A higher safety level with lower emissions due to condition based replacement of service connections.

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Summary

Liander is a Dutch energy grid operator with 2,3 million service connections. Major cities like Amsterdam are being served by Liander. In the Netherlands a large part of the gas grid has been installed after the start of the exploration of the Groningen gas field in the beginning of the 1960's. Before the ending of the sixties, nearly 75 percent of all the Dutch households had a connection to the gas grid.

A large part of the service connections is now in the phase that replacement or renovation is needed. Liander developed a method to allocate her budget to those assets that need attention the most. Liander works with a risk based model to coordinate her activities in order to prevent future failures. Leakage of service connections is a threat to our company's values of safety and sustainability.

In the newly developed method leakages of the past 60 months are projected, on the national postal codes on several scales. Solely the leakages related to the condition are taken in account. Third party damage, for instance, is excluded. The total number of leaks over the last 60 months is then made relative by dividing them by the number of connections in the considered area. To make this result more applicable, we multiply it by 1000 and divide it by 5. In this way we have an average amount of yearly failures per thousand connections. In this way the failures of connections are made comparable between postal code areas. The result is called the Relative Leakage Frequency (RLF). The RLF is then compared to a benchmark value, based on the performance of all Dutch grid operators and the safety indicator. The postal codes with a RLF level above the lower limit, are being projected on the GIS map of Liander. In this way areas which need investment are clear in a glance.

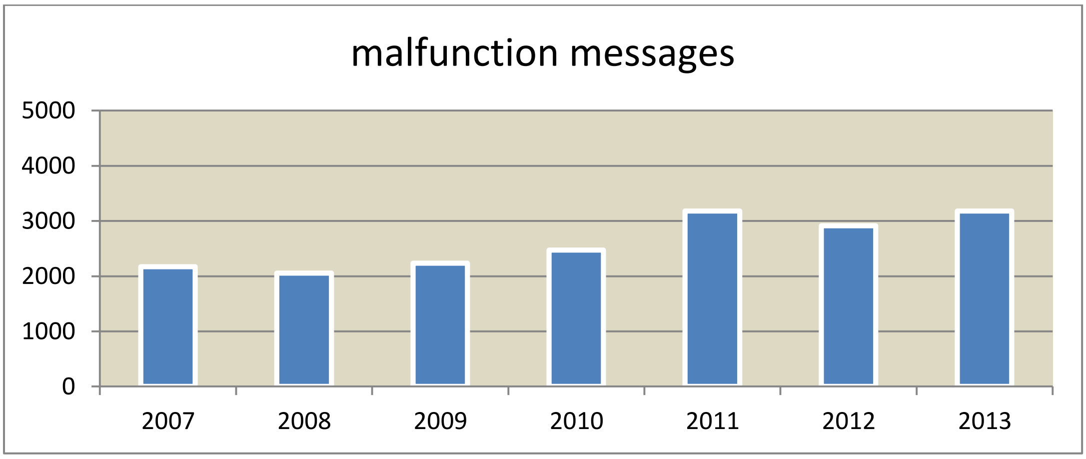
With the RLF a list is made up of high to low RLF rates. In this way a kind of RLF 'billboard chart' of service connections is made every quarter of a year. As well as this a list is made of the fastest rising postal code areas in this chart. They get special attention in this way and can be used to prevent future failures in an early stage. After this analytic phase our NetPlanner regional asset specialist enriches the list with local information. Depending on the RLF a representative sample is drawn from the postal code area on which a specific technical inspection is performed. The inspection includes a visual check and a measurement of the wall thickness for metal service connections. Based on the results of the samples, the service connections in the postal code areas are being replaced or repaired are marked as safe for the upcoming years. Liander already developed several new repair methods to prevent unnecessary total replacement. For instance the Quick Repair Clamp which was developed in close cooperation with AVK.

Liander has started working with this new method in 2012, in 2013 the method has been evaluated and improved after inspecting 23,500 service connections. The RLF method provides Liander with insight in the quality of her service connections. The safety has been brought to a higher level and the emission of methane has been reduced. Due to a more focused way of working we see that after a first wave of replacements the spending on replacement in 2014 is lower than it was before the introduction of the RLF method.

Introduction

In the Netherlands a service connection for the natural gas grid is very common. With a coverage of 98% almost every household is connected to the gas grid. Although in major cities the gas grid had been established long before gas was discovered in Groningen (town gas), the large boost in the number of service connections has been driven by the discovering of the Groningen field at the beginning of the early sixties.

The gas in the Netherlands has a low caloric value. Gas is delivered to our households with a pressure of 30 or 100 mbar (g). Liander is the largest regional grid operator in the Netherlands, with a coverage of 34 percent of the Netherlands. Our asset base consist of 35.000 km of gas mains with 2,3 million households connected to the grid. The company has been formed in the first years of this century. During a decade approximately 50 gas grids and 10 electricity operators merged to what is now Liander. Therefore our asset base consists of a wide variety of materials and ages. Nevertheless there are also similarities. This is caused by the fact that a large amount of the service connections were laid out in the period between 1965 – 1975. In addition to the aging of the connections, Liander saw an increase in the number of malfunction messages over the last few years.



The number of failures caused by insufficient quality of the connection lines fluctuates around 2000 to 2010. After that year we see an increase in the regular failures up to 3,000 in the period 2011 until 2013. Failures caused by third party interference such as excavation damage or vandalism are not included in those rates.

Policy until 2012

Until 2012, the replacement policy was based on local expertise of the network, based on the knowledge and competence of the local experts. Choices where to replace connections, were based on constructions which are considered to be less safe and the result from frequent leak research. The leak research was reviewed by a local member of Asset Management. The Liander grid was divided in

17 sub areas which each have a separate team of experts. This method has the strong advantage that local knowledge was very well represented and the best experts were involved in decisions concerning replacement. However this big advantage has also been its big disadvantage. The local decisions were not centrally prioritized. A certain risk was solved in one region, while other regions were fighting projects which had much higher risk. It was also not clear what risks were solved or eliminated. Beside that there was a disadvantage that regional knowledge was not sufficiently shared among others. Moreover some constructions have a high risk in certain areas while this construction has no risk at all in another area. For instance a steel pipe in a sand soil has a significantly lower risk than a steel pipe in a clay or peat soil.

The challenge

The Asset Management department was asked to maintain good regional knowledge, but also administer a more fact-based approach. The goal was to achieve a higher level of security and less methane emissions, with the same amount of investment. The proposals had to fit in the changes in the organization that already took place in the same period. The question was how to apply the regional expertise into a centralized decision-making model.

The new method

The necessary regional expertise for prioritizing investment proposals is put together with the general policy, into a decision model at central level. The regional expertise is mostly based on practical experience. In the model, much attention has been paid to making sure that knowledge would not be lost. However, the justification for this practice was limited. The comparability of the risk of failure of a certain construction of a connecting line in one area with a similar construction in another area is difficult. The judgment of the risk of a construction on its own was not possible. This is caused by the wide variety of structures and variables that affects the technical quality for example the level of groundwater, kind of soil, construction quality, acidity of the soil, etc. The technical experts of Liander were quickly convinced that scaling up the regional method to a centralized method, would not be suitable. Certainly not a solution in a short term.

By focusing on the risk of connections, a model is set up to show areas where the risk of the connection is the highest. The risk is hereby related to the probability that a connection line fails by leaking. Leakage can lead to suffocation, fire and / or explosion. These are situations that have a negative impact on security. It is also negative on the business value of sustainability because of the methane emissions.

Conditions for the model

For the design of the new model there were the following preconditions:

- Only use existing information and no new data collection in the field;
- Uniform method;
- Measurable and objective criteria;
- Closure of the Plan Do Check Act circle;
- Practical knowledge has to be assured.

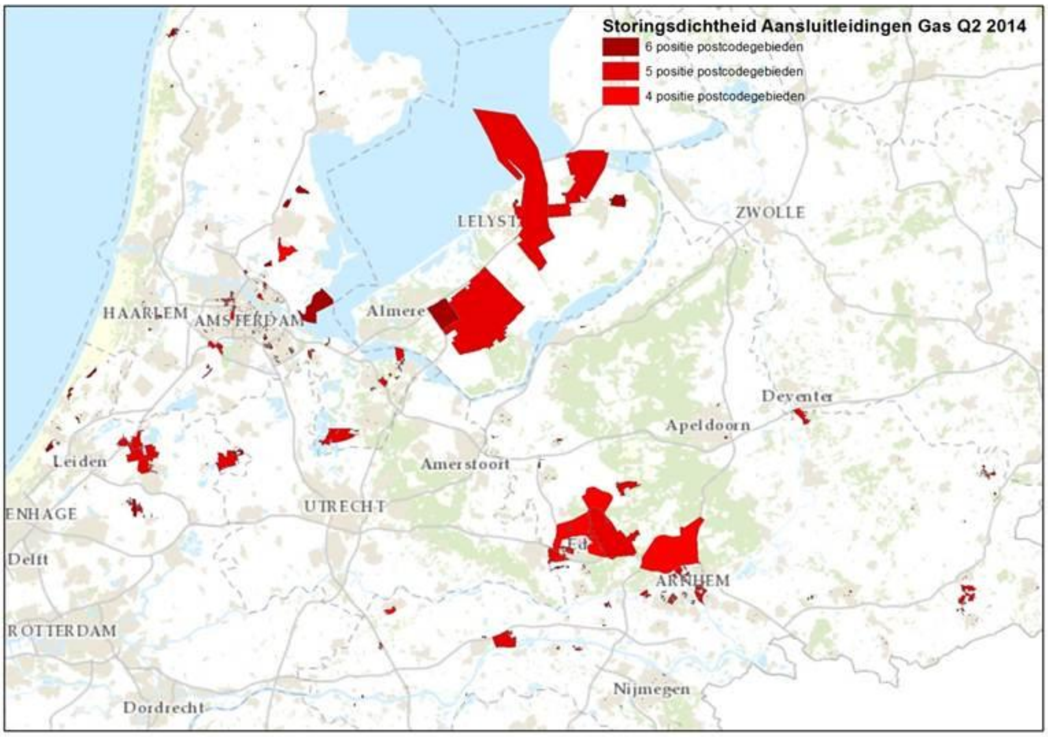
With these constraints, the methodology for the RLF (Relative Frequency Leakage) is developed.

Description of the methodology

In the new method, all the leaks of the previous 60 months are collected. The leaks taken into consideration have been reported by the public or found by leak detection. Leak detection has a minimum frequency of 5 years. Therefore a period of 60 months has been chosen. In this way it is guaranteed that results from leak detection are taken into consideration. Leaks caused by third party damage are ignored. As a result only those leaks remains, which are related to the natural decline of the quality of the connection lines. There is no distinction made in the leaks based on the size of the leak. In the method it is assumed that even a small leak is a preliminary indicator for a bigger leak and that every leak is an indicator for probably more leaks in the same population.

As a coherent area we took postcode areas. Similarities in the construction of houses are surprisingly often associated with a certain postcode area. In such clusters of houses the connection pipes are often made with a similar construction and build in a similar period. The Dutch postcode is made up of 6 characters always starting with four digits and ending with two letters. An example for the postcode is 1234AB. The more characters mentioned of a postcode, the smaller the number of connections there will be in that area. The average postcode area with 6 characters contains 20 addresses. 5 Characters contains approximately 200 addresses and 4 characters approximately 1,500.

In the method used by Liander the risk of leaks is now expressed per area in a Relative Leakage Frequency rate (RLF for short). The RLF makes it easy to compare areas by the number of leaks in the past. The number of leaks over the last 60 months is then made relative by dividing them by the number of connections in the considered area. To make this result more applicable, we multiply it by 1000 and divide it by 5. In this way we have an average amount of yearly failures per thousand connections.



Map with red collared areas, responding high RLF rates or fast raise of leaks

For the determination of the RLF, a process is set. Every quarter of a year, the RLF is determined. The RLF is a boost to the processes that follow. Areas with a sudden raise of leaks are easily detected. Areas with high RLF rates are colored red on a map to make them visible for the organization.

A critical value of the RLF is based on the number of connections in the considered area. The more connections there are, the lower the critical value will be. 2 Leaks in a population of 10 connections is very different from 200 leaks in a population of 1000 connections, although the RLF will have the same rate. The following values are considered as critical:

- Less than 100 connections: more than 3 leaks;
- Between 100 and 250 connections: RLF ≥ 6;
- Between 250 and 500 connections: RLF ≥ 4,5;
- More than 500 connections: RLF ≥ 3;

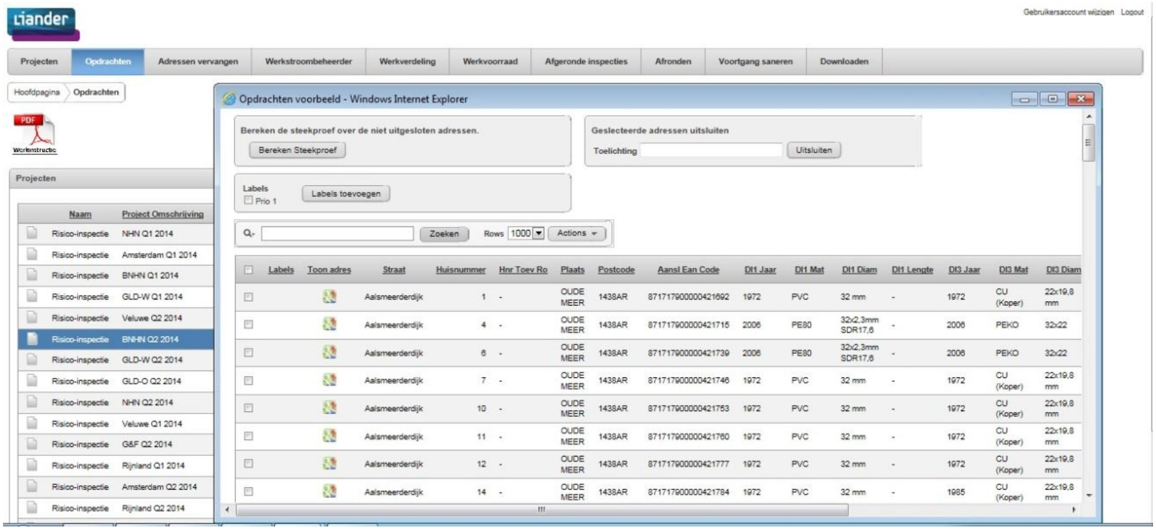
In this way, areas with a high risk for leaks can be discussed with regional responsible officials and local experts. The regional official is responsible for further action and decides what to do. Because the RLF is based on leaks in the past 60 months, there could be the possibility that the connections in that area are already renewed. Therefore it is very important that the local official is being consulted before doing anything.

Supporting software

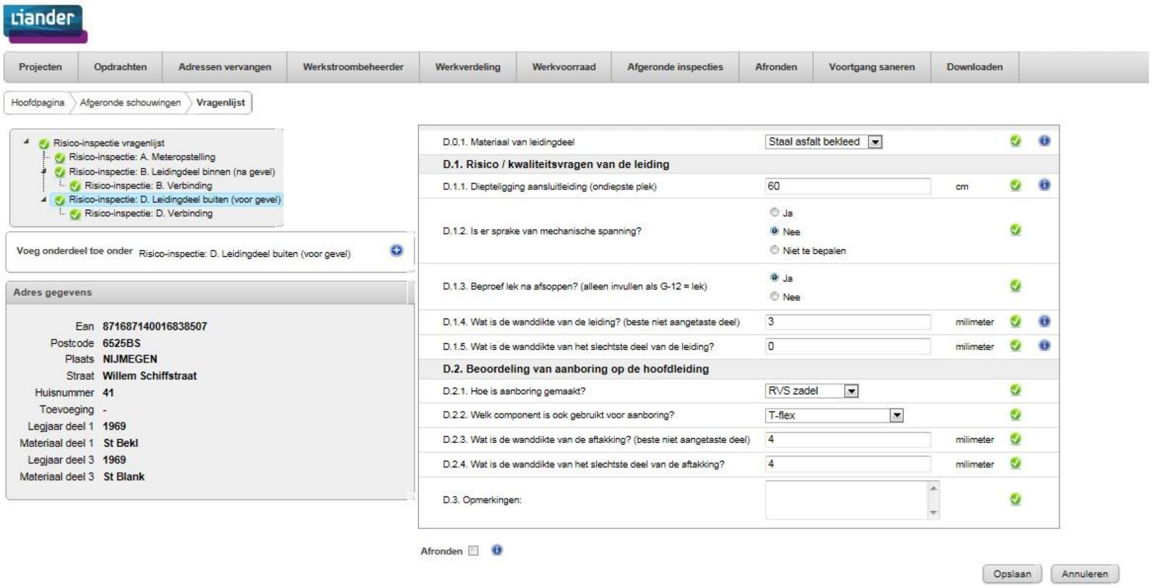
Relatively simple software is specially developed to unite the identified areas on the national scale with local expertise. The list of the identified areas is provided to the local NetPlanner. The local NetPlanner is able to remove or to add identified areas. An important advantage of the software is the required registration of reasons for the NetPlanner for the suggested changes on the list. A reason to remove an area from the list could be the planned urban renewal of an listed area.

The developed software shows the NetPlanner the data of the connections in the considered area like used materials and age. Depending on the considered number of connections the NetPlanner can decide to renew the connections immediately or to investigate what the causes of the leaks are.

The investigation is based on a representative, random test. If the NetPlanner chooses to investigate, the software will support him by providing the number of samples that is needed for a reliable decision and will support him in the selection of addresses where the examination has to take place. The software only takes connections into consideration that are representative for the areas. This is based on the used materials and ages.



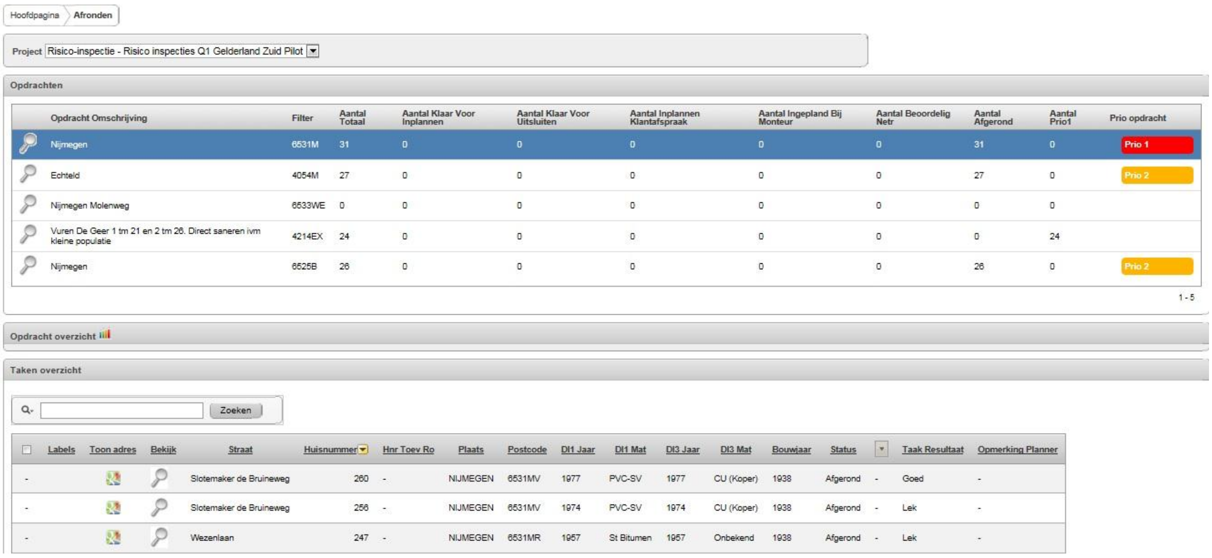
If the customer does not want to cooperate, the software will turn up the closed alternative address.



The examination of the connection is directly reported by the mechanic in the software. All the questions are shown and if an explanation is needed, it can be immediately asked. The examination can only be completed by answering all the questions.

Besides a visual judgment there has to be a mechanical judgment. The mechanical judgment is done by a seal test and a pressure test. The wall thickness of steel connections will also be measured.

After completion of all the inspections, the decision can be made what actions need to be taken in that area. For the determination of the urgency, some regulation is given. Those rules are also embedded in de software. So after processing the results into the software, the software will come up with those areas that need attention the most.



Hoofdpagina › Afronden

Project Risico-inspectie - Risico inspecties Q1 Gelderland Zuid Pilot

Opdrachten

Opdracht Omschrijving	Filter	Aantal Totaal	Aantal Klaar Voor Inplannen	Aantal Klaar Voor Uitsluiten	Aantal Inplannen Klantafspraak	Aantal Ingepland Bij Monteur	Aantal Beoordelig Netr	Aantal Afgerond	Aantal Prio1	Prio opdracht
Nijmegen	6531M	31	0	0	0	0	0	31	0	Prio 1
Echteld	4054M	27	0	0	0	0	0	27	0	Prio 2
Nijmegen Molenweg	6533WE	0	0	0	0	0	0	0	0	
Vuren De Geer 1 tm 21 en 2 tm 26. Direct saneren ivm kleine populatie	4214EX	24	0	0	0	0	0	0	24	
Nijmegen	6525B	26	0	0	0	0	0	26	0	Prio 2

1 - 5

Opdracht overzicht

Taken overzicht

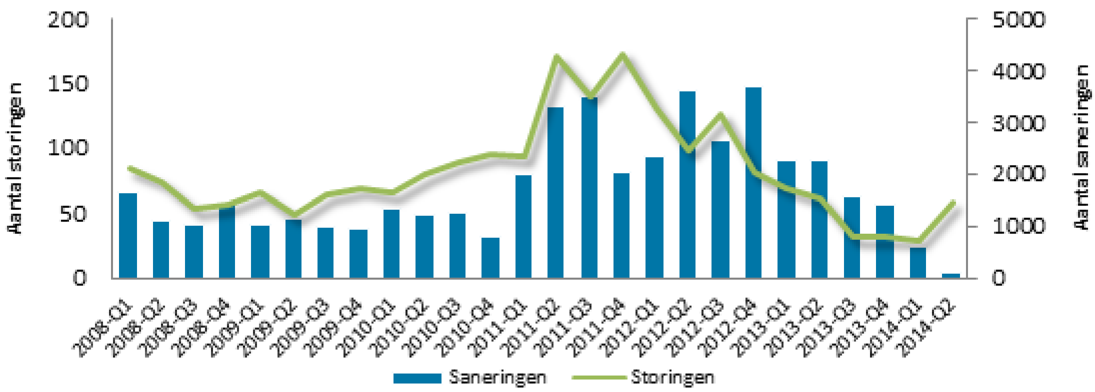
Zoeken

Labels	Toon adres	Bekijk	Straat	Huisnummer	Hnr Toev Ro	Plaats	Postcode	DI1 Jaar	DI1 Mat	DI3 Jaar	DI3 Mat	Bouwjaar	Status		Taak Resultaat	Opmerking Planner
-			Slotemaker de Bruineweg	260	-	NIJMEGEN	6531MV	1977	PVC-SV	1977	CU (Koper)	1938	Afgerond	-	Goed	-
-			Slotemaker de Bruineweg	256	-	NIJMEGEN	6531MV	1974	PVC-SV	1974	CU (Koper)	1938	Afgerond	-	Lek	-
-			Wezenlaan	247	-	NIJMEGEN	6531MR	1957	St Bitumen	1957	Onbekend	1938	Afgerond	-	Lek	-

For an area prioritized as Prio 1, a plan has to be reported by the NetPlanner within 9 months. For an area prioritized as Prio 2 it will be a period of 12 months. Solving the problems in the selected areas, which can take a maximum of 18 months, is monitored with the report of the total leaks from all the selected areas together.

Results

The goal is to see the number of leaks decline to nearly nil.



The left axis shows the number of leaks. The right axis shows the numbers of renewed connections. The green line shows the amount of leaks reported on the total network per quarter of a year during the start of introducing the new policy. After a rise of leaks in the beginning of 2011, a decrease in the number of leaks is seen.

Collateral benefits of the newly introduced method

Due to the inspecting and recording of the quality of the inner and outer connection line, we were also able to detect repetitive (or general) causes for leakages. In the case of Amsterdam, we found that almost all leakages were relatively small and due to a specific joint. The remainder of the connection line was still in very good condition. In response to this situation, repair material was developed in collaboration with AVK Netherlands. A clamp was made, that acts like a shell which envelopes the existing joint and as such resolves the leak. The clamp was invented, developed, tested and introduced in a period of six months. The testing took place at KIWA, an independent inspection body for the gas sector, and concluded that the Quick Repair Clamp (as the clamp is called) has a life expectancy of at least 20 years.
The newly introduced method of RLF has provided the insight that was needed for such new developments, like the QR-clamp, to emerge. Several thousands of joint can now be repaired in a way that doesn't include replacing the entire connection line. As such, great benefits can be found in public disruptions as well as in maintenance cost as a repair can save up to 80% of the costs.

Foto of a Quick Repair Clamp

Evaluation & Conclusion

After the first ideas of coordinating projects based on the RLF method, lists are made up of areas with a high RLF score. Solving the leaks in those selected areas is monitored with the report of the total leaks from all the listed areas together. The goal is to see the number of leaks from those areas decline to nearly nil. Developed software supports the new way to fight areas with a high RLF rate.

The other elements in the new method were introduced step by step. For instance the risk inspection of the service connection. The introduction took place at the end of 2013. The analysis of the inspections gave a lot of insight that was used for feedback of the constructed model.
Another benefit of working step by step was the input and close cooperation between the strategy department and the service engineers. In the evaluation Liander also concluded that it is rarely that the RLF of an area rises quickly. From this we concluded that the growth of leaks is normally a slow mechanism and that Liander can take measures in time. Nevertheless by examining all our areas every quarter we have enough time to take appropriate actions. Essential in the process has been a strong project management, close cooperation between the strategy department, service engineers, planning and IT and flexible work flow software which could be adjusted within one or two weeks after request. In the project management Liander was supported by First Consulting, a Dutch company specialized in project management in the utility business.

Conclusion (Wrap up)

With the RLF method we have successfully combined insight by central analysis, with local expertise of the grid. The local knowledge is improved by the introduction of risk inspections. It is possible to consult and compare these results centrally. In this way we focus on areas where connections have the highest risk for leakages. Since the beginning of 2014 the number of leakages is decreasing. This means that the safety of our customers is increasing. A positive side effect of a lower number of leakages is the decreasing of methane emission, which is good for the environment . Two years after the introduction of this method, we see a significant decrease in the number of service connections which have to be replaced in 2015. This decrease cancels by far the rise of inspections costs.

So we can conclude:

- *A higher safety level with lower emissions due to condition based replacement of service connections. -*