SUSTAINABLE POWER SUPPLY FOR REMOTE RADIO LINK STATIONS IN GREENLAND BASED ON DC MICRO GRID
SCIENCE AND TECHNOLOGY
SCIENCE AND TECHNOLOGY

- Classical science subjects
- Engineering
- Agricultural sciences
- Food research
- Environmental science.

Science and Technology key figures
- Student population 2017: 6,766
- PhD students 2017: 649
- Employees 2017: 2,985
- Publications 2017: 4,265
ELECTRICAL ENERGY TECHNOLOGY

Conversion and Transport of Electrical Energy

• Electrical production
  • Central production
  • Decentral production
• Transport and Storage of Electrical Energy
  • Reliable Energy supply
  • Safety
• Use of Electrical Energy
  • Use as little as possible
  • Energy savings
  • Smart energy usage

110 Students/year
ELECTRICAL ENERGY TECHNOLOGY
BACHELOR PROJECT

Sustainable power supply for remote radio link stations in Greenland based on DC micro grid


TELE-POST laver forsøg med grøn energi

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TELÉ-POST ønsker at gøre radiokøderne mere bæredygtige og spare ressourcer på driften. Derfor laver TELÉ-POST nu et forsøg med vindmøller.

Grønland har omkring 50 radiokøder langs vestkysten, der sikrer de fleste byer og bygder internetforbindelse. TELÉ-POST bruger i dag mange ressourcer på at leje helikoptere og sende medarbejdere op for at fylde brændstof i tanken på radiokøderstationerne.
BACHELOR PROJECT

The telecommunications infrastructure consists of digital radio link from Nanortalik in South Greenland to Uummannaq in North Greenland.

- Often placed in remote areas
- Own off-grid energy production
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Today
- Traditional AC system
  - Diesel generator
  - Solar panel
  - Battery storage
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Tomorrow

- Micro grid DC system
  - Diesel generator
  - Solar panel
  - Battery storage
  - Wind mill
DC MICRO GRID

Solar panel → DC → DC → AC → DC → Battery bank
Wind mill

DC bus system
Radio System

House load
SYSTEM DEMANDS

The system must ensure a stable supply.

• Service interval once a year

The system must be redundant.

• Must continue to run with short-circuit error and still supply radio with power

The system must be reliable and safe in error scenario

• Short circuits must be handled safely
  • No damage to equipment or personnel
SYSTEM ARCHITECTURE

Single bus unipolar DC

- Commonly used
- Simple

Missing redundancy
SYSTEM ARCHITECTURE

Single bus bipolar DC

- Increased reliability

Missing redundancy
SYSTEM ARCHITECTURE

Ring bus DC

• Increased complexity
• Power under service
• Redundancy!
INTELLIGENT ELECTRONIC SWITCH

Determine IF there is a failure
Determine in what direction the failure is
GROUNDING

Very challenging in Greenland
Rocks!
Sea electrode
   Conductor to sea with grounding potential
   Only possible at stations close to sea
Circular electrode
   Long conductor placed in ring around the station
   High ground resistance!
SYSTEM PROTECTION - GROUNDING

Grounding is needed

- Fault detection
- Keep stray current low
  - Corrosion
- Minimize common-mode voltage
  - Safety (person and equipment)
- Safe and reliable operation of power supply
GROUNDING CONFIGURATION

TN System

Use the neutral as ground connected

• Advantage
  • Minimized ground potential and enhanced safety
  • Easy detection of faults

• Drawbacks
  • Touch voltage can be too high (safety)
  • Large error currents
  • Ground potential rise
GROUNDING CONFIGURATION

TT System
Separate connection of ground and neutral

• Advantage
  • Minimized ground potential and enhanced safety
  • Easy detection of faults

• Drawbacks
  • Circulating currents
  • Higher voltage stress
  • Ground potential rise
GROUNDING CONFIGURATION

IT System
Positive earth

• Advantage
  • Less corrosion
  • Small currents with Line – Ground faults
  • Good resistance to lightning

• Drawbacks
  • Harder to detect errors
  • Needs insulation monitoring
INTELLIGENT ELECTRONIC SWITCH

The key to make a DC micro grid system that is

- Stable
- Redundant
- Reliable and Safe
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