CASE STUDY

DESIGN FMECA STUDY FOR NORTH WATER ENSURES RELIABILITY OF INDUSTRIAL WATER TREATMENT INSTALLATION

The industrial zone of the Eemshaven (in the Netherlands) has been undergoing considerable expansion in recent years. This means an increasing water demand from Northeast Groningen for industrial water to use as cooling and process water. In order to preserve precious groundwater as a source for the drinking water supply, surface water from a canal is used as cooling and process water. Due to the expansion projects in the area a new 28-kilometer long water pipeline from Garmerwolde to the Eemshaven is planned to keep up with cooling capacity demand. The new installation is commissioned by the consortium North Water, a joint venture between Evides Industry Water and Water Company Groningen. They asked MaxGrip to support a Failure Mode and Effects Analysis (FMECA) study on the design to ensure reliability of the assets.

OBJECTIVE: ENSURING RELIABILITY

The installation is designed to deliver 10 million m3 industry water per year. The yet to be built installation will consist of, amongst other things: four intake pumps, three parallel purification lines, six double-layered filters, two transport pumps and four chemical areas.

SUMMARY

Challenge: FMECA study to ensure reliability of assets

Approach: Design FMECA Study

Kick-off meeting to define scope and assumptions

Software system preparations and implementation

Perform the FMECA in group sessions

Define actions

Report conclusions and discuss with all stakeholders

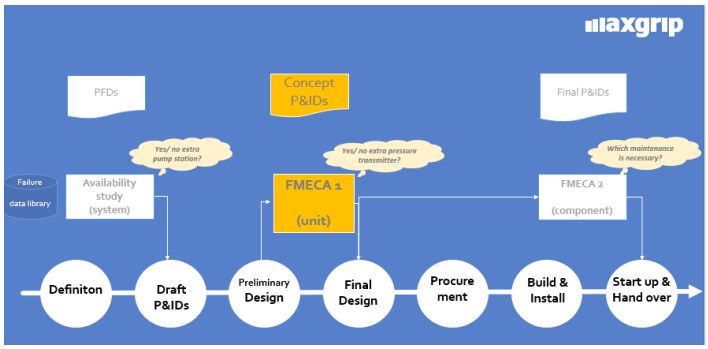
Results: Design modifications

- 10 Design modifications and 19 focus points for preventive maintenance program
- Optimization of plant breakdown structure and tagging
- Knowledge transfer between companies and disciplines

Keeping in mind that the delivery is 24/7 and 365 days a year, optimal reliability is key. So, the objective of the FMECA was to timely identify potential failure, to assess associated risks and to advise preventive actions for these assets. A design FMECA is also a way to prove compliance as per North Water's policy.

APPROACH: ITERATIVE PROCESS

The design FMECA that we performed investigated the risk of technical failures of the preliminary design of the plant, assessed the preliminary design against the performance and reliability requirements and served as advice on required design changes and preventive maintenance focus points. The scope of this study encompassed 140 units and 900 components.

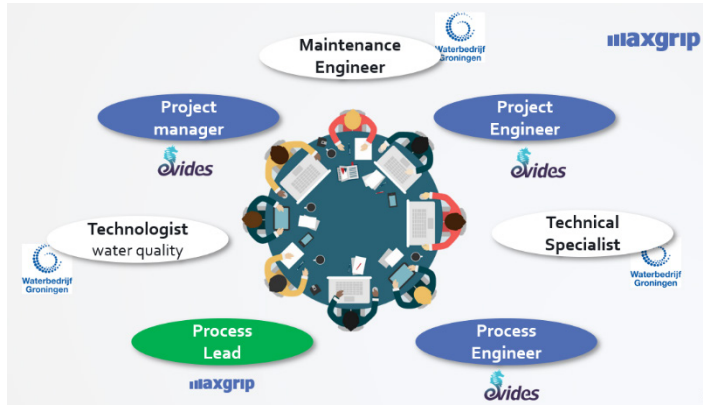


It is essential to choose the right moment to perform the design FMECA. Premature execution results in too many uncertainties in the design which can seriously hamper performing a proper FMECA; doing it too late means it is no longer possible to make changes to the design. Therefore, we proposed to make the design review an iterative process (see visual). A design FMECA (FMECA 1) was performed on unit level (in yellow in the visual) to challenge the preliminary design. The structure, information and data can largely be reused in the following FMECA which goes one level deeper (component level of the final design).

By using this approach, we had enough information to do a design FMECA on the preliminary design, to determine essential improvements to the final Piping and Instrumentation Diagrams (P&IDs), and to identify the risks and necessary alterations to the design as well as determine what components will need preventive maintenance to offer full availability and reliability of the installation.

The design FMECA project included these steps:

Kick-off meeting to define scope and assumptions
In this early stage in the project the scope and level at which the FMECA would be performed was clearly defined. The contract requirements were re-checked and verified by the team. Other parameters were also included concerning, for instance, build-in redundancy and the desired (peak or normal) load situation. The asset users' own risk matrix was leading for the risk assessment.



Software system preparations and implementation
In this stage, we built a plant breakdown structure of the system in the Risk-Based Maintenance (RBM) software system. 140 units were defined, such as 'pump unit', 'self-cleaning filter' or 'dosing unit'. We then implemented the risk matrix in the software and assessed 340 failure modes against the risk matrix, which revealed 29 potential unacceptable situations.

Perform the FMECA in group sessions
The group consisted of representatives of MaxGrip and North Water. This multidisciplinary team worked well as they could challenge each other and make sure no blind spots were kept unnoticed and unsolved. The experts met sever times in order to perform the entire FMECA as scoped in step one.

Define actions
Based on the performed FMECA and together with the maintenance experts, we defined the actions to take for undesired (medium risk) and unacceptable failures (high risk). Of the unacceptable failure modes, the measures were either to modify the design or to keep as is but to focus on preventive maintenance. An example of such a risk analysis per unit with preventive maintenance as concluding advice can be seen below.

Risk analysis unit 'Coarse Grid'

Tag	Function
Coarse grid	Capture of coarse parts > 1000 mu

Failure mode	Explanation
Insufficient inlet flow rate of water	Obstruction. redundancy partly lost, decreasing capacity.

FAILURE EFFECTS						TIME	PROBABILITY		
Quality	Quantity	Environment	Safety	Cost	Image	MTTR	MTTF	Highest Risk	Advice (measures)
1. No effect	2. Loss of redundancy	1. No effect	1. No effect	1. Cost <= 5k	1. No effect	3 Hours < X <= 8 Hours	0 Hours < X <= 1 Years	undesired	Preventive mainte-nance

Report conclusions and discuss with all stakeholders
All important stakeholders of North Water were presented with the results and recommendations. The overview included all of the failure modes, advice on design modifications and focus points for preventive maintenance at a later stage.

RESULTS: PREVENTED RISKS AND KNOWLEDGE TRANSFER

The results can be split up into three categories:

1. **Design modifications and focus points for preventive maintenance**
With this design FMECA we were able to detect critical failure risks in time to be able to change the design and appoint focus areas for the preventive maintenance program and thereby ensuring the reliability of the installation. Of the 340 failure modes, 29 were deemed unacceptable. Ten design modifications were determined as well as nineteen critical focus points for the preventive maintenance program were revealed.

2. **Visualization of structure and tagging**
Because the design FMECA was an extra 'dry exercise' at unit level before implementation in the asset management system, it offered the opportunity to change the plant breakdown structure where needed. This way of visualization helped with anticipating and optimizing the structure and preventing mistakes from the go-live. In addition, due to this 'dry exercise' tags were optimized before implementation of the breakdown structure in the EAM system.

3. **Knowledge transfer**
Another result is that due to the structured way of working in a multidisciplinary group, different experts from the collaborating companies Evides Industry Water and Water Company Groningen were able to share a lot of knowledge, connect and collaborate more strongly on this joint project. With this design FMECA North Water was able to prove that they are compliant with their demands and policies.

ABOUT MAXGRIP

MaxGrip consultants enable organizations in asset-intensive industries to achieve continuous improvements on their asset performance, also using the power of Digital Transformation. MaxGrip embraces APM 4.0 with a maintenance track record of over twenty years in industries like Oil & Gas, Food & Beverages and Utilities & Infrastructure. We operate on all continents and have a global presence with our main offices in the Netherlands (HQ), USA, Malaysia, and, Australia.

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