Oil Be Back!

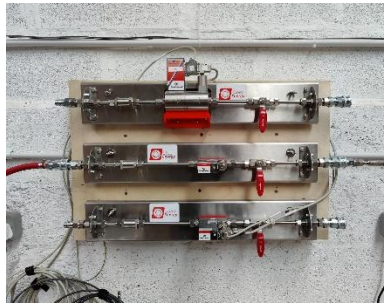
SAMPLING PMTS WITHOUT THE SHUTDOWN

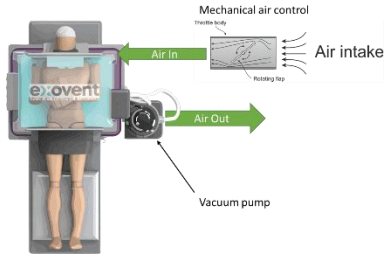
Mike MacDonald

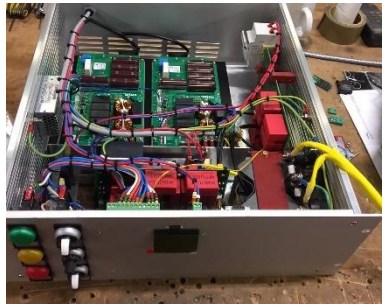
Steer Energy

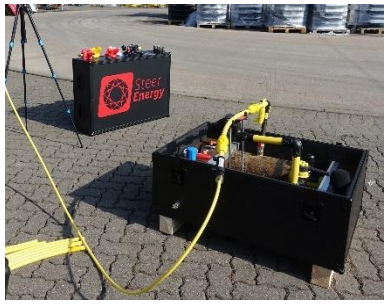
Steer Energy

www.steerenergy.com









Steer Energy

Scottish & Southern Electricity Networks

SSEN DISTRIBUTION
NETWORK AT A GLANCE

Nearly **4 million** homes and businesses

Over **128,000km** of overhead lines and underground cables

Over **460km** of subsea cables powering our island communities

Over **4,400** employees across the country

About UK Power Networks

8.3M homes and businesses

28% of UK Total

9.3GW+ Distributed Generation Connected

32% of UK Total

16GW+ Peak Demand

28% of UK Total

UK Power Networks
Delivering your electricity

PROBLEM

Testing 88,000 PMTs for PCBs currently costs £3-6k each, involves removing potentially good infrastructure, and requires taking customers offline

Steer Energy

Can the oil sample be taken with the PMT in situ?

— PMT should remain energised

— Operator working outside of exclusion zones

— Oil sample required for analysis

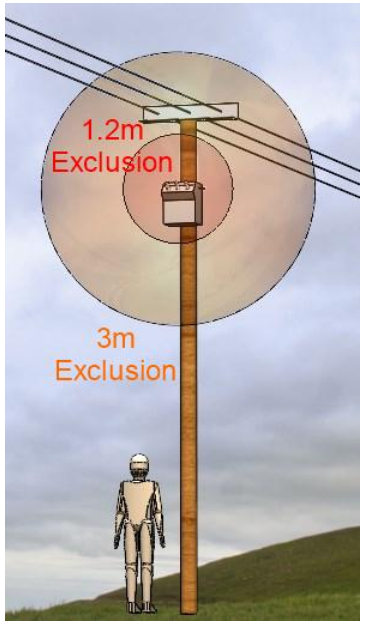
PMT Constraints

— Energised PMT 33kV to 11kV or 11kV to 230V

— Sealed units (w/breather)

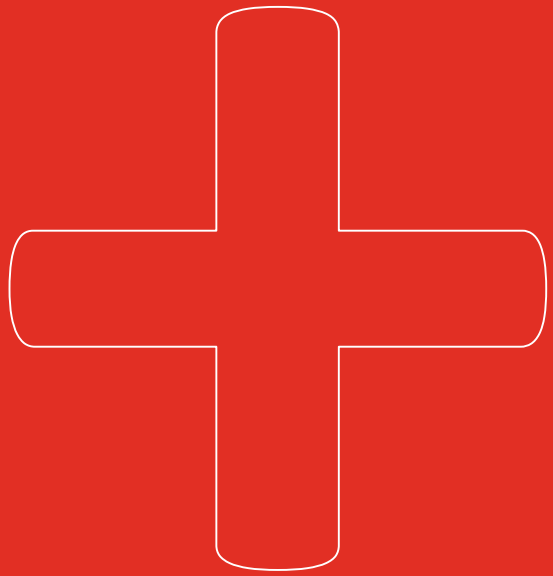
— Located 3-6m high on pole

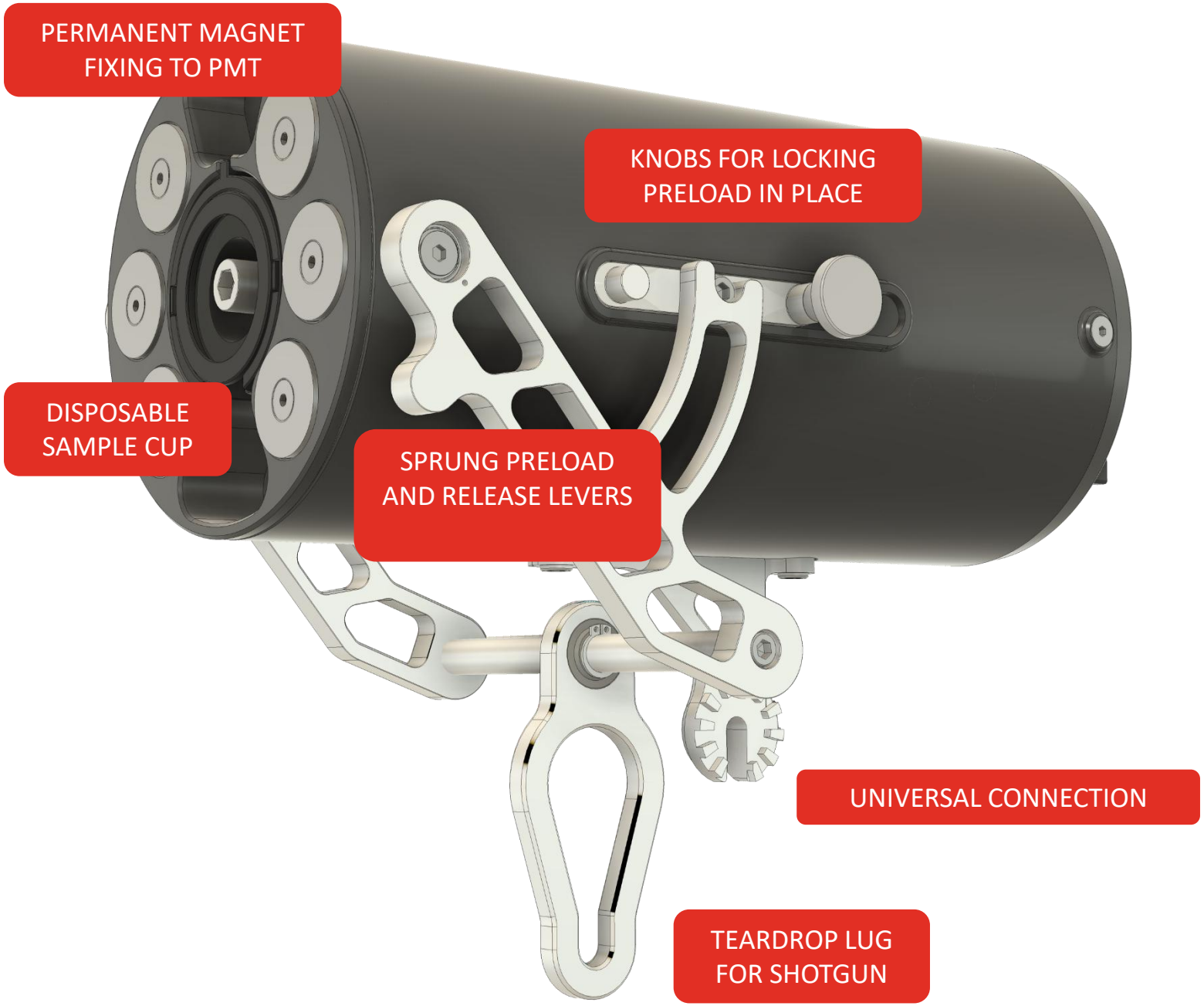
— Multitude of different designs

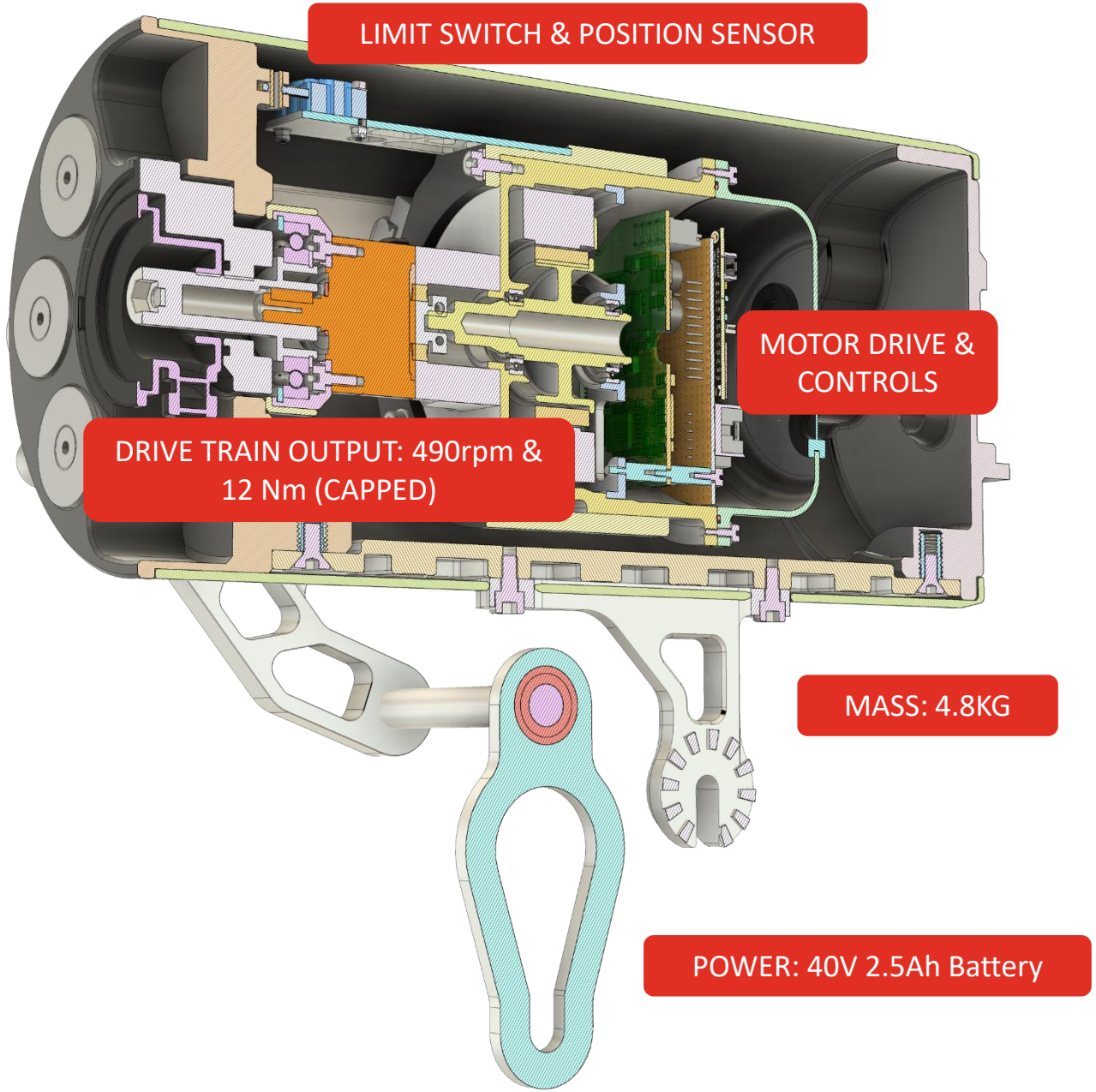


SOLUTION

Zero outages, significant savings, and a field-ready solution to transform UK network operations




PERMANENT MAGNET FIXING TO PMT
KNOBS FOR LOCKING PRELOAD IN PLACE
DISPOSABLE SAMPLE CUP
SPRUNG PRELOAD AND RELEASE LEVERS
UNIVERSAL CONNECTION
TEARDROP LUG FOR SHOTGUN

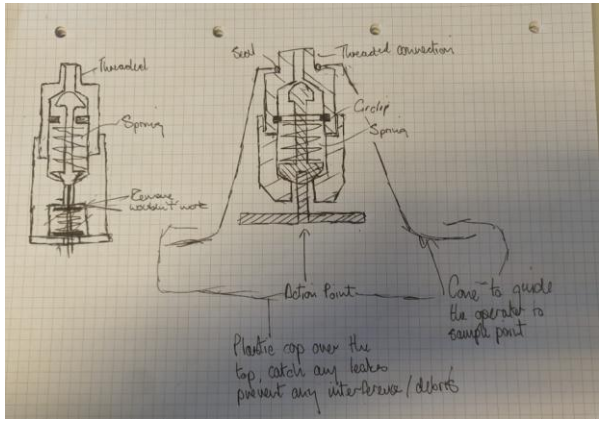

LIMIT SWITCH & POSITION SENSOR
MOTOR DRIVE & CONTROLS
DRIVE TRAIN OUTPUT: 490rpm & 12 Nm (CAPPED)
MASS: 4.8KG
POWER: 40V 2.5Ah Battery

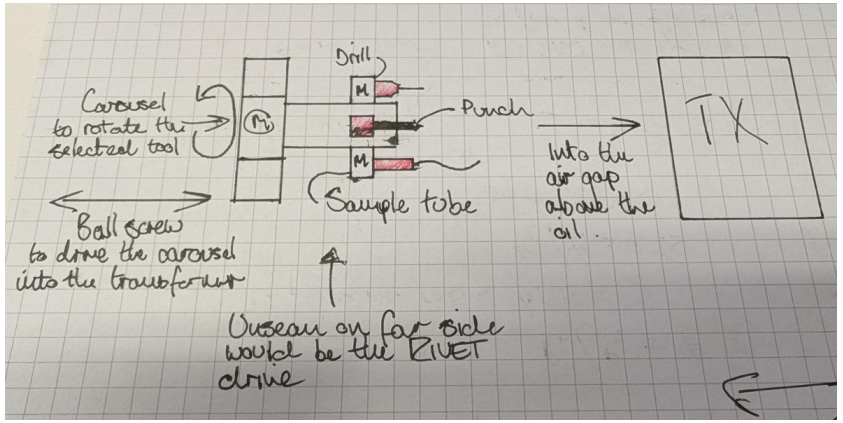

STOP

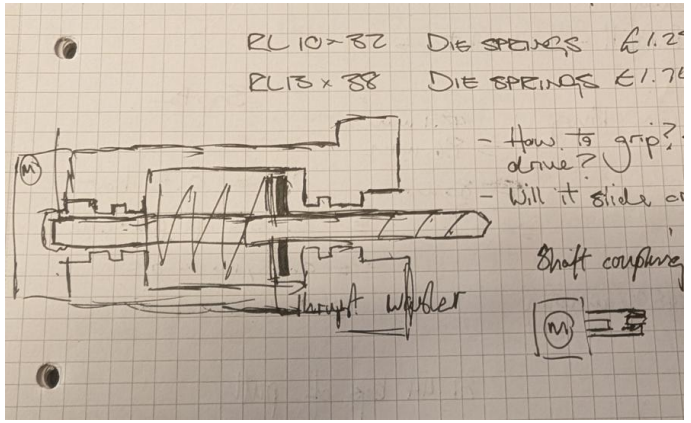
JOURNEY

The development of a concept to functional prototype and onwards, for live line PCB sampling without
de-energisation of the PMT

Phase 1
Concept Development







GENERATION

Present problem to wider Steer team

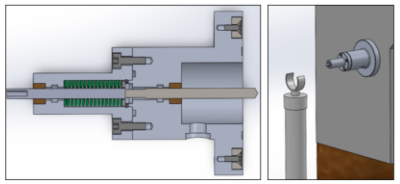
Investigation of existing tech

Investigation of tech used in different industries

Phase 1
Concept Development

Sealed Habitat (1/3)

Concept Description
- Magnet flange holds habitat to transformer
- O-ring & adhesive to seal habitat to external
- Spring loaded bit drills through Tx wall, into oil column, oil floods the body volume
- Check valve to drain oil to sample at ground
- Body left on transformer following ops

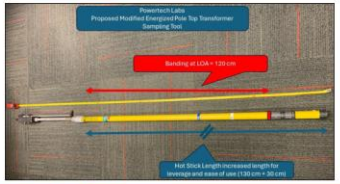


Concept Benefits
- Remote operation
- Single tool operation, no change required
- Deployed from insulated poles
- Lightweight ≈500g without drive
- Quick to prototype and test

Development Challenges
- Drive mechanism
- Proving the seal to the transformer
- Requirement for surface prep
- Protecting from external damage
- Non-mag transformers e.g. aluminium body

Powertech Equipment (3/3)

Concept Description
- Set of insulated poles with tooling
- Drill, punch, sample and seal
- Specially engineered rivet, qualified seal
- Available as de-energised kit (shorter)



Concept Benefits
- Field proven in Canada & North America
- Over 100,000 uses in the field
- Quick development
- De-energised kit being used in the UK

Development Challenges
- Need to be parallel to transformer
- Crew working within the 3m exclusion zone
- Hot glove team when working on live TX
- Alignment of multiple tools (cones and pole concepts help this)

GENERATION

REVIEW

Present problem to wider Steer team

Investigation of existing tech

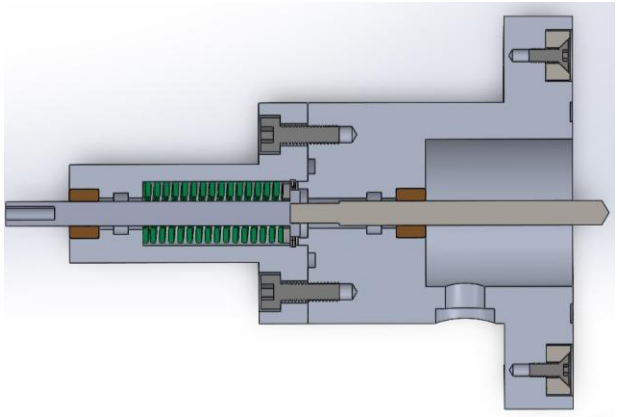
Investigation of tech used in different industries

Formal review with customer team

Constructive critique of presented ideas

Feedback gathered through follow up questionnaire

Phase 1
Concept Development



GENERATION | REVIEW | SELECTION

Present problem to wider Steer team

Investigation of existing tech

Investigation of tech used in different industries

Formal review with customer team

Constructive critique of presented ideas

Feedback gathered through follow up questionnaire

Concepts ranked by customer team

Two concepts selected

Preparation for Phase 2

Phase 2
Product Development Timeline

September 2024
Product specification agreed with SSEN & UKPN

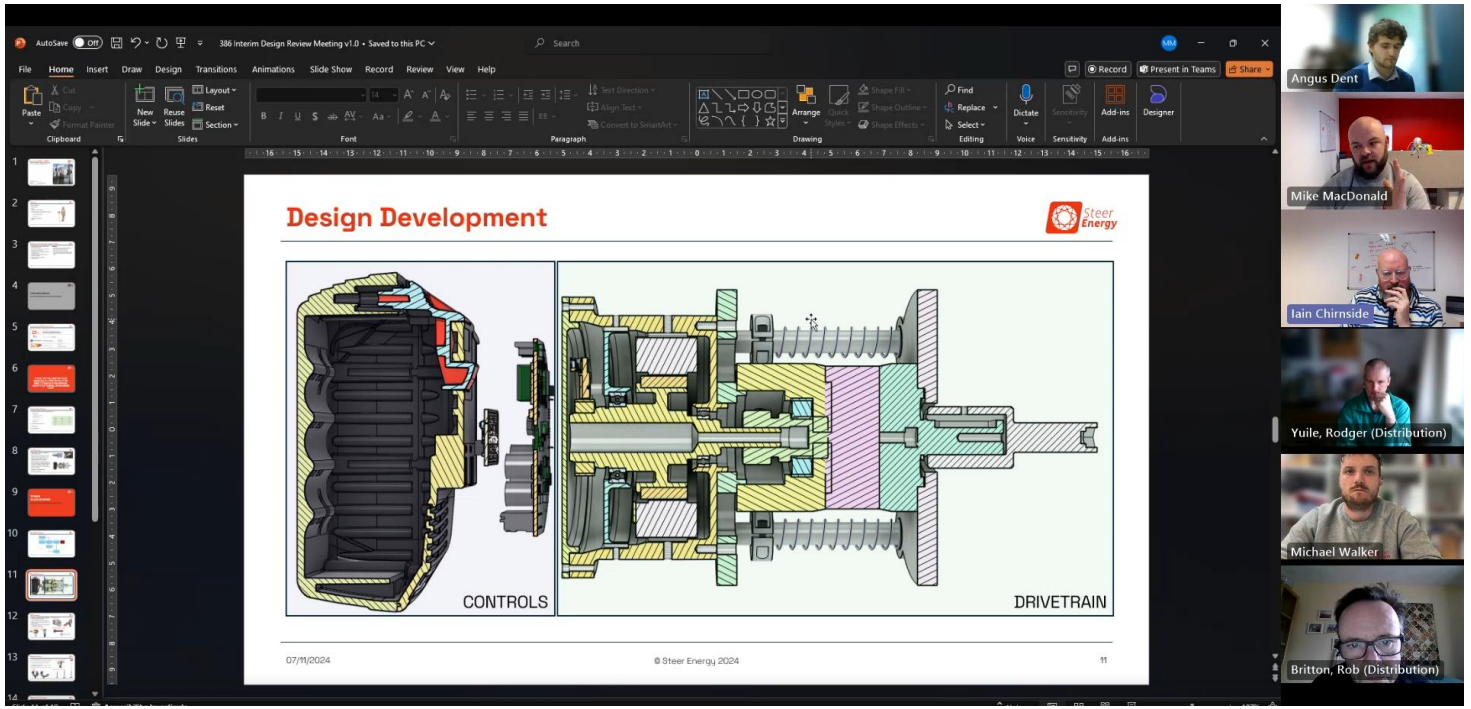
Tool Operating Temp: 0-40°C	Seal Temp Range: -40-100°C	Tool Weight: 2kg (desire) / 5kg (limit)
PMT Primary Voltage: ≤33kV	PMT Wall Thickness: ≤12mm	Chemical Compatibility: Mineral Oils & Weathering
Sealing Element Lifetime: ≥10 yrs	Fluid Sample Volume: 7ml	Wireless Operation: Yes

Sep 2024 — Dec 2025

Phase 2
Product Development Timeline

November 2024

Design progressing, establish weekly catch ups, first design review with SSEN & UKPN operational teams present



NOV '24

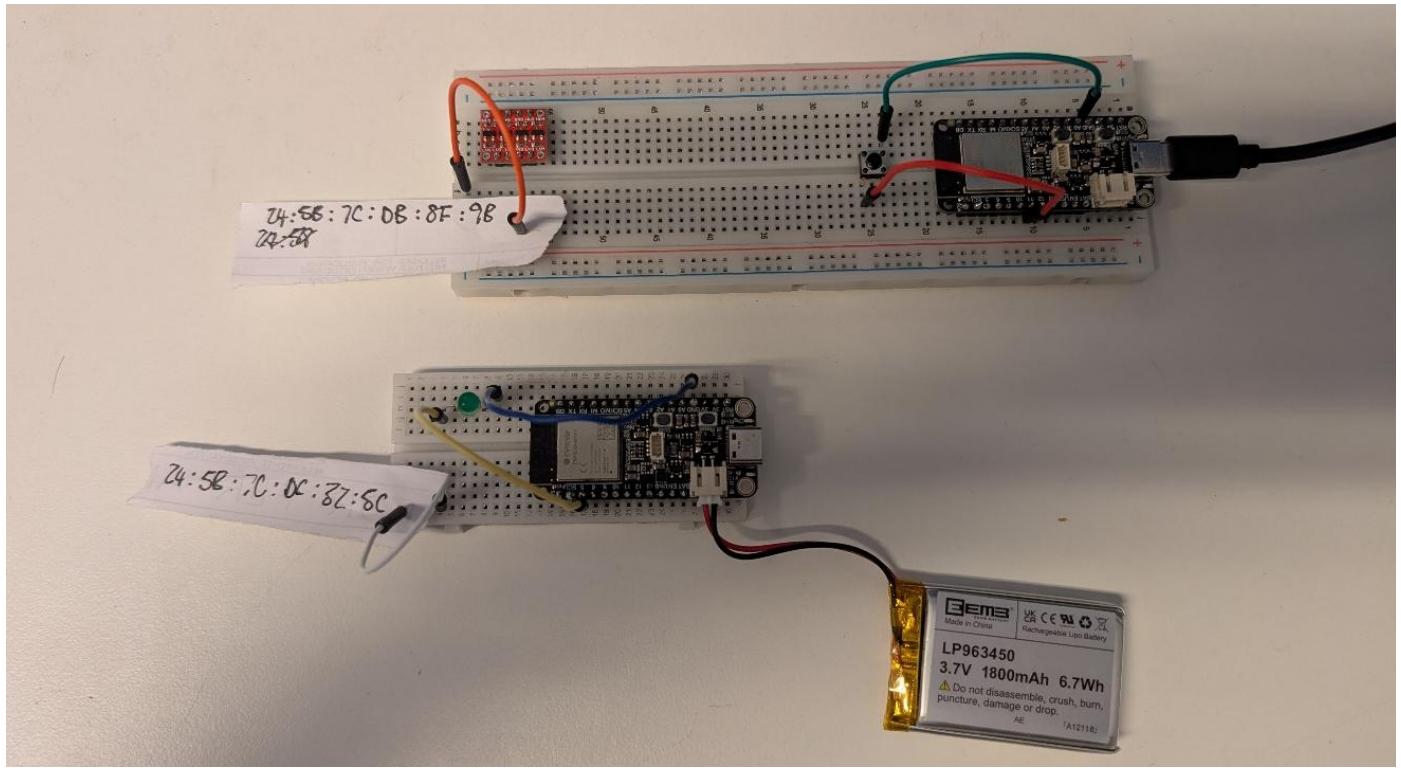
Sep 2024

Dec 2025

Phase 2
Product Development Timeline

December 2024

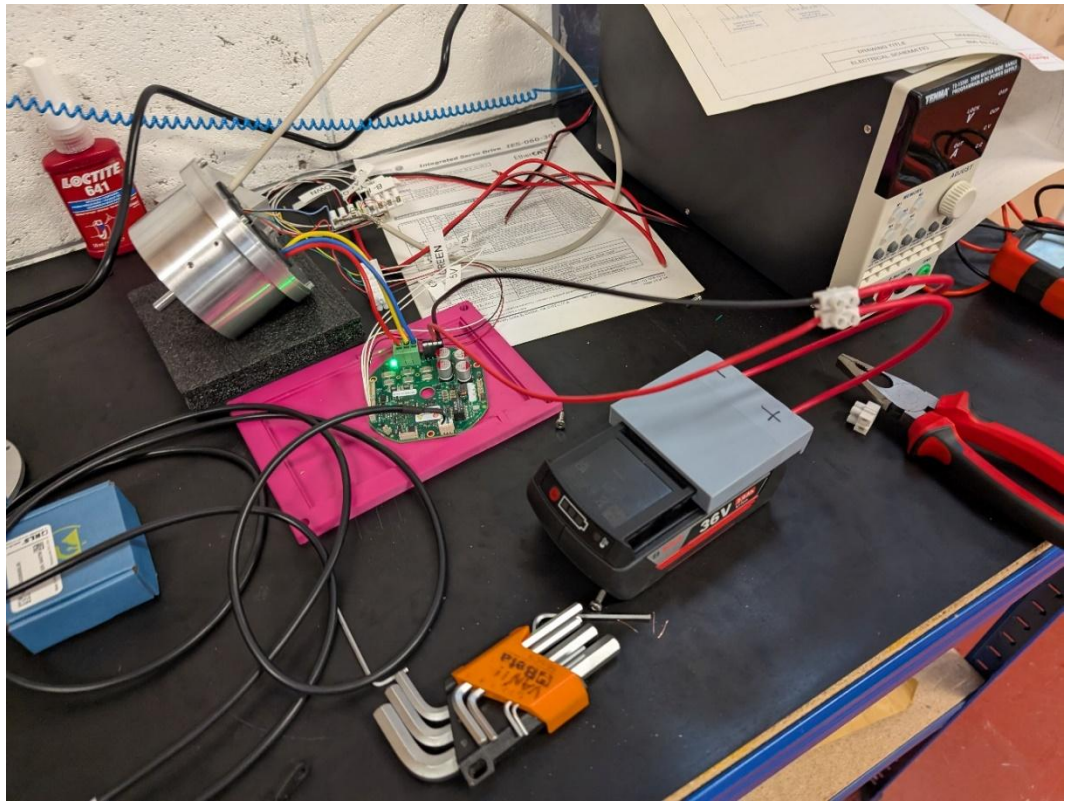
First attempt at wireless communications between the “tool”
and “remote control”



Phase 2
Product Development Timeline

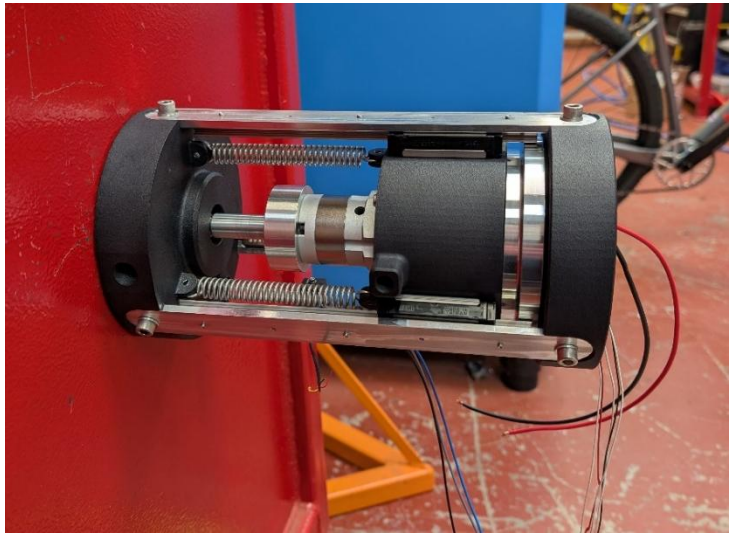
January 2025

Testing of the motor, motor controller and battery pack. First battery powered function of the motor



Phase 2
Product Development Timeline

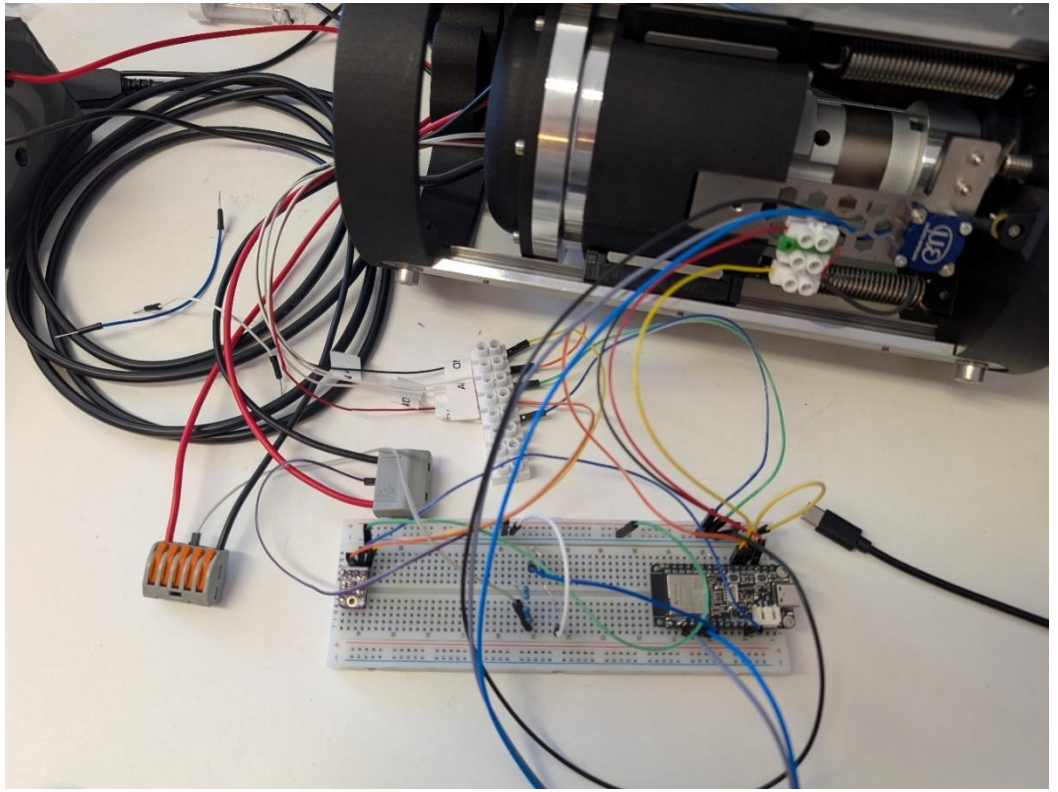
March 2025
Tool drivetrain (motor, gearbox and bit driver) assembled into tool chassis & first hole drilled using the tool
Second design review

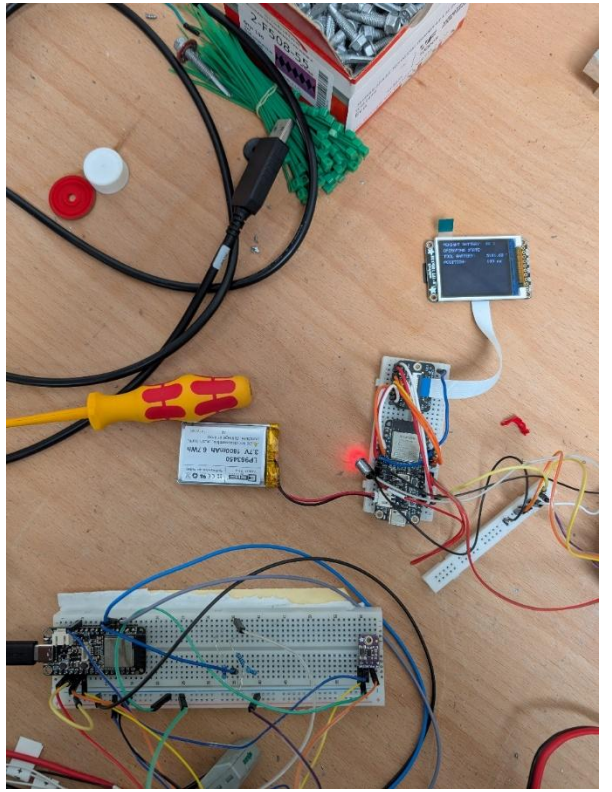


Phase 2
Product Development Timeline

April 2025

Installing control and sensor hardware onto the tool & development of the remote-control interface

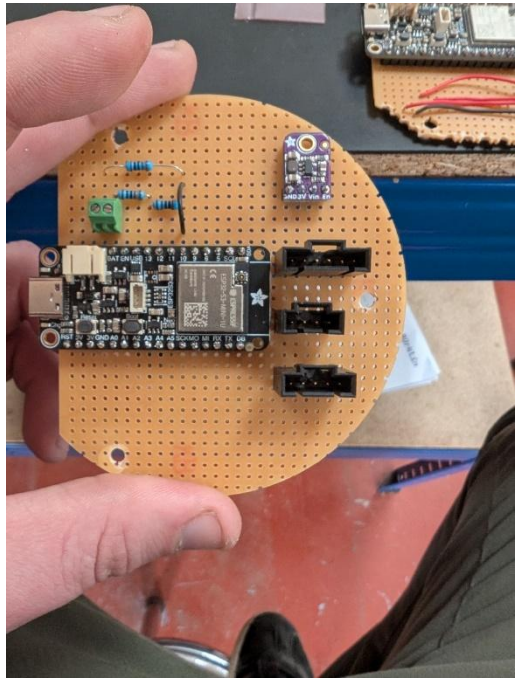




Phase 2
Product Development Timeline

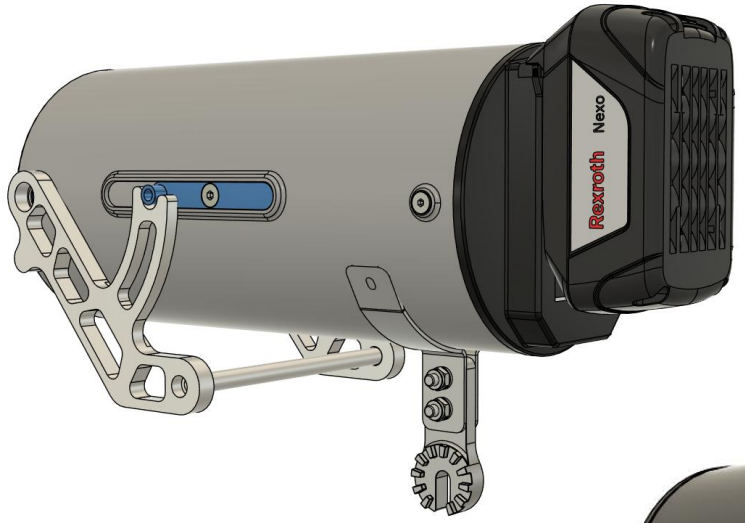
May 2025

First complete assembly of tool, prototype manufacture of circuit boards & customer workshop visit

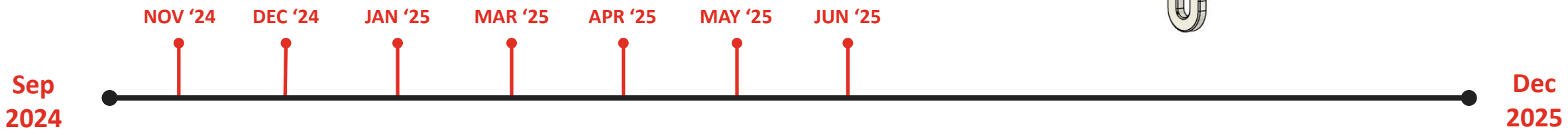


Sep 2024 — NOV ‘24 — DEC ‘24 — JAN ‘25 — MAR ‘25 — APR ‘25 — MAY ‘25 — Dec 2025

Phase 2
Product Development Timeline

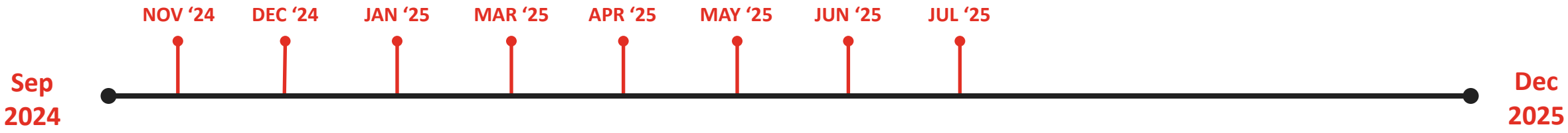


June 2025
Handling modifications to levers and universal connection



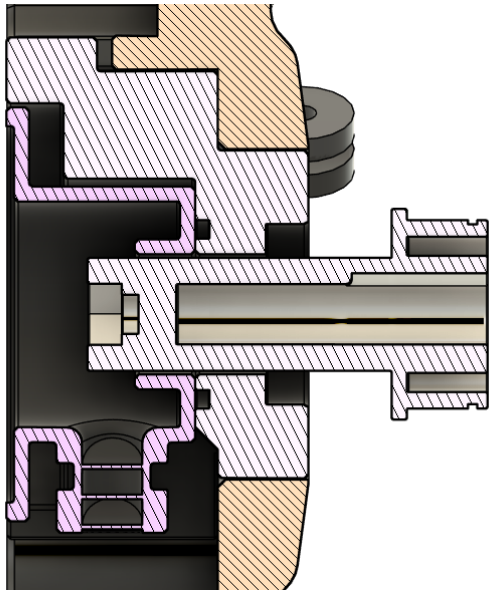
Phase 2
Product Development Timeline

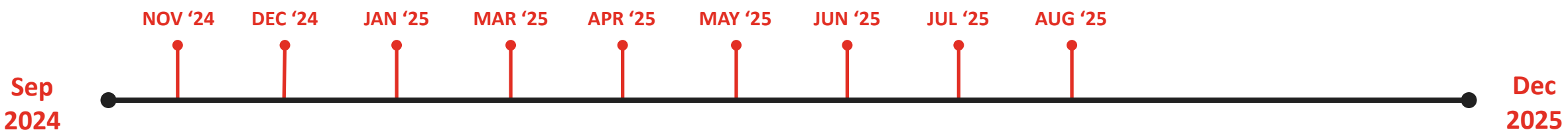
July 2025
First training centre testing on (de-energised) pole mounted transformers at SSEN training centre



Phase 2
Product Development Timeline

August 2025
Modification to sample cup and sealing interface to the PMT.
UKPN Training Centre testing

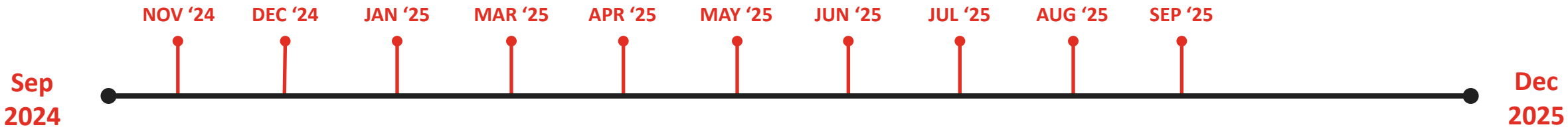




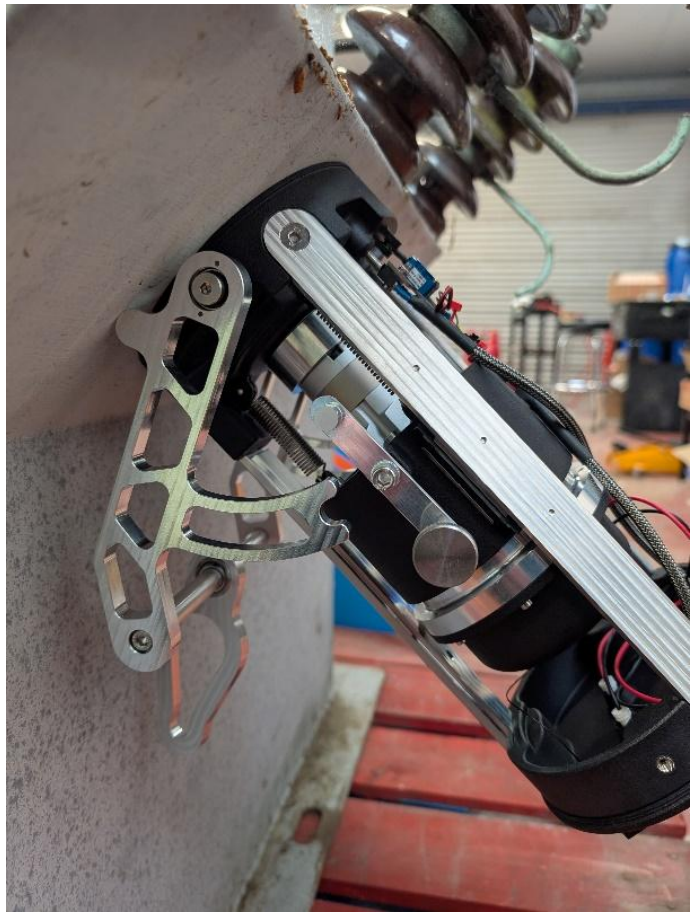
Phase 2
Product Development Timeline

September 2025

Improvement to comms signal strength &
completed formal workshop testing

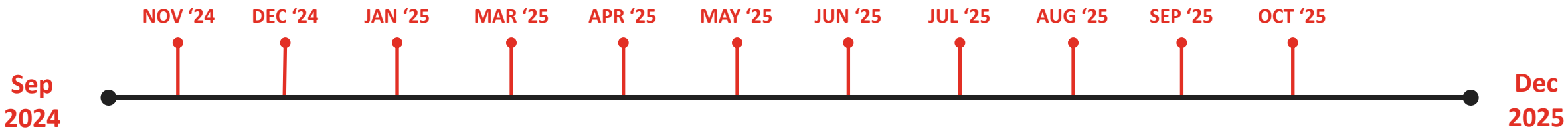


Phase 2
Product Development Timeline



October 2025

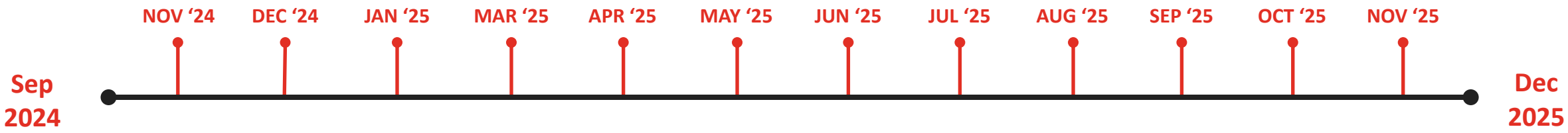
Design mods to capture lessons learned during workshop and training centre tests.
Visit to SSEN Thatcham workshop



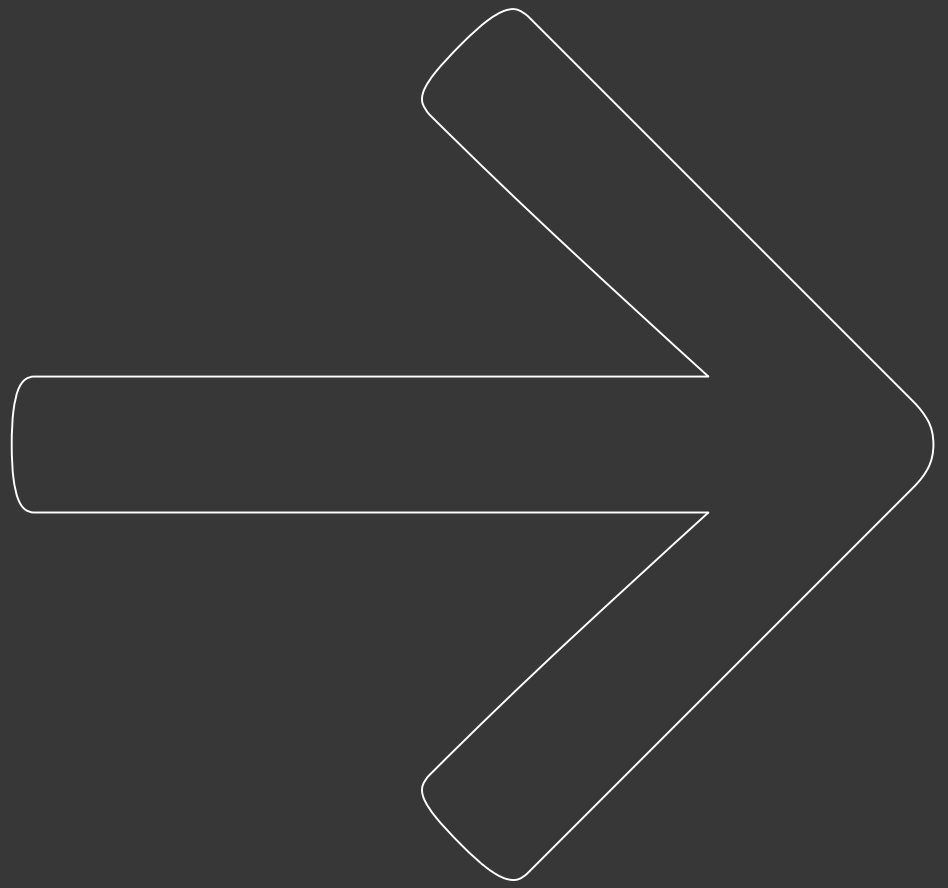
Phase 2
Product Development Timeline

November 2025

Return to UKPN Risby Training Centre
Manufacture of 4 prototype units. Delivery to SSEN and UKPN to start using in the field



NEXT STEPS



QUESTIONS

Visit us on the SSEN & Steer Energy Stands

Prototype tools on both stands

Name the tool