

# A MINIATURE HIGH-POWER POS DRIVEN BY A 300 kV TESLA- CHARGED PFL GENERATOR

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The Institution of Engineering and Technology

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In association with

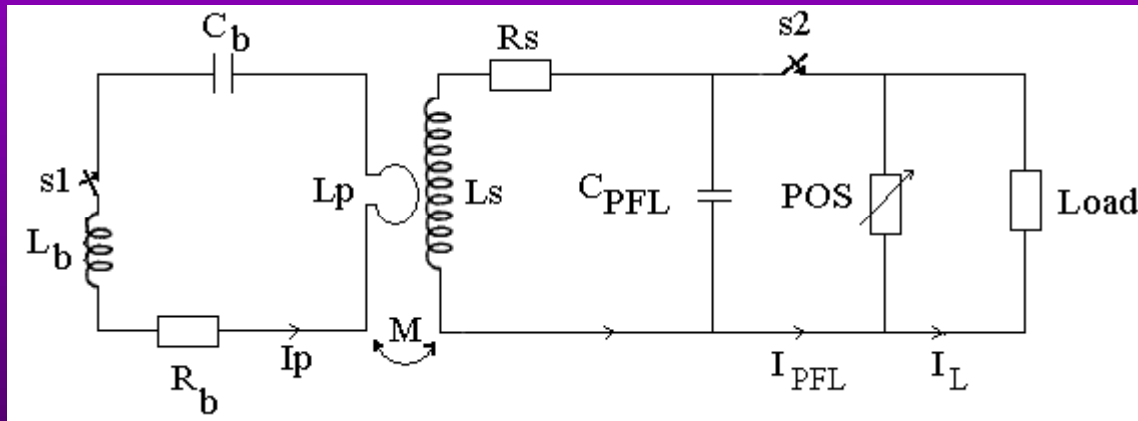


# Content

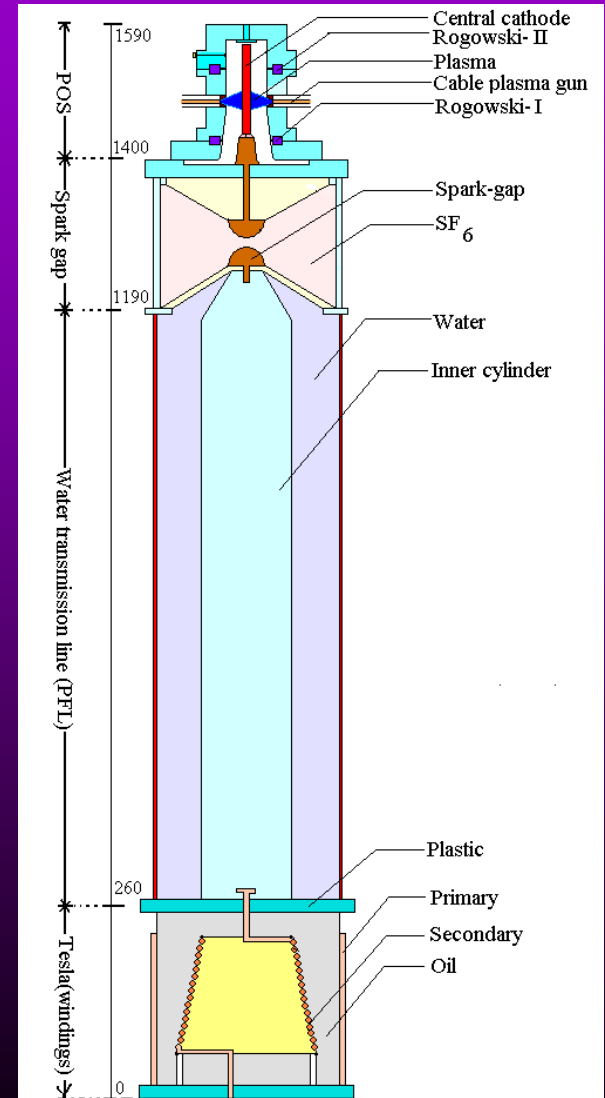
- **The pulsed power generator**
- **POS**
- **Conclusions**

# The pulsed power generator

# Pulsed power system



Electrical scheme of the 300 kV Tesla-PFL generator to drive a miniature and repetitive POS for preliminary testing



# System components: Tesla transformer



primary

Parameters	Simulated	Experimental
Primary winding inductance	163.8 nH	165 nH
Primary circuit resistance	50 mΩ	47 mΩ
Secondary winding inductance	62.69 μH	62 μH
Stray capacitance of secondary coil	70 pF	60 pF
Resistance of secondary circuit	2 Ω	2 Ω
Mutual between primary and secondary circuit	2.16 μH	2.10 μH

Tesla transformer  
300 kV

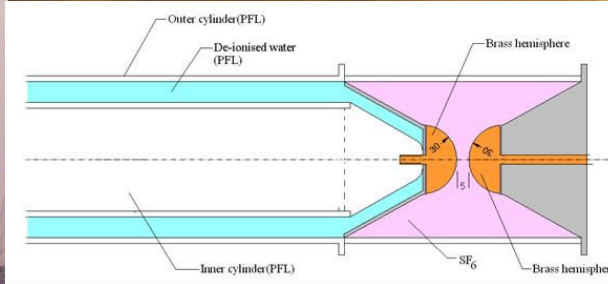
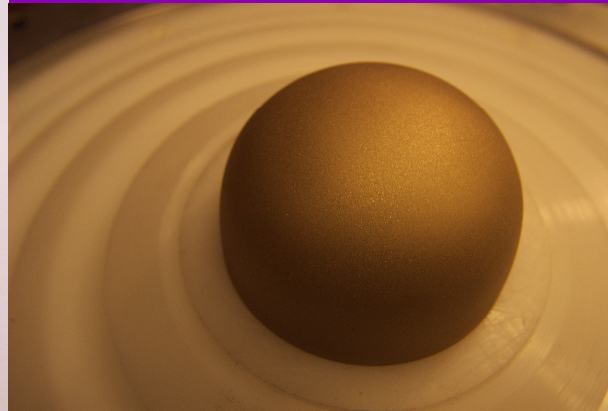


secondary

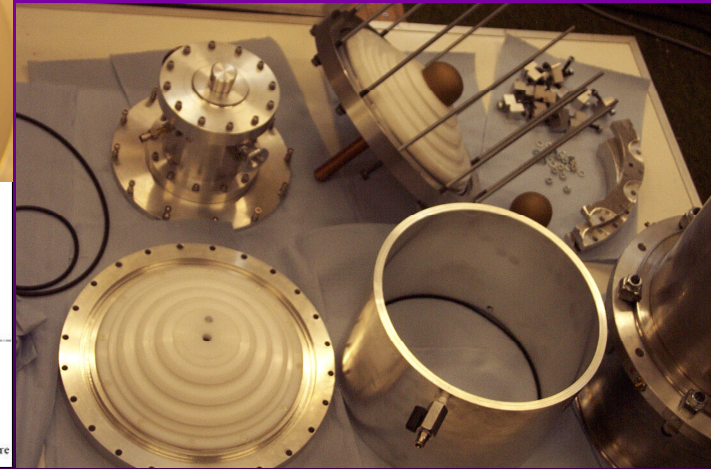
# System components: pulse forming line (PFL) and high-voltage closing switch



Pulse forming line  
3.8  $\Omega$  / 53 ns

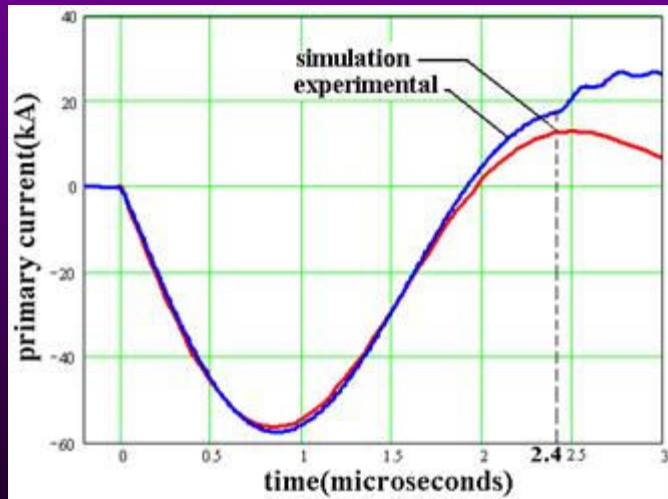


Closing switch

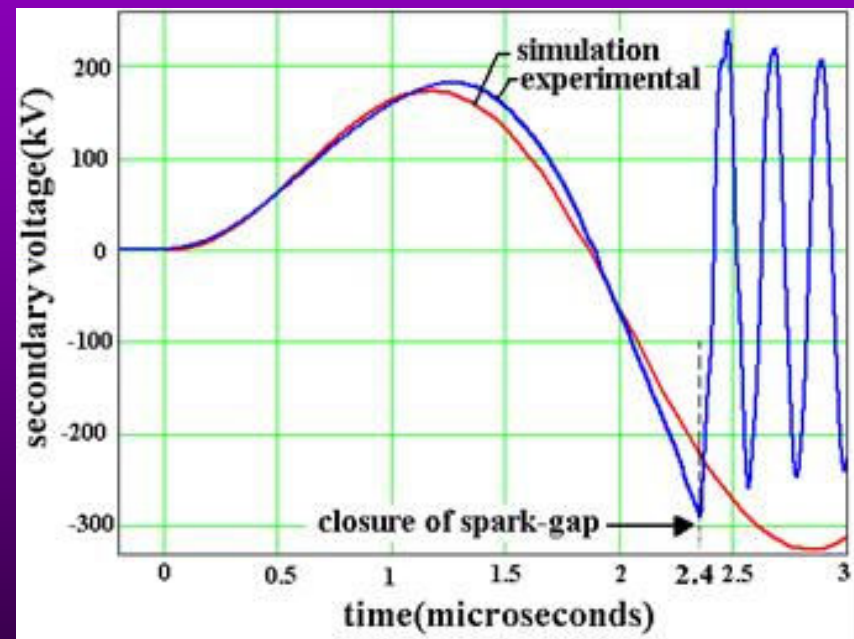


Various components

# High-voltage test with PFL, closing switch and load



Primary current

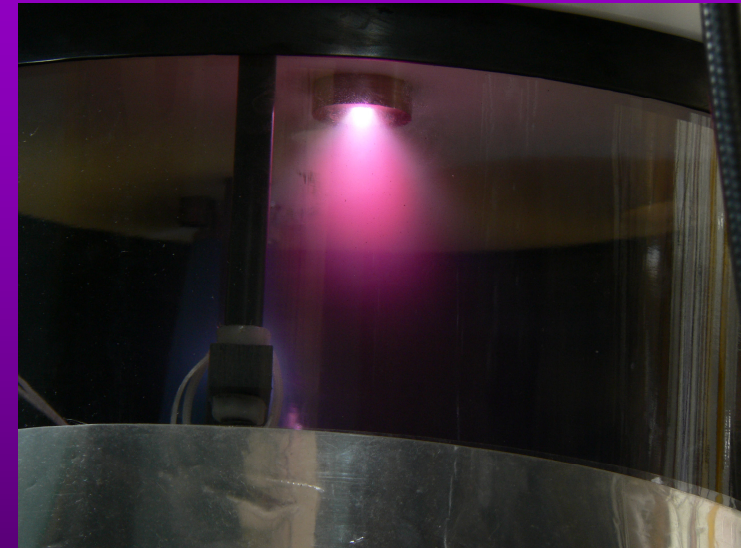


PFL output voltage

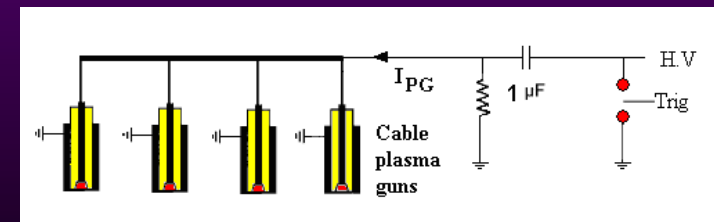
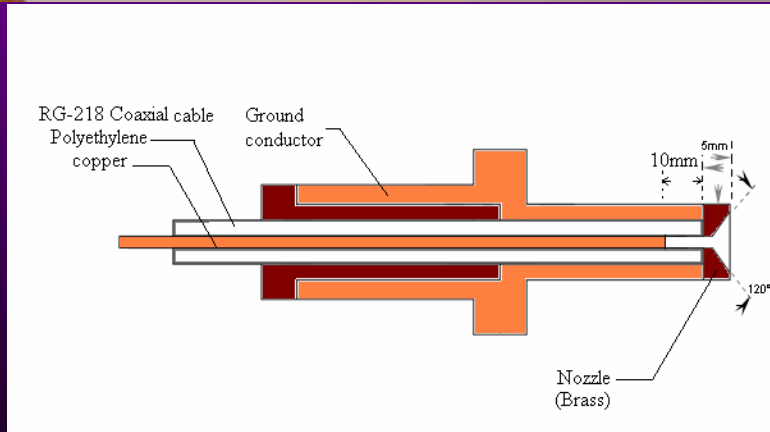
POS



# Plasma guns



Ions emitted in vacuum



Plasma gun power source

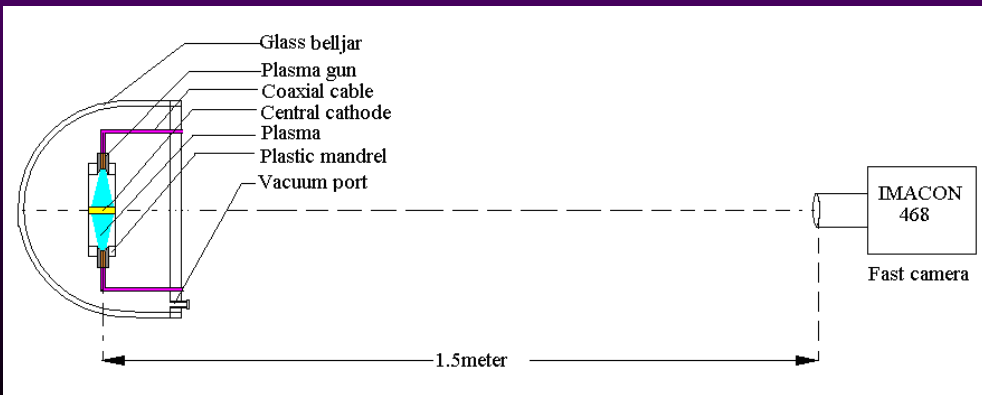
# Ultrahigh speed camera study



POS (mock-up) with 4 plasma guns and central cathode

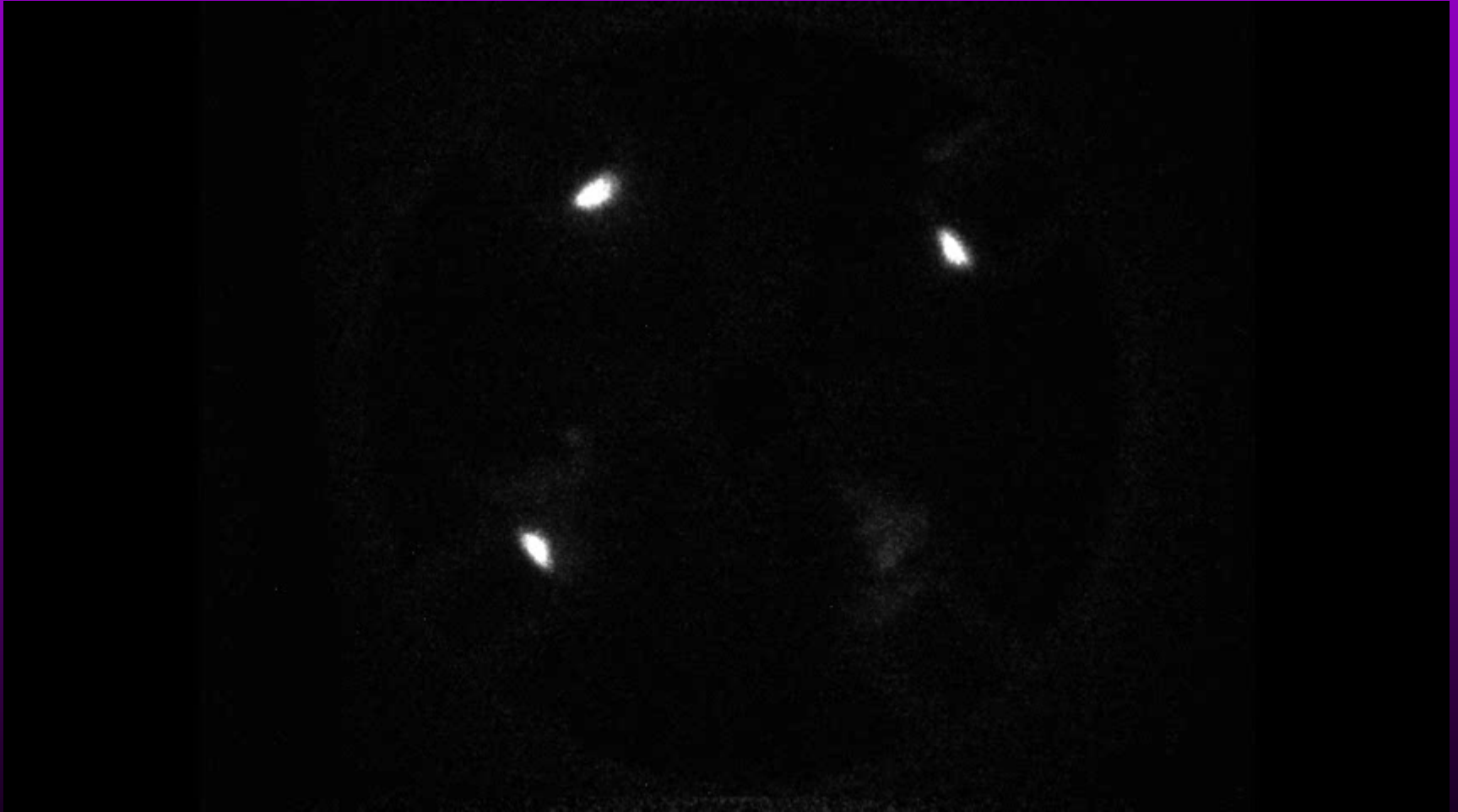


Imacon 468 (John Hadland)  
Nikon lens, 8 frames  
10 ns gating speed

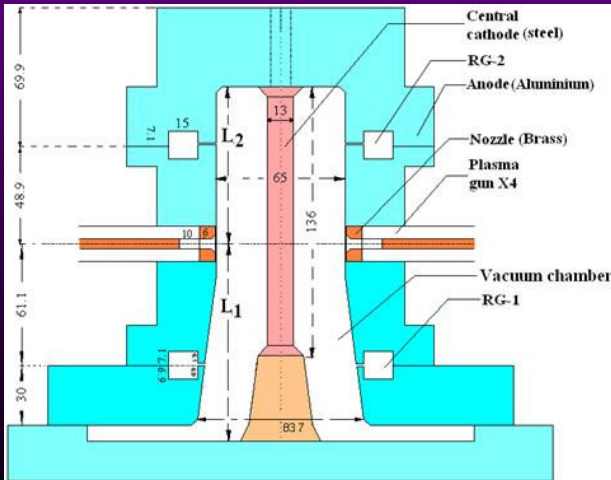


Arrangement

# Ultrahigh speed camera study

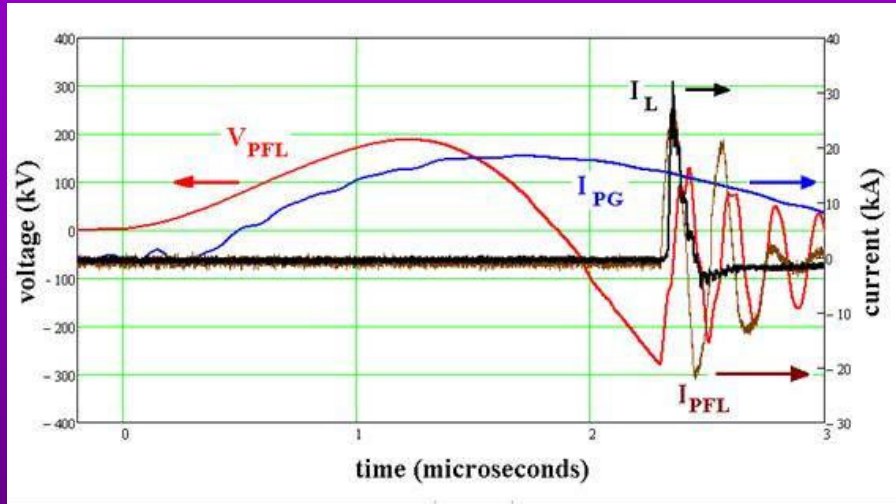


# POS

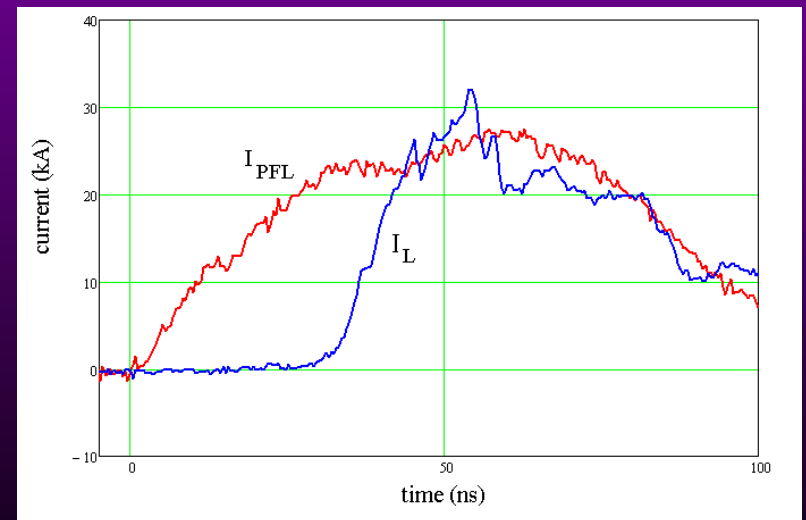


POS installed on top of generator

# POS results with short-circuit load

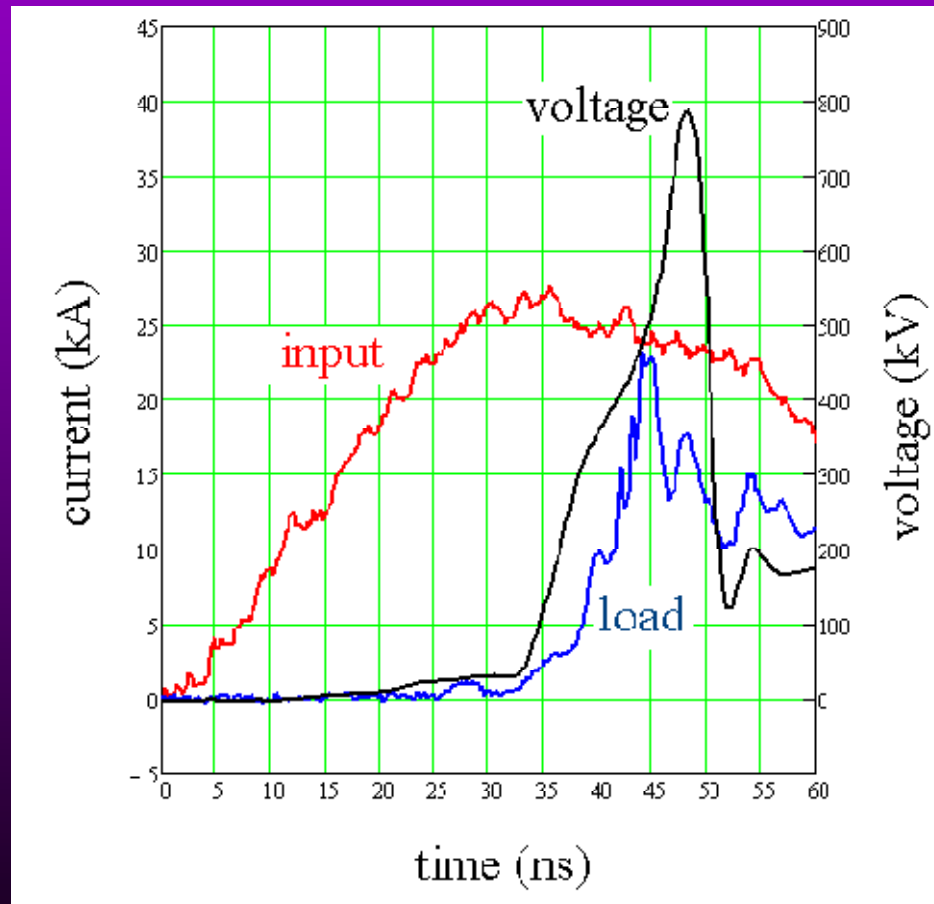


Time variation of system voltages and currents



Upstream and downstream POS currents

# POS results with dynamic load



Power well in excess of 10 GW

# Conclusions

- **The *first stage* of a major Loughborough programme, with the aim of demonstrating a table top repetitive system with an output greater than 10 GW, was successfully completed**
- **A powerful Tesla driven PFL pulsed power generator was built and operated with a high reproducibility. The generator reached all the design specifications**
- **Plasma guns have been constructed and successfully operated**
- **Plasma gun studies performed with Faraday cup sensors show that protons and carbon ions are both emitted**
- **Ultrahigh speed camera studies helped in understanding the plasma dynamics**
- **Tests using a miniature POS demonstrated that a power well in excess of 10 GW can be produced on dynamic loads**
- **The way is open for demonstrating a table-top, repetitive, 15 GW machine based on a miniature POS**

Thank you for your attention!

Any questions?