Green Mountain
DATA CENTRE

Green Mountain Data Centre

«The greenest data centre in the world»

Knut Molaug

The owner

SMEDVIG

- Norwegian privately held family office
- Typically long term owner
- Equity base of approx. 10 BNOK
- Investment areas:
  - Property
  - Industry
  - Venture / private equity
  - Opportunistic
  - Portfolio of more liquid assets

www.smedvig.no

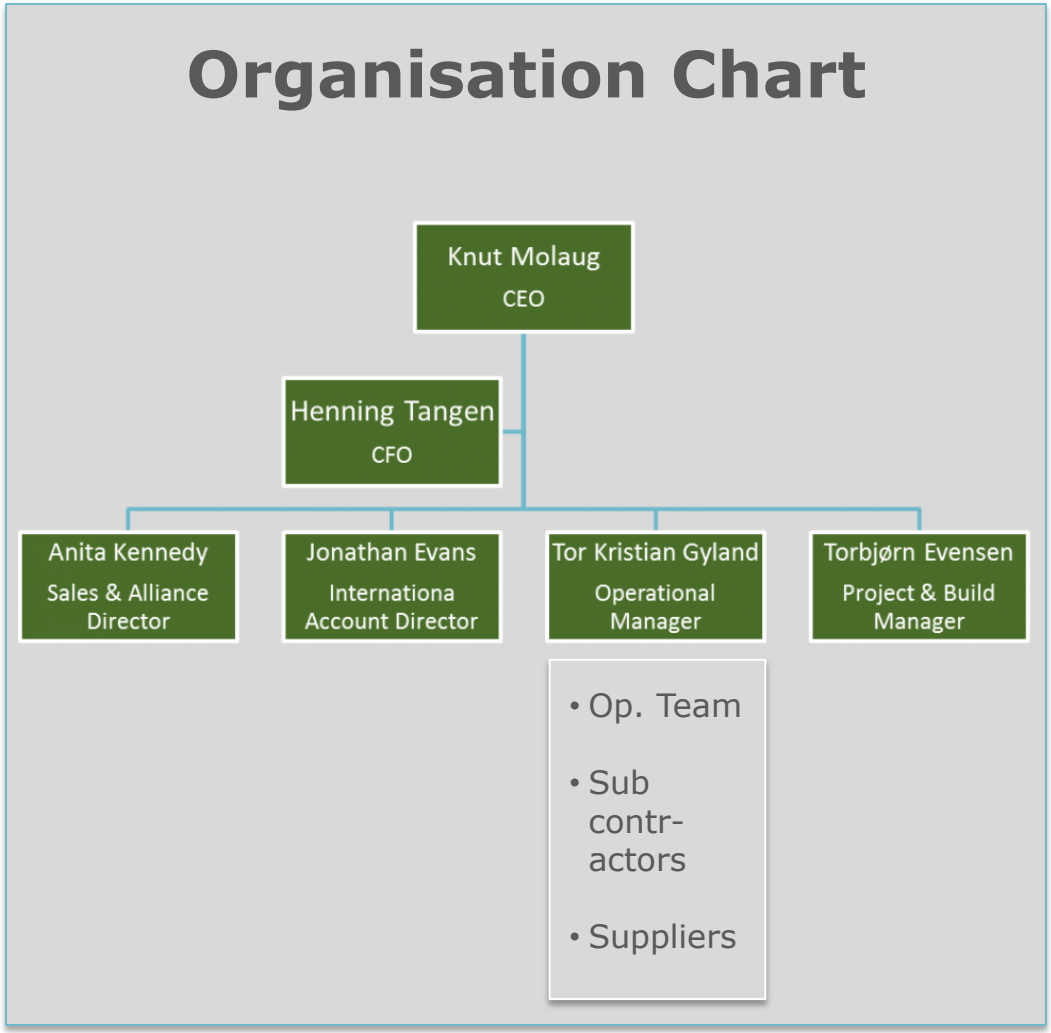
An industrial initiative by Smedvig

Organisation

- Knut Molaug, CEO

- Anita Kennedy, Sales & Alliance Director

- Tor Kristian Gyland, Operations Manager



Our DC location

- Former NATO facility
- Proximity - city of Stavanger:
  - 30 min from city centre
  - 40 min from airport
  - Enthusiastic municipality
- About Stavanger region:
  - ~300.000
  - Oil industry hub
  - High tech
  - University
  - Growth region

The site seen from the air

- The administration building is seen in the foreground
- Data centre entry is through 100 m long tunnels into the mountain
- 6 separate mountain halls
- Mountain halls are covered by 100–200 m of solid rock
- Adjacent to 140 m deep threshold fjord

General DC design parameters

- Uptime institute Tier III
  - Utilising Uptime certified personnel in design team
  - 3'rd party review performed
  - Conferences directly with Uptime Institute personnel during process («certification ready»)
  - All items in compliance with Tier III level
  - Most items in compliance with Tier IV level

- Telecommunications Industry Association Standard - TIA 942
  - All DC specific installation of material and cabling done according to TIA 942
  - Customer rooms design according to TIA 942
    - Clients may choose otherwise if required

Tier III +

	Tier I	Tier II	Tier III	Tier IV
Number of Delivery Paths (power and cooling)	Only 1	Only 1	1 Active 1 Passive	2 Active
Redundancy	N	N + 1	N + 1	N + N or 2 (N + 1)
Compartmentalization	No	No	No	Yes
Concurrently Maintainable	No	No	Yes	Yes
Building Type	Tenant	Tenant	Stand-alone	Stand-alone
Useable for critical Load	100% N	100% N	90% N	90% N
Uninterruptible Cooling	None	None	Maybe	Yes
Single points-of Failure	Many + human error	Many + human error	Some + human error	None + human error
Theoretical availability	99,671%	99,741%	99,982%	99,995%

Unique power availability

- 3 independent / partly independent feeds
  - Lyse Elnett (22 kV)
  - N+2
- Underground cable feed
- Proximity power plants
- Proximity to largest reservoir
- Low prices region (NO2)
- Low cost distribution

Power availability to the site estimated to: 99,99997%

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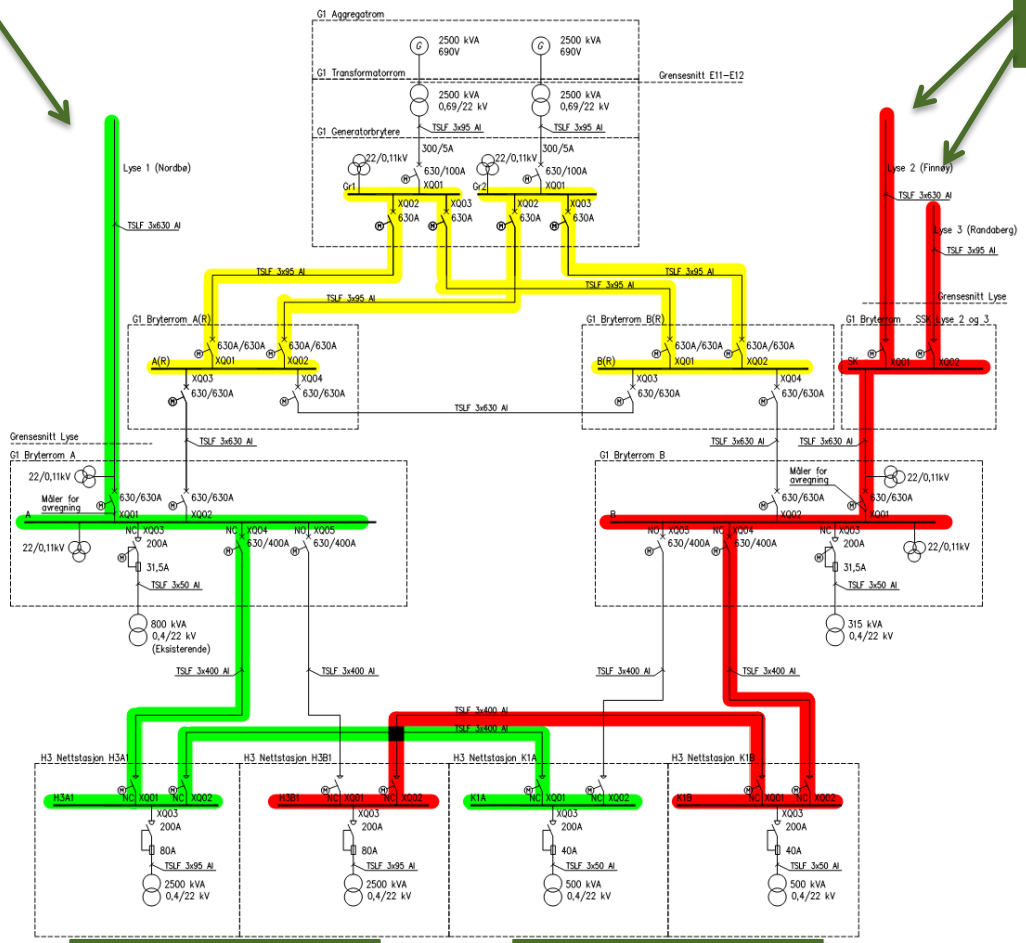
HV: A and B distribution incl. Genset

Generator station

Grid supply #1

Grid supply #2 and 3



DC supply

Cooling station

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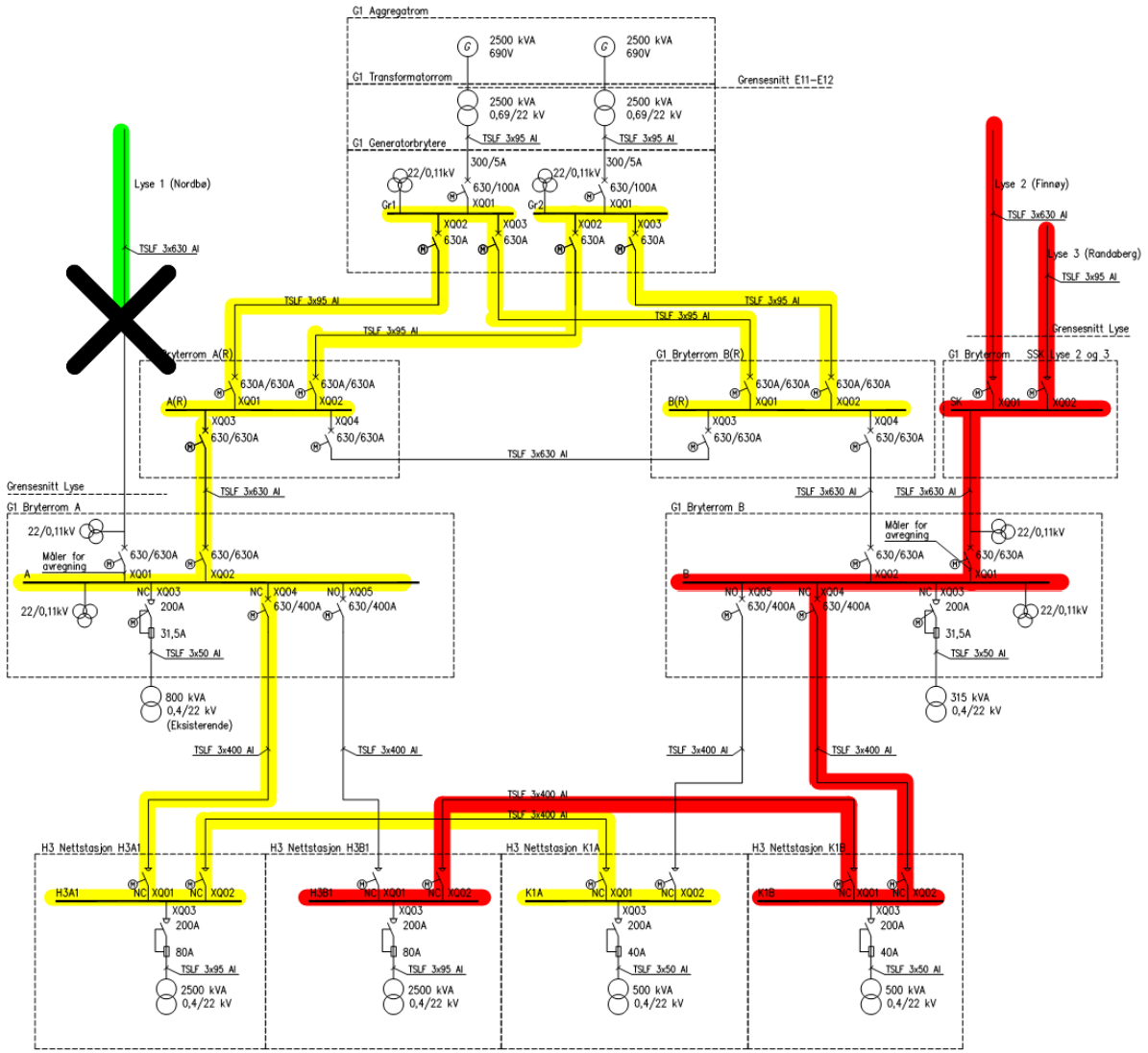
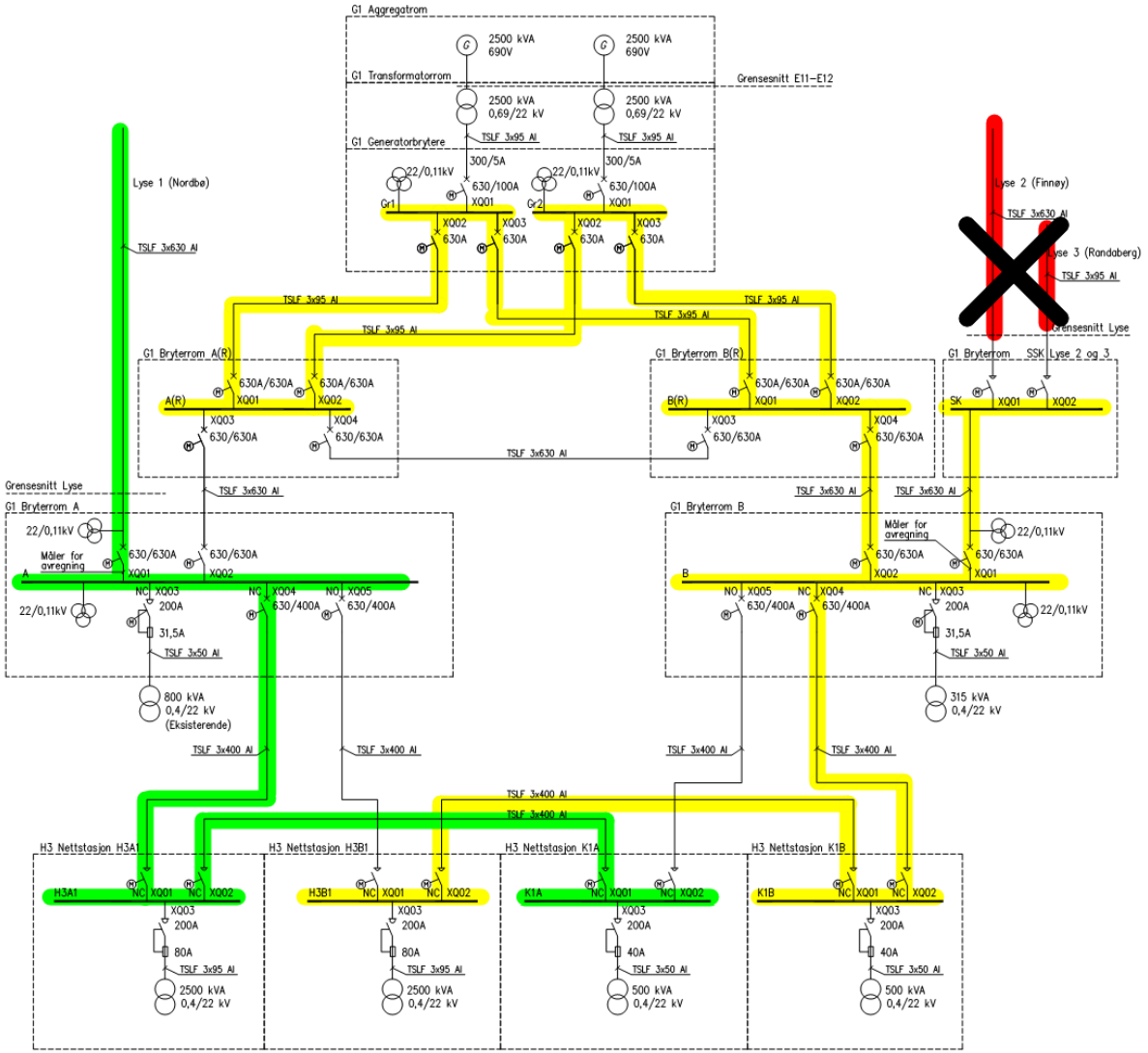
Failure on A (Grid #1 failure)



Failure on B (grid failure #2 and 3)



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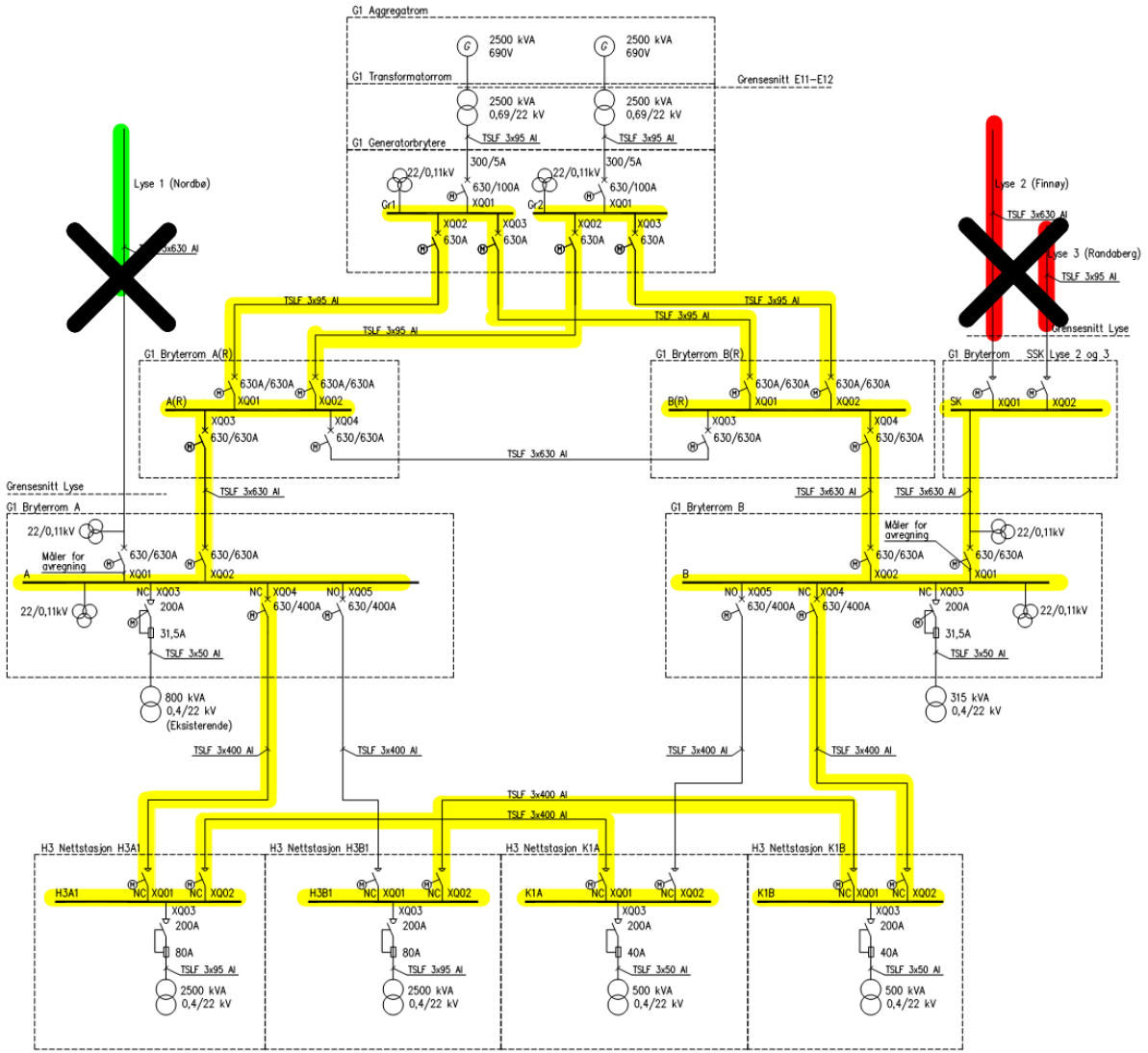
Failure on A and B



Power house

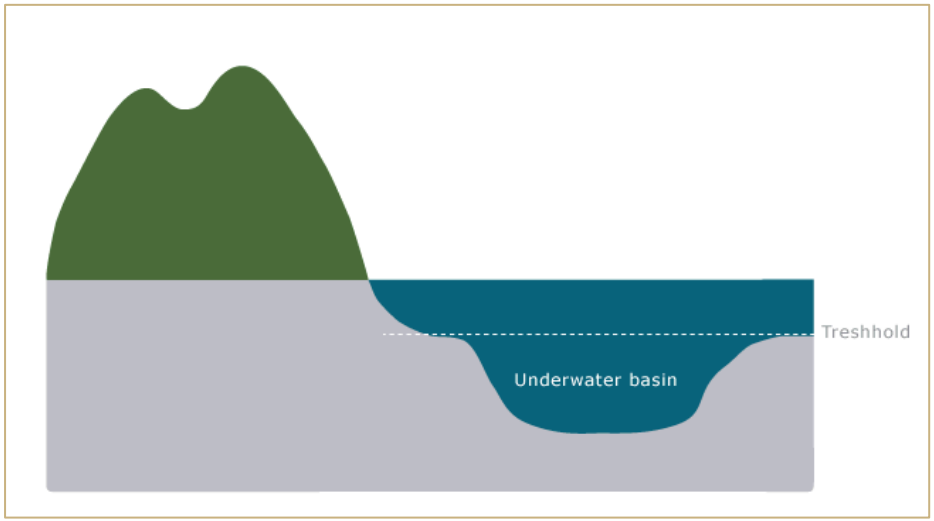
The power house

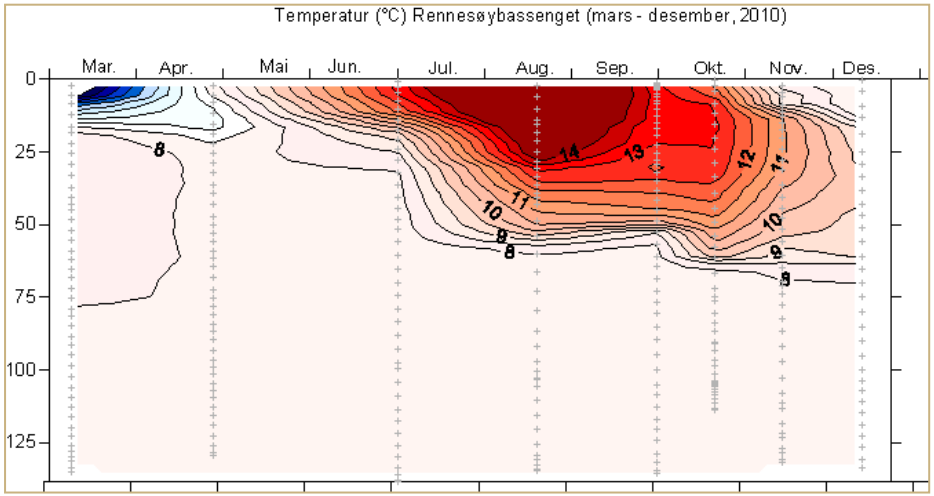
2,5 MVA power generators in N+1 configuration

HV supply (A and B)

HV Control switching

Unique free cooling from the fjord

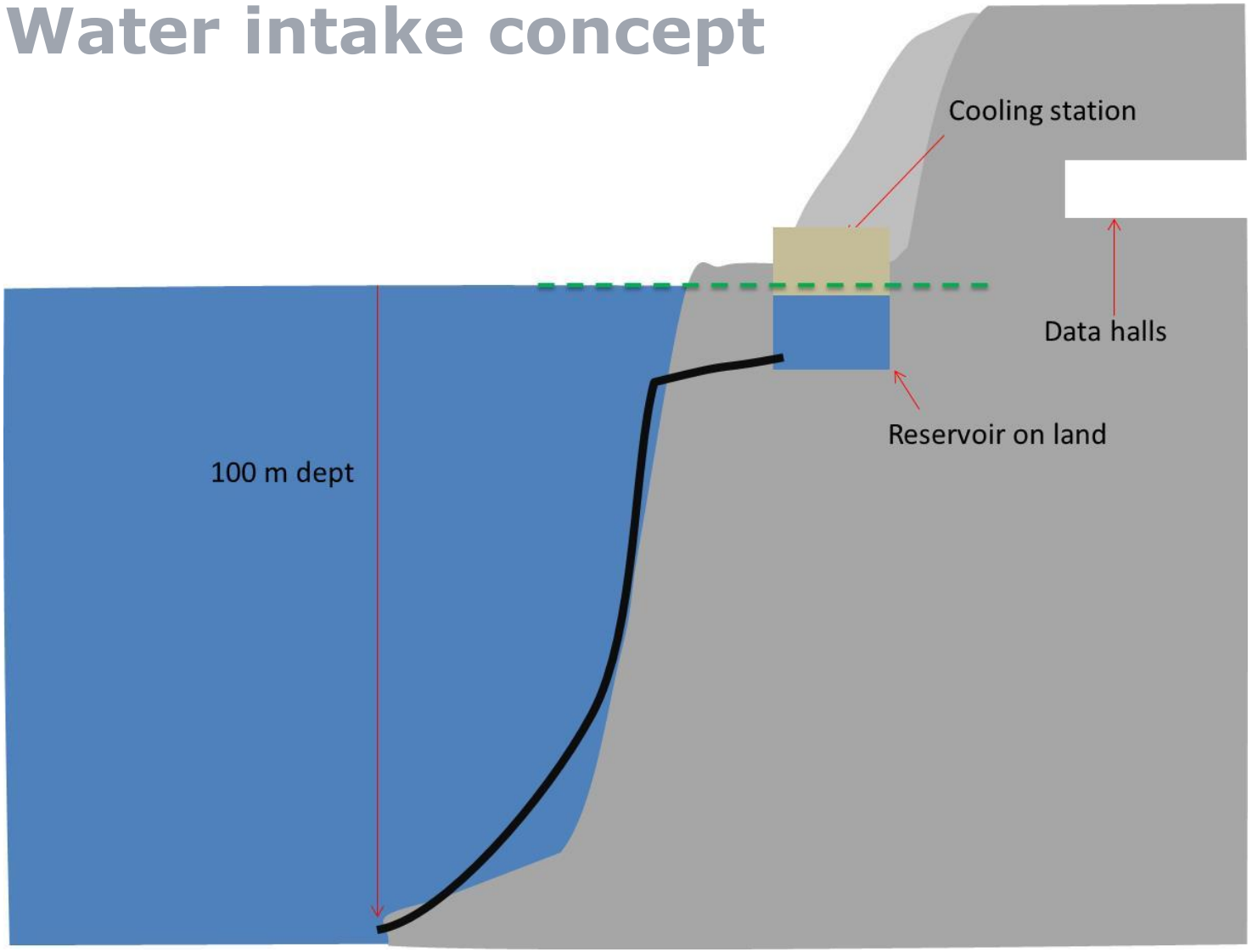




- A threshold fjord
  - Large underwater basin
  - Several cubic kilometers of water

- 8°C (46 F) water available year round.
  - Water inlet at 100 m+ depth just outside the facility
  - Securing ample access of 8°C (46 F).

Water intake concept



Cooling station

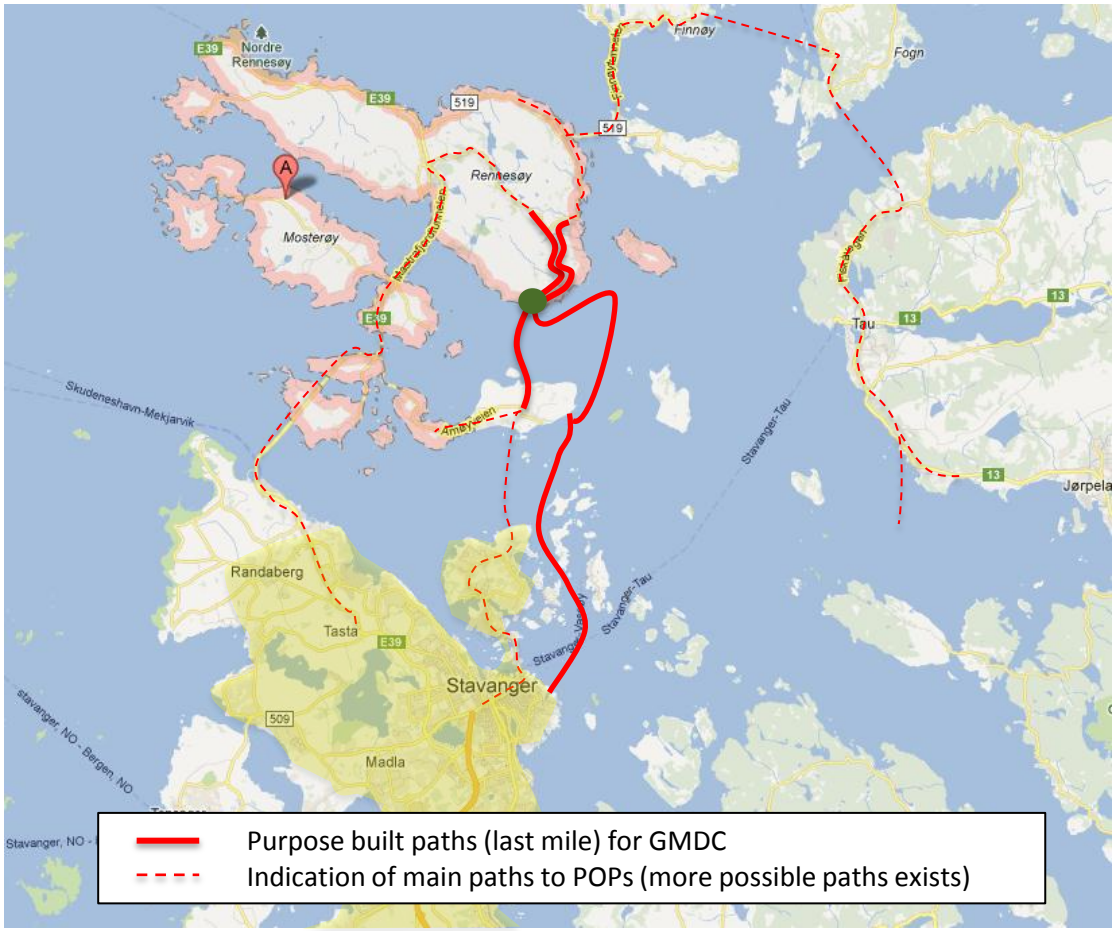
From the cooling station (B-side)

From the cooling station (A-side)

High power density and efficiency

- The cooling system allows for high power density
  - Up to 6 kW/m^2 as standardised solutions
  - Above 6 kW/m^2 as bespoke solutions
- Price efficiency for increased power density
- World class PUE

Communication – fiber path last km's



- Carrier neutrality
  - Lyse / Altibox
  - Telenor
  - TDC
  - Broadnet
  - Others
- Good connectivity
  - High capacity fiber to Oslo
  - Low latency (2,8 and 3,6 ms)
  - Good connectivity across the North Sea
  - New connectivity to Denmark in 2014.
- Dark fiber availability

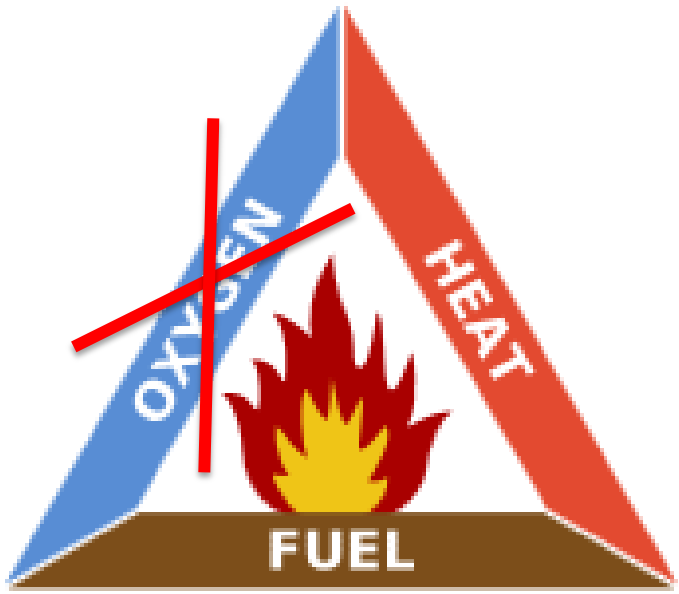
Communication – rest of Europe

- Multiple paths into European markets
  - Via Oslo – multiple carriers
  - Across the North Sea – single carrier
  - Across to Denmark – multiple carriers
- Low latency international connectivity

Destination	Latency (one way)	Comment
Oslo	3 ms	
Copenhagen	8 ms	
Stockholm	7,3 ms	
London	6.5 ms	Across North Sea
Aberdeen	4,5 ms	Across North Sea
Amsterdam	12 /13 ms	Via London/ Copenhagen
Frankfurt	15,5 ms	

Fire suppression and protection

- Use of mountain halls enables use of hypoxic air venting.
- Continuous fire suppression
  - 0_2 level reduced to about 15% (from 21%)
  - Fire can not occur since the combustions process does not get enough oxygen
  - Corresponds to an altitude of approx. 3.000 m
- Hypoxic air venting:
  - Reduces / limits smoke creation
  - Fire not possible
  - Secures continuous operation
  - No fire damages
  - No secondary extinguishing damages (corrosion, environmental damages, toxic gasses etc.)
  - No risk due to release of fire extinguishers
- Extraordinary clean air
  - Creates optimum operational environment
  - Avoiding any corrosion damages from saline air
- Continuous monitoring



The **fire triangle**;
- Without ***heat***, a fire cannot begin, and it cannot continue;
- Without ***fuel*** *(burning material)*, a fire will stop;
- Without sufficient ***oxygen***, a fire cannot begin, and it cannot continue.

Vault security

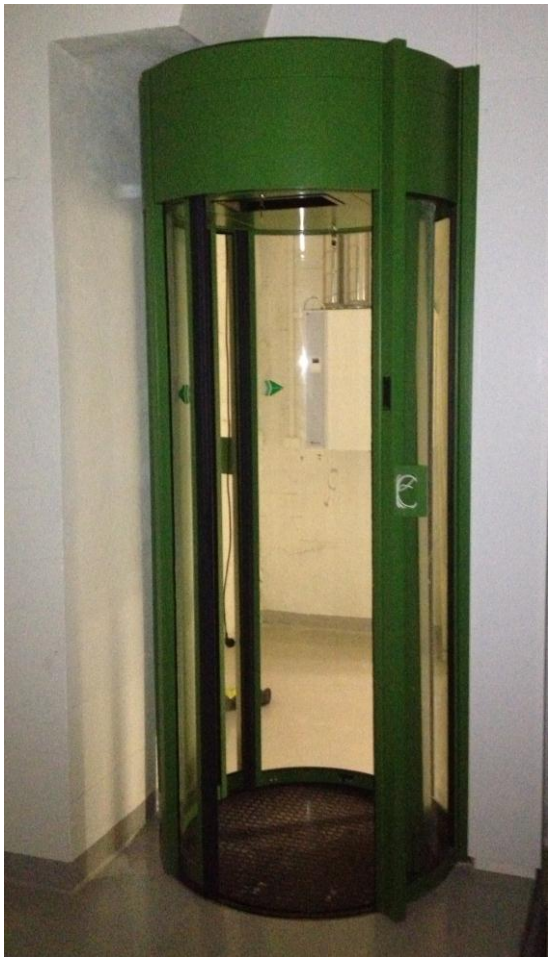
- A former high security NATO ammunition storage (largest in northern Europe)
- Built for highest military security level
  - Protected against Electro Magnetic Pulses (EMP)
  - ”Nuclear secured” facility
  - Protected against sabotage and direct attacks from the sea.
- ”Best in class” data security

Security - Perimeter

- The centre is a former NATO facility built for high security
- Only one road leading in to the facility
- No other activity in the vicinity
- 24/7/365 surveillance
  - Using thermal and PTZ IP cameras
  - Cameras covering all doors and entrances
- Intelligent video analysis (IVA) is used in combination with the thermal cameras
  - The IVA software is capable of distinguishing between animals, humans and other "normal" vs. un-normal" movements and objects at the location

Security - Mountain

- The Mountain halls can only be entered through one entrance.
- This entrance is secured with a man-trap and biometric access control
  - Allows only one person at the time entering the facility
  - Person has to be registered in the approved access database
  - Includes weighing and stereo camera
- The Mountain halls are protected through several security zones,
  - Access to zone requires authorization
- 24/7/365 surveillance
  - Using thermal and PTZ IP cameras
  - Cameras covering all doors and entrances
  - Human recognition software



Operation and reporting

- DCIM system from Schneider

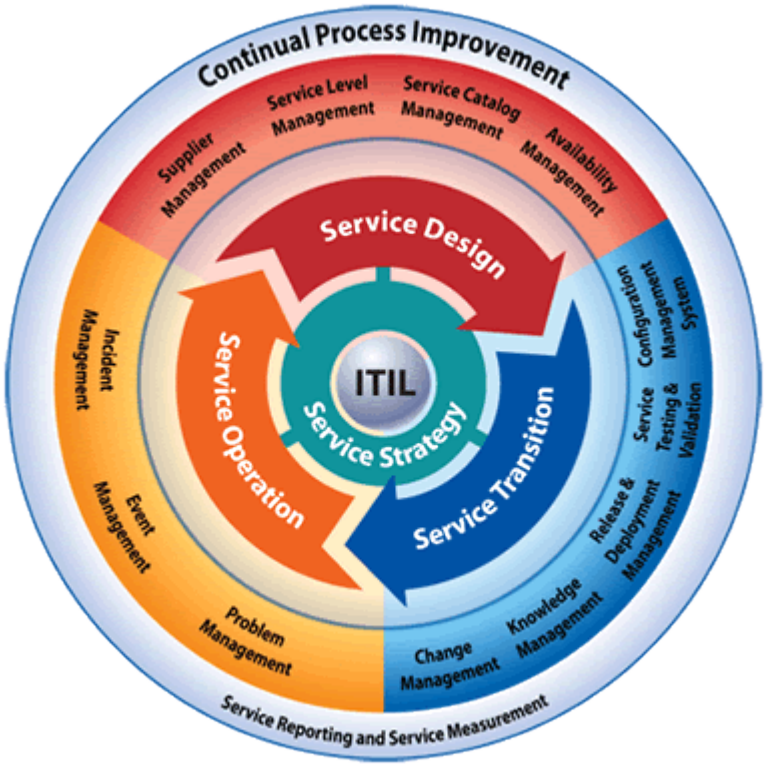
- Capacity management
  - Simulation
  - Planning and optimization
  - Reporting
- Power monitoring
  - Power management
  - Billing
- Energy efficiency
  - Intelligent PUE/DCiE analytics at subsystem level
- Presentation
  - Apps available for mobile devices

- Each customer room is equiped with a display showing the current PUE and O² level

- Monthly reporting is done on agreed KPIs, such as:
  - Power usage and availability
  - Power load
  - Cooling availability
  - PUE
  - O² level
  - Temperature
  - Humidity
  - Access to room

Operation based on ITIL processes

- Service strategy
  - Service portfolio management
  - Financial planning
- Service design
  - Service Level management
  - Capacity management
  - Availability management
  - Continuity management
  - Security management
- Service transition
  - Change management
  - Asset management
  - Configuration management
  - Release management
- Service operation
  - Incident and request management
  - Event management
  - Problem management
  - Order management
  - Access management
- Continual service improvement



Thank you for your attention!

The administration building is seen in the foreground