eSled a basis for Zero Emission Mobile Instrument (ZEMI)

Ari Karjalainen
Arctic Power Research Group
Lapland University of Applied Sciences

Leverage from the EU 2007–2013
European Union
European Regional Development Fund

Index

- o eSled-project
- o CSC2015
- o ZEMI
- o Future

eSled history 2009 -

- eMotion – project 2010 – 2013
  - budget just below 1 000 000 €
- ECV – project 2012 – 2014
  - about 500 000 €
- CSC + PTC 2015
  - about 90 000 € (travelling about 30 000 €)

eMotion – project 2010 - 2013

- This phase was in FC-program, funded by Tekes (+EU)
  - first version of eSled,
    - Lead acid-batteries
    - several controller manufacturers
    - several DC-motor manufacturers
  - Methanol FC (EFOY 65W), range extender (concept testing)
    - With Lead-acid batteries
  - Lithium-Ion
    - European Batteries (Finnish manuf. lately bankrupted)
  - Hydrogen FC
    - Metal hydride hydrogen container
    - PEM FC (Horizon)

ECV project 2012-2014

- phase was in ECV (Electric commercial vehicles)-program, funded by Tekes (+EU)
- 4 pc's fleet of eSled's with Lithium-Ion batteries from different manuf.
- about 4000 km test driving in total,
  - used also at safaris
  - all data recorded via remote DAQ-system with GPS positioning
  - data includes:
    - speed
    - battery current
    - motor current
    - battery voltage
    - SOC
    - …

SAE Clean Snowmobile Challenge 2015

- Held in Houghton, Michigan 2 – 7. March 2015
- Organizer KRC/MTU Jay Meldrum, staff and volunteers
- Finnish heritage very strong in Houghton
  - Street names in Finnish
  - Many of the inhabitants has Finnish names
  - Finlandia University
  - Some of the people speaks Finnish
    - At static display many came to speak Finnish with us
- We will be back again !!!

Our CSC 2015 team: students, ESO and me

From left: Jori-Jaakko, Matti, Jarno, Ari and Hanna-Maaria

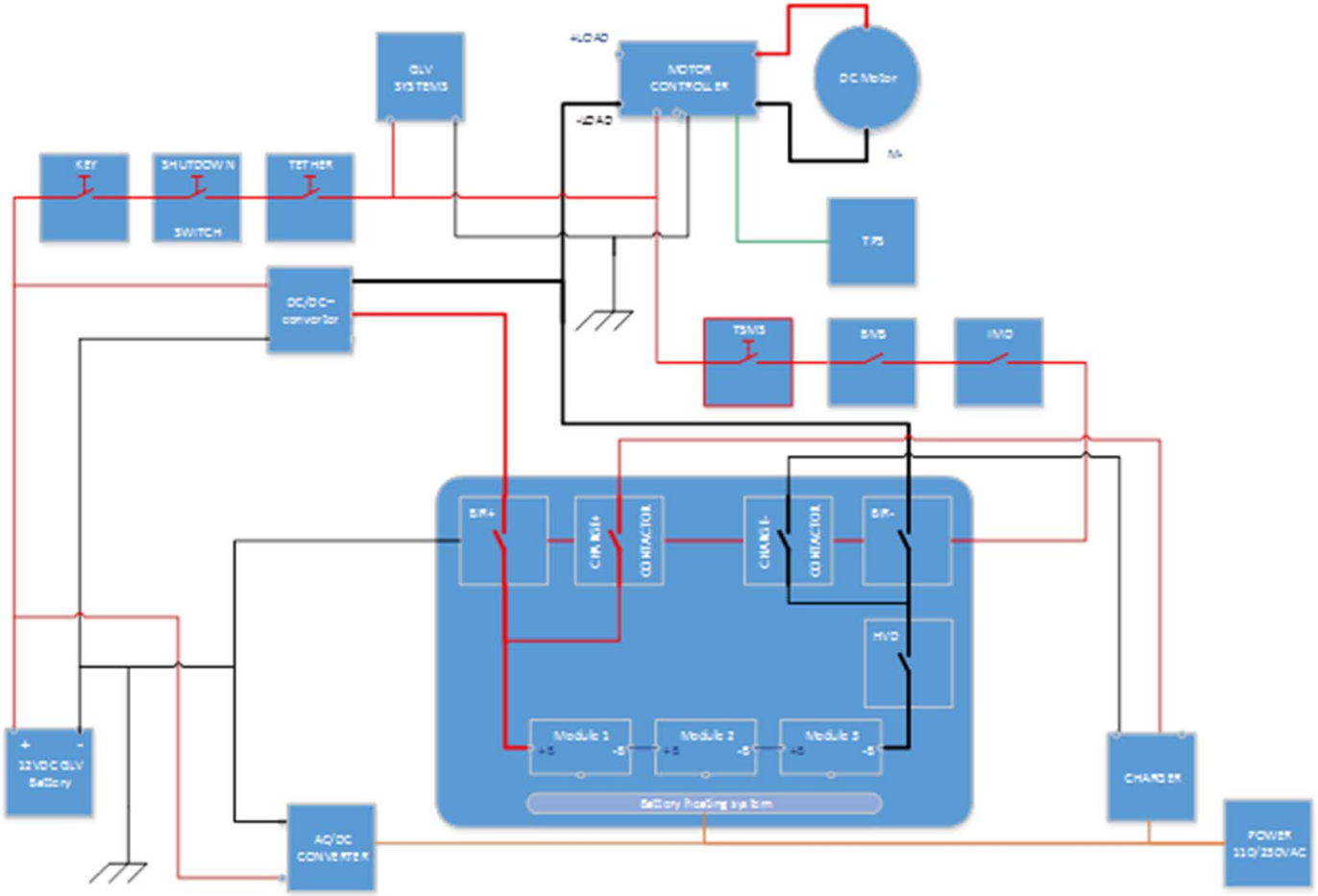
Our eSled specs

- Based on Lynx Adventure 2011 chassis
- Specs:
  - Weight 292 kg
  - Energy on board 4,9 kWh
  - Energy consumption 0,2 kWh/km (driver, 80kg on board)
  - Range 30,2 km
  - max speed 45 km/h
- operating temp. range -15°C … +20°C (lower temp set by battery manuf., can be decreased)

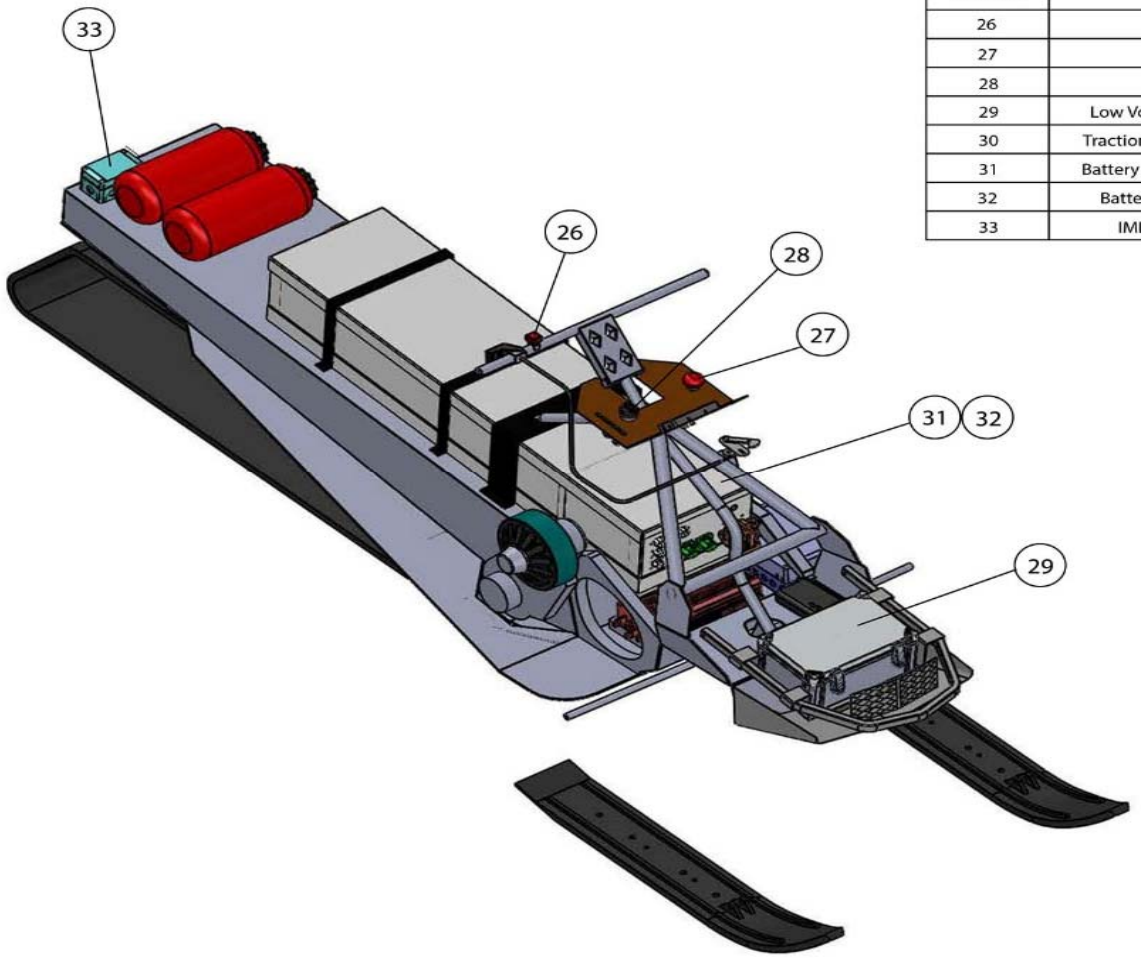
Operation principles:

- according to **CSC regulations**
  - Safety:
    - Main sw.,
    - Tether,
    - Kill sw. (operation principles same as IC-sleds)
  - startup seq.:
    - power on
    - crank (like car), (precharge takes about 10s)
    - “ready to go”- sound
  - driving:
    - throttle
    - brake
    - lights
- hand and thumb heating
- Informative digital display

Main parts of the tractive system



3D model



ITEM NO.	PART NAME	QTY.
26	Kill Switch	1
27	Tether	1
28	Key Switch	1
29	Low Voltage System Relays	1
30	Traction System Main Switch	1
31	Battery Management System	1
32	Battery Isolation Relays	1
33	IMD Error Latching	1

Reliability comes with…

- Simulations (Spice) together with 3D modelling (Solidworks)
- Design for modular structure -> easy assembly
- Design for easy maintenance -> easy service
- EV-connectors and cabling
- Correct tools
- No rush… well hurry, but anyway

CSC competition structure

- 14 different parts
  - Design paper, price estimation, static display, oral presentation
  - Weight, noise, coldstart
  - Acceleration+load
  - Handling
  - Range
  - Drawbar pull

CSC results

- Paper works were late…
- Inspection, in time
- Range test, 30.2 km, 1st, pdf
- Weight, 1st
- Noise test, 1st
- Drawbar pull, 1st
- Cold Start, fail (own mistake, driver forgot main switch), video
- Acceleration + load, 1st, video
- Handling (speed), 2nd

- FINAL RESULTS:….

WINNERS

Idea for ESF – ZEMI Zero Emission Mobile Instrument

- Mobile eSled
- Meets requirements needed
  - Polar conditions (cold, wind, snow blow,…)
  - Reliability
  - Normal sled operation (easy to adapt)
  - Energy source for measurement equipments
- Communication on-board (user selectable, Iridium?)
- Instrumentation easily to connect
  - BUS, rack, …

What next?

- Need for eSled?

QUESTIONS ?