.*
[15] *Two for Hydrogenated Pyrolysis Gasoline and one for Carbon Black Feed Stock.*
[16] *Filling advise note is prepared by BCPL's fire and safety department after inspecting the conditions of the tanker vehicle and is based on statutory norms. It is prepared in Terminal Automation System.*
[17] *Before loading of tanker with hydrocarbons it is weighed to measure its tare i.e., weight of empty tanker.*
[18] *After loading of tanker with hydrocarbons, it is again weighed. The difference in this weight with tare is deemed the quantity of hydrocarbons delivered.*
[19] *Mass Flow Meter is an instrument to measure flow of fluids.*
[20] *Hydrogenated Pyrolysis Gasoline.*

Thus, there was under reporting of quantity of hydrocarbon delivered on SAP during the manual entry. It may be concluded that non-integration of Terminal Automation System with SAP resulted in loss of source documentation and rendered manually entered data on SAP unreliable.

The Management, in their reply (March 2022), stated that with the present configuration of Terminal Automation System as well as SAP, it was not possible to integrate Terminal Automation System with SAP for all the transactions. However, possibility of integration would be reviewed and explored at the time of upgradation of the existing system. It was also stated that variation in measurement of Hydrogenated Pyrolysis Gasoline was mainly due to the difference in accuracy level of two different types of measurement systems i.e., weighbridge and batch controller.

The Ministry, in their reply, stated (June 2022) that the possibility of integration with SAP was under review with the Original Equipment Manufacturer and would be implemented during Terminal Automation System upgradation.

The Ministry's/Management's replies may be viewed in light of the fact that as per the Company's business blueprint document for sales and distribution, the loaded quantity of hydrocarbons should pass to the SAP automatically through an interface between SAP and Terminal Automation System. Hence, both SAP and Terminal Automation System should have been configured accordingly. Further, due to the difference in accuracy level of two different types of measurement systems, the Company incurred pecuniary loss.

> *Recommendation 7: The Company may ensure that the loaded quantity of hydrocarbons should pass to the SAP automatically through an interface between SAP and Terminal Automation System.*

(F)   Difference in Delivery Orders between Terminal Automation System and SAP

In SAP, Delivery Order numbers are recorded in standard SAP table LIPS in Sales and Distribution module. Further, as per documentation provided by the Management, the Filling Advise Note data from the Terminal Automation System is recorded in table ZSDTASINTERFACE in SAP. Analysis of this table and comparing the same with delivery data from Terminal Automation System revealed the following:

➢ Out of 11,521 records in Terminal Automation System, the Delivery Order was not recorded for 35 deliveries between August 2016 and December 2018 for 600.40 metric tonnes of hydrocarbons indicating insufficient check in Terminal Automation System. As Delivery Order uniquely identifies each delivery, in absence of Delivery Order these delivery documents cannot be traced to SAP. Therefore, Audit could not vouchsafe that these transactions were duly recorded in SAP, billed and accounted for in the books.

Picture 4: Delivery of liquid hydrocarbon at tanker after weighment in Weighbridge.

➢ 532 records in Terminal Automation System recorded zero or negative quantum of deliveries resulting into inconsistency. In the absence of documentation, Audit could not vouchsafe if these tankers were filled with hydrocarbons or left empty after initial weighment.

➢ As stated above, the Filling Advise Note data from Terminal Automation System were to be recorded in the table ZSDTASINTERFACE in SAP. During audit, comparison of data obtained from Terminal Automation System with the table ZSDTASINTERFACE revealed that 148 records[21] in Terminal Automation System were not recorded in SAP table ZSDTASINTERFACE between August 2016 and October 2021. These constituted 3,353.50 metric tonnes of hydrocarbons delivered valued at ₹11.11 crore. Audit observed that not all data points were automatically uploaded from Terminal Automation System to SAP and as a result, manual entry of data from Terminal Automation System to SAP was necessitated.

➢ Further, as all the data from Terminal Automation System does not flow automatically to ZSDTASINTERFACE, consequently they also do not flow to SAP table LIPS[22]. The data from Terminal Automation System is manually entered into SAP through t-code Vl02n. During audit, comparison of data from Terminal Automation System with LIPS revealed that 58 records from Terminal Automation System were not recorded in LIPS. These 58 records pertained to delivery of

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[21] *Excluding those without Delivery Order in Terminal Automation System.*
[22] *SAP table that documents delivery item data.*

hydrocarbons between August 2016 and October 2020 aggregating 1,196.40 metric tonnes valued at ₹3.90 crore**.**

Audit observed that due to absence of automation, completeness of records on SAP was compromised. Further, manual entry of records entails the risk that all records might not be entered if there is absence of necessary controls. Audit also observed that necessary controls such as control totals or count documents were absent.

The Management stated (March 2022) that there was technical issue with the Terminal Automation System till March 2019 and thereafter system reliability had improved. The Management also assured that a robust documentation system would be developed to record weighment of tanker. The Management further contended that the data as mentioned in the audit observation were available in SAP without mentioning table names.

The Management's reply may be seen in light of the fact that it had not mentioned the tables where these data were recorded. In this connection, Audit had pointed out the relevant tables where they should have been automatically recorded for Filling Advise Note after delivery.

The TheMinistry, while accepting the audit observation, stated (June 2022) that the Company would explore and develop a robust documentation system.

(G)   Verification of polymer delivered on weigh bridge

The Company has four weigh bridges out of which two weigh bridges are dedicated to weighment of tankers at the time of delivery of hydrocarbons. The remaining two weigh bridges are located at material store and between polymer loading point and exit gate for trucks. These two weigh bridges were meant to weigh material coming into store and delivery of polymer. However, the weighs bridges located at material store and between polymer loading point and delivery gate were never made operational.

Picture 5: Bags of polymers kept at Product Transfer Department

Consequently, the quantity of polymers sold are not weighed on weigh bridges. Instead, the Company dispatched polymers after manual counting, witnessed, and verified by different agencies including Central Industrial Security Force. Audit observed that had the Company practiced weighment of the trucks before and after delivery of polymers, it could have created an additional check that would have ensured that correct quantity of polymers was loaded in the trucks for delivery to customers. In this connection, it is worth mentioning that the Company found (March 2020) two trucks that were carrying 280 bags of polymers more than their authorised quantity. The valuation of these seven metric tonnes of polymers was ₹5.93 lakh. Audit observed that had the Company practiced the weighment of trucks

carrying polymers for delivery and recording of the same on SAP, it would have deterred such events as well as provided an assurance that the trucks were always loaded with correct quantity of polymers for delivery.

The Management stated (March 2022) that the Company was following manual counting method for dispatch of polymers and the same was witnessed and verified by different agencies including Central Industrial Security Force.

Picture 6: Unused Weighbridge near PTD

The Management's reply may be viewed in light of the fact that weigh bridges were installed and the same should have been used at the time of delivery of polymers.

The Ministry stated (June 2022) that Terminal Automation System system was configured only for loading of liquid products/liquid hydrocarbons. However, The Ministry's reply does not address the reasons for non-automation of weighment of trucks carrying polymers both before and after loading to automatically determine the quantum of polymers loaded in each truck and reconcile the same with polymers dispatched recorded in SAP.

(H)   Inability to create single source of data

The Company, through "Exaquantum" software[23], automatically records the quantity of polymers it sends to packaging department and the number of bags that are filled and included in pellet. At the packaging department (also responsible for transport and delivery), the number of bags of polymers are physically counted and recorded on SAP through t-code MIGO. When production data for polymers is sought, the Management uses a customised t-code ZSDPRODUCTION_V in SAP to report the same. The table below shows production data for polymers recorded on Exaquantum data generated by the Management from SAP using customised t-code ZSDPRODUCTION_V and the production data recorded through MIGO by packaging department and stored in SAP standard table MSEG.

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[23]   *This software gets the data from Distributed Control System. It is a standalone software and cannot be accessed over network, unlike that for SAP.*

Table 1.2: Statement showing multiple values for quantity of production of LLDPE* and HDPE** in each year.

Year	Source	Production of LLDPE & HDPE (At the point of bagging in PTD (A))	Quantity of LLDPE & HDPE Packed (At the point of pelletiser in Product Transfer Department (PTD) (B))	Wastage/sweep etc =(A-B)
2018-19	**Source: Exaquantum Software Data**	2,22,995	2,22,628	367
	Source: Using SAP T-code ZSDPRO DUCTION _V	2,35,417		6 (SAP data manually entered on MIGO by PTD)
	Source: From SAP Table MSEG for movement type 521	2,17,798		
2019-20	**Source: Exaquantum Software Data**	2,25,067	2,24,036	1031
	Source: Using SAP T-code ZSDPRO DUCTION _V	2,35,308		19 (SAP data manually entered on MIGO by PTD)
	Source: From SAP Table MSEG for movement type 521	2,41,051		
2020-21	**Source: Exaquantum Software Data**	2,29,091	2,27,438	1,653
	Source: Using SAP T-code ZSDPRO DUCTION _V	2,32,446		94 (SAP data manually entered on MIGO by PTD)
	Source: From SAP Table MSEG for movement type 521	2,31,350		

* LLDPE - Linear Low-Density Polyethylene ** HDPE –High Density Polyethylene

From the above table[24], it is apparent that the data generated from each of the above source were at variance with each other. Audit observed that manual input of data, in absence of appropriate controls, cannot always ensure that records were correctly entered in SAP. On the other hand, automatic capture and recording of data into SAP would have resulted in real-time availability of correct data with single source.

The Management, in their reply (March 2022), stated that Distributed Control System was not integrated with SAP due to vulnerable exposure of process safety which may lead to disastrous consequences. However, the Company will review the risk and explore future possibilities of integrating Distributed Control System with SAP.

The Ministry, in their reply, stated (June 2022) that the Company would review and explore future possibilities of integrating Distributed Control System with SAP.

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[24] *Management could not provide the instrumentation reading on Distributed Control System for the years 2016-17 and 2017-18.*

(I)   Internal Controls and business processes not mapped on SAP

While developing an Enterprise Resource Planning system, it is imperative that the required controls necessary to mitigate risks are configured into the Enterprise Resource Planning. During implementation, SAP can be configured to ensure that the necessary internal controls are in place and operational. During IS audit of the Company, it was observed by Audit that some key internal controls including delegation of powers applicable to the Company's operations were not configured in SAP. As a result, the necessary approvals were taken in files on paper trails and note-sheets. In this connection, Audit observed the following:

i.   The Company had a policy whereby credit exposure to a consignment stockist was determined based on the bank guarantee submitted by them. In one instance, the Company approved (March 2018) supply of polymers more than the exposure limit stipulated by the policy. Subsequently, the consignment stockist was unable to pay or return the stock to the Company. As of November 2021, ₹11.46 crore was outstanding for over three years from this consignment stockist.

Audit observed that while maximum credit exposure limit was configured on SAP, the same could be manually overridden. SAP should have been configured to prevent such overriding.

The Ministry/Management, in its reply (June 2022/March 2022,) stated that there was no provision for maximum limit in the t-code.

Reply of the Ministry/Management is to be viewed against the fact that the Company did not explore the possibility of stopping the manual overriding of maximum exposure limit in t-code manually.

ii.   When supplies or deliveries are scheduled, the details of the vehicle assigned should be available for verification on a computer terminal at the gates by security personnel to independently assess the *bona-fide* purpose of such vehicles. This would also create a record for vehicle movement into and out of factory premises and provide an additional security. Audit observed that no computer terminals were available at gates.

The Ministry/Management, in their reply (June 2022/March 2022), accepted the audit observation and stated that implementation of such system at material gate would be explored.

iii.   Contracts with specific price variation clause were not separately identifiable on SAP. Price variation provisions are not mapped in SAP for automatic computation based on specified inputs. Audit observed that there were instances where price variation allowed on High Speed Diesel for transportation contracts was at variance from formulae stipulated in the contract.

The Ministry/Management, while accepting the audit observation, stated (June 2022/March 2022) that they would explore the possibility with the help of SAP Original Equipment Manufacturer.

> *Recommendation 8: The Company may implement Production Planning and Plant Maintenance module. Automatic input of source data may be prioritised to create single source of data.*

1.6.4 Monitoring and Evaluation

1.6.4.1 Master File Changes

The purpose of master file controls is to ensure the ongoing integrity of the standing data contained in the master files. It is vitally important that stringent 'security' controls should be exercised over all master files. These include the establishment of adequate procedures over amendment of data, comprising appropriate segregation of duties and authority to amend being restricted to appropriate responsible individuals and regular checking of master file data to authorised data, by an independent responsible official. In this regard, Audit observed following:

- The Company did not have a documented policy, procedure or method of evaluation of changes made to master tables.

  The Ministry/Management stated (June 2022/March 2022) that Standard Operating Procedure for changes in the master table would be prepared.

- One user had the authorisation of making changes in the bank master and creation of bank key while also having authorisation to make changes in vendor master and customer master. Therefore, risk of fraudulent transaction could not be ruled out.

  The Ministry/Management, in their reply (June 2022/March 2022), stated that the point was noted and the authorisation for changing the vendor and customer master data and bank master data would be reviewed for further strengthening the internal control system.

- From April 2016 to September 2021 total 53,208 changes (create and edit) had been made in the vendor master by 16 users. It was further noticed that one user had authorisation of t-codes XK01 and FK01 for creation of vendors as well as t-codes of F-40 and F-53 for making payment to the vendor. From April 2016, the said user had made total 3,879 number of changes in the vendor master.

  The Management accepted (March 2022) that it had allowed multiple users to create/change Vendor Master Data, however, the same was not documented. The

reply was silent on the fact that a single user had been authorised to both create vendor as well as to make payment to vendor.

The Ministry, in their reply, stated (June 2022) that there was no case where single user had been authorised to create vendor as well as to make payment to vendor. The reply of the Ministry was factually incorrect as during inspection, Audit found that one user with authorisation to create vendor as well as payment to the vendor.

- General Ledger accounts master data is very critical in SAP as the entire transaction postings are based on General Ledger accounts. Any changes to General Ledger accounts data might be of interest to auditors from audit perspective. During test check, it was observed by Audit that one user had changed General Ledger line items six times from the year 2016. However, specific changes were not documented. In the absence of proper documentation, Audit could not vouchsafe that the changes were bonafide and necessary.

The Management accepted (March 2022) the observation and noted for future compliance. The Ministry also endorsed (June 2022) the views of the Management.

1.6.4.2 Periodical review

As per the Company's IT policy, the Company was required to conduct a SAP functional audit and a technical audit covering the entire IT infrastructure at least once in every two years. However, it was observed that no such audit was conducted till December 2021.

Moreover, the activities of Chief Information Security Officer of the Company should be reviewed by the Chief Information Officer or other senior authority. No such reviews were carried out till December 2021.

The Ministry/Management accepted the observation and assured (June/March 2022) that SAP functional audit and technical audit covering the entire IT infrastructure would be carried out at least once in every two years.

> *Recommendation 9: Internal control may be mapped in SAP itself and SAP functional and technical audit may be carried out at the earliest.*

1.6.5 Future vision and way forward for the Company's implementation of SAP

Due to rapid technological changes in the IT domain, there shall always be some gap in implementing the latest developments. The Company may ensure that the various components of the technology stack are upto date, fully supported by the concerned Original Equipment Manufacturers and all relevant patches and update installations are current, as far as possible, for all the IT systems installed in the Company.

The Management, in their reply, stated (June 2022) that upgrading of SAP Net Weaver 7.4 to the latest version of SAP Net Weaver 7.5 had been initiated on all the SAP portal servers (Development, Quality and Production). Similarly, Oracle 11.2.0.4.0 had been upgraded to the latest version of Oracle 19.0C in the Sandbox, Development, Quality SAP Enterprise Resource Planning servers, while upgradation for Production server was under progress. The project for migration from Windows Server 2012 R2 to Windows server 2019 was also under process. The Company was also working out on the technical requirement with Original Equipment Manufacturers to integrate Terminal Automation System with SAP for bi-directional data transfer. The Management was also actively considering implementation of production planning and plant maintenance modules in SAP and integrating the same with the Company's existing production control system.

1.7   Conclusion

The Company's IT Governance was inadequate and SAP was utilised as a repository of information, rather than complete management of business transactions as a fully implemented enterprise resource planning software. Moreover, the Company had not determined criteria and matrices to measure the success and failure of the IT project. The Company had an inadequate IT security and Business Continuity Plan. However, it needed to be tested for their efficacy at the time of crisis. Change management was inadequate and Table logging was not available. No policy was framed regarding role-based access to SAP and segregation of duties. Access to critical t-codes was not limited. Password policy had not been enforced. Automation of source data was inadequate and manual entries were allowed. Interface between SAP and other systems was not properly configured and other IT systems from which data could flow to SAP had also not been properly configured. Internal controls were inadequately configured in SAP and were on paper trails. SAP functional and technical audits were also not conducted periodically to assess the efficacy of the system.

Chapter II

Information Systems Audit of the Plant Maintenance Module of SAP ERP in Oil and Natural Gas Corporation Limited

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Information Systems Audit of the Plant Maintenance Module of SAP ERP in Oil and Natural Gas Corporation Limited

2.1   Introduction

Oil and Natural Gas Corporation Limited (Company) is an Oil and Gas public sector undertaking (PSU) engaged in exploration and production of oil and gas. ONGC, under the project Information Consolidation for Efficiency (Project ICE), implemented SAP ERP in October 2003 with 10 modules[1]. The total investment[2] on ICE excluding implementation cost amounted to ₹81.50 crore. The Plant Maintenance (PM) Module is one of the 10 modules implemented in the Company. The PM Module is used to maintain the master data of Equipment/Technical systems and map the maintenance processes to facilitate tracking of equipment history (technical and financial) and provide information for analysis and decision making at unit as well as organisation level. The different processes mapped under PM Module include maintenance planning and scheduling, unplanned maintenance, refurbishment processes and work permits.

The SAP-PM Module was implemented in ONGC during the year 2003. Due to lack of conversance and the optional nature of its usage, even the initial benefits could not be sustained. A second attempt was made in 2015 to revive it fully, under the project IMPACT[3], which was implemented in consultation with M/s Boston Consulting Group (BCG) in offshore plants. It was later decided to implement it in onshore area also in phased manner as Computerised Maintenance Management System (CMMS).

Many of the equipment identified by the Company as critical for its operations had surpassed their useful life determined internally (eight out of 15 critical equipment categories exceeded their prescribed life as detailed in *Annexure II)*, thereby emphasising the need for proper maintenance to minimise production/process interruptions.

The objectives of PM Module implementation at ONGC were to:

- standardise maintenance business processes across organisation;

- integrate maintenance business processes with other functions;

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[1]   *Financial (FI), Controlling (CO), Material Management, Plant Maintenance, Project Systems, Investment Management, Asset Management, Treasury, Sales and Distribution, Business Information Warehouse.*

[2]   *Cost of hardware, software, networking etc.*

[3]   *Improving Maintenance Practices through Accelerated Capability-building and Transformation.*

- improve quality of information, data transparency;

- achieve optimisation of available resources; and

- reduce time taken for procurement/issuing material and planning.

As against the expenditure under the head Repairs to Plant and Equipment of ₹1,281.16 crore as per the Profit & Loss Account statements for 2020-21, the PM order cost for the same period was available for only ₹99.22 crore. This indicates that all the repairs and maintenance costs do not flow from Plant Maintenance Module and there is partial utilisation of the Module. The Compliance Audit Report No. 19 of 2021 of the Comptroller and Auditor General of India on 'Water Injection Operations in Western Offshore, ONGC' had earlier brought out status of maintenance of equipment used in water injection and their impact on the operations. The Report touched upon the sub-optimal utilisation of PM Module with regard to equipment used for water injection (***Annexure III***).

2.2 Audit Objective, Scope and Methodology

The audit objective was to review the implementation and utilisation of the Plant Maintenance Module of SAP in ONGC to assess the:

i)   correct mapping of business rules and requirements of the Company;

ii)   controls in place to ensure reliability and integrity of data; and

iii)   effectiveness of Plant Maintenance Module as implemented in the Company.

An Entry Conference was held with the Management on 27 October 2021 through video conference for explaining the Audit objective, methodology and criteria to be adopted. Audit methodology adopted included:

- Collection of Data dump from the Company for the said period for transaction data and entire Master data and its analysis. Company provided data dump of the tables of PM Module master data and transaction data pertaining to the period April 2014 to August 2021.

- Test of controls to determine reliability of internal controls.

- The verification of transactions from source documents (SAP data/other data maintained by the Company).

- Evidence collection through Audit requisitions.

The draft Audit Report was issued to the Management on 8 March 2022 and response was received on 30 March 2022. An Exit Conference was held with the Management on 31

March 2022. The report incorporating Management responses was issued to Ministry of Petroleum and Natural Gas in April 2022 and the response of the Ministry was received in November 2023. The responses of the Management/Ministry have been considered and incorporated in the report.

2.3   Audit criteria

Audit criteria were drawn from the Original Equipment Manufacturer (OEM) norms for periodical maintenance/running hours/maintenance Allocation Chart, Policies/guidelines/Standard Operating Procedures adopted by the Company for critical equipment, Minutes of Top Management meetings and Business Blueprint[4] document.

2.4   Limitations to Audit

The Human Resource related information[5] provided to Audit was incomplete. The Monthly Performance Reports prepared by the locations (Plants) were not from the SAP system but maintained and reported manually. A single format was not followed and there were changes to the structure and information furnished across ONGC and within the same unit, over time. The information was also not available for the entire audit period. This made it difficult for Audit to combine the data and compare it across units/study their trends and verify the data integrity.

2.5   Audit findings

Plant Maintenance module caters to both planned and unplanned maintenance activities. The Master data in module consists of Functional location, Equipment, Measuring Points, Task Lists and Maintenance Plans. The planned maintenance is scheduled based on task lists created for an equipment category. Maintenance processing for unplanned tasks involves creation of maintenance notification, maintenance order and execution of work order.

Audit findings based on the assessment of the PM Module utilisation have been elaborated in the ensuing paras.

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[4]   *Business Blueprint is a detailed description of the Company's business processes and system requirements at the time of implementation of the ERP.*
[5]   *Audit requested for access to Human Resource Module of SAP ERP. Training data was provided but details of employees posted in Maintenance was not furnished. In the absence of details of employees, Audit could not compare data across units/study their trends and verify the data integrity.*

2.5.1 Mapping of business rules and requirements of the Company

2.5.1.1 Observations on Master data creation and Maintenance - Asset Master Data

The master data for the PM Module included Equipment, Functional Location, Measuring Points, Task lists, Bill of Materials and Maintenance Plans. The scrutiny of the master data of equipment[6] made available to Audit revealed the discrepancies as detailed in table below:

Table 2.1: Discrepancies in the master data of equipment

Parameter	Total records	Discrepancy	Impact
Asset Number	62,000	Field not filled in 60,671 records (97.86 *per cent*)	Asset numbers are the crucial link between PM Module and Asset Management of Financial Accounting Module. ERP software work on the basis of inter linkage between the modules. In the absence of these linkages, data flow is affected from one module to another. For example, while Asset is retired in Financial Accounting Module, the equipment continues to be shown as in service in PM Module.
Manufacturer details and Model numbers	51,546	Field not filled in 35,343 records (68.57 *per cent*)	Performance/downtime comparisons between manufacturers/similar models are not possible.
Cost-centre	51,546	Field was blank in 8,155 records in Equipment master (15.82 *per cent*)	Could not be ensured that the costs are loaded to the appropriate cost- centre.
Start up date	51,546	Field was blank in 49,761 records in Equipment master (96.53 *per cent*)	Start-up date is the date when the equipment operation started. In the absence of information, reports that rely

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6 *Table on Equipment master and Warranty Master.*

Parameter	Total records	Discrepancy	Impact
			on this data would show wrong results like MTBR (Mean time between Repairs).
Business Area	23,866	Field was blank in 5,176 records in Equipment master (21.69 *per cent*)	In the absence of this data, complete linkage between PM Module and Finance Module could not be ensured.
Warranty details	51,546	Vendor details, Warranty Date, Warranty end were not filled in all the 51,546 records (100 *per cent*) in Asset Master. Audit test check of equipment also revealed blank warranty data.	In the absence of warranty particulars, the controls regarding warranty management/cost-controls were not found functioning. Appropriate information message for Warranty check to be displayed at the time of creation of Notification/Maintenance Order during warranty period could not be generated.

In the absence of relevant data, the controls mapped with the Master data were less effective or the linkage with other modules was not possible to that extent.

The Management, in reply, stated (December 2021/March 2022) that the Equipment number was not made mandatory in view of existence of sub-equipment and an exercise to review/cleanse the master data asset wise is being taken up. Cost centre have been updated in 60,112 records.

The Management assured to review and update Master data. However, in the absence of Asset number in Master data in PM Module, linkage may not be possible between PM Module and other Modules in the ERP. Equipment were not being retired in the PM Module even when related Assets were removed in Finance Module. Also, despite the availability of facility to capture the warranty details, reliance on manual check does not the serve the purpose of ERP implementation.

The Ministry stated (November 2023) that an internal multi-disciplinary committee shall be constituted by the Company to formulate the broad guidelines on interlinking of Finance Module with Plant Maintenance Module. The Company had initiated Asset condemnation

mail trigger process in SAP system wherein mails are sent for updation in PM Module, when an Asset is condemned. The Management had taken corrective action by deleting 1,330 equipment which were reduntant, by incorporating manufacturer/model details in new equipment and updating in existing equipment (15,587), updating start-up date fields in 48,431 records and steps were taken to reduce errors by incorporating drop down menu. The Ministry referred to the Management's corrective action of incorporating system control for new equipment wherein warranty details are made mandatory. Technical Services of ONGC had initiated the review of Functional structural Hierarchy as well as cleansing and updating of Equipment master data asset-wise in a phased manner.

The Ministry/Management's reply may be viewed in light of the fact that the interlinkage of PM Module and Finance Module would be effective with proper linkage of equipment number in PM Module with the concerned asset number in Finance Module.

> *Recommendation 1: It is recommended that along with the cleaning of equipment master data which should be done in a time bound manner, all fields in master data like manufacturer details, start-up date, Asset numbers and warranty etc., may be filled up mandatorily.*

2.5.1.2 Measuring Points

Measuring points describe the physical and/or logical locations at which a condition is described (e.g., the compressor discharge pressure, running hour details of a rotating equipment etc.). Measuring points can be either a parameter value or a counter. Measurement Readings are entered for the measuring point with reference to a specific time. Target values and Range of operations could be mentioned as part of master data accordingly. Notifications can be generated automatically if the value of the measuring reading exceeds the range specified in measuring point. Measurement and counter readings are stored in the system in the form of measurement documents. The measuring documents are the basis for performance-based maintenance planning.

The Blueprint document[7] envisaged that Measuring points were required for recording performance parameters like pressure, temperature, operating hours, vibration values, Parts per Million (PPM) etc., to document the condition of a technical object at a particular point of time. Various instrumentation items like temperature/pressure gauges, tachometer, hour meter, flow meter, speedometer and vibration probes are the different measuring points and counters, which are used for different types of equipment. Condition and counter-based maintenance tasks are the forms of predictive/preventive maintenance, which would reduce the number of breakdowns of the technical objects. These measuring points could be used to trigger performance-based maintenance plans, performance evaluation of equipment and

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[7] *An IT blueprint document is a planning tool or document that an information technology organisation creates in order to guide its priorities, projects, budgets, staffing and other IT strategy-related initiatives.*

creating warranty conditions. Discrepancies noticed in capturing measuring data are detailed in the table below:

Table 2.2: Discrepancies in capturing measuring data

Parameter	Total records	Discrepancy	Impact
Target value	3,319	Field was blank in 3,315 records (99.90 *per cent*)	Control regarding the limits up to which the equipment could operate, is deficient.
Equipment	3,319	Duplicates in Measuring point in 477 cases (14.37 *per cent*)	There could be only one measuring point against an equipment for a parameter and in case of multiple measuring points, the irrelevant ones had to be deleted. This may impact the monitoring of the condition of the equipment.

Audit observed that in the absence of valid data, blank fields and counters in the master data, the effectiveness of the PM Module is undermined. 3,309 measuring points out of 3,319 records, were only running hours and the balance being linear data related to pipelines.

In the absence of master data creation of units for pressure, temperature, vibration values, particle count, these parameters could not be captured as envisaged in the Business blueprint. This diminished the utility of the SAP system especially from preventive maintenance perspective.

The values other than running hours data aid in condition monitoring by capturing the data in the system and storing it at a single point in the ERP system. This would benefit the Company from the perspective of preventive maintenance, Root Cause Analysis and for ensuring continuous operation.

> *Good Practice*
>
> *In Hazira Plant, Vibration levels are being monitored and recorded as notifications by a separate Asset Integrity Cell for condition monitoring of the equipment.*

The Management stated (December 2021/March 2022) that measuring point for performance parameters have not been mapped in the system as ONGC has been following only preventive and periodic maintenance strategy.

The Management reply indicated sub-optimal utilisation of the SAP system. Review of measuring point discrepancies are required even for the periodic maintenance activities. In

case of Uran Plant, Inspection section monitors the vibration levels, but the condition monitoring reports are recorded manually outside the PM Module.

The Ministry stated (November 2023) that the work centres across ONGC has been sensitised to follow the good practices pointed out by Audit and policy guidelines were circulated (March 2022). The feasibility of developing and capturing measuring points, as suggested by audit, were explored for implementation. However, due to system limitation and bulk volume of various parameters data to be monitored and captured in SAP system it was not recommendeded for implementation.

The Ministry response indicates the sub-optimal utilisation of the PM Module. Presently, in the manual log sheet, daily and shift wise operation parameters are recorded against the target values by the field units of the Company. Audit recommendation is not for instantaneous and continuous capture of equipment parameters which may be resource intensive at this stage. Considering huge costs associated with breakdowns and disruption in operations, Company has to consider shifting gradually to preventive if not predictive maintenance at pilot locations by harnessing the available features in the PM Module. The condition monitoring needs to be progressively ensured through PM module to enable better control and assure timely maintenance.

> *Recommendation 2: The Company should consider developing measuring points and start recording the parameters like vibration levels, pressure and temperature in the SAP PM Module daily to effectively utilise the ERP system from preventive and predictive maintenance perspective and better monitoring of maintenance activities.*

2.5.1.3 Assets retirements in master data of PM Module with impact on scheduling and Backlogs

As per the process prescribed for equipment condemnation/scrap in the business blueprint, equipment identified for condemnation/scrap is dismantled from the functional location in the system and the user status of the equipment changed to "condemned". The equipment is to be sent to stores for inspection, transferred to scrap storage location and disposed off as per Material Management procedures.

Audit observed that during the period April 2014 to August 2021, multiple equipment were retired from active use. In the absence of corresponding data of inventory number or asset number referenced in the equipment master, it was not possible for Audit to link this report with equipment master tables of PM Module.

From the scrutiny of major equipment like Compressors, Vacuum Pumps (12 records), Draw works (61 records), Blow out preventers (BOPs- 116 records), it was observed that these equipment were regularly retired from active use/scrapped as per the Asset Retired Report (Financial Module). The same were, however, not updated in the PM Module by way of changing the user status. In case of compressors, in 827 records out of 832 records,

the status continued to remain as system healthy/system installed despite around 54 sub-equipment/equipment retired during 2014-15 itself. The remaining five records have also not been marked for condemnation. In the absence of updation of the status in the PM Module, these equipment were being shown as those in active use and their maintenance schedules were drawn up accordingly. This led to incorrect master data of equipment and impacted the planned maintenance/consumption planning and consequently the backlogs. This also led to incorrect reporting.

The Management stated (January 2022/March 2022) that the exercise of verification and cleansing master data had already started, trainings would also be conducted in phases to inculcate best practices of PM business processes among users for better utilisation of SAP PM Module.

The Ministry stated (November 2023) that action has been initiated for identifying equipment already been condemned/in the process of condemnation for deactivating the same in PM Master data. System control through generation of automatic mail with asset number and corresponding equipment details has been implemented.

The Management/Ministry reply needs to be seen in the light of the fact that in the absence of proper adherence to the procedures at field level, there is incorrect depiction of available equipment, continuance of redundant reports/data and incorrect reporting. Proper linkage is necessary between Financial Accounting Module and PM Module.

> *Recommendation 3: The Management may ensure that there is time bound verification/cleaning of equipment data and necessary controls are built so that the dismantling procedure is adhered to. Feasibility of integration of Asset accounting with equipment master may also be explored.*

2.5.2 Transaction data – Correctness and Completeness

2.5.2.1 Ineffective utilisation of PM Module in capturing transaction data pertaining to Measuring Documents and Daily Progress Reports

The measurement taken at a measuring point, or a counter is recorded as a measurement document in SAP system. This data can be fed automatically or manually. In ONGC, the measurement data is fed manually.

The running hours are required to be captured through the Daily Progress Report (PM- Daily Progress Report) by the maintenance team. It was observed that on certain days rather than through Daily Progress Report, a separate measuring document was created. Out of 9,64,410 measuring documents, 1,27,582 measuring documents (13.23 *per cent*) were not through the PM- Daily Progress Report. Audit highlighted that the measuring points with more than 500 entries were not through the PM- Daily Progress Report method.

Blueprint document envisaged that PM- Daily Progress Report would capture parameters pertaining to maintenance while some parameters were to be taken from Production Planning Module. The integration of PM- Daily Progress Report with PP- Daily Progress Report as envisaged was not complete. The Daily Progress Report was to be created on a daily basis. It was observed that there was delay in entering the Daily Progress Report in the system as could be observed from the difference between the system date (Time stamp field) and the Daily Progress Report created date. Out of 5,08,834 Daily Progress Reports for the Audit period, in 6,359 records, the Daily Progress Reports were delayed by 4 days to 84 days. Of these, in 588 records, the Daily Progress Reports were delayed by more than a month (32 days to 84 days).

The Management stated (December 2021) that the provision to enter Daily Progress Report within "the three-day window" has been incorporated recently in 2019. Still in some instances measuring document were created by user to regularise the Daily Progress Report due to lack of awareness. The Management added (March 2022) that compliance to daily report would be ensured and automatic escalation messages with respect to Daily Progress Reports would be incorporated with trigger points and trigger levels. The PM Daily Progress Report process was initiated in phased manner. The physical Daily Progress Reports were still in vogue to bridge the gap. Moreover, there were certain other challenges, such as absence of tech-savvy personnel, especially in onshore well services, as well as the connectivity issues due to frequent rig movements. However, these shall be addressed in the ongoing exercise.

The Management reply needs to be seen in the light of continuing reliance on manual records for daily reports which form the basis for PM processes, thereby defeating the purpose of adopting the ERP system. Concentration of authorisations to few individuals (discussed in subsequent para 2.5.3.3) also led to backlog. Audit had observed an instance where a Process Gas Compressor at a Platform was not functioning for 63 hours after tripping in June 2021. PM- Daily Progress Report were not recorded in the SAP system for 17 days during that month. The maintenance of primary and daily records about the equipment needs to be looked from the perspective of preventive maintenance and health of the equipment. Audit recommended to ensure daily reporting through SAP system, consider interface with equipment control systems/SCADA to minimise manual interventions.

The Ministry stated (November 2023) that as per ONGC, due to limited authorisations at installations, engagement of personnel in operational requirements and new equipment pending mapping, direct entries were allowed for Daily Progress Reports. Guidelines for compliance to daily progress reporting has been issued and escalation messages in case of non-compliance has been incorporated with trigger levels. Further integration of real time data with SCADA has been initiated and smart sensors are being installed for integration with SCADA in case of standalone systems.

Audit acknowledges the positive response by the Management in ensuring daily reporting and automatic escalation to highlight non-compliance and the assurance for integration with SCADA which would minimise manual interventions in recording performance parameters/ exception events.

> *Recommendation 4: Adherence to daily reporting within the window made available through the SAP system must be ensured for control purpose and to avail the benefits of the PM Module across the organisation. Interface with equipment controls/SCADA[8] may be considered wherever feasible to minimise manual interventions in capturing performance parameters/exception events. Responsibility may be fixed in case of delay in daily reporting.*

2.5.2.2 Transaction data deficiencies in Maintenance Orders

Maintenance Order is used to plan tasks regarding the type, scope, dates of maintenance activity and to monitor the execution of tasks. A maintenance order is created with or without reference to the system notification. Maintenance orders are created, and based on the priority assigned by the planner; these orders are released. After material issue/purchase order as required, the work would be technically completed, and the business settlement of orders would be done once in a month. In comparison to the two offshore platforms, erstwhile operated by private JVs which had more than 24,000 equipment mapped in each of their SAP ERP system, the highest number of equipment mapped in ONGC platform was only 6,357. Only three platforms had more than 1,000 equipment mapped in them indicating the lackadaisical approach in the ERP implementation and usage.

Out of 513 Plants in the PM Module, there were less than 1,000 orders in 449 Plants while one plant (Hazira) had created around 21 *per cent* of all orders in the Company, which indicates varying level of acceptance from the end users of the Module. The PM Order types are used to group orders according to application components. Realisation and subsequent processing options of orders are dependent on order types catering to different type of maintenance activity. In ONGC, order types[9] PM 10 to PM 70 are available for plant maintenance as detailed in *Annexure IV*.

It was observed that the order types were not properly adhered to, at the time of creation of such orders. Out of 8,72,309 records pertaining to PM40 (Preventive Maintenance orders) 6,490 records were maintenance orders for repairs/failures/trips which were not to be recorded under preventive maintenance but under PM15 Malfunction reports. Incorrect order types affect subsequent controls and flow of data for preventive maintenance of the equipment.

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[8]   *Supervisory Control and Data Acquisition*
[9]   *The numbering is kept with some gaps for future usage.*

It was further observed that in 11 onland locations, there were very high number of unplanned orders as compared to planned orders, showing lack of preventive maintenance as detailed in ***Annexure V.*** Planned maintenance is expected to reduce breakdowns and unplanned repairs. However, large number of unplanned orders as against planned orders indicate gaps in the actual maintenance in those locations.

The Ministry stated (November 2023) that Company would be issuing guidelines for compliance of proper order types. Review of existing and creating new maintenance plans for all critical equipment across ONGC has been initiated. In future, such discrepancies would be taken care of by regular monitoring at ONGC's Asset level.

The Management/Ministry accepted the observation.

2.5.2.3 Delay in business closure of completed maintenance orders

The business closure of maintenance orders has to be done within the same month of technical closure, so that the costs are absorbed within the financial period. It was observed that there were undue delays between technical completion of orders and their business closure. 88 *per cent* of the cases were delayed beyond 365 days (7,23,609 cases) with a possible impact on the financial accounting of that particular period. The cost (value) of such delayed orders was estimated to be ₹604.09 crore[10]. 2,45,525 orders which were technically completed during the period January 2014 to August 2021 were yet to be closed (March 2022) with the business completion.

The Management stated (January 2022/March 2022) that most of the anomalies in Order type were in the maintenance orders created during the initial period. After imparting training to the end users such anomalies or gaps in the system have reduced considerably. However, still an exercise shall be taken up to bridge such gaps by regular monitoring from the competent authorities at Asset level. More than 70 *per cent* of the orders for critical equipment were now auto-generated and they were in the process of review of existing and new maintenance plans for all critical equipment across the plants of ONGC. At the time of period closing, all the PM orders are analysed and Finance and Controlling Modules were reconciled. However, a background program will be scheduled for updating CLSD[11] status after settlement of cost for the period.

The Management further stated (March 2022) that as per the action plan for review of PM Module master data, preparation/review of standard task lists and maintenance plans along with their scheduling for all critical equipment would be done by March 2023. Due diligence shall be done to fix up desirable ratio of planned/unplanned orders and guidelines revisited.

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[10] *Considering the cost estimate available at MC18 report for maintenance orders during the audit period.*

[11] *Closed (Business Completion status after Technical Completion of maintenance order).*

The Management assured to implement a background process to update the closed status for those orders after settlement of their cost, and review of task lists and maintenance plans. However, the fact remains that in the absence of proper maintenance plan, the preventive maintenance schedule was jeopardised.

The Ministry stated (November 2023) that guidelines are already in place for maintenance compliance to be above 95 *per cent*. Adherence with preventive maintenance plan will automatically reduce the unplanned breakdown orders. Further due diligence would be done to fix up the desirable ratio.

The Management/Ministry accepted the audit observation.

Recommendation 5: To ensure reduction in unplanned orders, the desirable ratio of planned/unplanned orders may be notified for work centres and monitored through the PM Module. Responsibility may be fixed in case of non-adherence to maintenance plan.

2.5.2.4 Ineffective utilisation of PM Module as Root Cause Analysis reports are not generated/distributed in PM Module

Root Cause Analysis is done for equipment failures to understand the reasons for failure. The external consultant[12] report stated (December 2012) that Root Cause Analysis process was not followed stringently/discontinued in the Company and a method to fix accountability on persons for the Root Cause Analysis outcome was absent. Root Cause Analysis process re-design and guidelines for conducting the Root Cause Analysis were discussed in the Consultancy Report. The report recommended that data capture for Root Cause Analysis would happen via SAP (linked to break down work order). Root Cause Analysis will be conducted for break downs of critical equipment based on parameters of repair cost, production loss, environmental/safety impact and recurrence of fault with threshold limits. The Root Cause Analysis template was to be filled out by Maintenance manager within 72 hours of the closure of the breakdown work order and in case of delay, the matter would be escalated to Head Offshore/Onshore Maintenance. A circular issued by Corporate Technical services in July 2020 reiterated the need for failure analysis as a tool to prevent recurrence of failures including avoiding premature failures of equipment. The detailed failure report including Root Cause Analysis were to be furnished within one month from the date of failure.

Audit observed that ZPMRCAREP – a customised report for reporting Root Cause Analysis was developed by the in-house ICE team, but data table furnished by the Company contained only two records since inception (October 2003) to August 2021, of which, in only one notification, the details were available. Considering the number of Breakdown orders (7,760) generated during the audit period[13], the number of failures which would

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[12] *Boston Consulting Group.*
[13] *PM Order type- PM10.*

qualify for the Root Cause Analysis[14] ought to be significantly higher. In the absence of the data in the SAP system, it could not be ensured that the learnings/preventive actions were implemented across the work centres in the organisation having such equipment with similar make/model. Timely identification of root cause, fixing of accountabilities and adoption of preventive steps across the organisation could not be ensured.

The Management stated (January/March 2022) that Root Cause Analysis is generally carried out for critical equipment especially in case of premature failures. It was ensured that the recommended learnings were shared and implemented across the concerned work centres through mail/ONGCREPORTS portal etc. The Root Cause Analysis format in SAP System would be reviewed and guidelines would be issued for future compliance.

The Management reply may be viewed in light of the fact that due to absence of data in the SAP system, timely identification of root causes, fixing of accountabilities and adoption of preventive steps across the organisation could not be ensured.

The Ministry in its reply (November 2023) stated that the Root Cause Analysis format, criteria and process have been reviewed through an internal committee and necessary modifications have been implemented in the system as per revised format of Root Cause Analysis report along with recommended signatory levels and authorisations.

> *Recommendation 6: The Management should clearly fix the criteria for conducting a Root Cause Analysis and ensure that Root Cause Analysis reports are recorded in a suitable reporting structure in the PM Module.*

2.5.2.5 Non-utilisation of customised reports for Logbook and continued reliance on Manual records

The Logbook in PM Module is an easy-to-use tool to log daily maintenance activities for equipment like malfunction information, operating data, periodic inspection data, solutions adopted and maintain equipment history. The log notifications of defects can be used to generate maintenance orders and the maintenance completion can be certified.

ONGC work centres continue to maintain physical logbook of equipment for operation and maintenance. The maintenance logbook contains maintenance history of the equipment including details of equipment shutdown, overhauls, trips and the rectifications adopted. As mentioned earlier, Daily Progress Reports are also maintained by the operation team.

It was observed that Logbook feature had not been enabled in more than 50 plants out of total 513 plants. Even in those plants where it was maintained, these were blank entries/entries with minimum details. The notification/order numbers were not available.

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[14] *As per the threshold parameters provided by consultant Boston Consulting Group.*

The table data furnished by the Company did not contain the equipment number/status of the log in most of the cases (completed/in process).

Audit also observed that Input control was not available as incorrect dates like 2100/2201 were observed in some log date fields. Similarly, activities not pertaining to maintenance were also found entered in these logbooks (Sagar Bhushan – "Baryte taken from supply vessel"). The log entries were not updated and continued to be shown as "INPC" (in process) even after a lapse of more than three years from entry.

> *Good Practice*
>
> *In case of Dahej C2-C3 Plant, the logbook entries were found exhaustive and for almost all major equipment.*

The Management stated (February/March 2022) that emphasis has been from streamlining of master data, to following PM processes of Orders/notifications and implementation of Daily Progress Reports. Efforts had been made for acquaintance of users with SAP PM Log book through trainings.

The Management also stated that suitable validation for logbook date is done. The feasibility for simplification of the process to maintain logbook would be checked, so that it is automatically fetched and reflected as an entry in the logbook of the respective equipment during the SAP (S4/HANA) upgradation. However, an exercise shall be taken up to bridge such gaps by sensitising the end users about this pivotal feature and regular monitoring from the competent authorities at asset level. The Management assured to make efforts to avoid multiple data entries towards automatic fetching of data from inputs within the module and regular monitoring.

The Ministry stated (November 2023) that the logbook process was deliberated by an inhouse committee of the Company and it was decided to have single point of entry through PM Daily Progress Reports (DPR) and log book process has been incorporated in PM DPR process. Separate report for log book is being developed and guidelines being issued.

The Management/Ministry reply may be viewed in light of the fact that the availability of information of maintenance history of the equipment, shutdown, overhauls, trips and the rectifications adopted may have to be ensured in the system to provide complete maintenance details of the equipment.

> *Recommendation 7: The Company may ensure that the primary source of information like log books is maintained through PM Module for reliability, easy availability and from the perspective of preventive maintenance.*

2.5.2.6 Static equipment and safety critical equipment coverage in PM module

Work centres denote the critical equipment with moving parts (Pumps, Compressors, Turbines etc.) as Rotary equipment and those with no moving parts as static equipment (Filters, Knock out Drums etc.). In ONGC, maintenance of static and rotary equipment is handled by different groups- rotary equipment by the maintenance team, and static equipment by production/process team. The static and rotary maintenance teams report to different heads at Platform and Base. The gaps in the maintenance organisation structure were identified by the external consultant and integration of activities in static and rotary maintenance was recommended.

The maintenance issues, if any, in the static equipment critically impact the downstream rotary equipment e.g., filters to protect the pump. The business blueprint stipulated that master data was required for all objects which can be installed/dismantled from a location and those for which a maintenance plan was needed. Out of 1,42,978 equipment, 8,654 equipment were denoted by the Company as static equipment in the IT system based on the Authorisation group. Audit observed that there were no corresponding task lists[15] for 5,673 static equipment. Out of those, 724 equipment were marked as 'A' category equipment signifying that their non-availability had a high impact. In the absence of task lists, the scheduled maintenance plan for these 5,673 equipment could not be ensured.

The Executive Committee, in its 507th meeting, approved the policy regarding Safety Critical Equipment across the organisation in April 2018. Accordingly, a list of Safety Critical Equipment was to be mapped with their maintenance schedules. Provision exists in the system for the maintenance plan in PM Module to be based on parameters other than the running hours for static equipment (time-based/condition-based). The Safety Critical Equipment policy stipulates the intervals and the inspections to be done for various safety valves. The Management stated (February 2022) that the static equipment were maintained/inspected when the associated processes/trains were under shutdown (Boiler shutdown/Process Gas Compressor shutdowns etc.).

Thus, in the absence of regular maintenance/inspection data in the system, the timely maintenance of these equipment could not be ensured. Even in the monthly maintenance reports, the static equipment were not covered. The time-based maintenance schedule was not available in the PM Module for the above equipment.

The Management stated (February 2022) that the maintenance of static equipment is under process managers, as maintenance of such critical static equipment may involve planned process shutdowns due to non-redundancy. All the maintenance activities pertaining to process equipment (static as well as rotating) are carried out with mutual coordination and consultation. The gaps in the classification field of Authorisation groups in onshore

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[15] *Task lists contain a series of individual maintenance activities which has to be performed repeatedly.*

locations shall be identified and reviewed under upcoming exercise. In onshore surface installations mapping of static equipment, there are gaps mainly due to lack of availability of relevant data and relatively less-tech savvy manpower engaged in maintenance of these static equipment. Calibration and PMS records for the production critical static equipment are being physically maintained at asset level.

The Management added (March 2022) that the gaps relevant to scheduled maintenance plans for static equipment especially for production critical equipment in onshore areas will be bridged through upcoming exercise. Around 10,603 equipment have been classified as safety critical equipment and mapped with 3,049 associated maintenance plans. Mapping and classification of safety critical equipment is ongoing exercise expected to be completed in due course.

> *Recommendation 8: The Management may conduct a review of static equipment which are critical from operational/process perspective and map them with maintenance plans accordingly.*

The Ministry stated (November 2023) that the audit recommendation has been noted by the Company for compliance and gaps are being identified. Around 4,709 numbers of equipment were identified and classified as static in the system. The mapping of static equipment across ONGC is being carried out along with the maintenance plan for those equipment with a likely completion by January 2024.

The Management/Ministry accepted the audit observation.

2.5.3 Ineffective utilisation of PM Module and user acceptance of PM Module – Manpower issues

2.5.3.1 User authorisations and Training of Maintenance Personnel

The Management informed that during the period 2015-2019, 500 persons had been trained in PM Module. Of these only three *per cent* of the mandays were imparted to the staff below the level of E0, while the rest 97 *per cent* pertains to Executives/Officers. This needs to be seen against the fact that 42 *per cent* of the staff[16] posted in the field were below the E0 level.

Audit did not have access to generate HR reports pertaining to details of personnel posted at Maintenance Plants across ONGC. However, it was observed in audit that out of 1,180 officers/staff posted for maintenance duties in Mumbai Offshore, 665 persons had no PM Module authorisation. Even considering only officers (E0-E9), 311 officers (26.35 *per cent* of those engaged in maintenance) did not have any PM Module authorisations.

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[16] *Mumbai High Asset in year 2016*

Optimal usage of SAP ERP system was not found among the manpower engaged in maintenance. The continuance of manual registers/manual returns indicates that maintenance work process was not carried out through the SAP ERP system even when the facility is available. Absence of authorisation to even officers indicates lack of seriousness on the part of the Management in ensuring workflow through the ERP system.

The Management stated (March 2022) that in ONGC, SAP PM authorisation is generally given to Executive/Officer level employees. However, E-learning course under Company's portal is available for all levels. Since the year 2015, 500 maintenance persons have been trained in PM executive roles. Apart from these, 165 persons from various work centres were identified and trained as maintenance planners. The priority of sustaining operations through actual maintenance over virtual maintenance makes it difficult for PM module compliance to be made mandatory in nature.

The Management reply needs to be seen in the context of deficiencies pointed out earlier in the PM Master data maintenance, transaction data inputs and the utilisation of the Module (Para 2.5.1, 2.5.2 and 2.5.3). The ERP benefits would not be reaped unless the maintenance activities are routed through the system and the objectives for PM Module implementation would remain to be achieved.

2.5.3.2 Incorrect data in Manpower utilisation reports

One of the Key Performance Indicators recommended by the Consultant[17] appointed by the Company was for manpower utilisation. The data source were the maintenance orders from SAP system and it was based on the manhours used for maintenance against available manhours and this report was recommended to be part of the Management Information System furnished periodically. Audit analysis found that the customised report prepared for viewing manpower utilisation gave erroneous results like zero/1,000 *per cent* utilisation. As such, these results appeared unreliable.

Such unusual numbers have rendered a very effective tool unreliable due to data integrity.

The Management stated (March 2022) that the customised report developed in 2003 is not being used now. Alternatively, Manpower Utilisation Report was developed under Project IMPACT which is available with Daily Progress Reports (ZPMDPR). Incorrect data in Manpower Utilisation Report is mainly due to the unreliable man hour data entered in the maintenance orders. Lack of awareness among the end users about the repercussions of incorrect man hours against the operation/activities is the main reason for such gaps. Such gaps shall be bridged through trainings and sensitising the user about this pivotal data as well as regular monitoring by the competent authorities at Asset level. Moreover, all such

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[17] *Boston Consulting Group*

reports are planned to be reviewed during the process of SAP upgrade. Guidelines shall also be issued in this regard.

2.5.3.3 Segregation of duties

SAP prescribes separate roles for PM Module to ensure that the segregation of duties principle is not violated. It provides for separate roles for creation, processing, display of notifications/orders/measurement documents, processing of historical/refurbishment orders, completion confirmation of orders and resource planning/allocation. The task of the maintenance worker is to carry out maintenance activities while resource allocation, processing of orders, completion confirmation is assigned to a responsible person higher in the hierarchy.

Audit observed that multiple role authorisations were provided to same person across the work centres. In case of Uran, Hazira and Central Workshop Baroda, as many as 30 roles were authorised to same person. Out of 19,923 records in the table containing role authorisations, 332 records had no username and 18,508 were found to be duplicates (employee IDs with multiple roles).

Audit also observed that Daily Progress Report creation and executive roles, Daily Progress Report creation/executive and incharge maintenance roles were assigned to a single person. Maintenance incharge roles were clubbed with other authorisations. This leads to a weakened segregation of duty and control issues.

The Management stated (February 2022) that due to manpower constraints, in some work centres, multiple authorisations have been given to a single user, but only after getting the approval from competent authority. The Management further stated (March 2022) that the need for review of various PM role authorisations is agreed and an exercise shall be taken up soon to review the multiple-role authorisations. Approvers would be sensitised through suitable communications to ensure correct role assignments in line with the assigned duties along with trainings in phases to inculcate among users the best practices pertaining to PM Module.

The renewed efforts in training more personnel and assurance to review the multiple roles are acknowledged.

> *Recommendation 9: (a) The Management may conduct a systematic and complete review of role authorisations so that the inbuilt controls of segregation of duties are maintained.*
>
> *(b) The Management, through proper training for officials and staff, may ensure that maintenance work processes are carried out through PM Module only.*
>
> *(c) The Management may consider revisiting Maintenance SOPs to ensure that the maintenance work is carried out obligatorily through the SAP System.*

The Ministry stated (November 2023) that ONGC has taken corrective actions with respect to multiple authorisations in the two plants mentioned in Audit observation. With regard to other units, instructions were passed on to ensure the role assignments are as per business requirements and training are conducted to imbibe the best practices pertaining to PM business processes for better utilisation of SAP PM Module.

The Management/Ministry accepted the audit observation.

2.5.4 Use of Key Performance Indicators for effective utilisation of PM Module and the Management oversight

2.5.4.1 Performance Measurement and Monitoring

The Performance Management and Benchmarking Group of the Company formalises the Performance Contracts which are entered in the SAP system. After mapping Key Performance Indicators and the targets, it is signed by Strategic Business Unit chiefs and Directors concerned.

The Chief Technical Services office was entrusted (2016) with the overall responsibility of maintenance/upkeep of the equipment. Technical services sign a performance contract with concerned functional directors. The Management informed that there is no service level agreement entered by Technical Services.

2.5.4.2 Key Performance Indicators for maintenance performance

System availability and equipment availability are the Key Performance Indicators measured for the performance of Chief Technical Services. The system availability is a metric that measures the availability of all units required at any given instance for optimum fulfilment of operational requirement. Equipment availability measures the availability of individual equipment. For the purpose of determining equipment/system availability, running hours of the equipment and its standby hours are considered as available hours. The Key Performance Indicator targets are 100 *per cent* for system availability and 95 *per* cent for equipment availability. Audit observed the following:

- the Key Performance Indicators were not flowing from the PM Module or the SAP system but from the Monthly reports furnished to the Chief Technical Services office by the respective Plants/Assets/Basins maintained outside the system in Excel.

- The equipment availability and system availability targets were found to be achieved in all the years. The monthly reports denoting the Key Performance Indicators were not made available for the entire audit period (April 2014-August 2021) and also not for all work centres. It was observed that format for the monthly reports was not

uniform across the work centres and even within the same work centre over the period.

- Audit analysed the available Monthly Performance Report data with respect to data maintained in the SAP-PM Module and also other reports furnished to the Chief Technical Services office by the work centres. The Key Performance Indicator achievement claimed by the work centres were found to be based on unreliable manual reports. Instances were observed where equipment were denoted on standby even when under repairs as well as availability hours and cumulative hours were incorrect, Daily Progress Reports were not recorded continuously when major equipment was under repair etc. (Details are in the ***Annexure VI and VII)***.

- In the internal reports on analysis of decline of the fields of Neelam Heera Asset, it was observed that partial shutdown of 37 days in the field was effected during a Process Gas Compressor major overhauling. Subsequent to this incident, production loss of around 1,000 barrels of oil per day (20 *per cent* decline) happened in the Base wells[18], which could not be regained at later date. It was also cited by an International Domain Expert[19], engaged for vetting the reserve position of the field, that operational shutdowns for any longer period posed a serious risk to production and such operational shutdowns needed to be optimised in future to reduce the risk of production loss in the matured field.

  Such prolonged shutdowns happen when there is no proper standby equipment in running condition in place which is amplified by continuing to operate the equipment beyond the specified running hour norms prescribed by the OEM. The standby position and consequently the unreliable reporting of equipment/system as available for operations during the intervening periods needs to be seen in the context of relying on manual data despite the daily entries in PM Module.

- It was observed that the targets for equipment availability/system availability were not part of the Performance Contracts signed by the Assets/Plants. There is no percolation of the Key Performance Indicators from the top to the work centres/groups responsible for equipment upkeep.

The Management stated (March 2022) that;

- The Technical Services were mandated as Corporate Maintenance Management Group in June 2016 and therefore, equipment availability and system availability targets had been included in Technical Services performance contract since 2016-17 onwards. The maintenance Monthly Performance Report system was introduced accordingly in August 2016 to facilitate regular monitoring. The Monthly

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[18] *29 oil producing wells*
[19] *M/s Beicip Franlab*

Performance Report format was standardised since 2018. Once the Daily Progress Report compliance is achieved in the ongoing exercise, feasibility for automatic creation of Monthly Performance Report, capturing all the information from Daily Progress Report shall be explored.

- Standby equipment are available against critical systems as a philosophy, to meet any operational exigency and maintain the desired system availability. However, some times, it happens that the equipment trips or production is affected due to various other reasons like process upsets/valve malfunctions/pipeline leakages, despite the equipment being in healthy condition and available for operation. Considering the availability of standby equipment, it is quite possible that system availability is 100 *per cent*, despite the equipment availability being low. However, discrepancies as pointed out shall be checked, analysed in respect of standby availability, and will be taken care accordingly.

- Observation with regard to continuous standby of equipment is well-taken. The same shall be checked and accordingly respective work centres shall be suitably sensitised.

Continued reliance on manual reporting must be seen from the perspective of maintenance requirements of aged equipment, reliable information on their performance status and timely intervention to minimise process upsets.

> *Recommendation 10: The Management may ensure that the Key Performance Indicators are transmitted to the work centres who are ultimately responsible for maintaining the equipment/releasing the production equipment for maintenance purpose. The Management may also ensure that Key Performance Indicators flow from verifiable and standard data of the Plant Maintenance Module.*

The Management added (March 2022) that the audit recommendation is being taken up with Top Management for Key Performance Indicator transmission to assets. The Ministry stated (November 2023) that automatic generation of PM Monthly Performance Report in SAP PM was implemented by ONGC in July 2023. The Ministry futher stated that ONGC is in the process of implementation of Audit recommendation after internal consultation.

The Management/Ministry accepted the audit observation.

2.5.4.3 Maintenance data in PM Module not aiding Repair versus Replacement decisions

The repair versus replacement decision depends on information about equipment health, its intended repair cost, the carrying cost including repair costs till date and its replacement cost.

Audit observed that the PM Module reports were not used by the Management to aid their decision making. This could be attributed partially to the deficiencies in data and reports.

There is a SAP standard report for analysis of manufacturer-wise/equipment-wise/year-wise maintenance data for a particular period. The notifications created, breakdown reported, orders created, planned costs, actual costs etc., are indicated in the report. Audit analysed the report for a class of equipment - Motors. It was observed that same manufacturer had multiple entries[20] with slight difference in their names thereby making the manufacturer-wise analysis erroneous. Also, the carrying cost of the equipment was not available in PM Module Reports to understand the lifecycle cost of the equipment at any point.

In the absence of information about equipment health, its intended repair cost, the carrying cost including repair costs till date, PM Module is not used for the repair versus replacement decisions.

The Management stated (March 2022) being a free text field, multiple entries exist. Such irregularities/deficiencies like duplicity in manufacturer/make/model shall be addressed/rectified in the ongoing review of equipment master data. System controls shall be developed to select manufacturer from the drop-down list.

> *Recommendation 11: Reports in PM Module that could aid the Management's decision making for repairs/replacements and for comparative analysis may be made available and suitably used.*

2.5.4.4 Management oversight

The monitoring and management oversight through the PM Module were not prevailing as discussed below.

A) Monitoring of Backlog

The Maintenance orders (Planned and Unplanned) have a planned completion time frame and based on their priority, an inbuilt threshold (last allowed finish date) is also given. The back log of orders, if any, is worked out based on the difference between last allowed finish date and the report creation date.

The Consultant[21] appointed by the Company for the Project IMPACT, in its report (December 2012), had prescribed Management Information System report through SAP System including Backlog reports for maintenance activities with weekly, monthly and quarterly periodicity along with the escalation matrix. The quarterly review Management Information System dashboard recommended at Director level also included the backlog

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[20] *Manufacturer name had multiple entries, for example, Crompton, Crompton Greaves, Crompton Greaves Ltd (some other in Capital letters).*
[21] *Boston Consulting Group*

dashboard along with the major reasons for backlog orders, so that the same is monitored at Top Management level. Accordingly, a customised report was developed (June 2013) for PM Order backlog.

Audit observed following discrepancies in the backlog generation and monitoring: -

- The reasons for backlogs were absent in 27,38,166 out of 28,87,618 records (94.82 *per cent*) and thus, by not making the reasons field mandatory, the monitoring of backlogs was rendered ineffective.

- It was observed that out of 28,87,618 records, 1,14,644 records (3.97 *per cent*) had incorrect dates in the last allowed finish date field. Thus, due to lack of input controls, incorrect dates were entered in the last allowed finish date thereby making the backlog report incorrect.

- Out of 28,87,618 orders, 4,213 were closed without technical completion.

- Backlogs were measured as counts (running hours) and as days. The summary of backlogs after excluding the incorrect date entries in the last row, showed that the backlog days ranged between one day to more than two years.

- Out of 28,87,618 backlog records[22], 18,59,512 (64.39 *per cent*) were pertaining to high and very high priority. The backlog status was cross checked with the tripping details of the plants and it was observed that out of 28,87,618 backlog records, 5,107 were breakdowns (Order type PM10– after excluding incorrect dates) thereby signifying that even breakdowns were not attended on time.

Considering the continuous operational requirement especially where there was no standby mechanism, such backlog levels need a review of the maintenance process/systems and closer monitoring. The summary of plant-wise backlog of breakdown orders is given in *Annexure VIII.*

The ineffective adoption of breakdown notifications/orders brought out earlier coupled with incorrect/blank entries in backlog data and discontinuance of the exception reports despite recommendations of an international consultant has rendered the management controls/maintenance monitoring through the PM Module ineffective. The fact that even breakdown orders continued to be unattended and under backlog for long duration indicates lapses in monitoring and timely interventions.

The Management stated (January2022/March 2022) that open order status/backlog is being monitored using standard t-code: IW39 and customised report (ZPMSTATUS) other than Backlog Report. The reasons field shall be made mandatory after review and instructions

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[22] *AFIH (Priority type) + zpmdprblog +AUFK (TECO/CLSD status) tables*

shall be issued in this regard. Necessary modifications will be done in customised Backlog Report regarding last allowed date. Most of the anomalies in backlog of orders are in the maintenance orders created during the period before implementation of Project IMPACT and Computerised Maintenance Management System. After imparting training to the end user such anomalies or gaps in the system have reduced considerably. However, still an exercise shall be taken up to bridge such gaps by regular monitoring from the competent authorities at Asset level.

The Management assurance for corrective action on customised Backlog Report for last allowed date field, assurance for filling the gaps in the backlog report and its adherence is noted.

> *Recommendation 12: The Management may ensure that the escalation matrix is adhered to, through the system, for reporting the backlogs so that timely maintenance action is taken. Cleaning of old backlogs must be taken up on time bound basis so that monitoring of maintenance efforts could be effective.*

The Ministry stated (November 2023) that audit recommendation is accepted and escalation mechanism would be devised during S4 HANA upgradation and various dashboards on equipment overhaul, replacement, Daily Progress Reports compliance and maintenance order compliance are under development.

B)   Management Dashboard

Success of any IT system depends on the Top Management involvement and initiative which ensures correctness and completeness of data fed and timely completion of pending work. SAP Business Information Warehouse provides data warehousing functions, a business intelligence platform, and a suite of business intelligence tools. On the basis of this analysis, businesses can make well-founded decisions and determine target-oriented activities. The Business Information Warehouse is the analysis system defined in the Company for Plant Maintenance Information System.

Exception reports like Root Cause Analysis, backlogs of orders released, threshold reports, performance measurement system for scheduled compliance, backlog activities, manpower status, manpower effectiveness, breakdown analysis, manufacturer analysis, cost evaluation, mean time between repairs and mean time taken to repair were some of the customised developments made during/after the implementation of the module relevant for Top Management decision making and timely interventions.

The quarterly Management Information System review dashboard for Directors was suggested by the external consultant including the backlog dashboard along with the major

reasons for backlog orders, equipment availability of critical equipment[23], backlog status (with average overshot and average days delay) and reasons, spares procurement lead times, inventory turnover and maintenance cost. The consultant had also recommended standard reports on procurement lead time and Key Performance Indicators. Maintenance Dashboard were also generated for Director (Onshore) and Director (Technology & Field Services) pertaining to onland locations and for functional locations of rigs/vessels.

To an audit query on dashboard/reports made available to Top Management, it was conveyed that a dashboard containing the relevant reports (Business Information Warehouse - PM Reports Tab) was developed during 2006-07 as part of initial implementation and subsequent system upgrade. Audit observed that the dashboards were discontinued with effect from February 2019. In the absence of access to and involvement of Top Management, it is unlikely that the initiative to utilise the PM Module effectively would percolate down the line.

The Management stated (October 2021) that based on the present requirement by data owners/business heads, the revival of these reports/dashboard could be attempted. The Management stated that transaction code IW39 and customised report ZPMSTATUS were utilised to view backlog reports. It was observed during the field visit that even middle level management were not having PM Module access and maintenance planners were not designated in many locations.

The Management further stated (February/March 2022) that dashboard was available on ERP Central Component side under t-code: ZPMDPR and data was available till date except backlog status and reasons, which was discontinued as data was not getting properly updated. An in-built report shall be available for backlog status with escalation under SAP upgrade.

> *Recommendation 13: The Top Management may utilise the Maintenance Dashboard for effective monitoring.*

The Ministry stated (November 2023) that the Audit recommendation is accepted and maintenance reports/dashboard are being developed by the Company.

2.6   Conclusion

The Plant Maintenance Module was implemented in ONGC to improve maintenance practices and for ensuring timely maintenance activities.

Many of the equipment identified by the Company, as critical for its operations, had long surpassed their useful life, thereby emphasising the need for proper maintenance to

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[23] *Process Gas Compressor, Turbine Generator, Mail Oil Pump, Main Injection Pump, Sea water lift pumps etc.*

minimise production/process interruptions. ONGC initially implemented the SAP – PM Module in 2003 but due to keeping it as optional for work process, the implementation did not yield the identified results. A second attempt was made from 2015 to implement it through Computerised Maintenance Management System. However, the implementation of the PM Module has been slow across the work centres with some plants yet to adopt the system fully even after 18 years of implementation of SAP ERP.

There was sub-optimal and insufficient mapping of equipment in ONGC platforms which was in contrast with the mapping of equipment on two platforms operated by private JVs. There was partial implementation and adoption from the envisaged levels and manual data was still relied. Master data deficiencies, data multiplicity and incorrectness in customised reports were observed. Backlog monitoring or exception reporting through the system was not ensured. Unreliable manual data continued to be relied for performance monitoring.

By allowing the system-based working to be non-mandatory and by not ensuring the performance targets linked with data flowing from SAP PM Module, there was lack of thrust from the Management to ensure that the benefits of the ERP implementation were achieved.

The Ministry stated (November 2023) that audit observations for improved utilisation and better compliance of SAP PM Module have been well-taken and ONGC is committed to address all the issues raised, through an extensive exercise covering all the aspects and involving all the stakeholders.
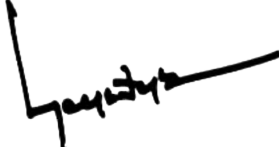
New Delhi
Dated: 22 March 2024

(Raj Ganesh Viswanathan)
Deputy Comptroller and Auditor General
(Commercial) and Chairman, Audit Board

Countersigned

New Delhi
Dated: 22 March 2024

(Girish Chandra Murmu)
Comptroller and Auditor General of India

Annexures

Annexure I
[referred to in para 1.6.3.5 (E)]

Statement showing difference in measurement of quantity of hydrocarbon delivered

Month	Total Delivery Order quantity (quantity desired to be loaded) (MT)	Total Batch quantity (quantity loaded as measured in Mass Flow Meter) (MT)	Net weight measured in Weigh Bridge (MT)	Difference in measurement between Mass Flow Meter and Weigh Bridge (MT) as computed by Audit
A	B	C	D	E (C-D)
Apr-18	3,441.43	3,300.39	3,274.75	25.64
May-18	3,344.54	3,202.27	3,188.99	13.28
Jun-18	5,033.68	4,769.96	4,739.38	30.58
Jul-18	6,077.77	5,728.91	5,738.42	-9.51
Aug-18	3,654.22	3,494.48	3,479.07	15.41
Sep-18	4,066.44	3,909.36	3,872.63	36.73
Oct-18	4,674.03	4,428.94	4,397.17	31.77
Nov-18	986.72	918.51	915.39	3.12
Dec-18	3,159.00	2,976.42	2,945.29	31.13
Jan-19	3,493.38	3,293.36	3,270.94	22.42
Feb-19	4,859.10	4,636.69	4,612.47	24.22
Mar-19	2,552.49	2,423.43	2,404.21	19.22
Total	**45,342.80**	**43,082.72**	**42,838.71**	**244.01**
Average Price (pre discount) ₹				36,648.00
Valuation ₹				**89,42,478.48**

Annexure II
(*referred to in para 2.1*)

Average age of critical equipment in ONGC against the norms adopted internally for replacement

Plants/ Offshore/ Onshore	Equipment Name	Year of Commissioning	Ageing of equipment (Years)	Average age (years)	Norms - Equipment replacement age as per ONGC (years)
Plants Onshore	Air Compressor	1987 -2015	6 to 34	15.26	22
Plants Onshore	Pumps (Reciprocating/Centrifugal)	1987-2018	3 to 34	10.09	16
Plants Onshore	Turbine	1984-2015	6 to 37	17.35	22
Plants Onshore	Off Gas Compressor	1988-2013	8 to 31	27.00	22
Plants Onshore	Propane Gas Compressor	1987-2013	8 to 34	26.85	22
Plants Onshore	Compressor	1981-2015	6 to 41	21.48	22
Off Shore Surface	Air Compressor	1987-2017	4 to 34	11.78	10
Off Shore Surface	Alternator	1982-2020	2 to 40	27.42	20
Off Shore Surface	Gas Turbine	1989-2019	3 to 33	17.67	20
Off Shore Surface	Pumps (MOL/MIPs)	1982-2019	3 to 31	20.44	20
Off Shore Surface	Power Turbine	1982-2017	5 to 40	29.71	20
Off Shore Surface	Compressor	1983 -2019	3 to 39	19.25	20
Off Shore Drilling	Air Compressor	1985-2016	6 to 37	18.91	10
Off Shore Drilling	Alternator	1982-2019	3 to 40	16.27	20
Off Shore Drilling	Pump	1982-2012	10 to 40	32.83	20

Annexure III
(referred to in para 2.1)

Highlights of observations on PM Module in Compliance Audit Report No. 19 of 2021 of the Comptroller and Auditor General of India on 'Water Injection Operations in Western Offshore, ONGC'

- Equipment logs/ history of repairs/ make-wise performance of equipment could not be obtained from the Plant Maintenance module in the absence of data not being fed or due to lack of mapping.

- In large number of cases, day-wise equipment availability data does not match with the monthly equipment availability data.

- The equipment history, tripping details and monthly performance reports were maintained outside the SAP system.

Annexure IV
(*referred to in para 2.5.2.2*)

Types of PM Orders

PM 10 Break down orders, PM 15 Malfunction orders, PM 20 Modular repairs, PM 25 Threshold orders, PM 30 Maintenance request orders, PM 35 Crisis management orders, PM 40 Preventive Maintenance, PM 45 Calibration orders, PM 50 Refurbishment orders, PM 55 Refurbishment orders – workshop, PM 60 Refurbishment orders – OEM/ External, PM 65 Audit orders, PM 70 PM orders for IMR activities.

Out of the 10,69,967 PM orders which were closed during the Audit period, the order type-wise break up were :			
Breakdown orders	7,760	Threshold orders	1,683
Malfunction	16,503	Maintenance requests	1,30,479
Modular repairs	92	Crisis management	1
Preventive maintenance	8,72,309	Calibration orders	5,340
Refurbishment	4,501	Refurbishment- workshop	27,639
Refurbishment – OEM	3,016	Audit orders	644

Annexure V
(referred to in para 2.5.2.2)
High Unplanned orders in 11 onland locations

Year	Order Type	Engineering Services Ahmedabad	Well Services Ahmedabad	Engineering services Ankleshwar	Engineering services Mehsana	Mehsana asset	Drilling services Baroda	Engineering services Cambay	Cambay Asset	Cambay Forward base	Central Workshop Sibsagar	Agartala
2014	Planned	50	1		14	156					137	44
	Unplanned	757	442	2,110	2,167	1,439		19		46	1,720	396
2015	Planned	63	4	2	6	330					91	248
	Unplanned	714	315	1,444	2,483	1,937	1	37		45	1,580	909
2016	Planned	107	173	1	20	260	1	1			112	181
	Unplanned	634	1,253	1,540	2,479	1,773	1	17	48	8	1,371	556
2017	Planned	69	65		19	311			5		72	107
	Unplanned	754	584	1,163	2,052	1,781	4	9	45		1,435	299
2018	Planned	72	128		8	243		1	3		69	2
	Unplanned	661	878	1,202	2,049	1,557		5	54		1,147	471
2019	Planned	81	101	5	1	138			11		58	13
	Unplanned	587	867	1,377	1,533	1,271		7	91	15	992	613
2020	Planned	27	26	1		143			17		58	2
	Unplanned	425	347	1,064	1,715	1,006	1	1	84		789	115
2021	Planned	42	3	1		24			12		77	22
	Unplanned	762	324	1,485	1,815	809		2	119	2	1,579	32

Annexure VI
(**referred to in para 2.5.4.2**)

Discrepancies in the Monthly Performance Report with SAP reports/other periodical reports

The data was maintained in EXCEL and from the data provided by the company it was observed that uniformity was not maintained in across work centres and within same work centre over time.

Asset/Complex	Equipment	Sub-Equipment	Reported Equipment Availability (*per cent*)	Actual Equipment availability (*per cent*)	Remarks
Neelam Heera	Turbine Generators	Gas Turbines, Alternators	100	0 to 89	Equipment were under maintenance and even then during entire month, system availability was reported 100 *per cent*. Standby hours/ maintenance hours were denoted wrongly.
	Sea Water Lift Pumps	Pump, Motor	100	0 to 85	
	Process Gas Compressors, Turbine Generators		100	0 to 85	
		Gas Turbine Engine	100	0 to 90	
Mumbai High	Process Gas compressors	Gas Compressors	100		Even when all 4 PGCs were used, system availability was wrongly denoted when equipment were under maintenance.
		HP Compressor and LP compressor	100	77.19 to 98.10	System availability wrongly denoted.
Uran Plant	Gas Turbines/ Auxilliary Power Utilities		100	0 to 90	Even for equipment without standby, standby hours were considered as available hours.
	Lean Gas compressor, Expander Feed Gas Compressor	Off Gas Compressor GT Thermax Boiler	0-90	Less than 100	Even when there were no standby, and equipment availability was less than 100 *per*

Asset/Complex	Equipment	Sub-Equipment	Reported Equipment Availability (*per cent*)	Actual Equipment availability (*per cent*)	Remarks
					cent. System availability was reported 100 *per cent*
Hazira Plant	Cogeneration Units/ Condensate Fractionation Unit/ LPG Unit	Gas Turbine, Process Gas Compressor, Lean Gas Compressor	100	Less than 100	Running hours were less, but system availability denoted 100 *per cent*.
Ankleshwar	Gandhar Central Processing Facility, Central Tank Farm Ankleshwar	Gas Compressors	100	Less than 100	
Bassein & Satellite Asset	Compressor	BC-A, B & C	100	Less than 100	Cumulative running hours were not changed even though monthly running hours were indicated, system availability wrongly denoted and running hours since last Boroscopic Inspection was not updated.

Annexure VII
(referred to in para 2.5.4.2)

Unreliable Manual reporting of System and Equipment availability

- There were instances where Audit observed that equipment were denoted as being in standby even when they were under repair. Process Gas Compressors were denoted as under standby even when all the equipment were under operation and System availability was claimed at 97.40 *per cent* - 100 *per cent*. List of cases are given in **Annexure VI** wherein there were incorrect reporting of 100 *per cent* system availability even when the equipment availability was less than 90 *per cent*.

- Pumps equipment availability was reported at more than 100 *per* cent and monthly running hours were reported more than 720/744 available hours during the month. System availability was denoted 100 *per cent* even when equipment were under repair/ unavailable during the entire month. Even in case of systems without standby, when equipment were down, system availability continued to be denoted as 100 *per cent*.

- The cumulative hours were reckoned for deciding the overhaul periodicity and the ageing of the equipment. The cumulative hours were incorrectly reckoned upward by 532 hrs in a Co-generation plant (during November 2020), thereby carrying forward wrong figures from November 2020 to August 2021.

- It was observed during 10 June 2021 to 13 June 2021, a PGC at a Platform was not functioning for 63 hours after tripping. The daily reports (PM-DPR) were not recorded in the SAP system during the period 12 June 2021 to 28 June 2021. In the monthly reports of June 2021, 100 *per cent* system availability was claimed.

- Equipment were continually kept on standby and sent for repairs. A Turbine Generator at Heera was under standby continuously during six months (2017-18) and thereafter under repairs off and on till February 2020. Five Gas turbines were operated on regular basis at Heera Platform. In 13 instances, the equipment did not run at all in entire month (equipment availability reported zero) still the system availability was claimed to be 100 *per cent*. Air Compressor I at Heera and Expander Feed Gas Compressor at Uran, were denoted as on standby continuously for more than five months. The standby is normally kept on rotation basis so that maintenance activities does not interfere with production process. Continuous standby of these equipment makes their availability status unreliable.

Annexure VIII
(referred to in para 2.5.4.4 (A))

Summary of Plant wise position of backlog of breakdown orders

PLANT code	No. of records
10D1	22
10P1	19
11F1	729
11F2	1,232
11F4	743
11F5	1,234
11F7	5
12F1	277
12F2	296
13F1	412
13F9	2
20A1	1
22A1	2
23P1	50
40D1	9
40W1	1
50A1	68
50D1	1
60A1	1
60D1	2
61W2	1