NEATPUMP – LOW CARBON HEATING …… NATURALLY

Criteria

1. **The system has a heating COPh of 3.05. This is for cooling seawater from 8C to 4C and heating the district loop from 60C to 90C.**

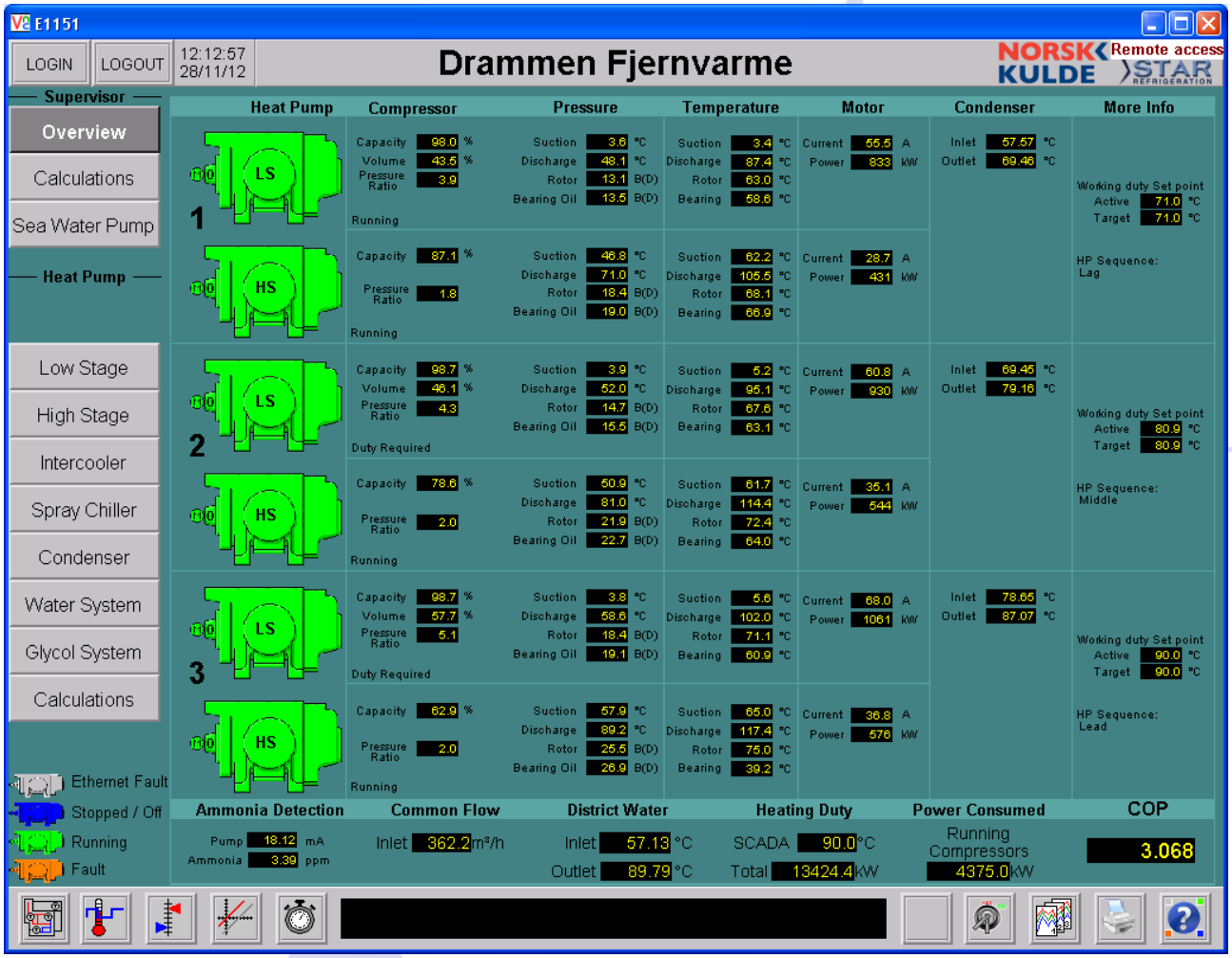

Figure 1 shows the typical operating conditions

2. **It is believed that this system is powered with hydro-electricity and hence near zero carbon eq. See #3 for secondary emissions abatement. If this were heating oil this would be 15,000 T of CO2 per year or around 4 Olympic swimming pools of coal.**
3. **The system has no combustion products from the heatpump so versus any combustion process these are reduced to zero. In addition, unlike more traditional large heatpumps using CFCs or HCFCs or HFCs there is no indirect ozone depleting potential or global warming potential from leaked refrigerants. For a plant of this size, it is reasonable to expect an equivalent distance of over 1 million miles per annum in a car in emissions of HFC.**
4. **Heatpumps are not new in concept or application. What sets this solution apart from others is the higher efficiency and use of natural working fluids. In terms of repeatability, this system demonstrates that higher temperatures are viable (90C). The intermediate temperature at circa 50C is crucial. This heatpump when taking heat from the fjord at 2C and raising to 90C is only viable in countries with a narrow spark ratio (electricity/gas cost) or Renewable Heat Incentive programme. However in <u>all</u> countries there are sources of heat from industry at far warmer temperatures than a fjord and our work has demonstrated a 2% shift upwards in efficiency for every degree the heat pump operating range narrows. This can be achieved with warmer sources of heat or cooler distribution loops. 90C is really somewhat excessive and given that we are aiming for sanitary hot water at around 50-60C and space heating at 21C, then likely network temperatures of 70C will be more prevalent. This project proves that these can be economically viable with a spark ratio of 3.0 as the COPh would be closer to 4.0 or above.**

   A further application of this technology is that it can be used for district cooling but harnessing the heat to provide the thermal driver for desalination. We call this NeatDesal and there is more information in the additional info section. However in short, noting that 60% of the Middle East's energy is for cooling, with this all being thrown away together with the extracted solar gain from the building, then if this 240% of electrical load can be harnessed a massive quantity of drinking water could be a by-product from the system. This would lower the cost of drinking water by 40%.

   <u>This system proves that harnessing medium grade waste heat is viable.</u>

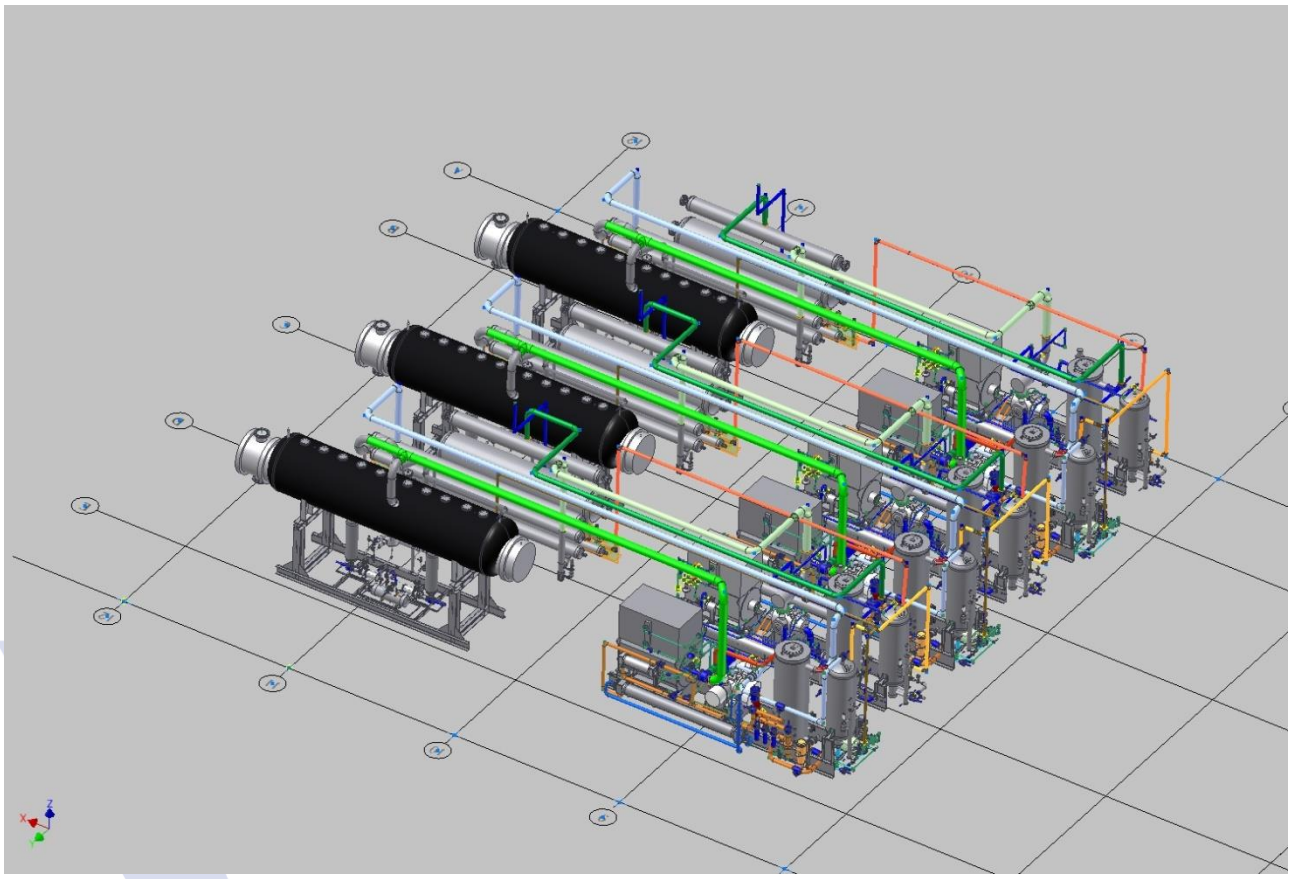

Figure 2 shows the equipment layout - seawater heat exchangers and 6 compressor units

5. It is hard to comment on the impact of the community but it is clear from the design of the building, adjacent to outdoor recreational land that the city is proud of the interaction visually, even if the community doesn't realise the heat is coming from the fjord. The building even has glass walls so the world's largest heatpump using a natural working fluid is on full display.

Figure 3 shows the installation in Drammen