Abstract - To ensure the quality of the process of energy meter manufacturing, the parameters which are electrically connected are manually calculated after every single step. The process of measuring manually become outdated, erroneous, and it also take more time rather than the automatic, effort and human resources. In addition, it can be easily manipulated and can go ahead to lower products being moved, either because of deliberation or because of evil intents. With incorrect readings of the electrical parameters, the reliability of product to work has been reduced. To improve the reliability of the calculation of electrical parameters and make the process quicker, automated measurement system with application software was developed. When the energy meter is attached to the test bench, the software measures all the parameters and transmits to a data base system i.e. Meter No., Password, kWh, kVarh, Maximum Demand (MD) Interval, Cumulative MD of Tariff 1 & Tariff 2 and MD Counts etc. These parameters will be checked at every step to manufacturing and while moving from one lab to another lab and finally will be compared with previous parameters to check any abnormal behavior of the product.

Keywords: Maximum Demand, Design, Quality assurance Implementation, Smart Energy Meter, Algorithm

I. INTRODUCTION

We wondered by analyzing that many defective smart energy meters were in the market due to lack of quality assurance. The quality control could be more effective in preventing such situations. The problem of the quality of supervision and control software systems in the field electrical energy equipment's manufacturing is of great importance. The quality of the system depends on the quality of all hardware and software components. First, we must be aware of the energy field importance. It is common thinking that the field of power and the future of Smart Grid cannot work without precisely monitoring parameters of electrical equipment's in electrical substations. To ensure product quality and to have a reliable product with as minimum possible failures ratio is very important. In the worst case, the situation may generate a power outage in a geographical area and significant material cause damages for consumers.

Public electric power companies are often needed by national or local governments or by energy buyers to validate the precision of electricity meters working in the area [1]. To meet these requirements, utilities generally acquire the amount to first test the exactness of each meter (or a statistically important number of meters) on acceptance of a company. One time maintenance, utilities suffer again the cost to verify the accuracy of each meter to validate its sustained accuracy of the date of fixing. Thus, utilities regularly send eligible people tested meters to meters sites, especially those of large energy buyers, for measurements on the job of meter precision and regulate if necessary. Rarely, however, may need to be taken from the meter to be adjusted field and this may result in extra costs for services. All these expenses are eventually reflected at larger scale of energy to the buyer.

To keep power at economical rates and provide quality control of billing functions, services typically create computer archives covering in-house upkeep histories of all service stalls. These records can include data cataloged by the amount of meters in series, production date, customer name, etc [2] [3]. These upkeep stories can then be used as a response form to services and meter companies to guarantee precise measurement of energy. However, the construction and upkeep of these files requires a personal computer, software and extra database that can be costly.

Services began to require companies of meters not only offer meters with a high degree of precision, but also deliver meters that can easily be analyzed and regulated [4]. Utilities have also started to request extra data from the particular accuracy of each meter before delivery. Companies currently offer this information in the media, such as print or floppies however, this information must often be transferred into a format which is friendly with the database conveniences and re-recorded in the file [5] [6]. This process can be prolonged and costly.
Thus, by using these attempts to confirm the precision of the meter and provide precise billing operations, there is still a necessity to offer a more effective and cost-effective database to counter data and means of authentication of the accuracy of energy meter.

II. THE MANUFACTURING PROCESS

Manufacturing process of energy meters consists of following major steps:

A. FLOW CHARTS

1) Full Factory Process Complete Knock Down (CKD)

A knock-down kit is a kit containing the parts essential to make a product. A conventional form of knock down is a complete knock down (CKD), which is a perfect kit necessary to make a product. He is also a parts provide process to a market, especially in delivery to different countries, and serves as a means of counting or price. CKD is a general practice in buses, trucks and rail vehicles automotive industries, as well as electronics, furniture and other products [7].

2) Semi Knock Down (SKD) manufacturing Process

An incompletely disassembled kit is known as SKD for semi-knocked-down manufacturing process.

B. DESCRIPTION OF MAJOR STEPS

1) SMT

First of all electronic components are mounted on the Printed Circuit Board (PCB) which is imported from China or somewhere else. Then after checking their functionality with the gadget, these PCB’s are transferred to assemble shop with the help of conveyor belt.

2) Assembly

Acrylonitrile butadiene styrene (ABS) base is properly checked and faulty base is separated. Current terminal wire is connected to the pressure plate. PCB kit is fixed in the base. Ready meter base with kit is checked with a gadget for quality check and moved for dust cleaning through air blow through conveyor belt.

3) Calibration

Meters received from assembly section are visually checked and then fixed on the test bench for calibration and accuracy check. Meters which pass through calibration and accuracy check are given specific numbers. Meters are then sent for name plate fixing in the quality check through visual. Before sending to the sealing and welding shop, the following parameters of energy meters are saved to the log files through this designed software. Parameters are

   a) Meter Number
   b) kWh
   c) kWh T1
   d) kWh T2
   e) kVarh T
   f) kVarh T1
   g) kVarh T2
   h) MD T
   i) MD T1
   j) MD T2
   k) C.MD T
   l) C.MD T1
   m) C.MD T2
   n) MD Count

As all the required parameters have been saved in the log files of calibration shop and one mirror is created in the main
server and one in the packing shop. After this calibrated meters have been transferred through conveyor to sealing and welding shop. At any stage after calibration shop, energy meter parameters can be checked through this algorithm by simply searching the meter number from log files.

4) Sealing & Welding

Meters which are received from calibration shop are then prepared for sealing and welding. Top cover and meter base plate is printed with meter number. Again all meters are cleaned by air blower of high pressure. Meters are fixed in the top cover as per meter numbers accordingly. Sealing wire is also used to ensure the security of meters. Lead seal is used to plier the meter with sealing wire. Meters are fixed in the base plate as per meter numbers. Ready meters from the sealing line have been moved to the welding section through conveyor for the welding purpose. Now the meters are welded through ultrasonic welding machine.

5) Packing & Quality Control

Welded meter is received from sealing shop through conveyor at packing shop. Meter strip is fixed in meters. Meters are properly visually inspected for

1) The materials used are of good quality finish and do not contain surface defects or other imperfections injurious to the working of the meter.
2) The parts of terminal block e.g. terminals, pressure plates and terminal screws are of specified material/quality.
3) Sealing screws are made of steel.
4) The design or construction does not differ in any respect from that of the approved prototype.
5) No part or component is missing, loose or damaged, effecting use or performance of the meter in any respect.
6) Clearance between various live parts and that between live and earthed metal parts is sufficient.
7) The connections of leads to the potential coil are soldered securely and do not show tendency to opening.
8) Sealing screws are captive. If washers are used to keep them captive, they are of proper design.
9) Sealing hook for the terminals is of proper design, size and is not found broken.
10) Gaskets are of neoprene, properly embedded, do not show cracks and has even thickness of surfaces.
11) Meters are uniform in quality; do not show scale, chips, dented or bent edges or other disfiguring/blemishes.
12) The terminal block is not chipped at any place; do not show signs of breakage, presence of weak points or other molding defects.
13) Ultrasonic welding is strong and smooth.
14) Joints are in proper alignment; do not cause assembly defects of nature that interferes with normal working.
15) Nameplate markings are available, complete, correct, legible, permanent, and in accordance with relevant clause.
16) The connection diagrams and terminal marking are available, complete and applied in a permanent manner.

17) Polycarbonate cover is clear, transparent, properly finished, aligned and does not show burrs, extra material, cracks, cold shots, voids and air bubbles etc.

But this quality check is only related to Material, Workmanship, Finishing, Marking, Design and Construction of the manufactured energy meters but doesn’t ensure the quality of its software working behavior. This will be ensured when every single energy meter will pass the quality check software through which again parameters which were checked at the end of calibration shop will be compared with the main log files file to ensure the integrity and authenticity of software functionality. For this the energy meter will be energized through gadget and checked for the above mentioned parameters. After comparing all the parameters the PASS indication will be shown to ensure the proper working of energy meters. Meters will be then packed in plastic bags with related accessories of rag bolts and instruction manual. Then meter is packed in box on which meter number is mentioned. And finally sent to storage house through conveyor.

III. ALGORITHM WORKING

A software quality assurance procedure that was developed to address device effectivity, reliability and general aspects required for monitoring manufacturing systems of energy meters are discussed. Solutions are proposed to ensure the quality of product and its software, including methods to prevent malfunctioning, to isolate the fault and eliminate defects. The research objective is firstly the implementation of a flexible production line, fully automated with a particular focus on the aspects of quality. The results are displayed on the computer screen and stored in a log files.

Fig. 3. Screen Short of Implemented Software

A system of a monitoring and control requires the existence of electronic devices (sensors) that monitor the parameters of energy meters, one or more computers (servers) that centralize monitored data and saves in a log files and one or more computers (clients) running client software that aims to present the parameters monitored for quality check staff[8] [9]. Generally, such a system has a client-server infrastructure.
Server software applications are real time values of the parameters of energy meters recorded by serial COM Ports and process these values and then save it in a basic local or central log files. The client software receives data from the log files and presents them to the user (the staff of the manufacturing unit) using a friendly user interface. Using a surveillance system developed in Pakistan as a case study, we proposed a system using Visual Basic .NET language, energy meter test bench software and LAN/ WLAN networks to estimate its reliability. An algorithm for smart energy meters manufacturing system was established and has been used in specific production processes and testing procedures.

IV. CONCLUSION

The purpose of present research is to provide energy meter manufacturing firms to ensure accuracy of energy meters and to have an effective and economic data base to maintain the meter measurement data. Another object of the current research is to offer distribution companies and customers for enabling automatic paperless allocation of meter measurement data to an exterior log files. This will create a level of trust among manufacturer, Distribution Company and consumer to ensure the accuracy of energy meter.

REFERENCES