Pioneering Solutions

R&D and Expert Services in Advanced Materials, Diagnostics, Energy Management, and Power Systems

50 YEARS OF SERVICE

EXPERIENCE THE EXCELLENCE

Introduction to R&D Focus Areas

The **Research and Development** division focuses on conducting both sponsored and in-house research projects across five areas.

- **Advanced Materials** (with Expert Services for Failure Analysis)
- **Diagnostics** (Electrical & Mechanical)
- **Power Systems & Smart Grid** (with Expert Services for Power Quality Measurements)
- **Energy Management Services**
- **New Product Development Engineering**

Advanced Materials

The **Advanced Materials** section at ERDA specializes in research and development related to various material technologies, including electrically insulating materials, nano-dielectrics, industrial coatings, battery technologies, and contact materials used in switchgears.

Research Focus Areas

Dielectric Materials

- Cable Insulation:
  Cross-Linked Polyethylene (XLPE) and jacket materials
- High Voltage (HV) Insulation:
  Epoxy and silicone rubber
- Transformer Insulation:
  Including paper and oil-based materials

Energy Storage

- Sodium-Ion Batteries
- Aluminum-Ion Batteries
- Green Hydrogen Technologies

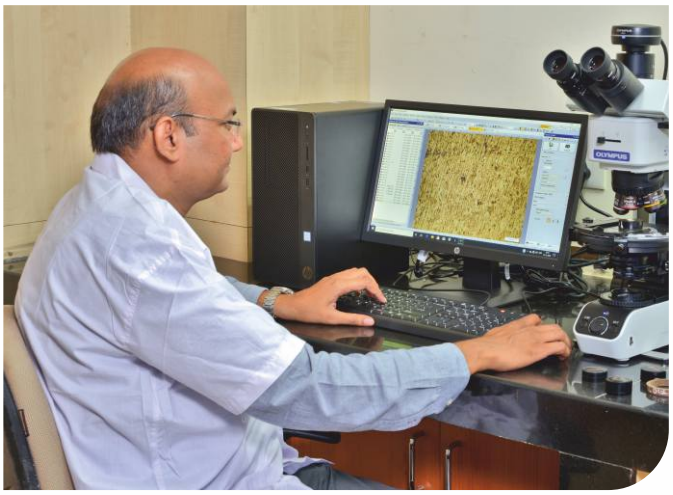
Metallic Materials

- Switchgear Contacts
- Ceramics for HV Insulation

Expert Services:

Root Cause Analysis

- Failure analysis of electrical products, including cables, insulators, and transformers
- Investigation of failures in power plant components such as boiler tubes, motor shafts, and transmission line parts



Material Characterization and Analysis

- Broadband Dielectric Spectroscopy (BDS):
  Evaluation of dielectric properties over a wide frequency and temperature range
- X-ray Diffraction (XRD)
- Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray Spectroscopy (EDS)
- Electrochemical Impedance Spectroscopy (EIS)
- Thermal Conductivity Measurement, Battery Cycler, and Dissolved Gas Analysis
- Analysis of electrical and thermal aging of materials

Infrastructure

- Functional coin cell and pouch cell fabrication laboratory
- Materials mixing and compounding equipment:
  Twin screw mixer, sonicators, liquid mixers, and two-roll mill
- Metallurgical sample preparation facilitie

Electrical Diagnostics

Electrical Diagnostic Services for Power & Process Plants

The Diagnostic section of ERDA provides specialized electrical diagnostic testing services for various high-tension (HT) equipment used in power and process plants. These services primarily benefit the power sector, with a particular emphasis on generation (both government and private) and transmission companies.

With extensive experience in electrical diagnostics, ERDA has worked on over 400 transformers, 1500 motors, and 100 generators. ERDA offers a comprehensive diagnostic portfolio through a dedicated mobile testing van, delivering services across India.

Power Transformers

- RLA (Remaining Life Assessment) Study
- Capacitance and Tan Delta testing for winding insulation and bushings
- Sweep Frequency Response Analysis (SFRA)
- Dielectric Response Analysis (DIRANA) for transformer winding insulation
- Partial Discharge detection using acoustic emission techniques
- Tap changer analysis by dynamic resistance measurement

Switchyard Equipment

- Online Partial Discharge (PD) Survey using RFI and NL acoustic camera methods
- Capacitance and Tan Delta testing of CT/CVT
- Third Harmonic resistive leakage current measurement of lightning arresters
- DCRM of Circuit Breaker

Rotating Machines

- Stator Insulation tests (Capacitance/Tan Delta, IR/PI)
- Rotor Monitoring (RSO & Impedance Tests)
- Stator core monitoring using ELCID
- Online monitoring through current signature analysis
- Polarization & De-polarization current analysis of rotating machine insulation

Cables

- VLF testing of cables up to 22kV as per IEEE 400.1 & 400.2
- DAC testing of cables up to 60kV as per IEEE 400.4
- LIRA testing for HT & LT cables

Mechanical Diagnostics

Residual Life Assessment (RLA) and Non-Destructive Testing (NDT) Services

ERDA, recognized by the Central Boiler Board (CBB) as a **"Well Known leading Remnant Life Assessment (RLA) Organization"** under the Indian Boiler Regulation (IBR), 1950, offers a wide range of offline and online conventional and advanced NDT services for Remaining Life Assessment of various Mechanical Equipment Like Boilers, Turbines, Reactors, Vessels, Storage Tanks etc.

With extensive expertise in mechanical diagnostics, ERDA has conducted Remaining Life Assessments (RLA) on over 350 Boilers and 220 Turbines including Hydro Power Plant, Bare Inspection & Fit for Service on over 120 Package Boilers/Reactors/Vessels, Thermography Inspection on over 300 Electrical Utilities and Vibration Severity Analysis over 700 motors.

Range of Service Offered

- Visual Inspection (VI)
- Liquid Penetrant Testing (LPT)
- Magnetic Particle Inspection (MPI)
- Ultrasonic Test (UT)
- In – Situ Metallography (IMG)
- Hardness Measurement (HM)
- Positive Material Identification (PMI)
- In-Situ Chemical Analysis (CA)
- Deposit Analysis (DA)
- Dimension Measurement (DM)
- Borescope/Videoscopy Inspection
- Phased Array Ultrasonic Test (PAUT)
- Time- of - Flight Diffraction (TOFD)
- Vibration Severity Analysis
- Thermography Inspection
- Eddy Current Inspection (ECT)
- Natural Frequency Test (NFT)
- Fatigue and Creep Life Prediction
- Finite Element Analysis (FEA)
- Mechanical Test Laboratory
- Full Fledged Root Cause Analysis (RCA)
- Scanning Electron Microscope (SEM)/ Energy Dispersive X – ray Analysis (EDS or EDAX) Spectrograph

RLA Services for Steam Generators (CBB Approved, Govt. of India):

ERDA assesses components such as economizers, convective and radiative super heaters, water walls, drums, headers, piping systems, coal mills, support systems, and structures.

RLA Services for Turbines:

Components like rotors, blades, casings, parting plane studs, steam admission components, stop and control valves, steam piping, condensers, bearings, and barring gear are assessed using various RLA techniques.

Bare Inspection and Fit for Services for Reactors, Vessels, and Small Process/package Boilers:

Bare Inspection and Fit for Service has been offered for Package Boilers, Vessels, Reactors and Piping system of various Process Plant, Refineries, Pharmaceutical & Textile Industries as per IBR and API guide line.

RLA Services for Hydro Plants:

Components such as Hydro Turbine Shafts, Coupling Bolts, Runner Blades, Guide Vanes, Thrust Bearing & Pads, Lower Guide Bearing Pads, Penstock Gate Shafts etc. are assessed through various NDT techniques in Remaining Life Study and Condition Assessment Study.

Power Systems & Smart Grids

ERDA's specialized expertise in power systems and advanced software tools positions it as a leading provider of critical services in the power sector. Our offerings span across power system studies, power quality measurement, engineering analysis, and infrastructure support. Below is a brief overview of the key services and infrastructure provided:

Expert Services

Power System Studies

- Load Flow Analysis: Optimizing system performance and stability
- Short Circuit Studies: Assessing fault levels and system protection
- Insulation Coordination: Ensuring adequate insulation for system safety
- Relay Coordination: Ensuring proper operation of protective relays
- Very Fast Transient Overvoltage (VFTO): Analyzing fast voltage surges
- Dynamic & Transient Stability: Studying system stability under dynamic conditions
- Protection Audit: Reviewing protection schemes for reliability
- Parallel Operation Charge: Evaluating the impact of parallel operation of generators
- Transmission System Planning & Evaluation: Developing efficient transmission network strategies

Power Quality Measurement & Mitigation

- Harmonic Measurement (IEC 61000-4-7): Analyzing voltage and current harmonics in power systems
- Flicker Measurement (IEC 61000-3-7): Measuring flicker effects due to load fluctuations
- DC Current Injection: Testing for potential issues with DC current in AC systems

IEC 61850 Based IED Testing (UCA Accredited)

- Ensuring interoperability and functionality of intelligent electronic devices (IEDs) in power systems

Engineering Analysis Centre:

- EFM Analysis of Insulators: Evaluating electrical field distribution and insulation integrity
- Motor Design: Optimizing motor performance and efficiency
- RLA of Turbines: Life assessment of turbine components
- Thermal & Fluid Structure Interaction Analysis: Analyzing temperature distribution and interactions with surrounding structures
- Multiphase and CFD Analysis: Simulating fluid dynamics and multiphase flows
- FEM Analysis: Performing detailed stress, vibration, seismic, and structural analyses

Infrastructure

Power System Study Softwares

- ETAP, PSS/E, EMTP-RV, Mi-Power: Advanced software for load flow, stability, and protection analysis

Analytical Softwares

- Tools such as SolidWorks, CFX & Fluent, RMxprt, MATLAB, and Ansys Workbench to perform design and simulation tasks
- Specific software like CFD, FEM, and Ansys Maxwell for detailed analysis in multiple domains of engineering

Power Analyzer

- Class A, compliant with IEC 61000-4-30 for accurate power quality measurement

High Sampling Speed Oscilloscope

- Equipped with high-voltage probes for detailed signal analysis

IEC 61850 Communication Protocol Facility

- UCA-accredited facility to test and validate communication protocols for power systems

Energy Management Services

Following the implementation of the Carbon Credit Trading Scheme (CCTS) by the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, improving energy efficiency and reducing emissions has become a key priority for industries. Leveraging its advanced infrastructure and a team of Bureau of Energy Efficiency (BEE) accredited auditors, ERDA provides comprehensive Energy Management Services aimed at helping organizations optimize energy consumption, lower operational costs, and enhance energy efficiency.

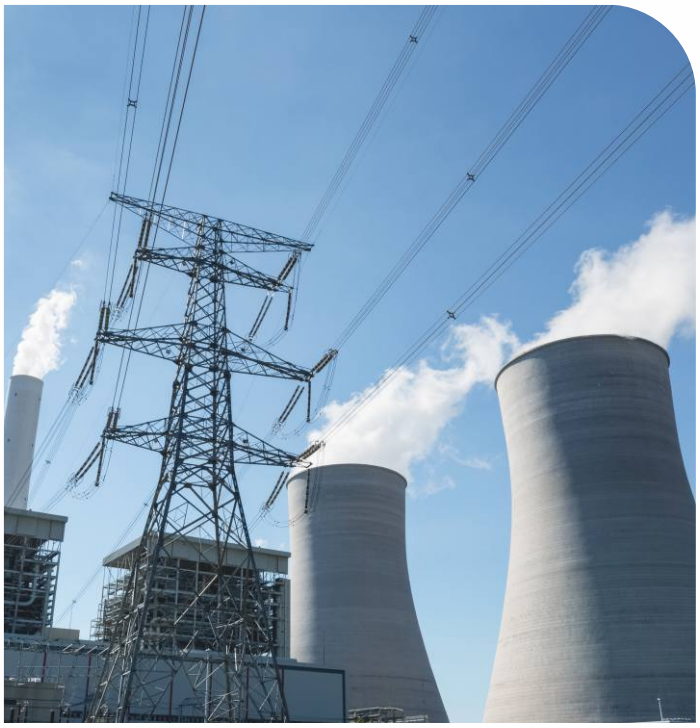
The primary objective is to identify energy-saving opportunities and implement strategies that reduce consumption and minimize waste while ensuring compliance with relevant energy standards. ERDA has successfully conducted over 450 energy audits, leading to potential savings of 78 MW and a reduction of 4.37 Lakh MT in CO_2 emissions.

Range of Services

- Mandatory Energy Audit & M&V Audit (as per BEE's PAT Scheme)
- GHG Audit (under the CCTS Scheme)
- Water and Emission Audits
- Waste & Environmental Management
- Project Management Consultancy (PMC) for Greenfield Projects
- Electrical & Process Safety Audits

Industries We Serve

- Process Plants: Refinery & Petrochemicals, Chemicals, Pharma, Mining, Fertilizer, Textile, Iron & Steel, Dairies, and more.
- Power Plants: Including Thermal, Gas, Nuclear, and Renewable Plants.
- Commercial Buildings
- Manufacturing Companies with more than 200 kVA demand.



New Product Development Engineering

New Product Development Engineering at ERDA focuses on the development of controllers for various renewable energy applications. The section also undertakes contract research projects, including the development of specialized controllers, converters, IoT-based sensors, electric vehicle (EV) drives, EV chargers, and more. Additionally, ERDA is involved in the performance evaluation and certification of renewable energy components such as solar photovoltaic (PV) systems, electric vehicle supply equipment (EVSE), and grid-scale energy storage solutions.

Research Focus Areas:

- Solar Photovoltaic (PV): Research includes advanced PV panel failure detection systems, performance degradation rates in commercial modules, and more
- Renewable Energy: Development of converters for solar and wind system grid integration, as well as grid synchronization
- Electric Vehicle Supply Equipment (EVSE): Includes AC and DC fast chargers, and controllers for Vehicle-to-Grid (V2G) and Grid-to-Vehicle (G2V) applications.
- Energy Storage Test Pad: Focused on integrating renewable energy sources with energy storage systems and microgrids

Infrastructure:

- Simulation & Modelling Tools: MATLAB/Simulink-based tools
- DSpace Microlab Box & LabVIEW for real-time testing and simulation
- ORCAD PSPICE for circuit simulation
- Orcad PCB Designer Professional Software for designing printed circuit boards
- Integrated Development Environment (IDE): CCS, Keil µVision
- PV Simulator: For simulating various solar irradiance conditions
- Grid Simulator: For testing and simulating grid integration scenarios

Technologies Developed (Available for Sale):

- Automatic Solar PV Cleaning System
- Hot Spot Detector for Distribution Transformers
- Smart Solar Inverter with Reactive Power Compensation
- Online Fault Sensor for Transformers
- Self-powered Wireless Thermal Sensor
- BLDC Controller for E-Bike Applications
- Solar MPPT-based Charger for Golf Cart Applications
- DC Charger for Electric Vehicles (EV)

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ELECTRICAL RESEARCH AND DEVELOPMENT ASSOCIATION

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