



Introduction to E3 Consultants

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Introducing E3 Consultants

E3 Consultants Ltd or “E3C” are a technical engineering consultancy , we are specialists in Electrical, Electronic and Energy Systems. We provide Research, Development, Design, and Consultancy services across a range of industries. Working throughout the systems lifecycle from requirements capture and derivation through to design, development, qualification, certification, and acceptance.

From our base in Lincoln, United Kingdom. E3C provides Electrical, Electronic and Energy Research, Design, Development and Consultancy services. We have experience throughout the whole systems lifecycle from requirements capture and derivation through to design, development, qualification, certification, and acceptance

E3C pride ourselves in offering effective engineering solutions that are delivered through our extensive practical engineering experience and made possible by our strong theoretical and analytical capabilities. We believe that today’s engineering challenges, whether a full complex system, associated engineering, or technical support benefit significantly from a structured yet agile Systems Engineering approach.

Whether a full life cycle development, or a focused support package for a specific aspect of your project E3C offer a range of engineering services for sectors including Defence, Aerospace, Automotive, Industrial and Commercial.

We offer you access to high calibre, flexible and experienced staff, supported by our engineering focused management. As a team E3C will work with you to tackle the toughest technical challenges or support you in keeping your projects and programmes on schedule.

If you would like to know more about what E3C do or how we can help you please get in touch.

Defence - Land

Within the Land Domain E3C are specialists in the Electrical and Energy engineering requirements of Land Platforms. Including the requirements, architecture, design, development, test, and qualification of entire platforms, associated sub-systems and products.

E3c have an exceptional understanding of the demanding operational environments within the Land Domain, and the challenges and opportunities it can represent.

We are leading experts in Defence Standard 61-5 Part 6 and MIL-STD-1275. One of our Consultants was even engaged by the UK Defence Science and Technology Laboratory (DSTL) to support its development to Issue 7. This puts E3C in a unique position to support our customers on current and future requirements.

E3C have worked with a wide range of Military standards (Environmental, EMC and more), and specialise in developing systems that enable the best possible use of Commercial/ Military Off The Shelf (COTS/ MOTS) equipment on vehicles/ platforms.



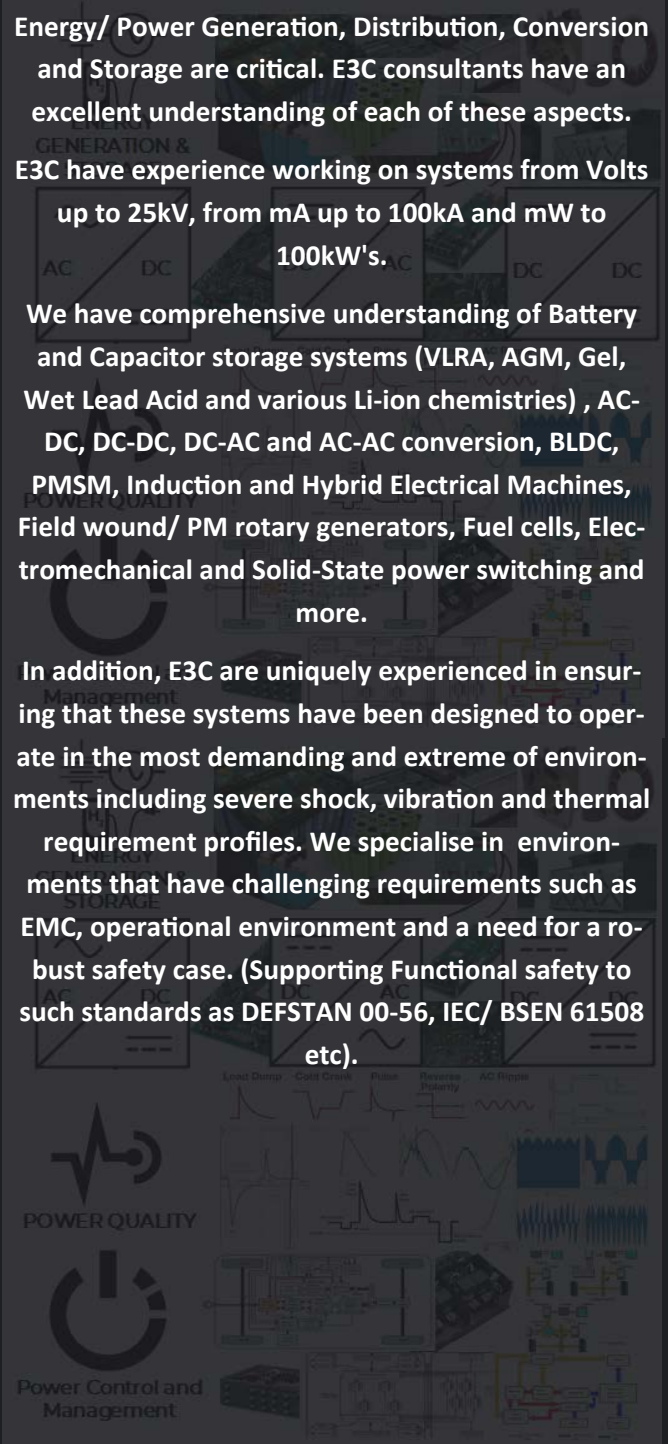
Energy/ Power

Energy/ Power Generation, Distribution, Conversion and Storage are critical. E3C consultants have an excellent understanding of each of these aspects.

E3C have experience working on systems from Volts up to 25kV, from mA up to 100kA and mW to 100kW's.

We have comprehensive understanding of Battery and Capacitor storage systems (VLRA, AGM, Gel, Wet Lead Acid and various Li-ion chemistries) , AC-DC, DC-DC, DC-AC and AC-AC conversion, BLDC, PMSM, Induction and Hybrid Electrical Machines, Field wound/ PM rotary generators, Fuel cells, Electromechanical and Solid-State power switching and more.

In addition, E3C are uniquely experienced in ensuring that these systems have been designed to operate in the most demanding and extreme of environments including severe shock, vibration and thermal requirement profiles. We specialise in environments that have challenging requirements such as EMC, operational environment and a need for a robust safety case. (Supporting Functional safety to such standards as DEFSTAN 00-56, IEC/ BSEN 61508 etc).



Transport/ Automotive/ Vehicles

E3C is ideally positioned to design and develop electrical/ electronic Power and Energy architectures from requirements capture through to qualification.

This could be a more traditional 12V, 24V or 48V system for higher power capacity and/ or mild hybrids or up to 1500V suitable for electrified vehicles.

We have the expertise and capabilities to analyse, design and create bespoke architectures, requirements, specifications, equipment and subsystems for every type of vehicle electrical and electronic power system.

This may be the latest plugin/hybrid battery or Fuel Cell EV derived powertrains for vehicles ranging from special purpose, transport, mass transport to light weight personal transport such as e-bikes.

Whether you require a full system solution or a specific part of your wider system application we can provide - tailored energy storage, charging, drives/ inverters and/or electrical safety systems. E3C can provide you with solutions from prototype to production ready.

Our systems engineering and design capabilities/ services offer a wide variety of services that complement our capabilities including modelling, simulation, design, integration, test, qualification, and certification.

Not forgetting our flexible Intellectual Property/ Design ownership approaches gives our customers true flexibility in how they proceed through the various lifecycles of a project.

Test & Measurement

We have experience in all aspects of test and understand the critical part played by each aspect of a test solution.

With our whole spectrum of test and measurement experience from requirements mapping into test specifications, through to test, reporting and acceptance, with tailored solutions for qualification and production.

Our consultants have experience working with some of the leading test equipment providers where we work closely to specify, procure, build, and commission complex test systems and supporting data including measurement uncertainty, and statistical assessments such as Gauge R&R and SPC.

From de-risking to full qualification, test plans to reports E3C ensures that your testing requirements can be satisfied.

Our Sectors

Aerospace

Our consultants Aerospace experience reaches from Requirements to Manufacturing.

At a systems/ design level we can offer experience in relation to aspects such DO-254 (RTCA DO-254 / EUROCAE ED-80, Design Assurance Guidance for Airborne Electronic Hardware), DO-160 (RTCA DO-160/ EUROCAE ED-14, Environmental Conditions and Test Procedures for Airborne Equipment). We also have extensive knowledge of equipotential bonding and lightning diversion.

We also offer solutions within the aerospace manufacturing equipment and capability arena, including Airframe manufacturing equipment and test systems.



Other sectors.....

Our extensive engineering background combined with the common themes of energy generation, storage, conversion, distribution and utilisation have led to clients in many other industries drawing upon our services.

E3C's understanding of working with complex and rigorous standards, challenging requirements and constraints where safety and performance are paramount puts us in a position where our expertise is truly transferable (We have found that every industry has its own challenges!).

These sectors include established markets such as Rail and Marine to emerging markets such as Energy Storage Systems and Hydrogen Systems.

All of the works E3C conduct are enabled and supported by our core capabilities, these include;

- our technical specialists, who will execute works engaging with you as required (Depending on the scope and the objective, this can be a collaborative effort with frequent interaction or where your resources are constrained, we will minimise your burden, and “get the job done”). Utilising our ability to understand your requirements and develop close working relationships to ensure successful and timely delivery.
- subject Matter Experts (SME) in COTS, Defence and Aerospace Standards including ISO7637, ISO16750, MIL-STD-1275, Defence Standard 61-5, Defence Standard 00-82, Defence Standard 29-03, Defence Standard 00-35, MIL-STD-810, Defence Standard 59-41/411, MIL-STD-461, DO-254, DO-160 etc.
- the execution and delivery of complex systems/ electrical/ electromechanical projects. With technical responsibility working at all levels from LRU and subsystem to full system level with companies of all sizes, engaging at all levels of our clients business as required.
- understanding of V cycle and other methodologies, supporting clients through or with specific aspects of the systems engineering process.
- execute projects to meet with national, international and industry specific requirements, including ISO, DIN, DEF-STAN, MIL-STD, MIL-PRF, BS-EN, SAE etc including design certification such as CE marking etc.
- extensive experience in interacting with multi-discipline project teams and often our clients end customer.
- experience of working in projects with complex structures, multiple nationalities, with export controls and restrictions.
- Commitment to openness, as such we offer flexible and “common sense” Intellectual Property (IP) agreements, ensuring the rights of our client to utilise contracted works and in most cases royalty free.

- **Systems engineering including:**
 - Execution throughout the V-cycle, in both agile and waterfall project structures
 - Requirements
 - Model Based Systems Engineering
 - Architecture
 - System Simulations
 - Testing Planning, Test Equipment, Testing and Verification
 - System and Architecture Trade Studies
- **Power/ Energy systems and subsystem development, design, documentation, and associated engineering analysis including:**
 - Power System Architecture
 - Power System Modelling, Documentation inc. Design Reviews and Power Control Plans
 - Growth studies and upgrade option evaluations, proposals and proof of concept
 - Generation (generators, alternators, power supplies, chargers, fuel cells, solar etc.)
 - Electrical Transient suppression and “clean” power system solutions to maximise the use of COTS and MOTS equipment and reduce overall system cost.
 - Energy storage (e.g. Batteries, Capacitors, Flywheel etc.)
 - Power Conversion including DC-DC, AC-DC and DC-AC, electrical to mechanical
 - Power Distribution Strategies, Architectures, and Units
 - Power Control and Management
 - Power System Integration and Test

- **Electrical development, design, documentation and analysis including:**
 - Wiring Diagrams
 - Harness Design
 - Design Calculations
 - Circuit protection design, studies and calculations
 - Fault protection studies
 - Earth Bonding schemes, calculations and documentation
- **Electronics development, design, documentation and analysis including:**
 - Specialists in Power Electronics (DC-DC, DC-AC, AC-DC, AC-AC, Motor Inverters, Electromechanical Drives)
 - Electronic Design Services (Design to Requirements, PCB Design, Schematic Capture, Embedded Software (C and VHDL)
 - Design for EMC and harsh environments
 - Design, project and management technical risk reviews
- **Mechanical development, design, documentation and analysis including:**

Our mechanical services have been developed to ensure that as part of our systems, electrical and electronic engineering we can support the full design life-cycle and allows effective communication across domains with our clients projects.

 - Computer Aided Design (CAD)
 - Modelling and simulation, thermal management, stress, shock and vibration
 - 3D Printing and prototype/ low volume components

The following list is not exhaustive, however they provide an overview of our excellent understanding and adoption of relevant standards as a fundamental aspect of the work E3C do:

- **Commercial Standards**
 - ISO 7637/16750 (Road vehicles—Electrical Disturbances)
 - LV123/124/148 (Road Vehicles— Electrical Characteristics/Safety, High Voltage)
 - MBN2200 (Daimler— Commercial Electrical Vehicle Standard)
 - ISO 26262 (Road Vehicles—Functional Safety)
 - IEC 61508 (International Standard—Safety Systems. Electrical/Electronic)
 - DO160 (Aerospace – Environmental)
 - DO254 (Aerospace - Complex Electronic Hardware)
 - J1939 (CAN bus)
 - UN38.3 (Li-ion – Transport of Dangerous Goods)
 - UL 1642, UL2054, UL 2580 (Battery Technologies— Design, Test, Safety for Commercial/ Domestic use)
 - IEC 62133, IEC 60086-4, IEC 61960, IEC 62281 (Battery Technologies—Design, Test, Safety)

Defence Standards (UK)

- 61-5 Part 6 Issue 6 (Military Vehicles—Electrical Standard—Current)
- 61-5 Part 6 Issue 7 (Military vehicles—Electrical Standard—Future Vehicles)
- 59-411 (Military Vehicles—EMC)
- 00-56 (Military Safety—Defence Systems)
- 00-35 (Military Environmental—Defence systems—Shock, Vibration, Temperature etc)
- 00-82 (Military Vehicles— Vetronics)
- 23-09 (Military vehicles—Generic Vehicle Architecture)
- 61-21 (Military Batteries—General Specification for Batteries)

Defence Standards (USA)

- MIL-STD-1275 (Military Vehicles—Electrical Standard)
- MIL-STD-461 (Military Vehicles—EMC)
- MIL-STD-810 (Military Environmental—Shock, Vibration, Temperature etc)
- MIL-HDBK-217 (Military—Reliability Electronic)
- MIL-PRF-32565B (Military— Vehicle Battery Systems)

VG Standards (German)

- VG 95218-5 (Cables and Insulated Wires—Ratings)
- VG 96950 (Power Distribution—Electronic Equipment)
- VG 96916-5 (VG 96957-1, VG 96957-2) (Land Vehicles—DC Power Networks and Drives)
- Various other standards for connectors, accessories etc...

E3C projects are often involved in aspects that are fundamental to system safety. Our consultants have provided supporting works focused on vehicle power systems on major projects within the UK, including:

- electrical, electronic and safety justifications, joint multidisciplinary reviews and concurrence reached with client's and external customers SQEP (Suitably Qualified and Experienced Personnel).
- provision of SQEP electrical, electronic and energy in support of our clients projects and programmes.
- analysis and evidence assembly for power, electrical and electronic product/system hazards and their impact on both functional and physical aspects
- electrical/ power system, design and physical safety analysis in support of standards such as IEC61508 and ISO26262.
- functional electrical, electronic and energy safety analysis
- specific electrical, electronic and power safety analysis including aspects such as risk of; fire, electrocution, electrical energy, functional risks and effects of transients etc.



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