Loughborough University

PULSED POWER GROUP

HIGH-VOLTAGE PULSED-POWER GENERATOR FOR DRIVING LARGE IMPEDANCE LOADS

B.M. Novac[1], M. Parker[1], I.R. Smith[1], P. Senior[1]

G. Louverdis[2]

[1] Department of Electronic and Electrical Engineering, Loughborough University, Loughborough,
Leicestershire LE11 3TU

[2] Dstl Security Sciences Department, Fort Halstead, Sevenoaks, Kent TN14 7BP

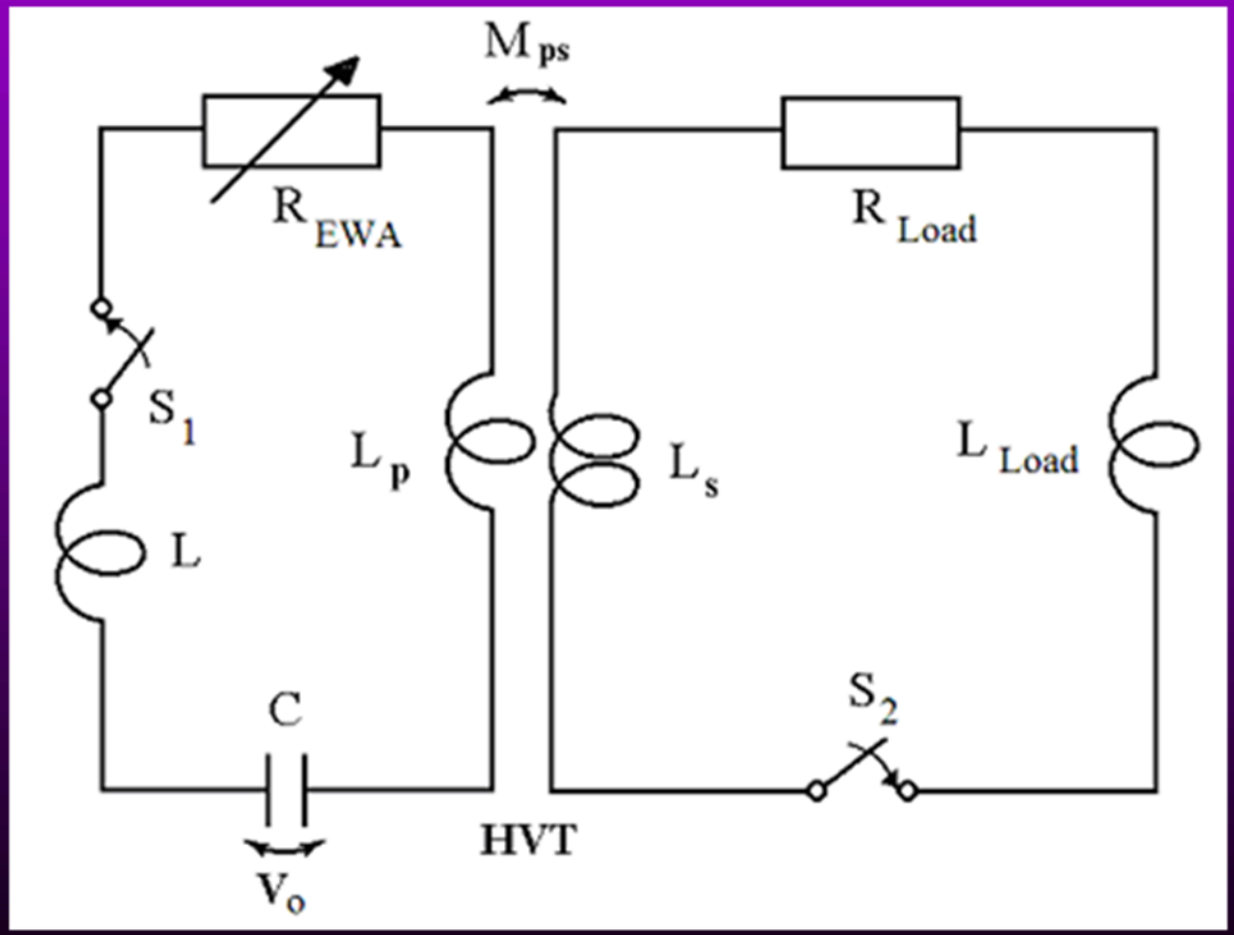
Content

- Introduction
- Inductive storage scheme
- Components
- Results
- Conclusions and the way ahead

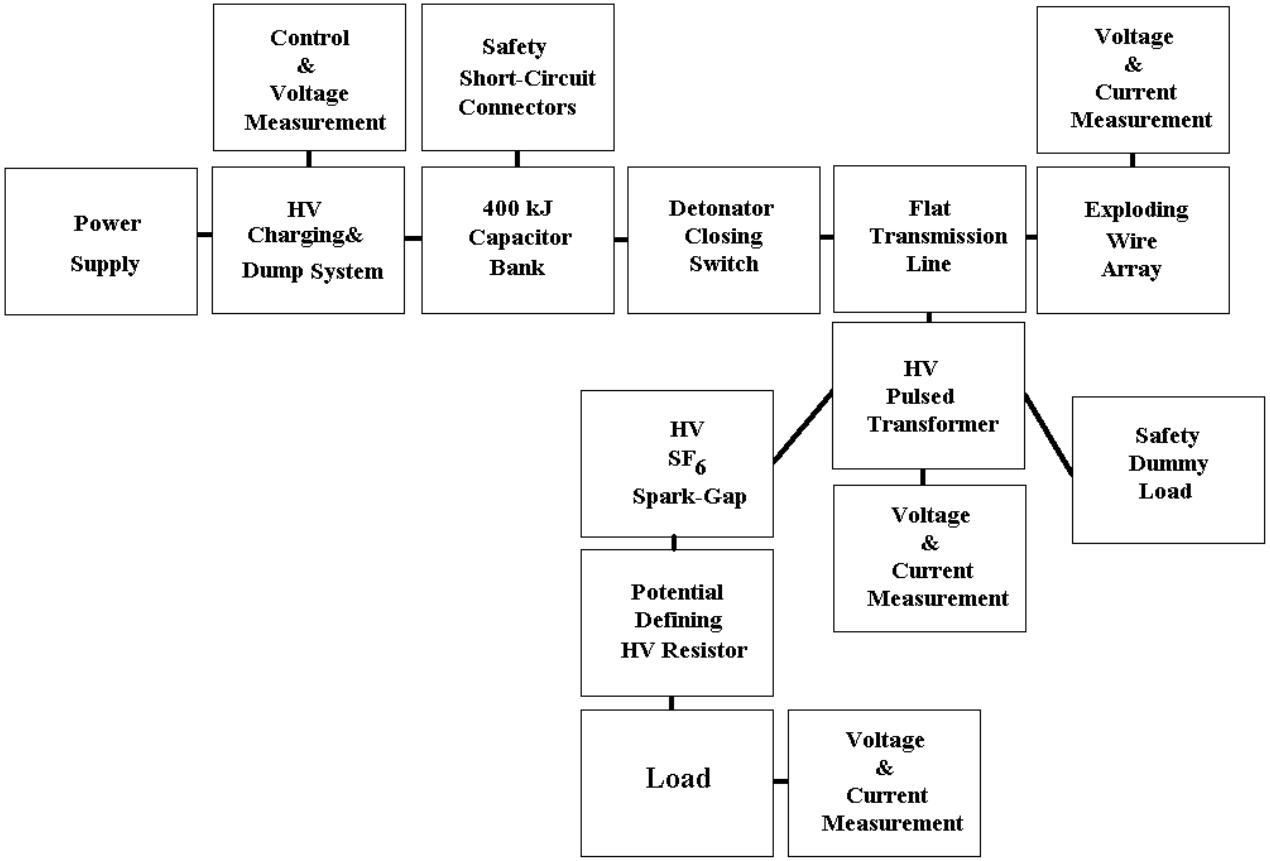
Introduction

- Challenge: generate currents in excess of 10 kA in an unusual high-impedance load
- Load has 30 Ω and 30 μH
- The final pulsed power system must be fully autonomous and transportable

High-energy generator based on an inductive storage scheme



Complete high-energy system



High-energy bank and HV transformer

415 kJ / 22 kV capacitor bank

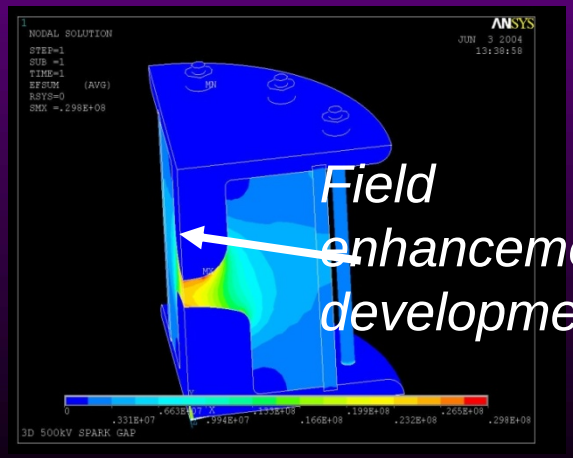
>0.6 MV transformer

Ancillary equipment

Aqueous high-power resistive load

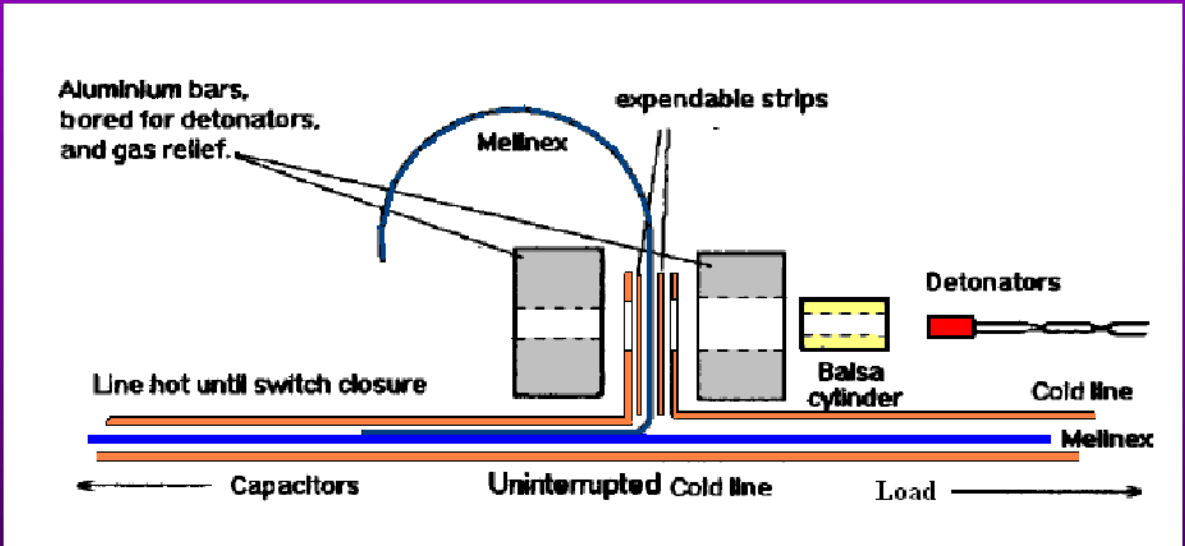
SF_6 pressurised spark-gap (components)

Rogowski coil



Electrostatic modelling of the spark-gap

High-Coulomb detonator-activated closing switch



Advantages:

-very low: - inductance (< 0.2 nH)

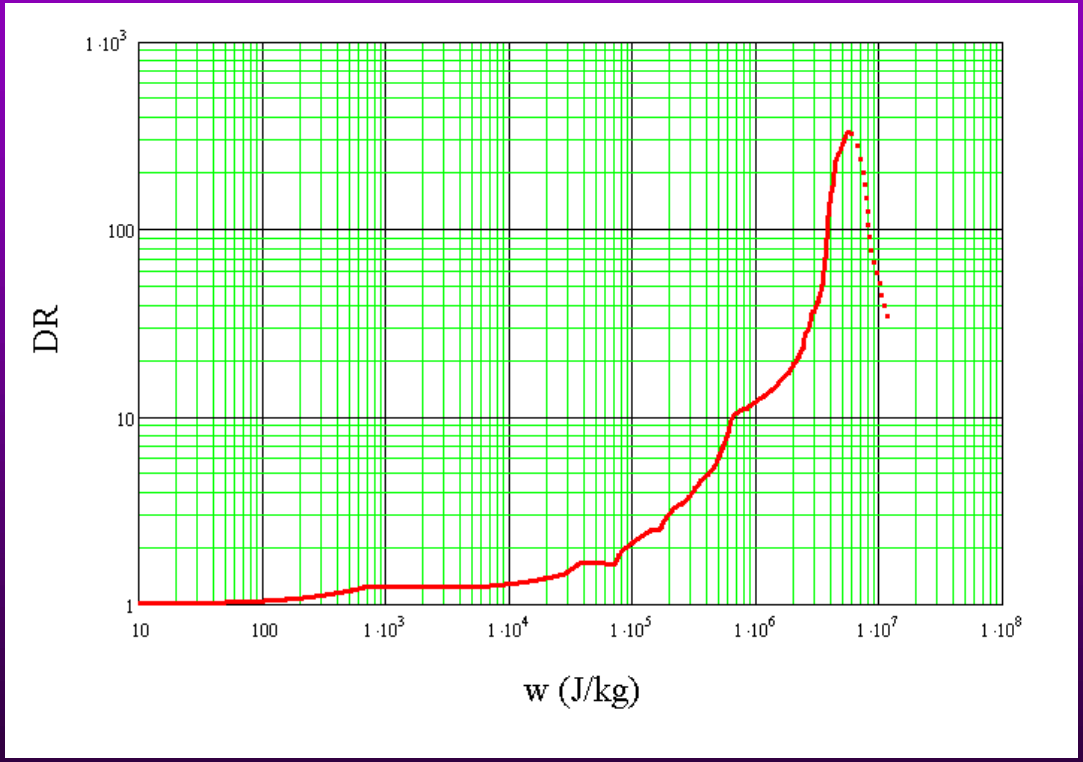
- resistance (< 0.5 mΩ)

- easily scalable to > 30 C

- very low cost

3-detonator switch

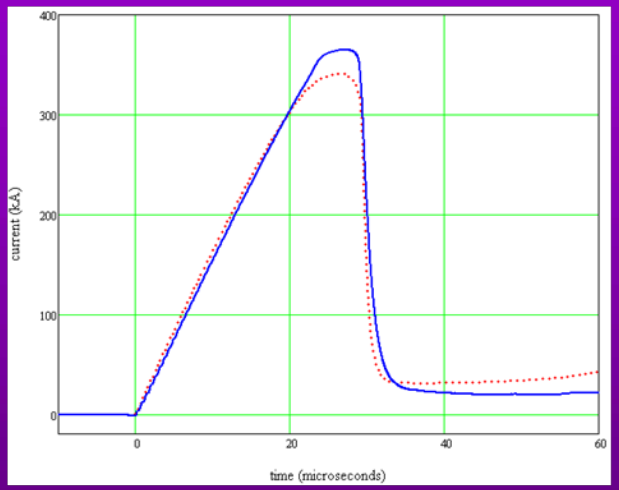
Numerical modelling of EWA based systems



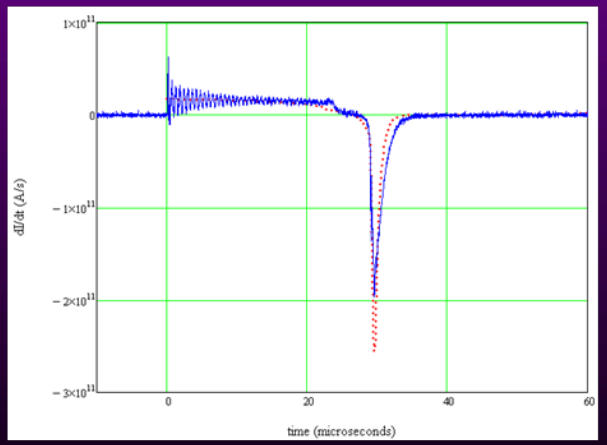
Loughborough exploding wire model (in air)

DR=R(t)/R(0) is the dynamic resistance and *w* is the specific energy

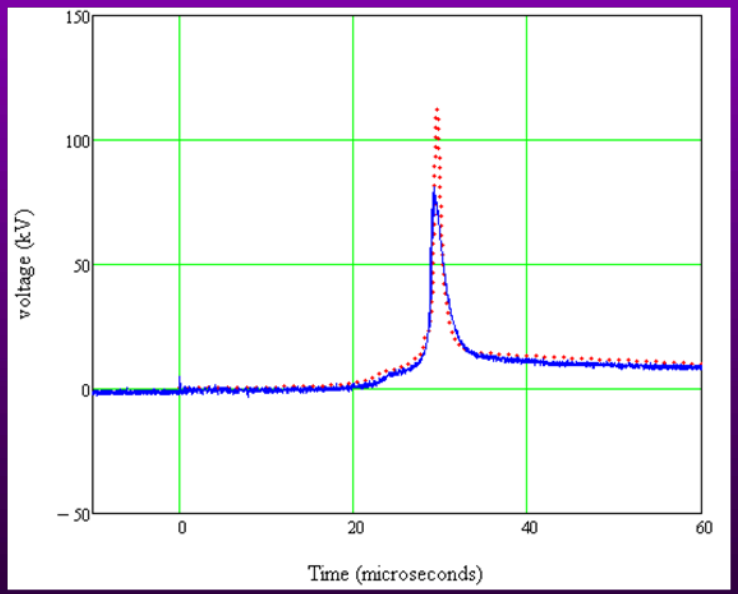
Results at half energy: primary circuit



Bank (primary) current

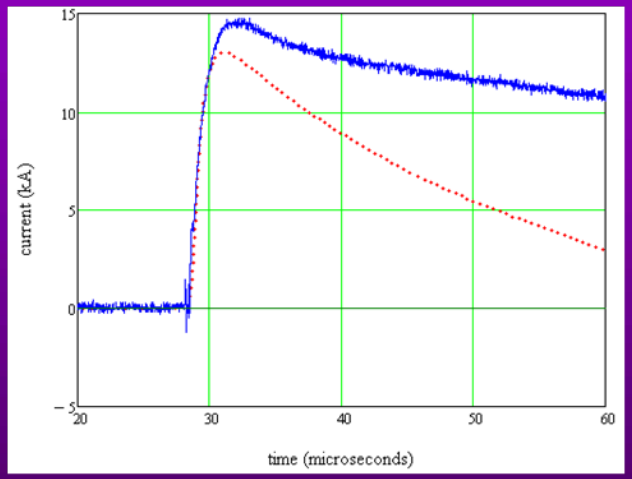


Primary current dI/dt

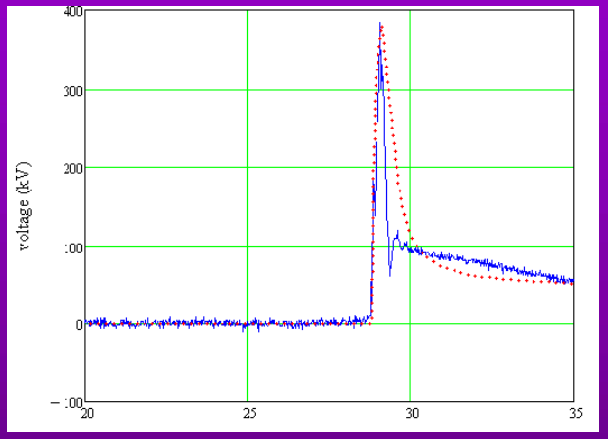


Voltage across EWA

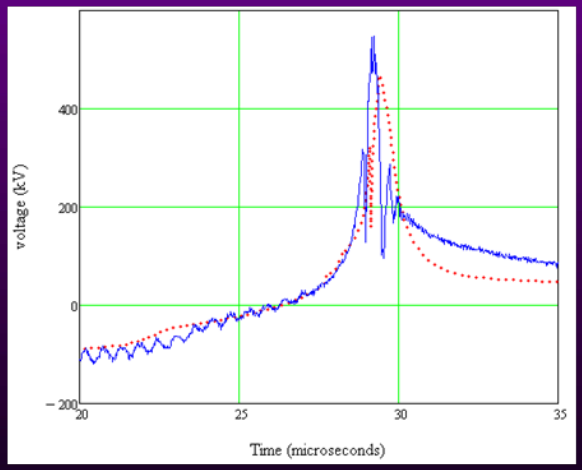
Results at half energy: secondary circuit



Load (secondary) current
Rise time: about 1.5 µs

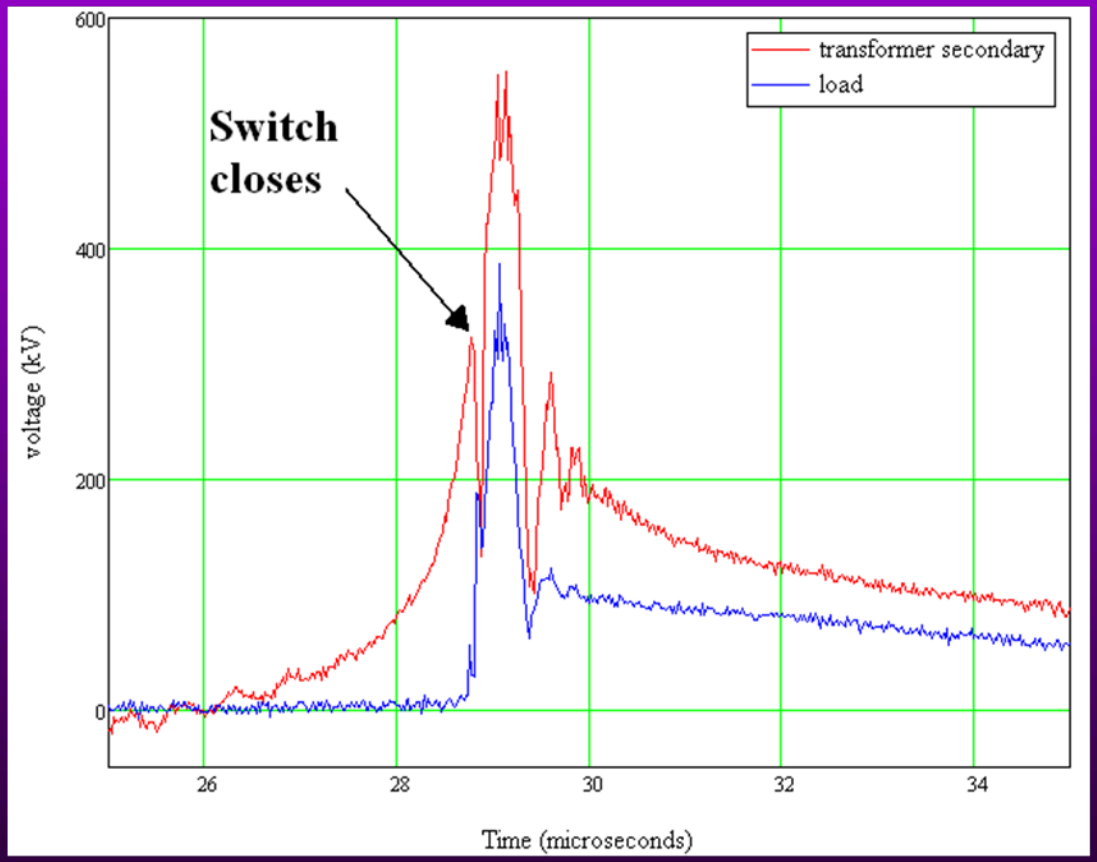


Voltage across load



Voltage across transformer secondary

Results at half energy: analysis



Energy transfer: about 7% from the energy stored in the bank was transferred to the load at over 3 GW power

Conclusions and the way ahead

- A high-energy pulsed-power generator capable of producing a peak current in excess of 10 kA in a high-impedance load was designed and assembled
- Preliminary testing at half-energy was successful
- Full energy tests are under way
- Future plans include transformation of the generator into an autonomous transportable source

Thank you !

Questions ?