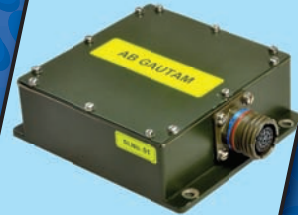


अनुसंधान एवं विकास रिपोर्ट - 2014

राष्ट्रीय प्रौद्योगिकी दिवस मई 11, 2014

R&D REPORT - 2014

National Technology Day May 11, 2014



इलेक्ट्रॉनिक्स कारपोरेशन आफ इंडिया लिमिटेड

Electronics Corporation of India Limited

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FOREWORD

On the occasion of the National Technology Day 2014, it gives me great pleasure to place before you the R&D Report-2014 giving a glimpse of the products and technologies developed at ECIL in the year ending on 31st March 2014.

I am also pleased to inform you that ECIL has been awarded the ELCINA-EFY Certificate of Merit for Research and Development in the year 2012-13. Coming as it does on the heels of the the SCOPE Gold Trophy for R&D, Technology Development and Innovation for the year 2011-12, this is a further confirmation of the excellent work being done by the R&D team at ECIL.

ECIL's activities span the nuclear, defence, aerospace, security, telecom and e-governance domains and the report carries the developments in these domains and provide a bird's eye view of the technologies being pursued by ECIL in its renewed quest to establish itself as a Centre of Excellence in strategic electronics.

A few years ago, we have made a conscious effort to re-align our focus on developing our own technologies even while we continue to take up projects involving integration of complex, one-of-a-kind systems.

While the primary focus of R&D is to provide indigenous technology solutions to strategic and allied sectors driven by the need to retain technology independence, self-reliance, security and combat technology denial regimes, enhancing localization and improving value addition also are key drivers. The products reported in this catalogue are representative of these drivers.

Among the products mentioned in the report, the Ultrastable High Voltage Power Converters meet the requirements of the major international science programs being carried out at FAIR, Germany and ITER, France. The Smart Area Gamma monitor is an upgrade with additional features and functions over the earlier model. The high-

temperature boron coated detectors are used for neutron flux monitoring in nuclear reactors. The Chamber Inspection System has been developed for BARC to enable inspection of dark, radiated chambers.

The Wideband Digital Recorder finds application in electronic warfare while the Static Energy Meter is for use in domestic and agricultural applications.

The OPC UA is an add-on module to EC-SCADA which enables the SCADA system to exchange data with third party systems. The secure manufacturing software package has been specially designed for a trusted facility for manufacturing strategic equipment.

While Meghdoot is meant for sending and receiving voice, SMS and e-mails securely over GSM and GPRS networks, AB GAUTAM is an encryption unit to provide encryption and decryption facility for messages sent using mobile satellite services terminal. The development of the above products as well as other technologies would not have been possible but for the unstinted support extended by several national R&D institutions.

I would like to express our gratitude to them and look for their continued support in our endeavours to reduce the country's dependence on imports in the area of strategic electronics.

P Sudhakar
C&MD, ECIL

R&D REPORT

ECIL and R&D

Established in 1967, Electronics Corporation of India Limited (ECIL) is a Government of India Enterprise under the Department of Atomic Energy. The company is engaged in the design, development, manufacture, supply, installation, commissioning and maintenance of a wide variety of electronic equipment for use in areas such as Atomic Energy, Defence, Security, Space, Information Technology, Telecom and e-Governance. The company is a multi-disciplinary and multi-product organization with the ability to handle multiple technologies under a single roof and offer complete solutions encompassing control and automation, instrumentation, computers and communications.

While the primary focus in the initial years was on meeting the control and instrumentation needs of the country's nuclear power program, the pioneering efforts of the company resulted in a number of products which have contributed to ECIL being recognized as a torch-bearer of electronics and information technology revolution in the country. The company has also played a pivotal role in encouraging entrepreneurship and indigenous

technologies. ECIL has also played a vital role in supporting the country's strategic programs in times of technology denials.

ECIL is, presently, a multi-product and multi-disciplinary organization providing cutting-edge technology solutions to the requirements of the country's strategic community in the areas of Defence, Atomic Energy, Aerospace, Security, IT & e-Governance. The company is a DSIR recognized R&D house, with the R&D activities focusing on state-of-art product development, obsolescence management, refurbishment, import substitution, technology denial regime management and participation in international mega science projects.

Since its inception, ECIL has been playing a crucial role in the country's nuclear power program. All the country's indigenously built nuclear power plants depend upon ECIL's control and instrumentation systems for their reliable and safe operation. The developments undertaken in control and instrumentation have also found extensive use in thermal power plants, oil and gas pipelines and more importantly, in international science programmes such as the Large Hadron Collider project at CERN, Switzerland, and

the upcoming projects at International Thermonuclear Experimental Reactor (ITER), France and the Facility for Antiproton and Ion Research (FAIR), Germany.

ECIL has also been playing a significant role in meeting the defence requirements and has been supplying a wide range of professional grade components, equipment and integrated strategic systems to the military. These span secure and jam-resistant communications equipment, electronic warfare systems, simulators, communication intelligence and interception systems, antennas, SATCOM systems, stabilized platforms for air-borne Radars, C⁴I and missile support systems, electronic fuzes, inertial sensors and actuators.

ECIL is India's premier security systems integrator and solutions architect. Systems designed and engineered by ECIL protect vital installations and premises all over the country. ECIL has been producing radiation detectors of state-of-the-art technology which are deployed in CBRN based security solutions.

ECIL's Electronic Voting Machines with their field-proven simplicity, integrity and ruggedness have helped simplify the electoral process and strengthen democracy, setting a benchmark around the world.

Given the extremely high rate of obsolescence in electronics, ECIL is continuously investing in upgrading existing products and developing new products to meet the ever-changing requirements. The R&D board of ECIL, which includes technical experts from nuclear, defence and aerospace establishments, constantly monitors the shifts and changes in preferences and steers the R&D activities to align to the emerging technologies and products. While the export potential of R&D products is very high, the strategic nature of the products requires that the decision regarding exports be taken at a very high level in the strategic establishment.

The successes achieved by the company have been made possible due to the strong multi-disciplinary R&D foundations of ECIL reinforced by collaborations with nation's leading R&D laboratories and academic institutions. These strengths have helped the company act as a fortress against technology denial regimes.

R&D Organization

The spectrum of technologies the company is involved being broad, the R&D activities are decentralized. Each strategic business unit carries out its own R&D with the Corporate R&D division providing overall coordination as well

as management of technology development and innovation.

In addition to overall coordination, CR&D itself develops cutting-edge technologies that are utilized in different domains. Apart from Hyderabad, CR&D has units in Bengaluru and Mumbai focusing on encryption technologies and VLSI design for detectors respectively. ECIL has about 200 engineers, with a blend of experience and youth, working in R&D area. The R&D Board (RDB), with Director (Technical) as its Chairman, oversees the R&D activities of the company. The company prepares an R&D plan annually for approval by the Board of Directors of ECIL.

In addition to its own funding, ECIL also receives grants-in-aid support from the DAE for carrying out R&D in the areas of interest to the Department. A Technology Development Council (TDC), comprising of experts from DAE, BARC, IGCAR, NPCIL, DRDO, ISRO and C-DAC and ECIL, functions as an apex body for approving, guiding and monitoring the R&D projects undertaken with such support. The current composition of TDC is given in Table-1

Considering the wide range of technologies involved, the TDC is supported by three sub-committees to monitor and guide the projects in their respective areas. The sub-

Table -1

TECHNOLOGY DEVELOPMENT COUNCIL

Shri C K Pithawa <i>DS & Director (E&IG), BARC</i>	Chairman
Shri P Sudhakar <i>C&MD, ECIL</i>	Co-Chairman
Shri S A V Satyamurty <i>OS & Director (EI&RS) Group, IGCAR</i>	Member
Shri Y S Mayya <i>OS & Head RCnD, BARC</i>	Member
Dr N Sarat Chandra Babu <i>ED, C-DAC</i>	Member
Shri M Bharat Kumar <i>OS & Associate Director (Cnl R&D & Simulator), NPCIL</i>	Member
Shri E Vasantha <i>Dy Director, DCA, ISAC, Dept. of Space</i>	Member
Shri D Das <i>Head RIS, Electronics Divn, BARC</i>	Member
Shri B S Jagadeesh <i>Head Networking Section, Computer Divn, BARC</i>	Member
Shri Vivek Sanadhya <i>Head, DACS, CnID, BARC</i>	Member
Shri Jayaram M N <i>SO/H AGM, INRP Control & Instrumentation, INRPWMD</i>	Member
Smt V Prameela <i>Sc 'G' & PD, PJ10 (WCX), DRDL</i>	Member
Dr M Lakshminarayana <i>Sc 'G', DLRL</i>	Member
Dr R P Acharya <i>DS (I&M), DAE</i>	Member
Smt Meenaxi Rawat <i>Director (Finance), DAE</i>	Member
Shri M R K Naidu <i>Head, CR&D, ECIL</i>	Member-Secretary

Table -2
TDC SUB-COMMITTEES

CHAIRMAN DAE PROJECTS:

Shri S A V Satyamurty

OS & Director (EI & RS) Group, IGCAR

CHAIRMAN DEFENCE & SPACE PROJECTS:

Dr M Lakshminarayana

Sc'G, DLRL

CHAIRMAN SECURITY, IT, TELECOM & e-GOVERNANCE:

Shri B S Jagadeesh

Head NS, Comp. Divn, BARC

Table -3
R&D BOARD

Shri P Sudhakar, *C&MD and D(T)* - Chairman

Shri Ch V R S Gopalakrishna, *ED, ASG*

Cmde LM Khanna, *ED, CNSG & DSG*

Shri P Vishwanath, *ED, CSG, FSG & IT&TG*

Shri B P R Murthy, *GM, CNSG & SPD*

Shri A K Asthana, *GM, CSG*

Shri B Mahaveera, *GM, ISG*

Shri M R K Naidu, *Head CR&D* -Convener

committees are headed by eminent people in the corresponding areas. The composition of the sub-committees is shown in Table 2.

The Research & Development Board (RDB) oversees the R&D activities of ECIL carried out with internal funding. The RDB, headed by the Director (Technical) with members comprising of Executive Directors and General Managers of all verticals, promotes R&D activities in the technologies required to meet the company's business goals. RDB is supported by various sub-committees and design review committees which review the progress and review the designs. The present composition of RDB is shown in Table 3.

Performance

The new products and technologies developed during the year include Ultrastable High Voltage Power Converters, Wideband Digital Recorder, Chamber Inspection System (CIS), GIS based planning system for Defence Command Post, Single Phase Two Wire Static Energy Meter, Smart Area Gamma Monitor, High Temperature Boron Coated Counter, OPC UA support for ECSCADA, Solutions for Secure Mobile Communications-MEGHDOOT, Airborne GAUTAM, Secure Manufacturing Software for EVM Production and Integrated Threat Management Appliance.

The company has spent Rs.47crores on R&D activities in 2012-13. The R&D projects are grouped under 9 umbrella programmes - C&I solutions for nuclear facilities, C⁴I systems

Awards and Recognitions



Shri Kishor Rungta, Director (Finance) received the coveted ELCINA EFY Certificate of Merit award for Excellence in Electronics for 2012-13 in recognition of ECIL's outstanding performance in Research and Development, from Dr. Killi Kruparani, Union Minister of State for Communications & Information Technology on 21st September 2013 at New Delhi.

for missile programmes, electronic warfare, aerospace programmes, electronic security, other strategic applications, simulators, international science programmes and societal

applications. The expenditure on R&D on each of the nine umbrella programmes in 2012-13 is depicted in figure - 1

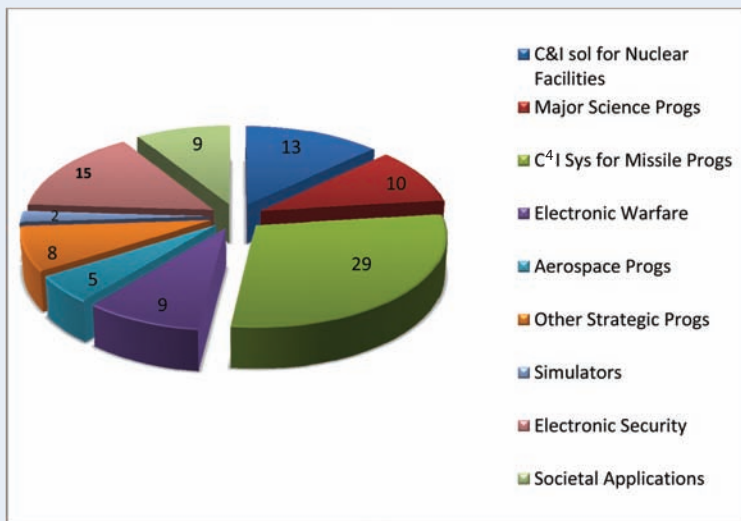
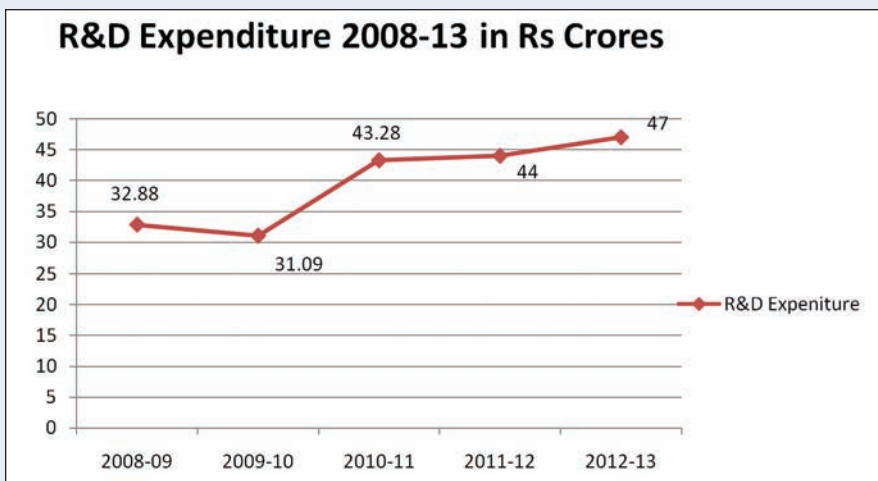


Fig.1: Umbrella Programme-wise-expenditure 2012-13 (in percentage)



ECIL R&D Expenditure 2011-13 vs. Turnover

	2012-13	2011-12
Total R&D expenditure in Rs. Crores	47.01	38.43
Total R&D expenditure as percentage of total turnover	2.72	2.96

NEW PRODUCTS & TECHNOLOGIES

Ultrastable High Voltage Power Converters

The ultrastable High Voltage Power Converters have been developed for meeting the requirements of international science programs at Facility for Anti proton and Ion Research (FAIR), Germany and International Thermonuclear Experimental Reactor (ITER), France. The power converters have been built using switched power supply (SPS) modules to deliver 75A current at a voltage of 7.9kV. The SPS modules have been designed using Pulse Step Modulation (PSM) technology.



SPS module

The Power Supply consists of a multi-secondary transformer and 10 SPS modules in series with a nominal DC link voltage of 790V and current rated at 75A and are switched in tandem from a controller to realize the required voltage and current. The modules are water cooled and stacked in a rack.



High Voltage Power Supplies for FAIR



High Voltage Power Supplies for ITER

Smart Area Gamma Monitor

The Smart Area Gamma Monitor can be used to monitor the gamma and x-ray radiation in a specified area. The monitor comprises of a GM detector and an electronic unit containing a high voltage power supply and processing electronics. The detector can be placed upto 100 metres away from the electronic unit. The resistive touch screen on the monitor allows the user to not only configure the unit but also to view the values.



Smart Area Gamma Monitor

The monitor supports an SD card on which the parameters can be logged with a time stamp. The SD card can hold the values of upto 180 days depending on the interval for logging. This ensures that data is available in the event of communication with the host being lost.

High Temperature Boron Coated Counter



High Temperature Boron Coated Counter

Boron Coated detectors are used for neutron flux monitoring in nuclear reactors. The detectors have a neutron sensitivity of 12cps/nv and are suitable for operation at high temperatures up to 250°C with low capacitance, very high insulation resistance and high signal-to-noise ratio. The detector is integrated into a radiation-resistant tri-axial mineral insulated cable to make it suitable for use in high temperature areas.

Chamber Inspection System (CIS)



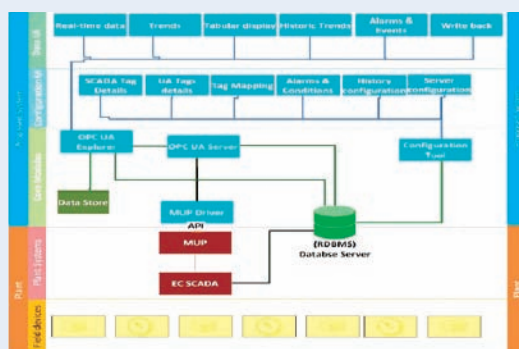
Chamber Inspection System

Chamber Inspection System is a compact, specialized unit for inspecting the dark,

radiated chambers through prefixed holes of 75 mm diameter.

The system drive unit is accommodated in an 70mm tube and consists of a camera, lighting and motors to control the elevation, pan and tilt of the unit. The entire unit extends and retracts using rope-driven telescopic sliders. The live pictures can be viewed and recording with the exact coordinates and location overlaid on the recorded video.

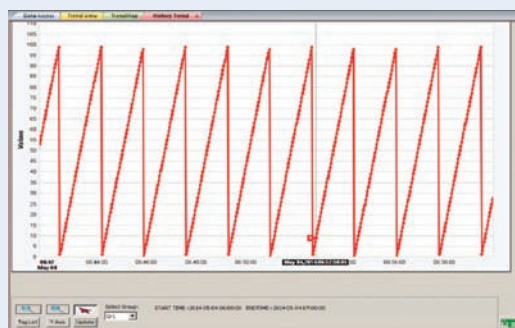
OPC UA support for ECSCADA



OPC UA architecture with ECSCADA

ECSCADA is SCADA-cum-HMI software developed by ECIL and deployed in several oil and gas pipelines as well as in power distribution and nuclear facilities. OPC (Object Linking and Embedding for Process Control) is an interoperability standard for reliable data exchange in the industrial automation space. The OPC UA specifications are the latest in the series of specifications released by the OPC foundation with the object of making OPC a generic and platform-independent with a

service oriented architecture integrating all the earlier specifications into one extensible framework. The ECSCADA software has been made OPC UA compliant to enable it to communicate with systems of other vendors for bi-directional data transfer.



OPCUA-HDA

OPC UA has three components i.e. OPC DA (Data Access), OPC A&E (Alarms and Events) and OPC HDA (History Data Access). All these facilities have been developed for ECSCADA to support both client and server functions facilitating exchange of data with third party systems. Conventional OPC systems also can be integrated with ECSCADA OPC UA by making use of standard wrappers.

Wide Band Digital Recorder (WBDR)

WBDR is used for high speed recording of the analog 70 MHz IF signal up to maximum bandwidth of 40 MHz. The signal is recorded on solid state drives. The replay feature enables reconstruction of the recorded signal back to the 70 MHz IF. The WBDR operates from an

intuitive GUI and can be controlled remotely over a network.



Wideband Digital Recorder

The unit is IRIG-B compliant and has a single channel which records at 200 million samples per second with 16 bit resolution with 4 hours of recording at 40 MHz. The sampling rate, IF and the bandwidth are configurable. The unit can support solid state storage media of upto 4 TB.

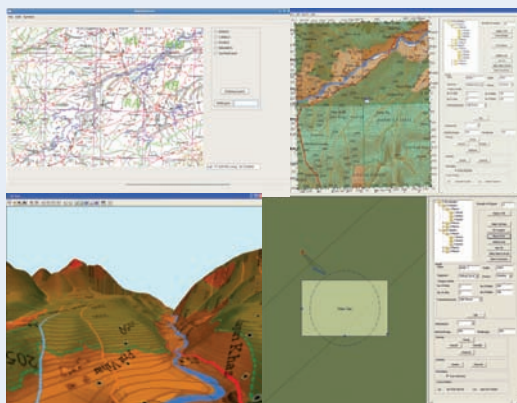
GIS based Planning System for Defence Command Post

Spatial data is of crucial importance to the Military Commander in the battle for analyzing and decision making by the commander. Military needs maps for different purposes within its operational command and each requirement is to cater for a specific purpose.

The digital base in GIS environment facilitates the creation of different types of maps to meet specific user needs without clustering with unwanted details. This facilitates the viewing

of spatial information on need to know basis either at command headquarters or in the field area. The battle commanders can evaluate thematic information for analyzing the real time scenario by manipulating the information available at their disposal.

In land based military operations military field commanders need to know terrain conditions, elevations for manoeuvring armour carriers, tanks and use various weapons. A detailed land map with information on the land use, terrain model and proximity of habitat are essential for military operations.



GIS based Planning System for Defence Command Post

Planning tools assist in selecting suitable sites for deploying vehicles, placing sensors/ weapons as well as computing resource requirement essential during combat operations.

In the current scenario a wide variety of GIS tools are available and while providing a solution to the user it was required to use

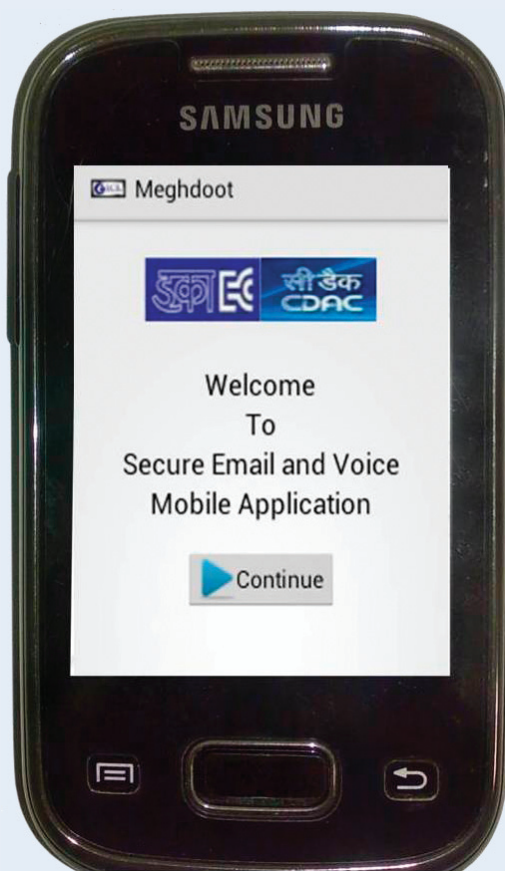
more than one GIS tool for achieving all required GIS functions that invariably makes an application larger. In addition in the command post all Command and Control functions are the most important module required for any C⁴I application software. Over this building a GIS based application coupled with the data handling capabilities of new generation of database management systems, rapid application development environments increase the development life cycle and cost.

To avoid such encounters, a spatially enabled user Interface was built with GIS functions embedded to the C2 Interface. An open source GIS tool was used to bring out GIS functions and carryout required application development. This solution avoids not only using a separate tool for GIS but also reduces development cycle time.

Solutions for Secure Mobile Communications- MEGHDOOT

Meghdoot is a product which enables mail and voice mobile communication securely over GPRS/ 3G network. This solution assures end-to-end security meeting the confidentiality, integrity and authentication requirements of the mobile user. The product supports mobiles working on Symbian and Android operating systems. This product also facilitates monitoring by Law Enforcement Agencies (LEA). The secure voice solution employs a proprietary algorithm to provide toll quality

voice on a 3G network. Secure SMS uses a proprietary algorithm to text confidential information securely on a mobile network.



Application Screen shot

Airborne GAUTAM

Airborne GAUTAM (AB GAUTAM) Encryption Unit is designed to provide encryption/ decryption for messages sent from Mobile Satellite Services (MSS) terminal. A high speed

Digital signal processor provides high level secured encryption/decryption and performs necessary control operations. This Unit will detect automatically from the input message for encryption or decryption.



AB-Gautam

The data received from the Ethernet data port connected to the PC is analyzed for authentication, encryption/decryption and processed, formatted and fed to the respective functional blocks. The encrypted data is then sent to the terminal interface block. The data received from the decryption block is processed, formatted and sent to the terminal interface block.

A proprietary algorithm has been implemented to perform encryption and decryption. A new key is generated for every data call. A key buffer is provided to hold second set of keys. The algorithm is implemented using non-linear stream ciphers so that error propagation does not exist.

The Key memory block stores the key information in a non-volatile memory. The key memory is password protected and can be erased in case of compromise using a password and command. Algorithm erasure is also possible by using another password. Key memory holds both Active key area as well as Buffer key area. The keys can be loaded into the buffer memory by selecting the appropriate mode from the keypad through Asynchronous data interface block. The keys can be downloaded from key gun. The keys will be loaded into the Key gun from the JCB supplied CD-ROM using a dedicated programming station PC. Facilities for ensuring the integrity of information transfer exist by employing checksums of store files.

Effective mechanism is in place to erase crypto algorithm or crypto data, in case of emergencies so that the system leaves no traces in the permanent memory of the system

Salient Features

- Developed for use with Mobile Satellite Service (MSS) Terminal
- Sophisticated and most secured proprietary encryption algorithm
- Auto lock mechanism
- Supports Ethernet for Data connectivity.
- RS-232/USB interfaces for Key management.
- Supports two independent Password protected key sets

- Facilitates Emergency information (ALGO & Keys) and Hardware Destruction
- Environmental Specifications as per Mil-810F
- EMI/EMC specifications as per Mil-461E

Secure Manufacturing Software for EVM Production

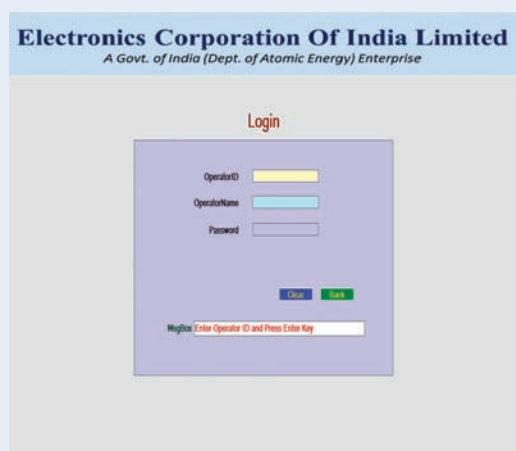
Today, electronics manufacturing is a symbol of efficiency and cost-effectiveness. However, the same technology that makes this possible also presents security challenges putting intellectual property and other sensitive information at risk. While educating users on the threat landscape is important, it needs to be supplemented by establishing a secure manufacturing facility which would address issues such as unauthorized disclosure, destruction, removal and modification of sensitive information and physical assets during manufacturing of strategic electronic equipment.



Main Screen

ECIL has put in place a secure manufacturing facility for production of EVMs. The facility employs public key infrastructure for digital certification based mechanism to provide protection against tampering of the EVMs. The secure manufacturing software provides security and also allows traceability of the EVM unit which would help in preventing security breaches, theft, misuse of EVMs as well as disruption or denial of services.

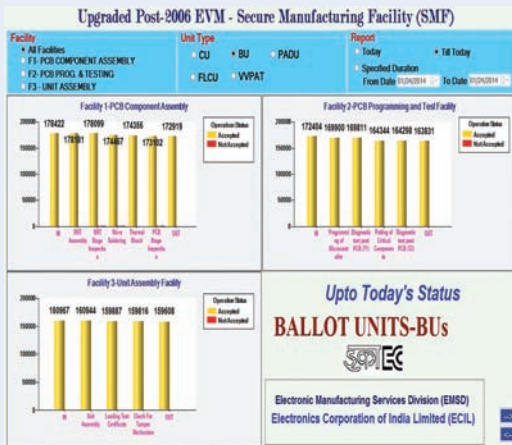
The new EVMs include features such as code authentication, PKI based digital certificate for mutual authentication by the Control Unit (CU) and the Ballot Unit (BU) and anti-tamper circuit mechanism.



Login Screen

The secure manufacturing facility is a trusted centre for manufacturing of sensitive and strategic electronic equipment. The facility has excellent program management and proven processes and quality to offer the highest level

of assurance that the EVMs are manufactured to the agreed specifications. The processes and procedures have been designed with appropriate levels of security at each stage to minimize the risks of insider attacks. All the stages and the activities are monitored and logged using the secure manufacturing software.



Manufacturing Status

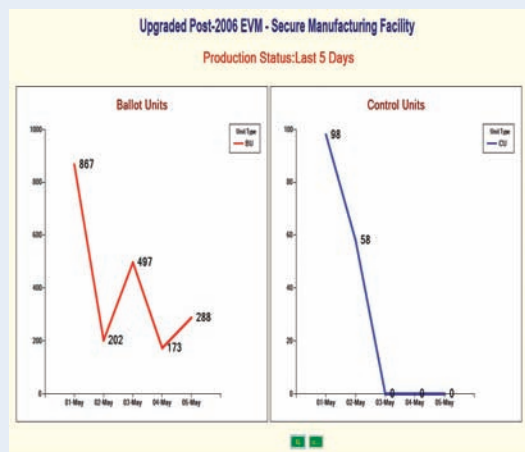
The secure manufacturing software monitors the movement of people as well as material. It also monitors and controls the manufacturing process, logs operational data and time stamps of each operation. It also maintains a log of the entry and exit of EVM units enabling tracking and audit of the units. The software also logs the movement of operators and their activity.

The software provides for

- a unique identifier to each EVM unit for traceability

- Recording all data relating to the EVM unit from the PCB stage to the final quality control, packing and shipment of the EVM unit including the details of all activities carried out along with the identification of unit, sub-unit at which it has been carried out. The details also include the operator identification and the date and time of operation.

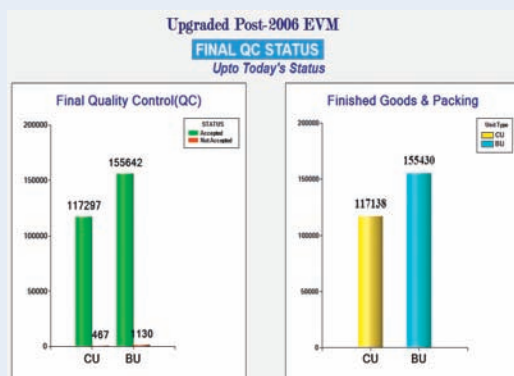
- Recording of information relating to packing of units in carrying cases as well as bulk carrying cases.



Production Status

- linking of sub-unit IDs with unit IDs
- recording of duration of each operation
- loading and engraving of serial numbers on each unit
- loading digital certifications on EVM units for authentication

- h) display of production status at each stage of manufacturing
- i) Alerts to be generated in case of operational errors, time delays, improper operating sequence and repetition of operations which are to be cleared by the stage supervisor before the unit can proceed to the subsequent stage.



Final QC Status

Being a unit which contains sensitive data whose integrity must be preserved, the EVM is required to be so manufactured as to make it tamper-proof as it would, otherwise, compromise the election process. The secure manufacturing software facilitates the realisation of this objective.

Integrated Threat Management Appliance (ECITMA-1000)

The Integrated Threat Management Appliance (ITMA) is an indigenous, comprehensive perimeter network security device and will

address multiple types of threats like spam, malware, viruses, and blended threats. The threats that affect the IT infrastructure and IT assets of an organization are primarily viruses, worms, spyware, spams, malware, intrusions etc., individually or in blended forms at multiple levels to inflict maximum harm and losses for an organization. The malicious attacks are becoming frequent and more complex. The impact of these attacks is also becoming more serious.

Because of the complexity of the attack methods and blended forms, security approaches protecting from single type of attack vector may not be effective and thus the relevance of an Integrated Threat Management appliance.



ECITMA-1000

ITMA, a joint development effort by ECIL and SETS, Chennai provides a unified solution with single console for management, updation and reporting. The ITMA platform will protect an organization against all threats and also provide networking features and multiple Gigabit ports for connectivity.

The key features of the Integrated TM Appliance are:

- Stateful Packet Filtering
- Spam filtering
- Web Content filtering
- Intrusion Detection System (IDS)
- Virus Protection in the SMTP and the HTTP traffic

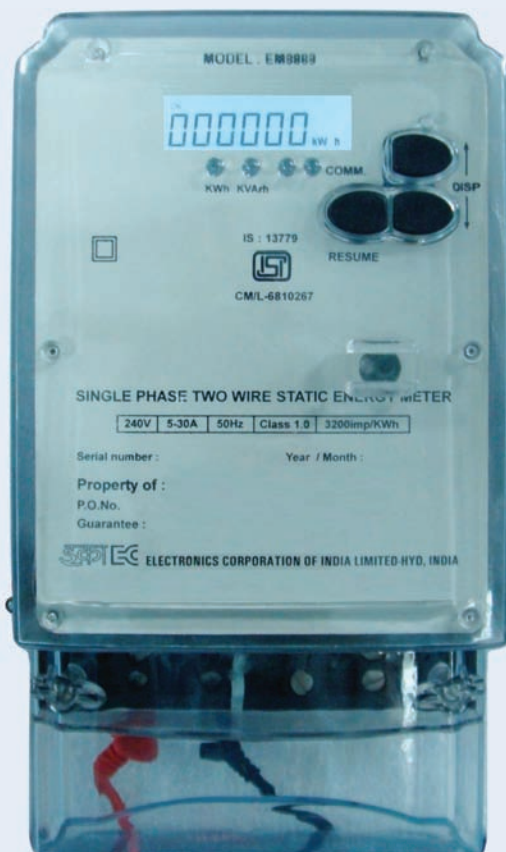
In addition to the above Critical areas of Threat Management, the appliance will also address the following areas of concern:

- SNMPV2/V3 MIBs
- Secure Remote access via SSH
- Patch Management
- Local Logging and Logging to Syslog server
- Alerting
- Log Export to External FTP server

Single Phase Two Wire Static Energy Meter - EM5869S (Smart Meter)

The Smart Meter is a single phase two wire static energy meter designed for use in two wire distribution systems and generally used in domestic and agricultural applications. The unit conforms to ARE: 13779(1999) / CBIP Tech. Report 88 standard including the latest amendments and can be configured for both pre-paid and post-paid operation.

The Meter can be configured remotely and facilitates remote acquisition of monthly billing information, time of day data, load profile and instantaneous values. The unit provides indication of tampering on the LCD display and enables remote connection and disconnection.



Smart Meter



ELCINA-EFY Awards
For Excellence in Electronics for 2012-13

Certificate of Merit

Awarded to
**ELECTRONICS CORPORATION OF INDIA
LTD.**
Hyderabad

In recognition of their outstanding performance in
Research & Development

T Vasu
President
ELCINA

ELCINA ELECTRONIC INDUSTRIES ASSOCIATION OF INDIA

September 20, 2013

Electronics Corporation of India Limited

A Govt. of India (Department of Atomic Energy) Enterprise
Corporate Research & Development
ECIL Post, Hyderabad - 500 062
Phone : 040-27122634 Fax : 040-27121318
Email : headcrnd@ecil.co.in Web : www.ecil.co.in

इलेक्ट्रॉनिक्स कारपोरेशन आफ इंडिया लिमिटेड

भारत सरकार (परमाणु ऊर्जा विभाग) का उद्यम
निगमीय अनुसंधान एवं विकास
ईसीआईएल पोस्ट, हैदराबाद-500 062
फोन : 040-27122634 फैक्स : 040-27121318
ई-मेल : headcrnd@ecil.co.in वेब : www.ecil.co.in