CONVERTEAM
THE POWER CONVERSION COMPANY

EMKIT

Electro Magnetic Kinetic Integrated Technology

EMKIT is an Electromagnetic UAV launch system demonstrator on test in the UK, with over 2500 successful launches to date.

Key Facts

Location – Bruntingthorpe Aerodrome and Proving Ground

No. of Launches	over 2500 to date
Max. Test Weight at max speed	524kg
Track Length	15m
Launch Energy	880 kJ
Thrust	59 kN
Max. Power	3MW
Max. Speed	51m/s / 114 mph
Acceleration	(8.7 G) 85 m/s2

EMKIT demonstrates and proves the technology needed to provide the capability to launch large UAVs, in a short launch length. This is a key stage in the development of Electromagnetic launch of manned aircraft from maritime platforms. This project exceeded its expected performance and de-risked the technology to allow significantly larger launchers to be developed.

The UK Ministry of Defence together with Converteam UK Ltd. had previously completed a study on the core technology required to launch aircraft from an aircraft carrier using an Electro Magnetic Catapult (EMCAT). The results from this study were extremely promising and showed that the technology had real potential for wider exploitation at a number of different scales from UAVs to manned aircraft launchers.

The EMKIT UAV launch demonstrator project was part of the UK MoD Above Water Effects research programme. The contract was awarded to Converteam in April 2005, testing began in February 2007 and the first successful launch at the rated speed and full mass was in July 2007. It has demonstrated EM launch technology by the design, build and testing of a high-speed, high-acceleration demonstrator. The test programme included full speed dynamic acceleration and stopping tests on a range of test masses, at a range of speeds, within a short launch length, in order to demonstrate the flexibility and scalability of the technology.

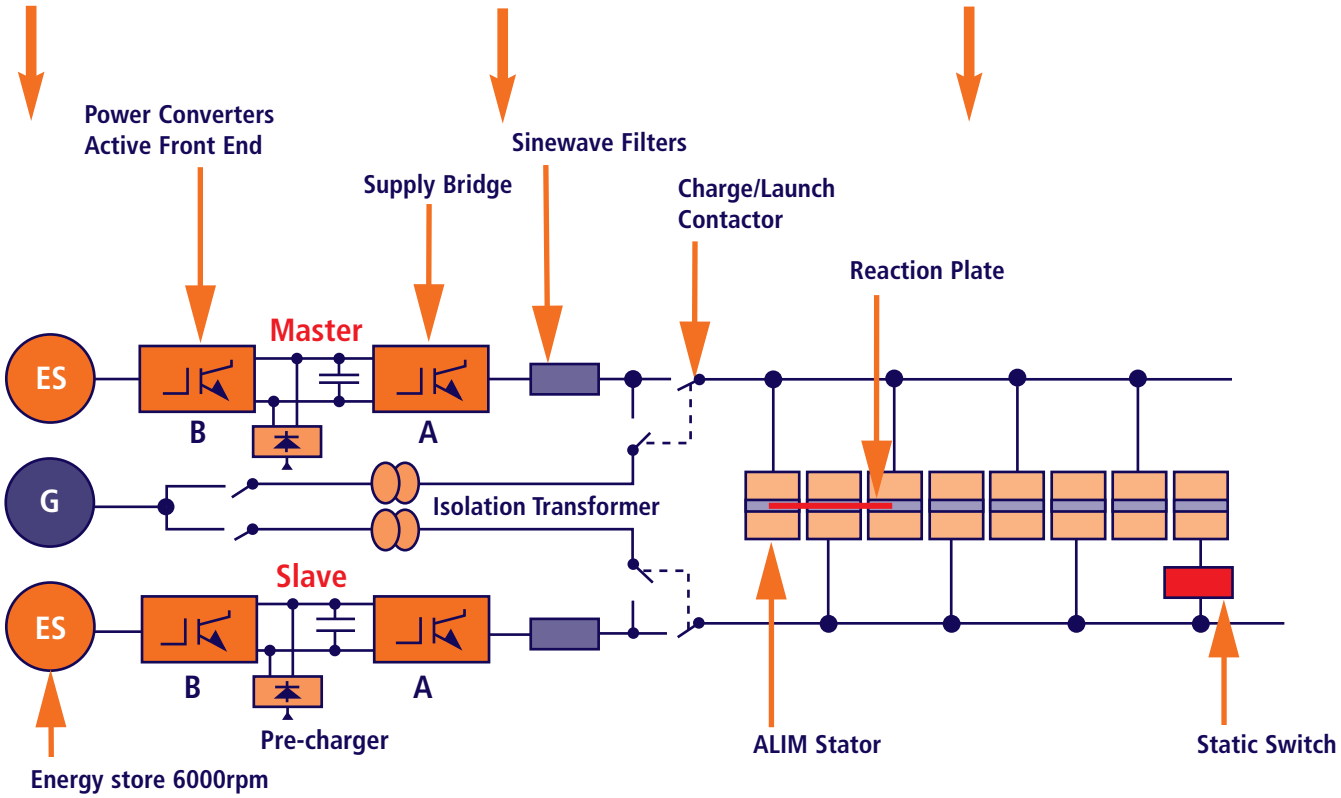
The successful demonstration of the requirements was deemed to be sufficiently demanding to increase the technology readiness level to a stage where a trial of a full-scale EMCAT system could be undertaken, in order to prove the launch of larger UAVs or manned aircraft from a naval platform.

The technology now exists to develop a range of EM launch systems for UAVs and aircraft. In conjunction with the wider electrification of naval propulsion, auxiliary and weapons systems, this offers a significant opportunity to provide an integrated system for aircraft launch as an alternative to steam catapults. The Royal Navy (RN) last used a marine catapult in 1978, which used the steam from the propulsion system. Future platforms such as CVF, the UK's Future Aircraft Carrier, have an Integrated Electric Propulsion System with no steam but with significant installed electric capacity. It is difficult to envisage the use of steam launch technology for future RN applications. This view is supported by a MoD study that concluded that EM launchers are the most operationally viable option for future aircraft launch.

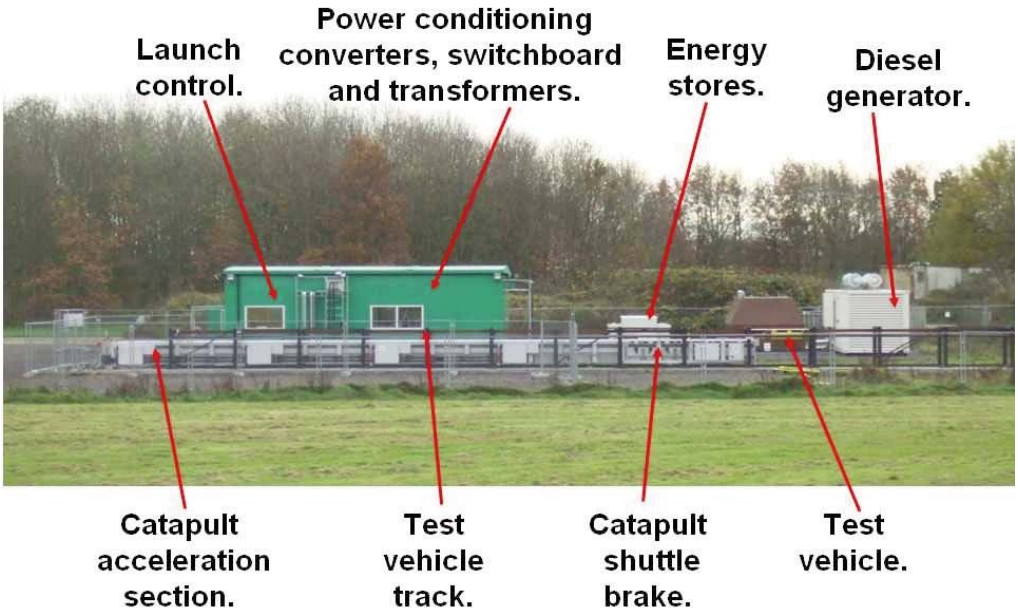
The EMKIT Demonstrator System

The EMKIT demonstrator consists of:

- Pulsed Alternator Energy Stores
- High Power Converters
- Diesel Generator
- Transformers
- Advanced Linear Induction Motors (ALIM)
- Reaction Plate
- Catapult Frame
- Friction Braking
- Static Switch
- Test Vehicle
- Switchboard



Test Site



Reaction Plate

Launcher and Track

High Powered Converter

The catapult principle is based around the application of ALIMs.

The Linear Induction motors work on the same basic principle as all induction motors, except the motor is effectively unrolled to provide a linear stator and rotor. The movement of the traveling electromagnetic field, hence the rotor is now linear and not angular. The rotor is called the reaction plate. It is the reaction plate that is coupled to the UAV and then accelerated at a constant rate, pushing the UAV up to the required launch velocity.

The high pulsed energy demands and short duty cycle of the system requires the use of energy stores to provide the power requirements to the catapult. This maximises the system economy, reduces disturbances on the platform power system and provides a near self-contained solution requiring minimum interface to the prospective platform.

The converters drive the energy stores up to their rated speed by taking power slowly and at a low level from the local supply, which in this case is the diesel generator, representative of the vessel power system. Once the energy stores are at the rated speed, the charge contactor opens, the launch contactor closes and the converters' supply bridge A effectively becomes the motor bridge and transfers the stored energy by Variable Voltage Variable Frequency (VVVF) supply to the ALIMs. The use of low slip ALIMs and suitable control algorithms allow them to be controlled open loop and apply constant force to the launch vehicle.

Once the vehicle is launched, the LIMs then brake and retract the shuttle to the start position and the converters automatically revert to their recharging configuration. This brings the energy stores back up to their rated speed, using closed loop vector control, ready for the next launch.

A key advantage of EM technology, compared with steam, is that the 'catapult force' can be accurately tuned to the weight of the aircraft and applied smoothly and constantly during the launch, thus reducing stress on the airframe. Another key aspect of the EMKIT system was to ensure that by careful design, launch speeds could be controlled to high accuracy, using linear induction motors without the need for any positive feedback to ensure reliability and availability.

Operating Controls

Energy Stores

Static Switch

The Test Vehicle

The Launch Track

References

Available from Converteam on request:

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Authors: Mr Jeff Proverbs, Mr Eric Lewis, Mr Graham Bellamy

An Advanced Linear Motor System for Electromagnetic Launch: Development and Opportunities
Authors: Mrs Helen Robertson, Lt Cdr Matt Bolton, Lt Mick Thomson RN

Optimising the AC Interface of High Power Pulse Loads on Combatants with Integrated Electric Propulsion
Author: Mr Eric Lewis

EMKIT – Commissioning and Performance Testing of a Technical Demonstrator for the Electromagnetic Catapult Launch of UAVs
Authors: Mr Graham Bellamy, Lt Mick Thomson RN

Electro Magnetic Kinetic Integrated Technology – Development of an Advanced Linear Induction Motor Powered UAV Launch Demonstrator
Authors: Mr Alan Foster, Mr Eric Lewis, Lt Mick Thomson RN

Development of an Electromagnetic UAV Launch Technical Demonstrator
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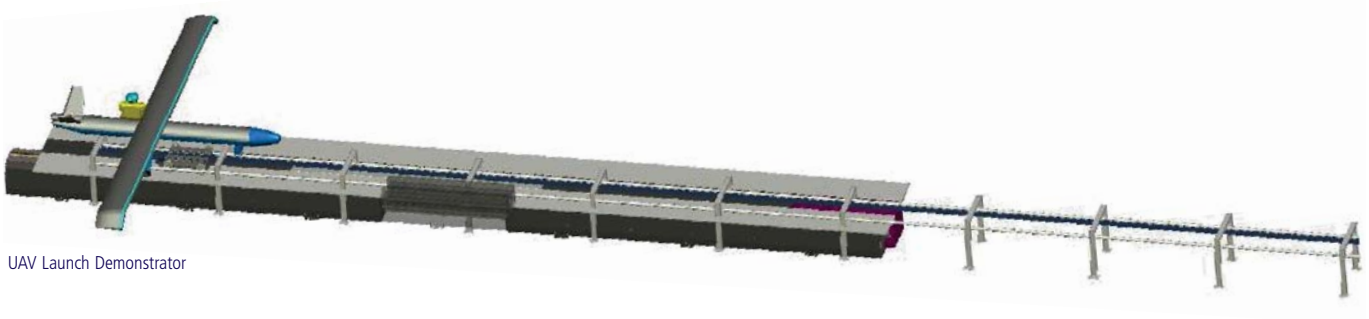

UAV Launch Demonstrator

Future Opportunities

EMKIT has now successfully completed the demonstration phase and the results have exceeded expectations. EMKIT has demonstrated the practicality of a full scale electromagnetic catapult and the feasibility of other applications such as next generation roller coasters, torpedo launch and ejector seat testing.

Example of a UAVs

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