**Requests to E.ON for the Preliminary Design Review**

1. Present a Failure Analysis that explicitly demonstrates the redundancy of all systems including cooling, water treatment and compressed air. (No single point of failure within the CUB systems should disturb the ESS operation.)

This work is ongoing together with ESS. Andreas will describe the status.

1. Show explicitly how the quality of the water is monitored, what happens if the quality requirements aren’t met and how redundancy is met.

Not in E.ON scope anymore.

1. The subcontracting engineers responsible for the water quality system design should attend.

Not in E.ON scope anymore.

1. E.ON should make a decision on the possible implementation of the “ectogrid”.

ectogrid will be implemented in ESS campus area. Negotiations ongoing with property developers in Brunnshög area.

1. Determine which part of the Central Process Systems needs to be attached to the backup generator. A restart strategy should also be developed.

ESS has stated that there is no need for backup power of the systems delivered by E.ON.

Regardless of this decision, all cooling grids will maintain circulation secured by circulation pumps in each circuit that are connected to backup power.

1. Provide the characteristics of the rejected water and inform ESS of the needs for draining.

Not in E.ON scope anymore.

1. Describe the noise environment.

E.ON design the facility to insure the fulfilment of the noise requirement:

The Contractor guarantees that the total noise level outdoors, caused by sound from cooler, will not under any normal operational conditions exceed the following levels:

* Equivalent sound power level of 93 dBA , dB re 10-12 W.

This maximum permissible sound power level is equivalent with a sound pressure level of 45 dBA, dB re 2 x 10-5 Pa, measured in free field conditions at 100 m distance. The cooler mounted as intended and in operation at maximum load.

1. Provide details on the optimization of electricity consumption.

E.ON and ESS have been working with temperature quality to enable:

* Direct cooling and heat recovery to the district heating grid.
* Improving COP of the heat pumps in CWH
* Improving seasonal COP heat pumps of CWL

VSP on all pumps

ESS need for space heating is mainly provided from the CWH cooling circuit

During the detailed design phase, energy optimization will be an important part. Both in terms of electricity consumption and heating & cooling solutions.

1. Describe a preliminary plan for operation, maintenance and troubleshooting.

#### Operation

E.ON will have a local control room in the CUB, where the plant can be supervised and operated. The local control room will mainly be used during commissioning, revision shutdowns, disturbances and when maintenance is performed. Normal operation is done from a control room in Malmö, where 7 shift teams supervise and operate the CPS as well as the district heating and district cooling network of Malmö.

The remote control room will have two separate fiber connections to the control system of the CUB. In the event of communication failure, the CPS will continue to operate in automatic mode and operator presence in the local control room will increase.
ESS control room will have possibility to contact the E.ON control room at any time.

E.ON intends to perform daily rounds at the CUB when ESS is in operation. During the ramp up phase of ESS activities, ESS and E.ON will agree on the extent of the cooperation and how E.ON shall operate the CPS depending on the operation mode of ESS.

#### Long term plans

E.ON use PLM plans (Plant Life Management) as a tool for long term planning. A PLM plan is a long term strategic plan for maintenance and development of a production plant.

The required information to create the plan is primarily the decided operating plan, which describes the expected future operation of the facility. This is key to determine e.g. efficiency, availability (start/energy), degree of automation, relation between maintenance and environmental requirements, other environmental requirements, etc. The technical status of the facility is determined by regular inspections and surveying, on top of analysis of historical data from previous maintenance activities.

The PLM plan should contain a well-documented description of the estimated maintenance needs of the facility as well as expected yearly maintenance and investment needs over the course of at least 10 years. A PLM plan is a working document which is updated yearly, preferably after revisions which bring new information about the machines’ and the overall status.

#### Pro-/re-active maintenance and re-investment

Based on the planned and the actual operation, re-investments and pro-active and re-active maintenance will be planned with the right balance to assure optimal impact on the availability. Plans for pro-active maintenance and re-investments are updated regularly based on permit assessments and periodic maintenance. The balance between pro-active and re-active maintenance are followed up to give early signals about eventual adjustments. Both pro-active and re-active maintenance is done in a structured fashion, as described in E.ON’s maintenance process.

#### Maintenance organization

The key of the organization design is that the maintenance organization has access to resources with the needed competence. This is achieved by allocating internal E.ON resources as well as external contractors and consultants. The main principle is to build up and keep the strategic competence internally. Independently whether the work is performed internally or externally, it is key to assure that needed knowledge about the facility is kept inside the organization in one way or the other. This is achieved by collaboration between internal and external contributors and a structured way of sharing knowledge. E.ON’s maintenance processes outline how this work is structured and realized.

E.ON regularly reviews the organization for single persons or roles with competence which is key to high quality delivery. Such risks are prioritized and most usually result in recruitment of additional individuals to spread the knowledge. By actively working with succession plans, E.ON avoids situations where knowledge is lost as a result of e.g. retirement. A similar situation appears when the strategic choice is made to use an external supplier for the maintenance work. Such risks are most often met by contractually making the supplier responsible for sufficiently sharing the knowledge within E.ON’s organization. Hence, a key aspect to consider when choosing suppliers, on top of price, is their time and cost for knowledge sharing and competence transfer.

#### Maintenance system

EON uses the SAP business system. The Plant Management module is used for maintenance. It is integrated with other modules for procurement, work permits, preventive and supportive maintenance and controlling, and together they form a complete business system. This means that all components of the entire heating and cooling plant of ESS will be stored in the system. All documentation will be stored on component level. Daily work with O&M, such as work permits, work orders, orders to contractors and suppliers are also handled in the SAP system.

#### Suppliers

Developing the collaboration with our trusted suppliers is prioritized and entails a large portion of the pro-active maintenance. Regular meetings are held, e.g. for sharing feedback, follow-up the operations, resource planning, and to continuously improve methods for work environment and safety. A common plan for each region is continuously updated with key suppliers, where a competence needs profile is matched with the right resources. E.ON is always acting with a long term mind-set for the selected close collaboration suppliers.

Planned efforts, such as maintenance needs, are always purchased under competitive bids, where normally price, quality, resources, and time are important evaluation criteria.

#### Root cause analyses

E.ON has a structured methodology for working with continuous improvements, which is used to visualize deviations and issues. The issues are resolved by addressing the root causes behind the apparent deviation in a structured step-by-step fashion. The method is applicable to complex as well as simple situation and in all levels of the organization.

#### Structured work

Standardizing tasks is the foundation for the co-workers possibility to carry out continuous improvements. E.ON has group common processes with descriptions and clear step-by-step instructions for the co-workers. The current methods are followed, and they are continuously improved.

Key principles for continuous improvements include the following:

* Decisions are based on long term improvement, even in the cases where short term goals are negatively impacted
* Continuously updated visual controls are used to assure that the root cause to the problem is found and that the “full picture” of the issue is visualized and no parts are overlooked
* Only tested and reliable technology is used which supports the co-workers and the process
* The persons who make the analysis always go to see the situation where the deviation occurs themselves and never rely solely on 2nd hand information
* Sufficient calendar time is allocated for making common decisions, with respect taken to all possibilities. Once a decision has been taken, the implementation is carried through without delay.

#### System support

The key criteria which E.ON uses when selecting system support is that the selected system supports the chosen way of working, but also supports E.ON’s rigorous demands on security safety, health, and environment. For maintenance, it is especially important to have an effective system support for planning and preparation of maintenance activities, reporting of deviations, and a simple and reliable support for handling permits. The system support for purchasing and controlling must allow for economic reporting and analysis. The spare part strategy is supported with correct and reliable inventory management.

1. Exploit the ESS replies to the questions listed in the section below (“Questions to ESS”).

**Recommendations to E.ON**

1. E.ON should take note of the ESS PLC and EPICS standards and is encouraged to apply them.

E.ON has there own PLC standard which consists of ABB 800 SA, this will be able to communicate with ESS and also towards our own central control room.

1. ESS and E.ON should work together to optimize any interlocks. Interlocks should be minimized if possible.

There are no known interlocks between E.ON and ESS identified.

Under investigation to be presented prior to detailed design

1. Examine the possibly of using the 80 C heat to produce the chilled water.

The performance of absorption chillers are less efficient than the possibility of combining heat recovery and the nearby district heating grid.

1. Examine decoupling the production of temperature from the distribution of the water.

All cooling circuits have been decoupled with the use of accumulators.

1. Consider the use of double walled heat exchangers between the ESS and the external circuits.

This will be under consideration during the Detailed design and also an issue during the risk assessment.

Regardless of that we have proposed is to install conductivity meters in CWM & CWH for indication of leakage between the cuircutis.