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Quality Management Systems Implementation In Tmeic Motor Factory

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Abstract

This paper explains the implementation of Quality Management System right from the inception of factory. At first stage, to establish the plant quality system, Sample Motor Accomplishment Project (SMAP) was conceived. A CFT (Cross Functional Team) was formed so that quality systems are established at all functions viz. Design, PPC, SCM, Production, QAQC.

The supplier quality evaluations were also performed to establish quality for outsourced parts.

5 Sample products covering the complete manufacturing range of motors were selected, the necessary regulations, QCP, WSS check-sheets, design standards, material standards, manufacturing standard documents were prepared as part of quality documents.

The products were designed, manufactured, and tested complying to above stated quality documents. The entire process was validated and confirmed by Japan Technology Executive. The necessary awareness on Quality Management Systems, Internal auditor course were provided to concerned employees.

In the second stage, Motor Factory decided to get the QMS certified as per ISO 9001-2015 standard. Accordingly, approached reputed international certifying agency, got the audit done and obtained QMS certification.

The paper explains the initiatives taken to share the learnings constantly and upgrading the supplier know-how and know-why related to Quality Management Systems.

The paper will also share few experimental learnings, best practices related to unified systems, new capabilities being added to the existing QMS Systems, analytic solutions to improve the system.

Fundamentals of QMS

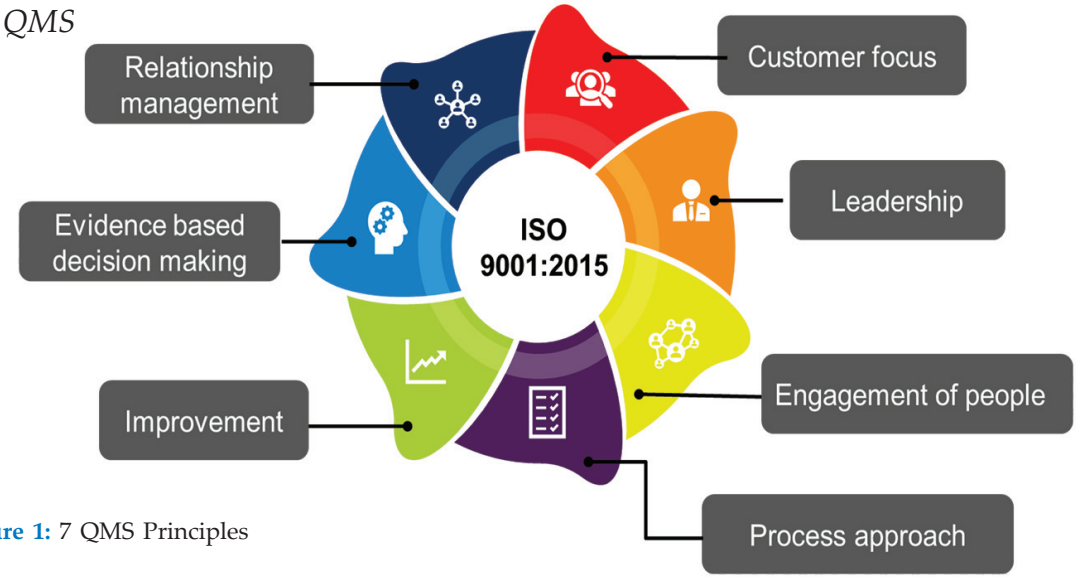

Figure 1: 7 QMS Principles

Figure 2: Process Approach (PDCA Cycle)

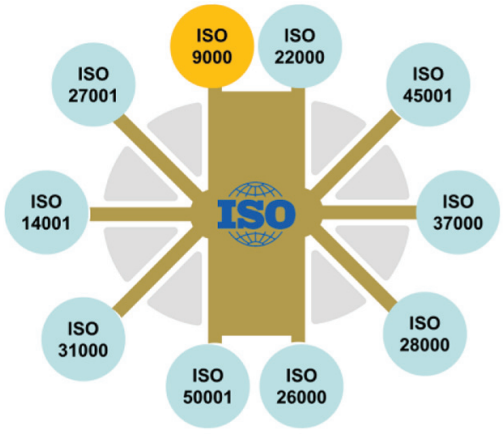

Figure 3: ISO Standards

1.0 Introduction

Motor Factory Operations started in 2016 after the initial establishment at Tumakuru. The plant was established to manufacture large induction motors from Frame size 315 to 900. During the plant and machinery installation, it was decided to further manufacture and test 5 motors to certify the product, process and system established. The 5 motors were having a coverage of the range of products - Fin Frame, Top Hat and Vertical.

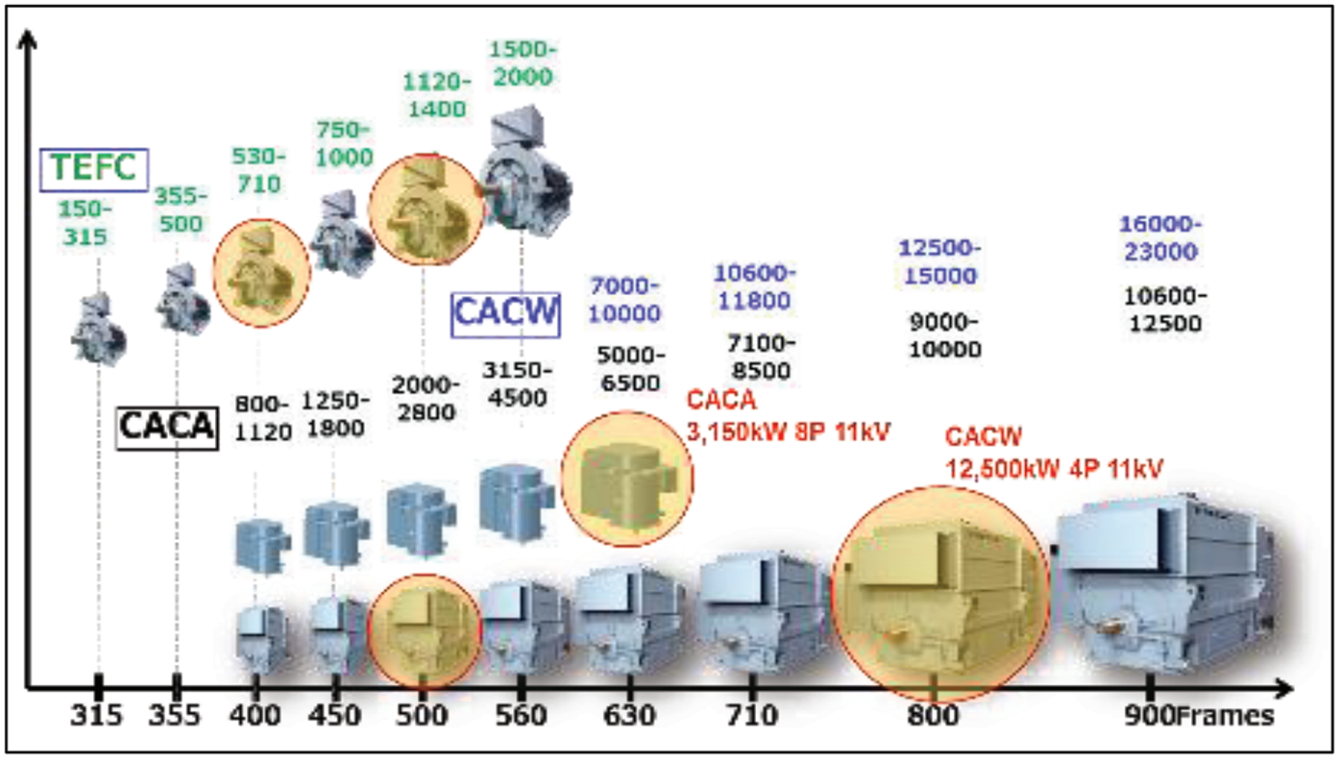

Figure 4: Sample Motors for Initial Product Approval

2.0 Roadmap for ISO Implementation

Consultant to support the ISO implementation was identified who would assess, intervene, teach-train-transfer the know-how to the execution team. 5 stage approach based on following activities were planned:

1) Initial Assessment
   a) Diagnostic Study
2) Training
   a) Awareness Course
   b) Internal Auditor Course
   c) Lead Auditor Course
3) Developing documentation
   a) Counselling sessions with Team members
   b) Adequacy of documents
4) Implementation
   a) Pre-assessment of the system
5) Certification
   a) Counselling for certification
   b) Final assessment by certification body

Quality manuals for each function linking with factory manual was prepared in line with the ISO standards. Operational documentations, regulation controls for all functions, Document control, Initial Manufacturing Product Acceptance, Technical Standard Control (DW), Quality Standard Control (QW), Manufacturing Standard control (MW), Skill Authorization control, Acceptance Inspection Control, Design Review (DR) System, Quality Objectives Control, WSS Control, QCP operational regulations, Special Process Control, Products handling and stage control, Facility and Equipment Control, Measuring Instruments control, Education and Training control were the initial Quality documents prepared to facilitate the process and product flow.

3.0 Design Review (DR) System

Design Review Management Regulation was formulated mapping the Order flow and Product flow to set the review system at all stages – Quotation, Order Receipt, Basic Design (Electrical), Detail Design (Mechanical), Manufacturing Review, Testing and Dispatch, Commissioning, Quality Survey, Non-conformance review. This is a unique process to address the customer requirements and ensure the fulfilment at all process stages.

The basic philosophy of DR system was set for technical study concerning the activities starting from quotation till tracking quality survey after product shipment and delivery to the customer. Documentation was arranged to perform in accordance with designated procedures and systems. The DR meeting was to focus and strengthen the system by evaluating the manufacturing feasibility for moving to next step in accordance with ease of manufacturing and avoiding risks such as exclusion of investigation / wrong evaluating conditions etc. at each technically

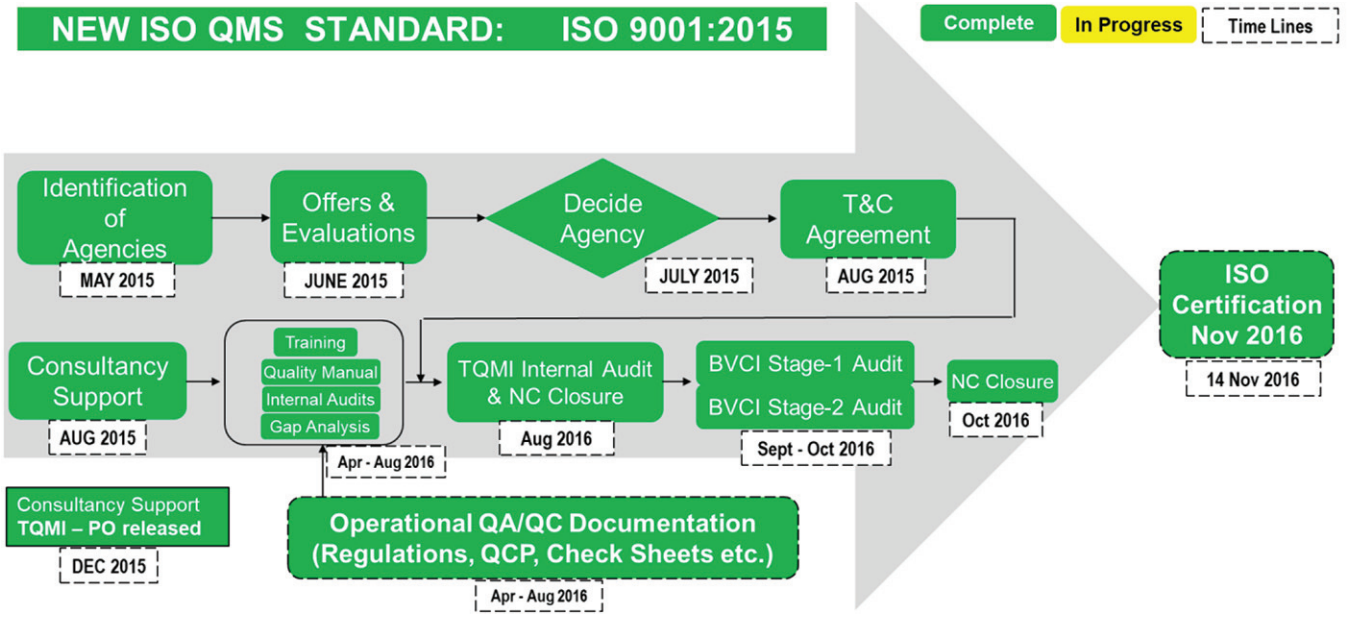

Figure 5: Roadmap for ISO Implementation

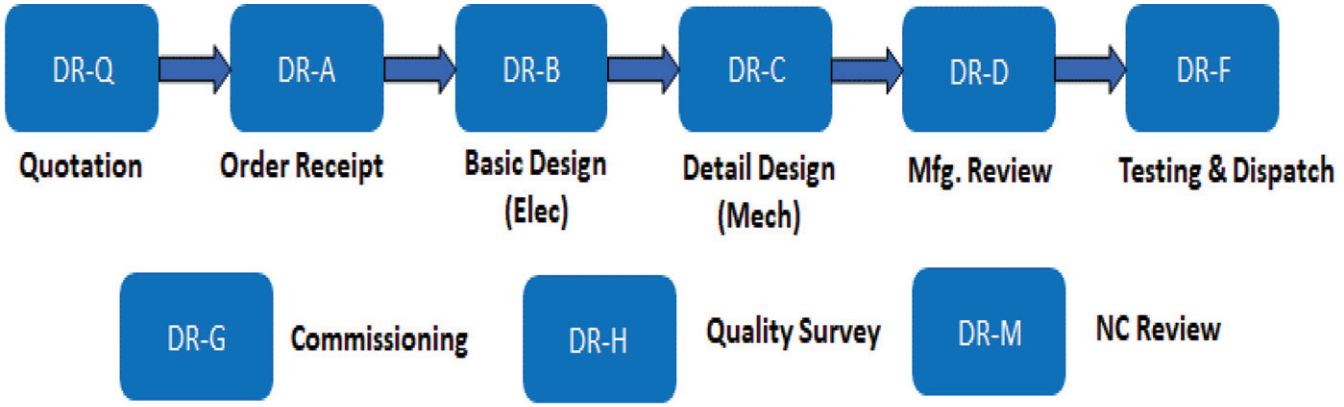

Figure 6: Design Review System at various Stages

challenging stage of product.

The DR meetings are sometimes held more than once to achieve the purpose. The purpose and scope before and after the meeting are always reviewed and confirmed.

4.0 Quality System (Figure 7)

5.0 Establishment of Manufacturing Proceses

This project was done by Indian team with support of Japan team. All the functions - Design, PPC, SCM, Production, QAQC were involved from drawing preparation, BOM creation, decide for inhouse and supplier scope for manufacturing, supplier development, Inspection of parts, Assembly, Testing of motor. This was named as Sample Motor Parts Approval activity. Team was involved in finalizing the material specifications and standards, Inspections and Test Procedures with Acceptance criteria, Check sheets for production, Inspection, and testing. This system was also aimed to ensure that Quality is built in the system.

The challenge for factory was to implement a Quality Management System from scratch. The initial focus was to establish the plant and integrate the quality system with the 7 QMS principles – Customer Focus, Leadership, Engagement of people, Process

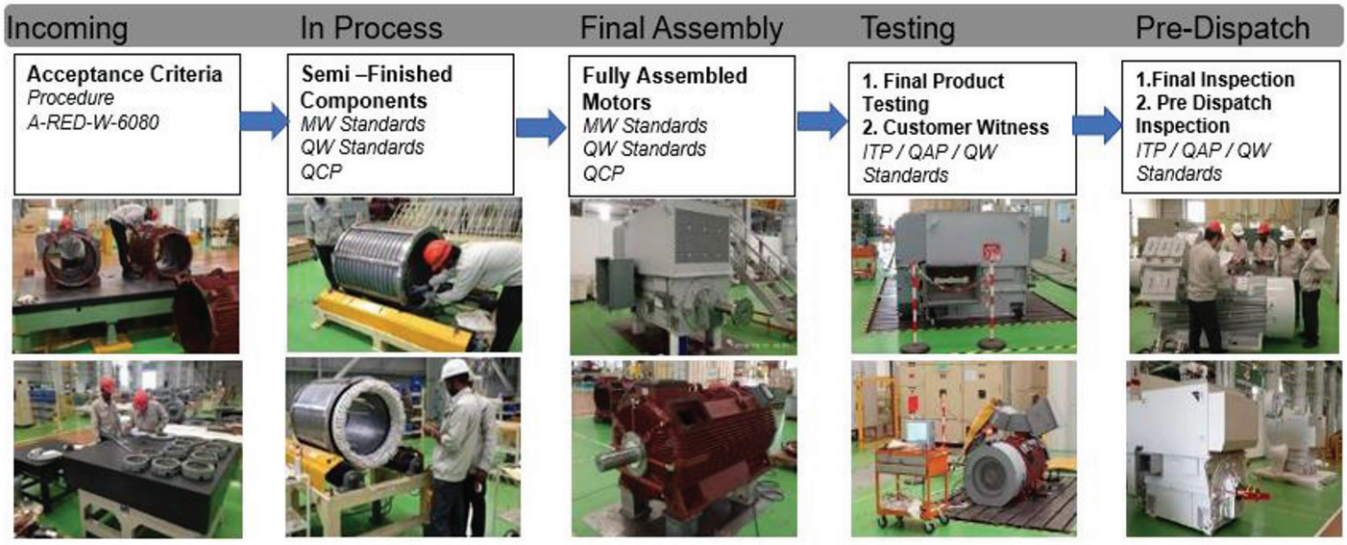

Figure 7: Quality Review System at various Stages

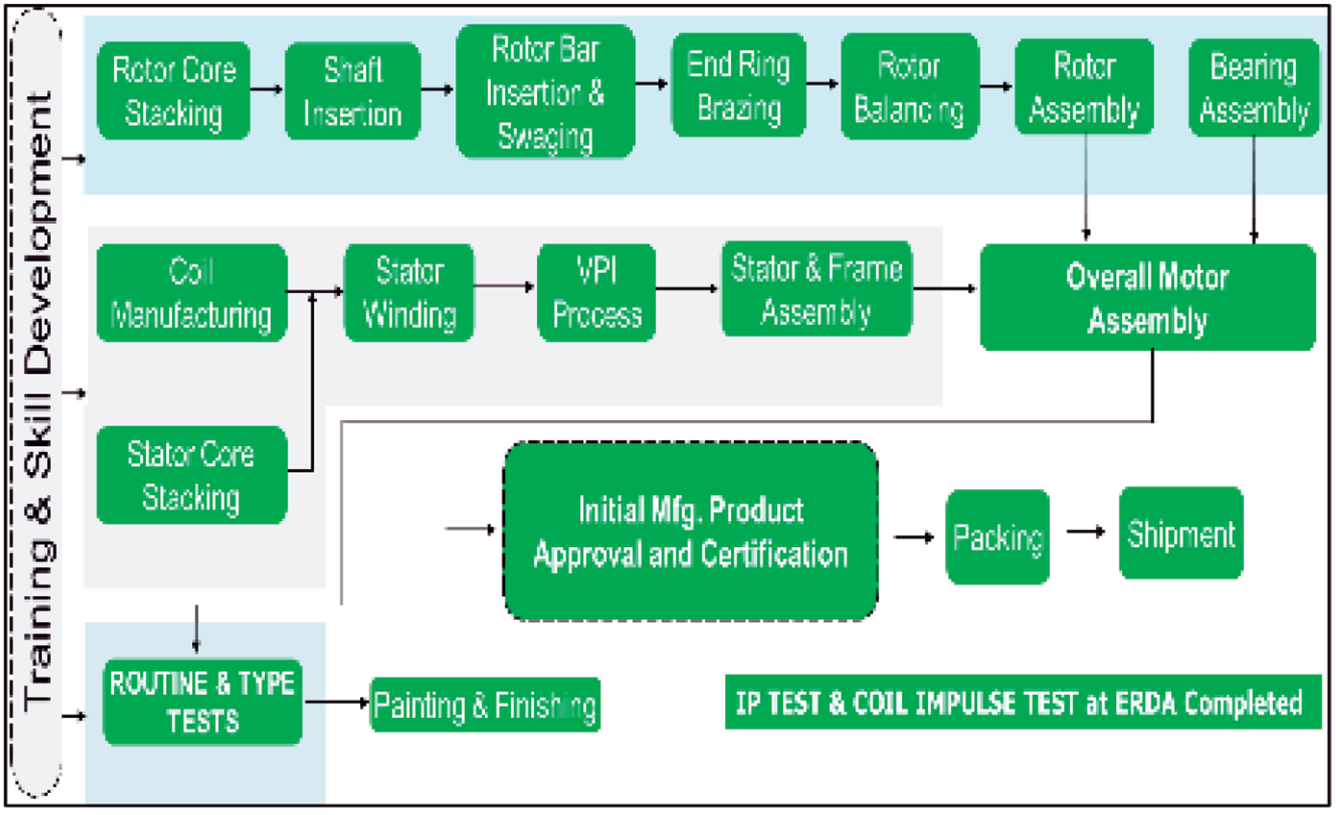

Figure 8: Establishment of Manufacturing Processes

Approach, Improvement, Evidence based decision making, Relationship Management. Quality Basic Policy was prepared based on Customer Centric core value. The ISO 9000 series of standards conveys the importance of making quality a fundamental part of day-to-day management which is efficient and connected.

6.0 Supplier Quality Evaluation Process

Identifying high-quality part suppliers having potential to associate was started with a mutual collaborative approach. Based on the defined outsourcing plan suppliers were explored.

A Road Map to build a Supplier development and Quality Culture to

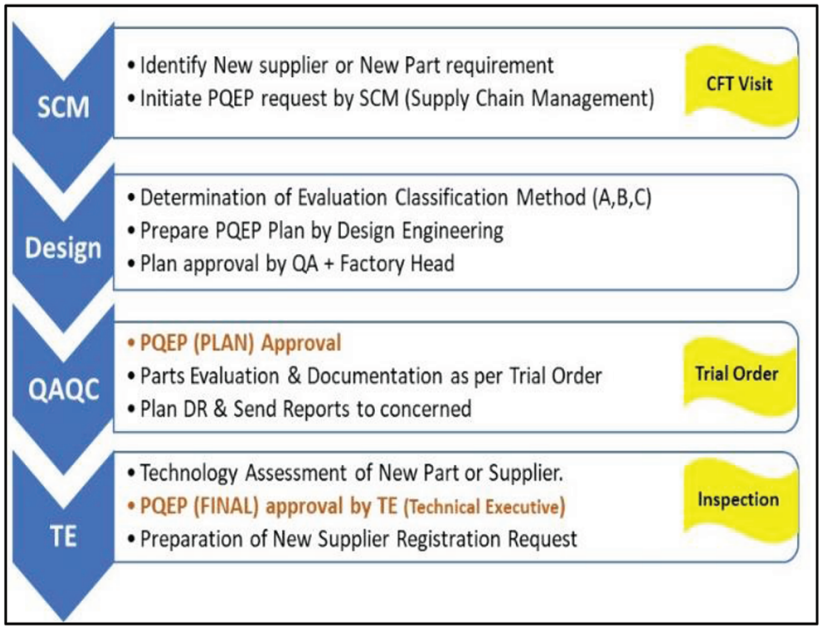

Figure 9: Supplier Evaluation Process

develop suppliers into interdependent working was based upon a PQEP (Procurement Quality Evaluation Plan). It is a detailed process of certifying that a supplier's manufacturing facility and process is good enough from a quality perspective.

This is viewed by supplier as an enabler tool. Supplier Evaluation process was started back in 2015 and parameters were established by team.

PQEP is a process of identification and development of suppliers to deliver high-quality parts. During the PQEP time, there is a realization of 'Supplier style' of working which could work together with 'Our way of working'. The learning during the PQEP phase is clear – suppliers want more guidance to keep their systems and quality in place. A detailed Procurement Technical Evaluation Regulation is prepared which regulates the procedure related to the technical evaluation pertaining to certification of new suppliers for procurement of parts and sub-assemblies to ensure good quality. The system emphasizes the work collaboration between company and suppliers. It regulates the evaluation procedure (proposal & approval procedure), working on the technical standards related to procurement. The technical evaluation related to certification of new suppliers is related to facilities, technology/skill, manufacturing method of supplier. Design Engineering evaluates the parts requirements with existing supplier based on technology, supplier capability and other evaluation criteria. The conclusion is based on the decision with Design, Manufacturing Engineering, Quality Assurance and Supply Chain Management.

A typical evaluation is carried out by document review, factory survey and actual product inspection. Manufacturing records, Manufacturing instructions, Quality reports, Mill Sheet, Heat treatment records, Facility and equipment list, Product catalog, Standard specification are few of the evaluation items for document review. Overview confirmation, Facility and Equipment check, QMS Check, Skill evaluation across the organisation is few of the evaluation items for Factory survey. Visual Inspection, Dimensional Inspection, GD&T, NDE (PT, MT, UT, RT), Composition analysis, Hardness Measurement, Mechanical Strength test, Surface Roughness inspection, Film Thickness inspection, Pressure test, High Voltage Test, Characteristics, and performance test are few of the evaluation items carried during actual product inspection.

7.0 Product and Quality System Certification

TMEIC

Certificate of Product approval

TMEIC INDUSTRIAL SYSTEMS INDIA PRIVATE LIMITED

(Plot No. 316, 2nd Phase, Vasanthanarasapura Industrial Area, Yalladadlu Village, Kora Hobli, Tumkur Taluka & District Karnataka State 572128, INDIA)

Rotating Machinery Division is certified to carry out Operations covering Design, Engineering, Sourcing, Manufacturing and Testing of TM21G series motors Top Hat Frame range 400-630 Vertical for domestic and international market.

M. Kikuchi

Minoru Kikuchi, Technology Executive,
Rotating Machinery Systems Division

TOSHIBA MITSUBISHI – ELECTRIC INDUSTRIAL SYSTEMS CORPORATION
Tokyo Square Garden 3-1-1 Kyobashi, Chuo-ku, Tokyo 104-0031
JAPAN

Issued Date:
18 – MAR - 2016

BUREAU VERITAS Certification

TMEIC INDUSTRIAL SYSTEMS INDIA PRIVATE LIMITED

TMEIC
We drive industry

PLOT # 316, II PHASE, VASANTHANARSAPURA INDUSTRIAL AREA, YALLADADLU VILLAGE, KORA HOBLI, TUMAKURU TALUK & DISTRICT – 572 128, KARNATAKA, INDIA.

Bureau Veritas Certification Holding SAS – UK Branch certifies that the Management System of the above organization has been audited and found to be in accordance with the requirements of the Management System standard detailed below.

Standard

ISO 9001:2015

Scope of certification

DESIGN, MANUFACTURING AND SUPPLY OF FORM WOUND ROTATING MACHINES OF,
VOLTAGE RANGE: UP TO 13.8KV
FRAME SIZES: UP TO 900
APPLICATION: SAFE AND HAZARDOUS AREA APPLICATIONS

Original cycle start date: 14 November 2016
Expiry date of previous cycle: 13 November 2019
Recertification Audit date: 18 October 2019
Recertification cycle start date: 30 October 2019

Subject to the continued satisfactory operation of the organization's Management System, this certificate expires on: 13 November 2022

Certificate No. IND.19.11310 U/Q Version : 1 Revision date: 30 October 2019

Signed on behalf of BVCH SAS – UK Branch
Jagdheesh N. MANIAN
Head – CERTIFICATION, South Asia
Commodities, Industry & Facilities Division

UKAS MANAGEMENT 0008

Certification body address: 5th Floor, 66 Prescot Street, London, E1 8HG, United Kingdom.

Local office: Bureau Veritas (India) Private Limited (Certification Business), 72 Business Park, Mirol Industrial Area, MIDC Cross Road 'C', Andheri (East), Mumbai – 400 093, India

Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organization. To check this certificate validity please call +91 22 6274 2000.

Figure 10: Initial Product Certificate and ISO Certificate

8.0 Sustenance and Maintenance of Quality System

Response to Customer Complaints - Monthly review of customer complaints with PSS team

DRF - 100% implementation - Monitor & Review DR-F of every project.

Daily QA Meeting - Identify short and long-term actions to improve quality (Correction & Corrective Action)

QRM - Monthly Quality Review meeting with TMEIC Japan to review Non –Conformities and counter measures

CCA - Sustainable Preventive actions for non-conformity - Identify the Non-conformity and work on

PDI - Reduction of observations of pre-dispatch Inspection

SEDAC Project - Drive the "Zero Inhouse Rework"

Identifying and reducing issues of manufacturing - J-Team guidance on manufacturing process is followed & monitored for effectiveness.

Assembly Skill Assessment and Evaluation of Bolt tightening, Crimping method, Painting, Electrical connections in all terminal boxes, Special accessories fitment. Promote visualisation of MW's

Skill change management - Monitoring of production process - Support & Review the Skill-up activities at In-house and Supplier.

TMEIC_J QMS Audit – Periodic audit of Motor Factory by TMEIC Japan

Figure 11: Periodic reviews of QMS

9.0 Continuous Improvements

The company desires to build a Learning Organisation with QMS in-built in the process, product, people to make a World Class Factory. Kaizen initiative was launched which yielded good outcome. The kaizens were linked with PQCDSIM (Productivity, Quality, Cost, Delivery, Safety, Information, Morale). The second phase was to shift to Operational Excellence activities to focus on delivering value to customers. The process is about commitment of people to comprehend the qualities of the initiative and best practices so that improvements become part of QMS.

The team learnt techniques while managing the Improvements. The techniques used for Managing the Improvements -

- 5S- Visual Management
- PDCA-Plan-Do-Check-Act—System
- One Point Lessons (OPL)—Training
- Analytical Tools for Fact finding & Root Causes

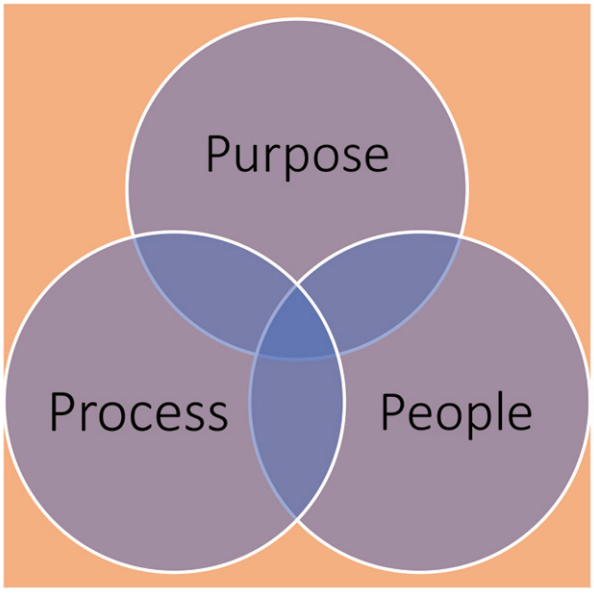

Figure 12: Drive Customer Excellence

    * 5 Why
    * 3W1E
    * 5W1H
    * 2W2H
    * SCAMPER Technique
- DFA/DFM- Design Optimization
- DFMEI- Failure Prevention by Design
- PFMEI- Failure Prevention by Process
- Jishu-Hozen- Check machine condition

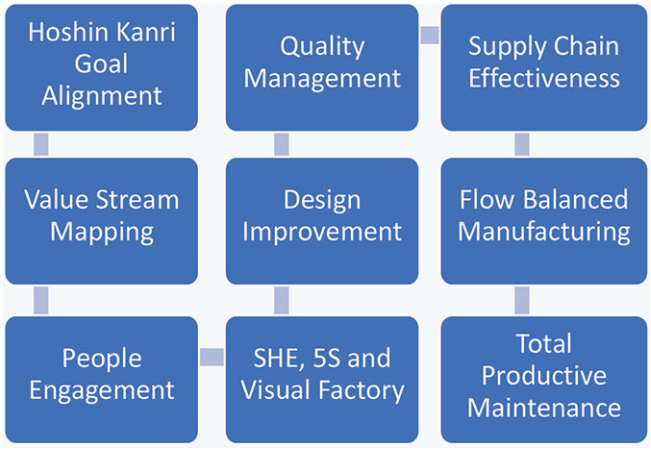

Figure 13: OpEx Nine Parameters

Team adopted SEDAC method of doing improvements. SEDAC stands for Structure to Enhance Daily Activity through Creativity. SEDAC charts are visual tools where in information can be referred at any given point of time.

SEDAC is a:

- methodology for managing improvement,
- a systematic framework for developing more effective standards,
- solving problems permanently, ensuring adherence,
- promoting employee involvement, and
- building the process of continuous improvement

SEDAC is a visual chart where a cross functional team works on a medium to long term project where in collective thinking is essential to resolve complex issues.

10.0 Experiential Learnings

Good practices like FMEI (Failure Mode Effect Improvements), Sony Window (focusses on standardization, Adherence, Communication, New Standards), 4M Analysis are followed with suppliers to have good Initial Product and Process control. Fabrication process stabilization and sustenance of quality is a challenge if the actions are man dependent. It has been the focus of supplier development team to understand the process and people issues and work on identifying the gaps in a methodical way and propose improvements. These are proven tools to build sustainable process quality. The challenge for any improvement actions is to have a sustainable path irrespective of the changes at supplier location. Having a constant review of the process along with the Quality, Process and SCM team and conduct process audits to ensure 'What is not the problem - today' does not gets converted as 'tomorrow as a problem'.

Developing a supplier requires timely synchronization of the processes with procedures and requirements under a QMS (Quality Management System). The team is engaged with suppliers with a step-by-step approach to implement agile practices as being followed in Factory. The best practices are adapted and covered for learning and implementation in supplier systems that include procedure set up, document control, create a product quality roadmap, risk management, handling Correction and Corrective Actions (CCA).

11.0 Analytics to Improve the System

The first phase began with instrument and systematizing the inspection activities. The assembly procedures were made easy with quick fixturing and gauges. Manual activities produced variables resulting to lots of data to analyse for improving the process. To have better insights to data on real-time basis, started exploring methods.

One such initiative is prepared for repetitive observations related to manual assembly activity. Prior to testing the motors, inspection is done wrt. the motor outline drawing and manufacturing standards. The activity was carried without a proper format, handwritten reports. Assigning responsibilities was a challenge and was very difficult to evaluate. Initially, excel based solution was provided. The next phase was to formulate a new software application to overcome report preparation issues, on spot report preparation through tab, and easy data analysis to rectify issues by phenomenon wise. This resulted on-time inspection report generation to improve product quality, reduce repetitive observations, reduce inspection, and report preparation time.

The next phase would focus on QMS solutions using advanced analytic techniques and machine learning. This would help engineers and users to be more productive and precise in their assessments.

12.0 Way Forward

QVM (Quality Value Map) is a technique to establish the Customer specifications to each process output specifications, Quality characteristics and equipment accuracy and processing conditions and working method. Cross Function Team (CFT) would get involved to prepare the Quality Value Map. This process would strengthen the QMS by making right first time, source control, verified process controls, improved controls and detection methods for source quality. The potential failures in terms of next process and final specifications for each process are listed. The mode of detection for the variation in input variables, or variation during process and measured on the output is mapped. Control systems are set by implementing JIDOKA (Detection of problems or defects at an early stage and proceed with the production only after resolution) and ANDON (An alert system notifying that a product/process issue has been detected) to control and ensure no variation in key input and process variables. Review mechanism is aligned to ensure the effectiveness of the controls set.

Figure 14: Quality Value Map

The company is in the process of setting up learning and growing together approach with suppliers. All the relevant best practices are embedded into standards and regular training given covering the skill-up of the suppliers and QMS sustenance. These are also linked to have maximum impact by horizontal deployment with other suppliers. Using this as framework, we plan to continue ahead in the journey to enhance Supplier QMS.

13.0 Nomenclature

QCP:	Quality Control Plan
QMS:	Quality Management System QA: Quality Assurance
QC:	Quality Control
PPC:	Planning and Production control SCM: Supply Chain Management PSS: Post Sales and Service
PDI:	Pre dispatch Inspection WSS: Workstation System OPEX: Operational Excellence
CCA:	Corrections and Corrective Action
GD&T:	Geometric Dimension & Tolerance NDE: Non-Destructive Examination
PT:	Penetration Test
MT:	Magnetic particle test UT: Ultrasonic test
RT:	Radiograph test

Reference

1) TMEIC Standards
2) Quality Magazine