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Development of the redundant power supply of automation systems

Thesis

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Automation engineering

Seinäjoen ammattikorkeakoulu
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Thesis abstract

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The purpose of this thesis was to explore Neste Oil's duplicated power feed system and check it for any faults. The thesis focused on eight different automation facilities that gave it a certain type of challenge. The thesis was made theoretically by using CAD pictures provided by Neste Jacobs. In the past years the power feed system has undergone several changes and upgrades and because of those a concern rose that something might have been overlooked.

The thesis was started by asking some CAD pictures from Neste Jacobs in order to get started with the subject. Examining the pictures led me to other pictures, and this cycle continued until I had all the pictures I considered necessary.

The power feed system has been made during a long period of time and by many different suppliers,which made the interpretation of the results much more difficult. Some faults were found in the power feed system.

Keywords: standards, electric systems, automation

SEINÄJOEN AMMATTIKORKEAKOULU

Opinnäytetyön tiivistelmä

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Opinnäytetyön tarkoituksena oli tutustua Neste Oilin kahdennetun automaatiojärjestelmän sähkön syöttöön, työssä etsittiin mahdollisia vikoja sähkön syötöstä. Automaatiojärjestelmät on sijoitettu kahdeksaan eri paikkaa, mikä antoi oman haasteensa työhön. Työ toteutettiin teoreettisella tasolla tarkastelemalla Neste Jacobsilta saatuja CAD-kuvia.

Sähkösyöttöjärjestelmään on tehty vuosien varrella muutoksia, parannuksia ja päivityksiä. Tämän takia uskottiin että jotkut kohdat sähkön syötössä ovat jääneet huomioimatta.

Työ tehtiin tutkimalla sähkökuvia. Työn tulosten tulkinta oli hankalaa, koska sähköjärjestelmiä oli muutettu pitkän ajan kuluessa, mukana oli myöskin useita toimittajia. Järjestelmistä löydettiin muutamia vikoja, joihin on suunniteltu tarvittavat korjaukset.

Keywords: standardit, sähköjärjestelmät, automaatio

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Terms and Abbreviations

CAD	Drawing made by using computer aided design.
Refinery	Is a place where raw material is converted to a more valuable product.
UPS	Uninterrupted power supply.
Thyristor	Solid stage semi-conductor.
Switching principle	Way to convert AC to DC with a thyristor.
ESD	Electrostatic discharge.
Extender	Used to transfer monitor, mouse and keypad data for long distances with a ethernet cable.

1 INTRODUCTION

1.1 Background

The concern is that the power feed systems of automation facilities may have faults in them so in case of a power failure the plant would stop immediately. Duplication helps to prevent these upcoming problems by getting power from many different locations which makes the system more reliable in case of a total black out. Neste has many UPS systems for backup power.

1.2 Research method

The aim is to find out the current state of the automation’s power feed systems from various CAD pictures and by checking them for any faults. When mapping is done, the next phase is to make a correct action plan for fixing them if some problems are found. The research will include a complete study of eight different automation facilities such as harbor automation, storage area automation, the control room, process automation facilities 1 and 2 and the process utilities. The main focus is the control room’s power feed because if a failure occurs in there, it would be most problematic.

The goal is to have a functioning power feed to every component of the automation tree so that in case of a power failure it gives time to fix the problem or perform a safe shutdown of the processing plant.

1.3 History

Neste oil is a Finnish oil refining company. Its predecessor Neste Oy was established in 1948 to maintain Finland's oil service. Naantali refinery started to work in 1957. The original capacity of Naantali refinery was 800000tons but as Finland's oil consumption had grown rapidly, in 1962 the manufacturing capacity was raised to 2,5million tons per year. The sales of oil products kept growing and it was clear Finland needed a new refinery. The second refinery was built in Porvoo and it began its work in 1965.(NesteOil 2013.)

Neste Oy was listed in Helsinki stock market in 1995. The government decided to merge their two companies Imatran Voima Oy (electric company) and Neste Oy (oil refining company) and the new company was named Fortum. It was listed in the stock market in 1998. The joint forces of oil and electricity lasted till the year 2005 when the oil refining part of Fortum diverged and listed itself to stock market under the name Neste Oil.(NesteOil 2013.)

1.4 Partners

Neste Jacobs is an engineering department with 50 years of knowledge in oil refining. Neste Oil owns 60 % of the company and the rest in owned by Jacobs Engineering. Neste Jacobs provides complete engineering solutions to its co-operating companies and that is why Jacobs had all of the electrical drawings that were needed for this thesis. (Neste Jacobs 2013.)

2 THEORY

2.1 Automation

Automation itself is includes many different categories. Theory part includes few different important automation devices and implementation.

2.1.1 Hardware

Automation system is a combination of many different devices. Mainly the system has a control room, automation center and instruments in the field. Field is a just a common term which means that the devices are not in the automation center. (KippojaTikka 2008, p7-10.)

2.1.2 Automation center

Automation center is the brain of the whole system. All the data processing is done there, so it is the place where all the instruments are connected to. The centers are usually made of metal or some sort of plastic. They house the relays, cable ducks, terminal blocks and other components that are needed. Automation center is the most important place in the system, as it receives all the information and processes it. After that it sends back the necessary information to the control room or into the field. The system may have a number of automation centers which can communicate to each other or not. Usually they do communicate because it improves the stability and safety of the system. This can be seen in figure (1).(Kippo and Tikka 2008, p44-46.)

Figure 1.Automation center.(Sähkö-Seppo 2013).

2.1.3 Instrument

Instrument is a device that can send or receive data from an automation center. Usually instruments gather data from the field and the data can concern pressure, flow and heat. Data can be either analog or digital. Digital information is just an on-off message and analog information can vary all the time depending on the variable changes. In automation the analog information in usually 4-20mA.(Kippo and Tikka 2008, p43,59.)

2.1.4 Programmable logic controller

A programmable logic controller, or in short a PLC, is like a small computer. A user makes a program in it and runs it through to make sure it works. Then it is advisable to try the program in a real situation. If there is a problem it can be detected in an early stage so it will not damage anything. (Kippo and Tikka 2008, p54-55.)

PLC consists of inputs and outputs that can be digital or analogical. There is a processor also, which is the most important piece as it runs the program, issues commands and interprets the data. PLC was born in the 1960's and it quickly come common in industrial usage. After sometime, when PLCs became cheaper, they also become well-known. Nowadays PLCs can be found in common households. Automation allows us to see things that people normally would not see and to manipulate objects that are too big, too small or too heavy. Automation helps us to do things that we would not normally do because they are dangerous, heavy or tedious. This can be seen in figure (2). (Kippo and Tikka 2008.)

Figure 2. Siemens PLC.(Siemens 2008).

2.1.5 Distributed control system

Distributed control system or in short a DCS. DCS is a combination of input and output circuits that are located closer to the actuator. Mainly DCS is used to control big and complicated processes like power plant, chemical plants, oil refining plants and steal industry. The system typically includes processing stations, control units, field bus, and programming devices. Monitoring unit communicates whit its control server and also whit its sub networks. Control unit gives out the control data and gathers information from distributed control units.

Distributed control units controls the process functions and operations by using data from sensor that are placed in the process itself. Normally all of these units uses field bus to communicate to each other this way the cabling can be kept to minimum.

DCS units controlling can be done whit machines control device, programmable logic, production process or simple feedback based units. Access to DCS unit is normally done Ethernet in this case the operator or maintenance can easily make changes to the process. Principal shown in figure (3).(Suomenautomaatioseura 2010.)

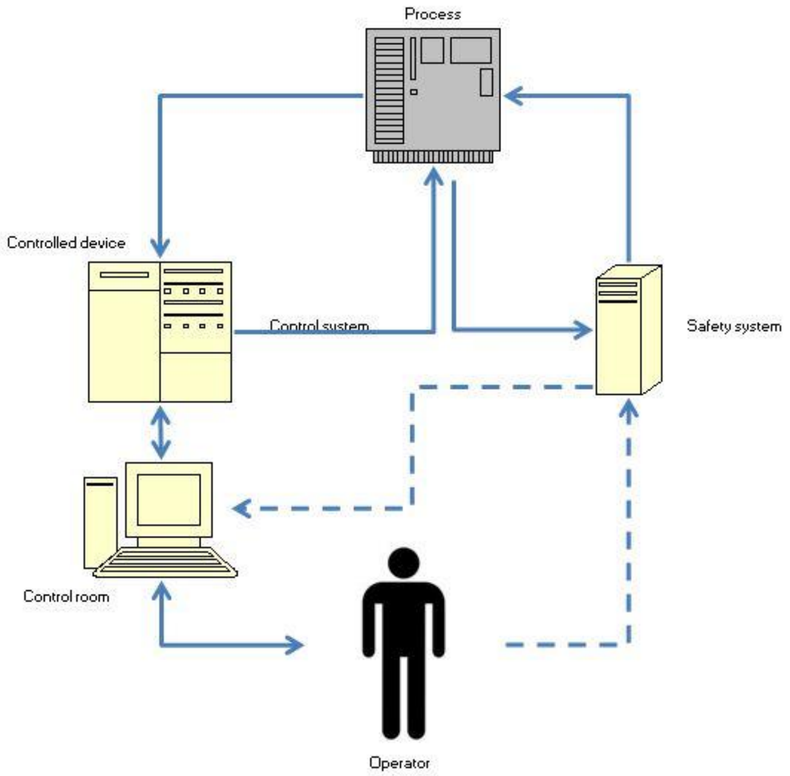

Figure 3.Principal of DCS system.

2.2 Control room

Control room is usually a certain place where all of the process monitoring devises are located. Usually the monitoring is done by a computer where operator can see real-time data how the process is running. Operator can do changes in the process if its needed for example operator sees that the furnaces temperature is dropping rapidly, operator raises the temperature manually to the optimal temperature. Control room is normally connected to the automation center by channels. Channels are used to connect control rooms and PLC's together. Seen in figure (4).(Suomenautomaatioseura 2010, p21-24.)

Figure 4. Control room.(Streambox 2013).

2.3 Duplicated power feed

Nowadays everybody depends on electricity, when we have a power shortage our world stops. Factories and people who want to secure their electricity has to rely on backup power sources like UPS or a generator, when the power shortage starts backup power kicks in and keeps everything running.

Duplicated power feed is taking a step farther from just supplying electricity. When a whole system is duplicated it means that every device in that section will get their power from two different places for example from main current and from battery packs as can be seen in Figure (5).(Hakanen, Bovellan, Heikkilä, Kapp, Kivekäs, Kousa, Poikonen, Sahlström ja Tummavuori 2005. p13-14.)

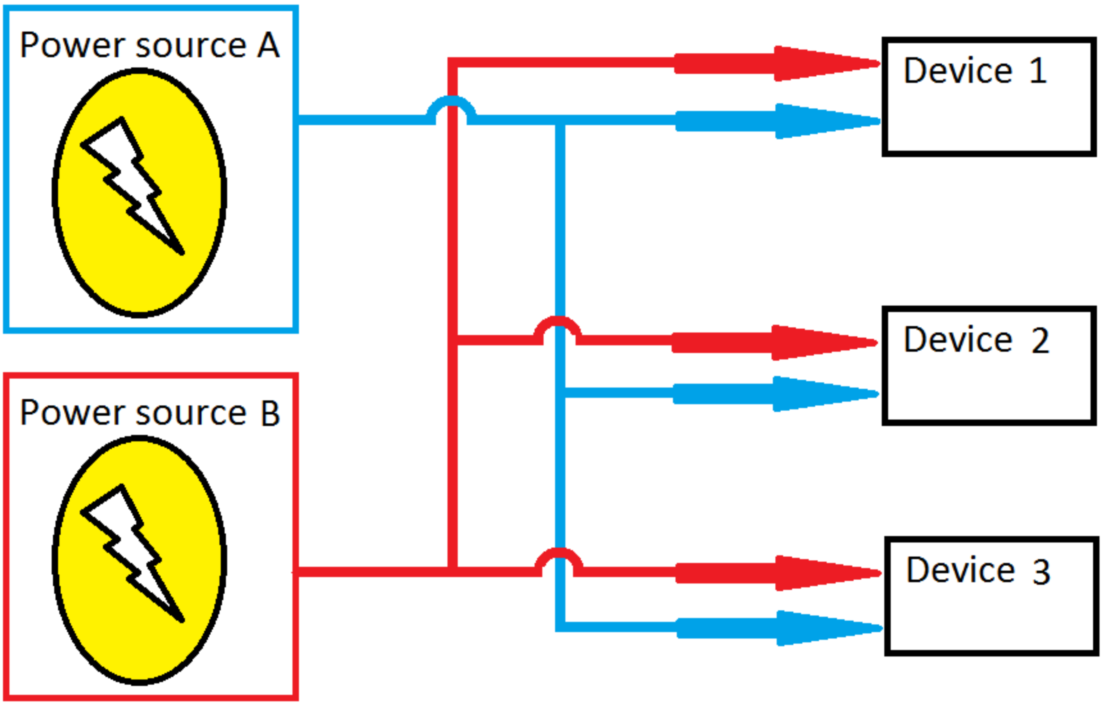

Figure 5. Pricipal of duplicared power feed.

2.3.1 Static UPS units

UPS (Uninterruptible power supply) is a unit that constantly feeds undisturbed and constant AC electricity to the critical load. Critical load gets its energy from main grid when it is available and at other times energy stored in batteries is used. UPS works by transforming AC current to DC and then back to AC by using semiconductor bridges. Usually UPS also has an override option for in case of overload or malfunction.

In normal situation UPS feeds energy straight from the grid through a UPS switch, UPS usually has a filter that block out harmful voltage peaks and the critical load gets clean energy. In case on a power failure or the voltage from the grid is outside of given range the UPS device directs itself to battery power. When that happens the UPS switch changer it is state and the inverter starts then energy to the critical load comes from the battery. There is a little power cut when UPS switch changes it's state but it is normally just around 2-4ms and this delay repeats itself when power from the grid is in reference value of juts comes back on. By using two UPS systems and connecting them parallel the reliability increases radically compared to a single UPS devise and by connecting UPS systems parallel the number of common parts are minimal. Figure 6 shows the principal of parallel UPS system. (Hakanen etc. 2005 p59-66.)

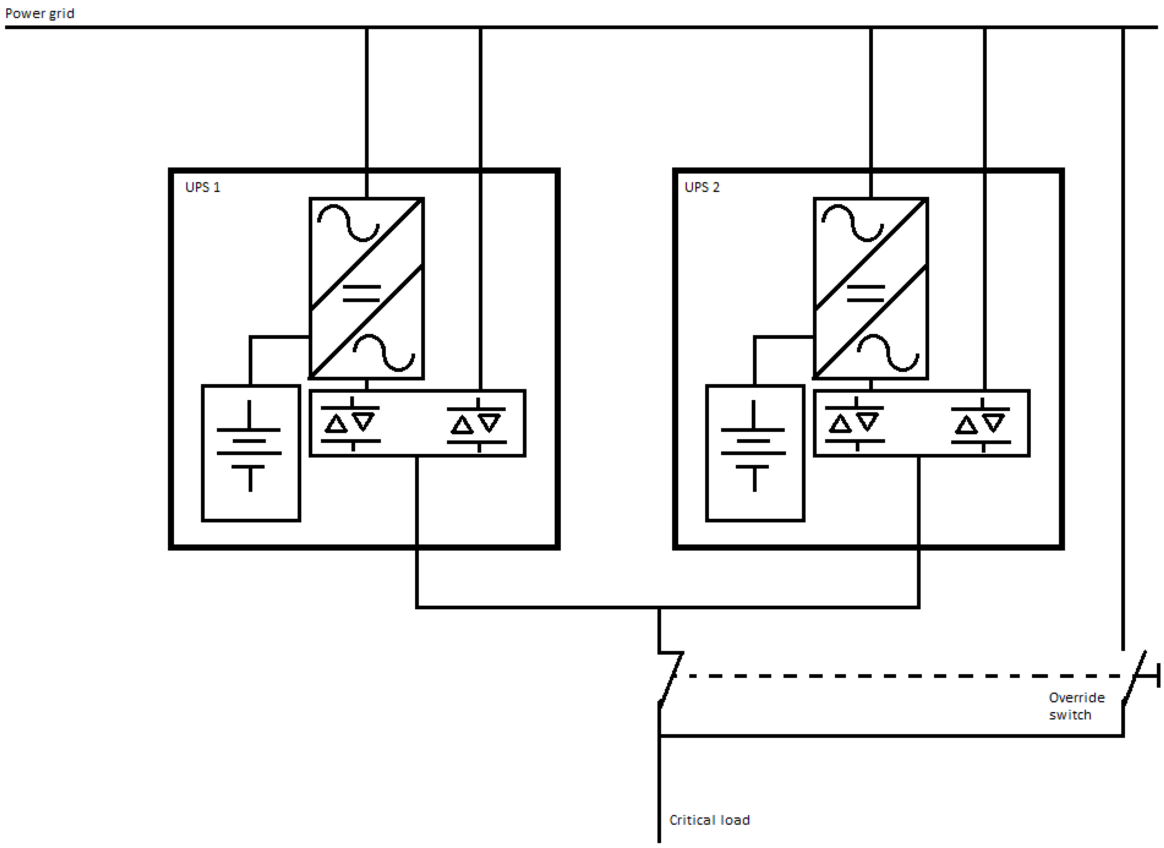

Figure 6. Parallel UPS.

2.3.2 Dynamic UPS units

There is many different solution models for dynamic UPS devices but they all share the same basics components they are motor, generator combination connected to same axis, a flywheel and a battery back combination. Dynamic UPS makes the electricity with coils not with power electronics like static UPS does.

Rotational energy is stored in the flywheel. High velocity models rotation speed is normally between 10000 and 50000rpm that gives out a smaller torque for relatively long time. Slow velocity models rotation speed usually is between 1000 and 5000rpm that gives out higher torque for a shorter period. Rotation time in both models is between few seconds to couple minutes. Because of a shot time given from the flywheel a backup power for it is required for example a diesel motor the time given from the flywheel allows the diesel to start. (Hakanen etc. 2005 p67-72.)

2.3.3 DC Power system

DC power systems are common in communication networks power feed, automation power feed and industrial power feed. Power systems use DC voltage and it has battery backup. Normally communication networks use 24Vdc and 48Vdc, the automation field uses 24Vdc and 60Vdc and the industries uses 110Vdc and 220Vdc.

Communication networks power system consist of parallel connected rectifiers, batteries connection module, control module and customers-DC power module. Rectifiers works on a switching principle and the number of the rectifiers depends on the individual power of a rectifier, how much power does the system take and capacity of the battery, normally there is one extra rectifier just in case. (Hakanen etc. 2005 p80-81.)

Automations power feed is build in the same way as the communication networks but the voltage is 24Vdc or 60Vdc and the system is negatively grounded. Simpler rectifiers and battery combinations can be used and rectifiers also work on a switching principal. Automation systems batteries condition must be monitored and that should be taken in to consideration when the system is build.(Hakanen etc. 2005 p82.)

Rectifiers in industrial use are different kind then in automation or communication it is based on a transformer and a thyristor. Output voltage is in normally 110Vdc or 220Vdc and output current can de between 50Adc to 1000Adc. Rectifiers are planned to power crucial DC loads and different kind of batteries. Rectifiers can be equipped whit different options like temperature controlled battery charger or an alarm. (Hakanen etc. 2005 p82.)

3 Affecting standards

3.1 Explosive atmosphere EN 1127-1

Explosion can be triggered by hot surfaces in the electric device or a sparks that can be caused by opening or closing a circuit or a loose connection. Ensuring that this doesn't happen all connections has to be checked so they doesn't heat or cause a spark. Hot surfaces has to be isolated from any flammable liquid or gas. Static electricity causes problems in certain conditions and may act as a trigger by using ESD equipment and protective gear the static electricity can be eliminated in a early stage. Electrical equipment are divided in three main category, (SFS-EN 1127-1.)

- Equipment category 1: Not any part in the device can reach over 80% temperature of the flammable gasses or liquids auto-ignition temperature not even in a rear case of a failure. (SFS-EN 1127-1.)
- Equipment category2: Not any part of a device can reach the auto-ignition temperature of the gas or liquid in question not even in a case of a failure. (SFS-EN 1127-1.)
- Equipment category 3: Not any part of a device can reach the auto-ignition temperature of the gas or liquid in question.(SFS-EN 1127-1.)

3.2 Safety requirement of a secondary batteries and battery installation

Battery stores electricity electrochemically by using electrolyte such as acid solution or alkaline solution. These electrochemical systems produces many different voltages depending on the positive and negative electrodes and from the electrolyte. When battery is empty it can be recharged whit appropriate DC voltage normally batteries supply power to different kind of systems or a vehicle that is separated from main supply. Batteries manufacturer has defined the methods and circumstances where and how the battery must be charged so the batteries would charge properly. The limit values and conditions has to be followed so ensuring the batteries long life cycle. It is recommended that the current and voltage is controlled by doing this abnormalities can be detected in time. (SFS-EN 50272-1.)

3.3 Marking of electrical equipment with ratings related to electrical supply SFS 61293

Electrical equipment has to marked in a proper whit electro technical labels so it presents the device, using rating plates or rating notes. Ratings has to be easily readable and has to last for the lifetime of the device. Some devices use different kind of input voltage or frequency both of them has to be marked properly.

The supply power has to be marked on the device so it can be connected properly to the correct network these markings has to show does the device use alternating current or direct current, number of the phases, any other useful cable and the systems voltage.(SFS 61293.)

3.4 Low-voltage electrical installation SFS 6000

Standard 6000 influences on electrical installations which has a nominal voltage of 1000V alternating current and 1500V direct current. Standards application areas are households, business buildings, public buildings, industrial buildings, agricultural and horticultural buildings, industrial made structure, camping and traveling vehicles, harbors, outdoor lighting networks, medical facilities, mobile systems and electrical grid.

When designing a power grid it has to be done in a way that no people, pets or property will be put in a risk and the whole electrical installation woks as planned. When planning a electrical installation many thinks has to be considered like calculating the correct wire dimensions, establishing a ground point and calculating a correct zero conductor. (SFS 6000.)

Standards that effect the emergency power systems are 6000-1, 6000-2 and 6000-5-56. Emergency power system is a power feed that keeps vital parts of the process running, main propose is to secure important functions that protect people.

Emergency power system includes a power supply and a wire to the instrument. In certain cases it can also have a emergency power system. There are two different kind of emergency powers, non automatic that has to be operated manually and a fully automatic that switches itself on whet its needed. Automatic emergency powers are divided in groups according to how long it takes to switch from normal feed to emergency power. (Hakanen etc. 2005 p53.)

- Uninterrupted: Automatic power switches that ensures a constant power feed to the device for example is a radical voltage or frequency change happens.(SFS 6000-5-56.)
- Very short break: it takes less than 0,15s for the emergency power to be in use. (SFS 6000-5-56.)
- Short break: it takes less than 0,5s for the emergency power to be in use.
- Medium break: it takes less than 15s for the emergency power to be in use.(SFS 6000-5-56.)
- Long break: it takes longer than 15s for the emergency power to be in use. (SFS 6000-5-56.)

Emergency power systems back up power has to keep the system running for sufficient time, depending of the device in question. Devices has to work in a case of a fire. Devices has to be protected from the flames either by the construction where the devices are or installation of the devices. (SFS-6000-5-56.)

Emergency power feeds devices must be installed in such a way that interval checks, testing and maintenance is easy to execute.(SFS-6000-5-56.)

Emergency power can have many different power feeds for example.

- Battery
- Independent generator

- Different electricity distribution network that has no connection to the main network

Power sources has to be installed permanently such that they can't get damage if the main power feed fails. Powers sources has to be placed in a way that no civilian has a access to them. Place where the power sources are ventilation has to be planned in a way that no gases, steams or exhaust gases will get in a same place as people are staying. (SFS-6000-5-56.)

Emergency powers and main powers circuits has to be separate. When the main power has a failure or any other kind of change it does not effect to the other systems operation. Requirement can cause that the wires has to be insulated whit fire proof materials, different wiring paths or other protective measures. Installing wires the emergency powers wires through a fire hazardous area should be avoided is this is impossible the wires has to be protected whit fire proof materials.(SFS-6000-5-56.)

Emergency power sources and its distribution centers, batteries and rechargers wiring has to be made in a way that minimizes the risk accidental contacts whit live parts. Wires can't be places near flammable liquids.(Hakanen etc. 2005 p55 and 56.)

4 Implementation

4.1 Control room (AB-200)

There was a concern that in the control room the power feed of the extender and monitors was contaminated due to updating and modifying. That is not the case, as the power feed to the computers is uninterrupted and backed up by a battery.

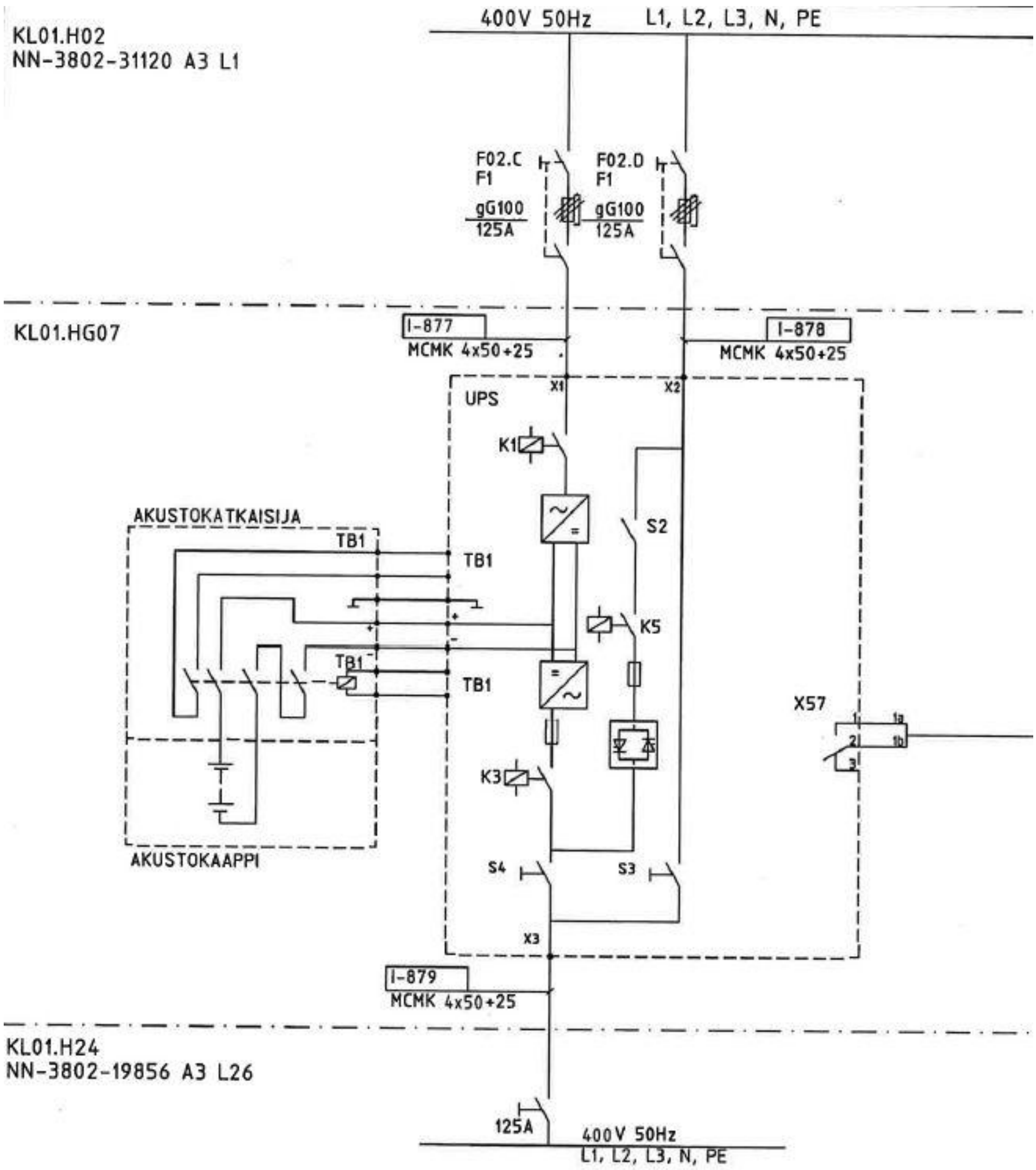

Figure 7.AB-200 Battery backup unit.(NN3802-35680).

Power comes to the battery backup system KL.HG07 from the main switchboard KL01.H02 along two different cables. From there it goes to KL01.H24, also known as JK13. JK13 powers the SK-301 andSK-302 which are divided to power the computer in the central control room. The socket connection can be seen in attachment NN3802-25404. Power goes from JK13 to JK14, JK15, JK16,JK17and also to two central computing units. All these devices have an uninterrupted power source. The principal is shown in figure (7).

This is the case in theory but in reality things are different. The power feed to the extenders and monitors comes from many different places, some of which are duplicated and packed up but some are not. In the control room there are two stations for every control place. One in the main place and the other one is for backup and they should get their power from different places. The problem is shown in figure (8).

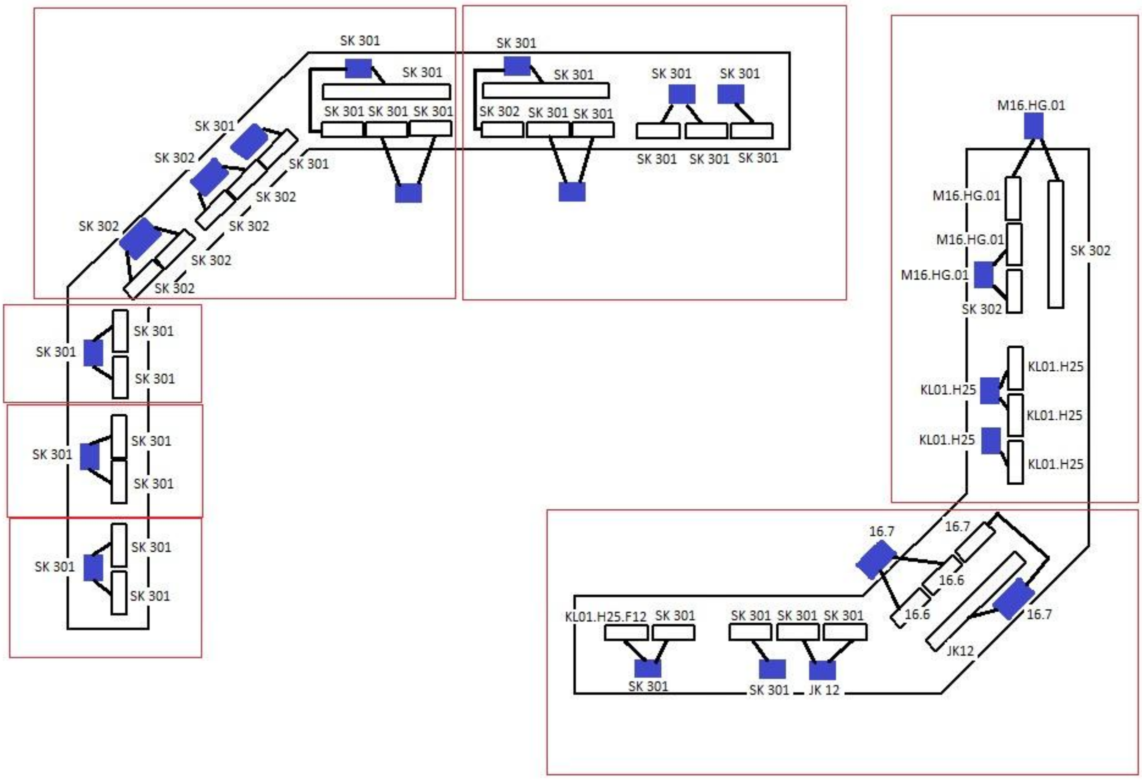

Figure 8. Control room's power feed.

In figure (8) blue boxes present extenders and their connections to monitors are presented with black lines. The power outlets are marked next to every device.

The red boxes show which computers are connected together. The same method is in use in figure (9).

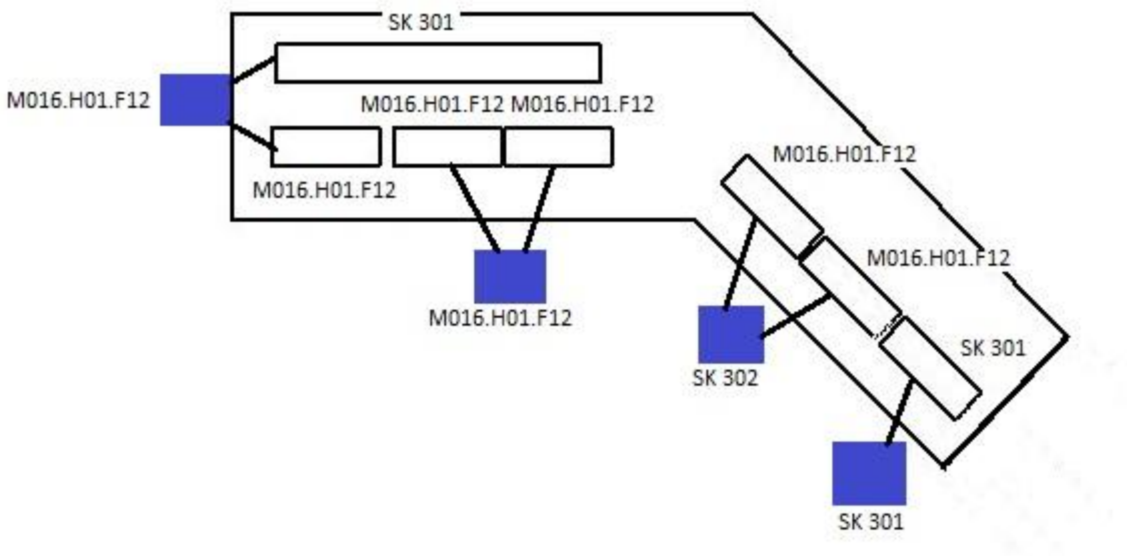

Figure 9. Control rooms Power feed.

4.1.1 Summary

By knowing where the power really comes from a corrective action plan can be made. The monitors and extenders are separated into two different groups inside every red box as seen in figure (7).Rewiring them from different power sources for example SK 301 and SK 302 is a good option because they have a UPS back up.

4.2 Process automation facility 2 (AB-298)

Automation facility 2 main power comes from three different places KL02H09, KL02.F12 and M002.R03. KL02H09 powers the KL02.H18 and KL02.HG2.1 battery UPS device that devise backs up the KL02.H18 can be seen in figure (10).

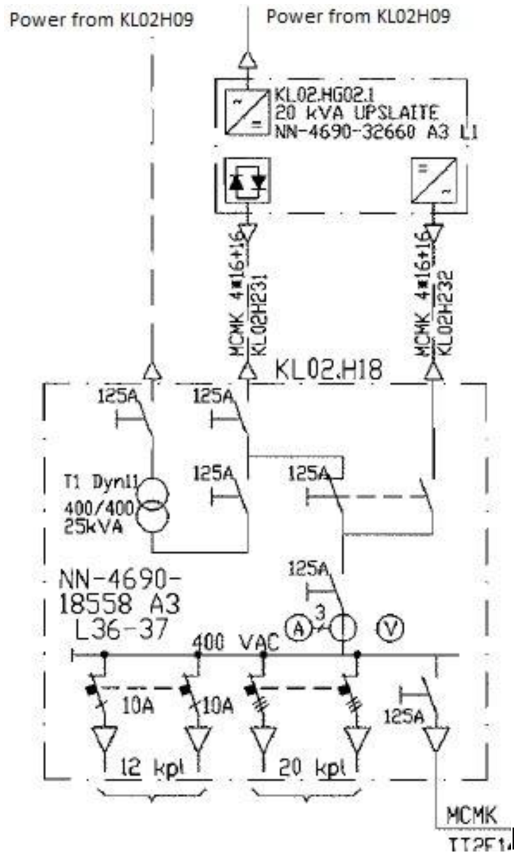

Figure 10.KL02H09 Backup power.(NN-3802-19862).

Power to KL02.F12 and M002.R03 comes through the same switchboard to M002.H09 and backup power M002.HG07.1 implementation is the same as seen in figure (10).

Combined power from KL02.F12 and M002.R03 also feeds many different automation cabinets. Backup power system is implemented little differently inside the automation cabinets where the voltage is rectified and fed to batteries so in case of a power failure the cabin itself can uphold its operations. Implementation can be seen in figure (11).

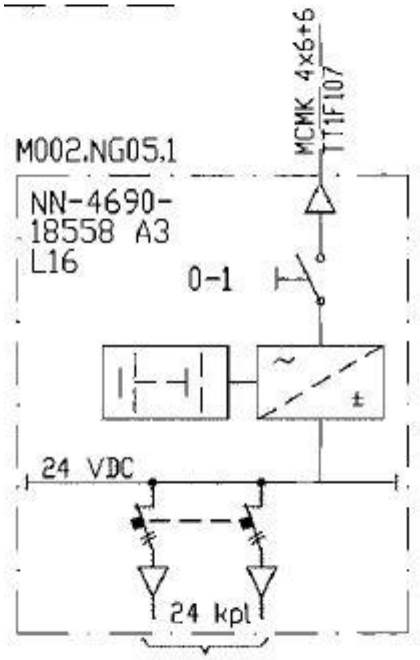

Figure 11.Backup power inside the cabin. (NN-3802-19862)

By making the backup system inside the cabin itself space can be saved. The load to main back up unit reduced.

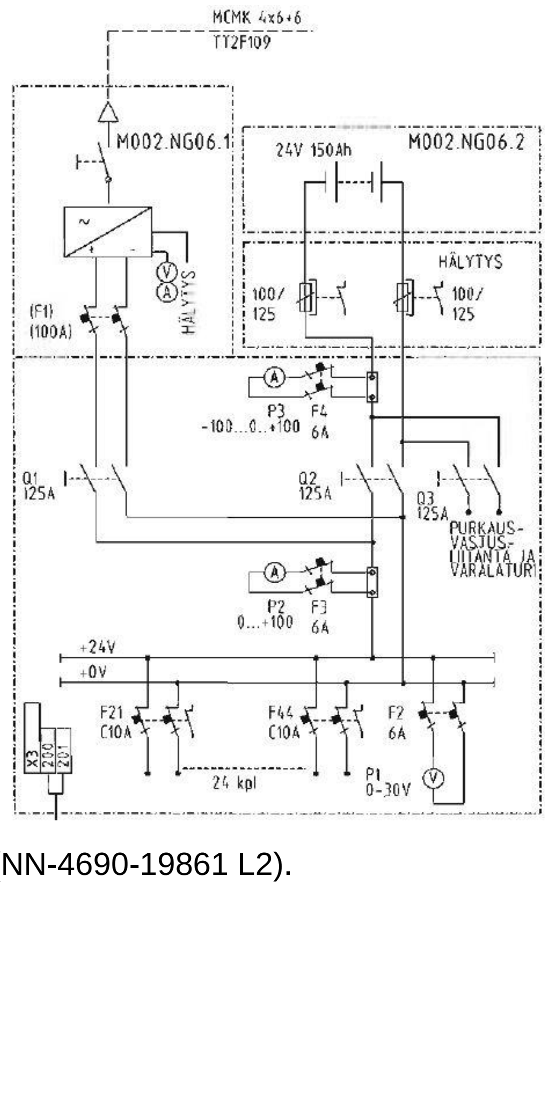

Figure 12. Principal of cabins power feed. (NN-4690-19861 L2).

Some cabins are equipped whit dual transformers for back up, it is done by using two different phases of the power grid and a common zero conductor. In this case if one of the transformers would break the other one can still keep the process running and there is still a battery backup in case of total power failure principal shown in figure (13).

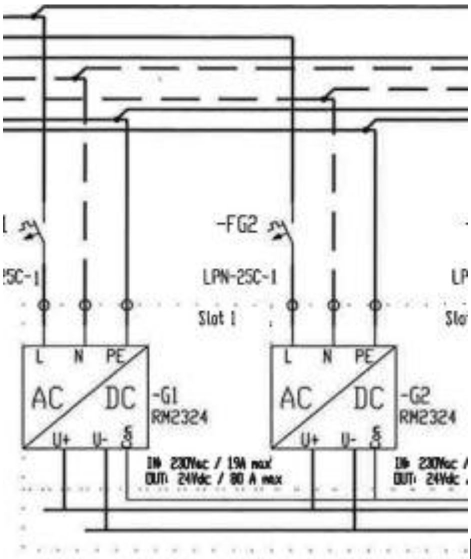

Figure 13. Power feed whit two converters.(NN-4690-19861).

4.2.1 Summary

Process automation facility houses a massive amount of DCS units and their components needed to run the process for example relays, switches and DCS expansion cards. The facility doesn't have a control center in itself and all of the controlling and modification is done process engineers from the main control room (AB-200). The power feed to the facility is ensured by many different power feed from different locations. Facility also has many UPS devises to power the process in case of total blackout. By checking all of the power inputs all the way to the automation cabins no faults was found.

4.3 Process automation facility 1(AB-299)

Process automation facility 1 is a big structure and constant power feed is crucial. Power feed comes from M01.F02 and KL02.H04 those two powers the central backup systems. Seen in figure (14).

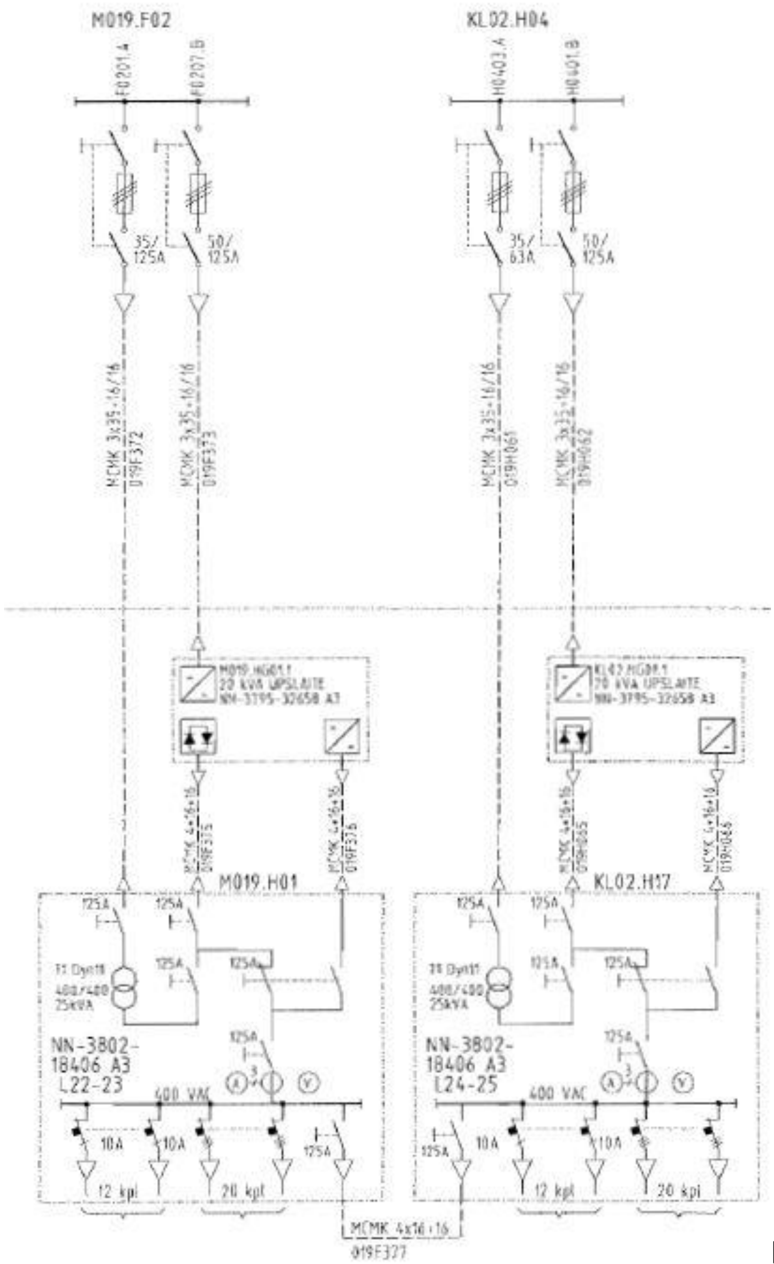

Figure 14.Process automation facilities backup power.(NN-3796-19808).

Power comes also from KL02.H08 and M002.R01 that are connected directly to main power also it power the automation cabins. These cabins use DC voltage is equipped whit their own backup system same like in automation facility 2. Seen in figure (15).

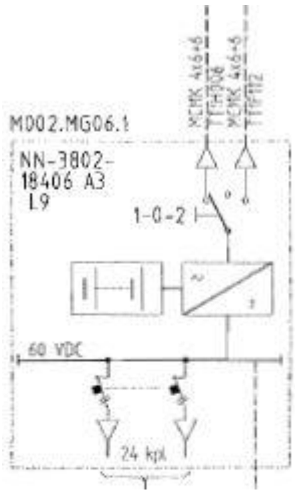

Figure 15.Battery pack in automation cabin.(NN-3796-19808).

Automation cabin that supplies 220V to analyzers has two power sources but it is changeable only by hand operating switch. One of the sources is directly from the grid and the other is from UPS system KL01.HG10.1.

4.3.1 Summary

By checking the power feeds from the main network no faults was found in automation facility 1 all of the automation cabins has battery backup and some of the has even a different places for power feed. Analyzers power comes also from two different places but its manual switch can prove to be problematic however normally the power comes from the UPS system. By checking the power inputs, all of the UPS devices and the automation cabinets power supply no problematic places was found.

4.4 Harbor (AB-233)

Harbors main power comes from M009.F001 whit two cables one of them one of them gets transformed and connected to M009.H01 the other cable if connected to the backup power M009.HG01.1. Backup system has two output channels and both of them is connected to M009.H01 connection can be seen in figure (16).

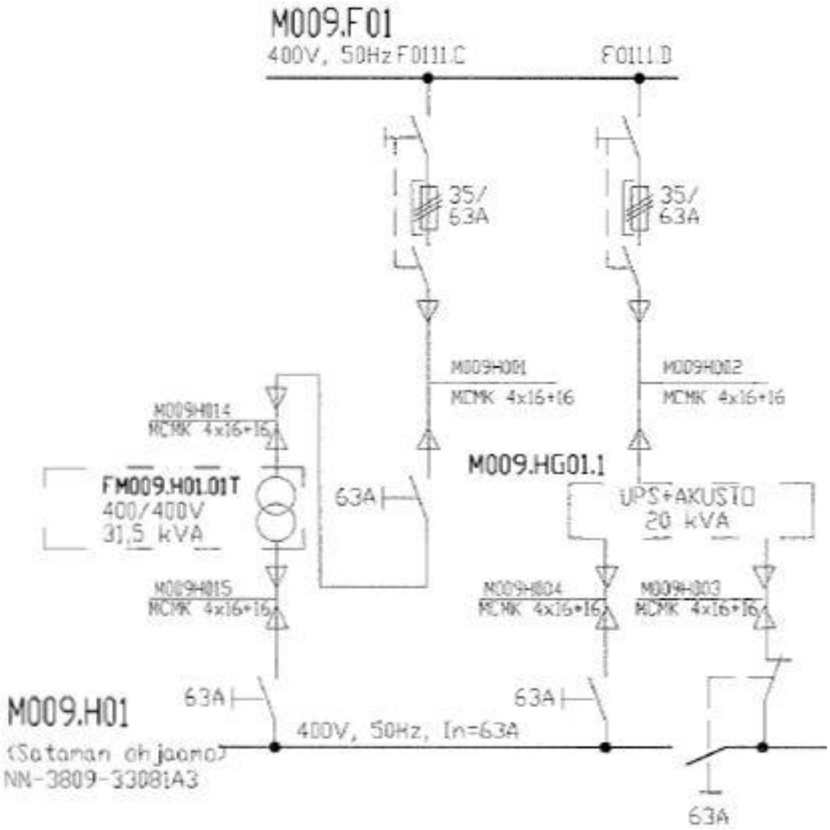

Figure 16. Harbors power feed.(NN-3780-25397).

M009.H01 feeds power to the automation cabinets through fuses F1-F9, F11-F22 so all of the automation cabinets have a constant and uninterrupted power feed can be seen in attachment NN-3809-33081 L1-4. Fuse F10 powers the harbors control rooms computer it also has constant and uninterrupted power feed

4.4.1 Summary

Harbors main power comes from two different lines one is directly connected and one goes through a UPS unit. By ensuring the power in the early stage the whole power trees reliability is ensured. By checking the power feed to the support center there was no errors or faults found in the system center has a good backup power and in case of total black out the UPS will supply the computers for some time.

4.5 Boiler and switch facility(AB-217)

Power comes from two different ways to the boiler and switch facility, one way is from KL01.H04 that is connected directly to the main grid and the other way is from KL01.H03 which is connected to KL01.HG05.1 and it is a backup unit that supplies continuous power feed. KL01.H19 powers every automation cabin and the monitoring computer. Connection shown in figure (17).

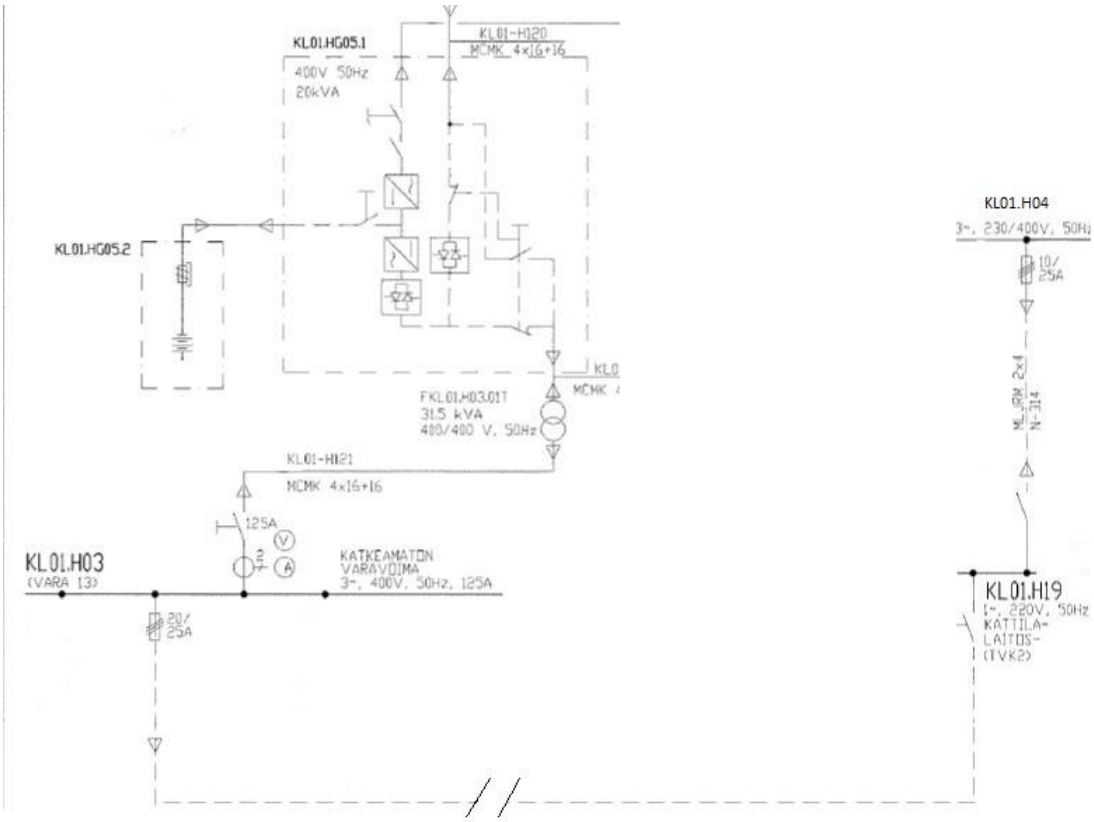

Figure 17. Boiler- and switch facilities power feed.(NN-3780-25398).

4.5.1 Summary

Boiler and switch facility power comes from two different ways and one of them is backed up by UPS device. If the facility has a problem in one or even two of the power supply unit it is still able to maintain its duty. No problems was found in the boiler and switch facilities power feed it is secured and does not need any modifications.

4.6 Intermediate pump (AB-215)

Intermediate pump has a small automation room and a control room. Main power comes from KL01.H01 and KL01.R09 which are direct feeds from main network they power up the backup unit. Figure (18) shows the connection.

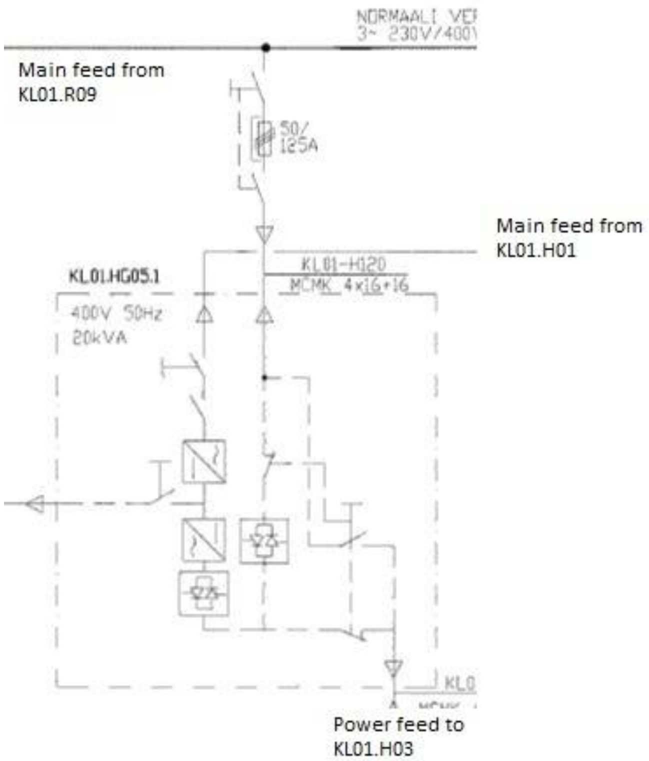

Figure 18. Intermediate pumps backup power.(NN-3780-25397).

Backup power feeds the KL01.H03 switchboard whit constant power. Switchboard divides the electricity through24 fuses can be seen is attachment NN-3803-25452 but most interesting are fuses 3,10,11 and 12. Fuse number 3 supply power to switchboard KL01.H28 where it goes to automation cabins and fuse F3 is connected to control rooms outlet. Fuse 3 in switchboard KL01.H19 powers the rest of the control rooms power feed.

Automation cabins power feed is also monitored by normally closed contact in the fuses and when they are tripped the contacts opens and it trips the alarm. Alarm structure shown in figure (19).

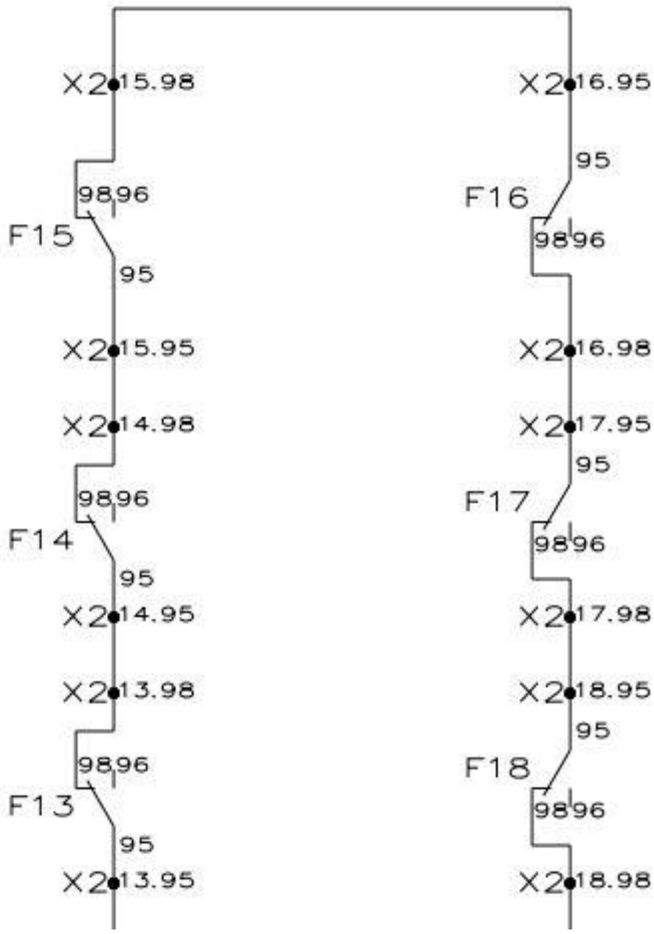

Figure 19. Example of the alarm system. (NN3802-33084).

4.6.1 Summary

Basically power feed to the intermediate pump comes from one line but the switching center before the feed center in secured by a UPS device and it has many different power feed paths. The automation rooms power feed in the facility is secured and the power to the control room comes from the same line of power it is secures as well. By checking the power feeds CAD pictures no problematic areas was found.

4.7 Storage area and dispatch (AB-116)

Main power comes from Bitumen plants control room whit two different ways one is a direct connection from main grid the other one comes after a backup unit. Both power feeds are connected to switchboard KL01.H31.

The storage areas automation room gets it power from switchboard KL01.H31 that is located inside the AB-116 building. Fuses F1-F4 powers the rectifiers that converts the voltage to 24Vdc and 60Vdc the rectifiers are doubled to ensure a constant power flow even if one of the rectifier would break. Figure (20) shows how the doubled rectifiers are connected.

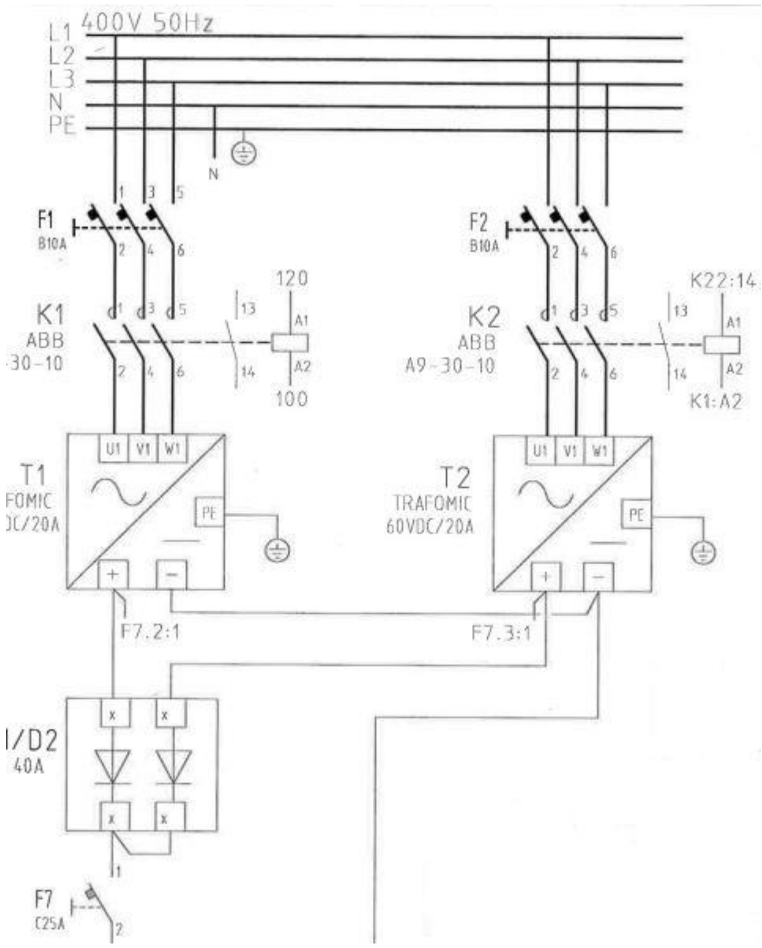

Figure 20.Doubled rectifier connection. (NN-3799-33882 L2).

The voltage is propped to 60Vdc after the rectifiers and the power is led to automation cabinets through fuses F10-F34. The 60VDC is led to automation cabins through fuses F100-F111. The 24Vdc is led to the cabins through fuses F200-F218.

4.7.1 Summary

Power feed comes from different places and the other one even has a UPS device. In case of a fault, power has many routes to supply the storage areas with power and if a total black out happens the UPS can support the system for a while.

4.8 Pressure proof support center (AB-158)

Support center doesn't have a lot of automation units but the main task is to monitor the refining process so all of the computers has to have backup power. Facility has a UPS device for backup all its power to the automation gear and all of the controlling computers. Figure (21)shows the UPS system.

Figure 21. Pressure proof support centers UPS device.(NN-3780-25397).

4.8.1 Summary

Support center is pressure proof because it located really close to the oil processing area and the whole area is considered a hazardous place so there is all ways a risk of fire and explosion.

Support centers power feed comes from a single line directly to the UPS device and from there the power is divided to computer and automation gear. There is a problem whit only one UPS device and power comes from one place if the UPS should break the whole automation in the support center is compromised. By connecting another UPS unit in parallel to the old one and connecting its power feed from different place the problem can be fixed.

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APPENDICE

Appendices has been deleted for the company's request.