PiReM | Systems

# PiReM Electricity

## Liberalisation and its consequences

Due to new EU regulations for the liberalisation of the electricity supply market, energy suppliers have, over the last decade, been faced with far-reaching changes in the market. Increased competition, regulated caps on revenues combined with rising operating costs and the demand for optimum quality of supply, means that energy companies are faced by profound management decisions.

Additional incentive systems for the promotion of quality measures were introduced at the same time as the liberalisation, to promote a high security of supply level. These systems act by causing directly proportional increases or reductions in revenues. Power network operators are consequently motivated to take all the necessary technical measures that ensure stable network operation. In particular, they must ensure their networks' reliability through long-term investment.

Network operators meet the requirements of the regulating authorities through periodic reporting on all network renewal and maintenance measures, the continuous monitoring of equipment and strategic and operational asset management. Computer-based analyses using PiReM based on individual GIS data, support network operators in developing optimal rehabilitation strategies and planning the necessary investment.

- Uninterrupted supply
- Condition and risk assessment
- Network and equipment reliability
- Renewal or maintenance
- Asset value development
- Integrated asset management

## Computer-based planning using PiReM

The starting point of analyses using PiReM is the adoption of a system-based overview of all the equipment forming the supply network. In a first step, all relevant data concerning the equipment is imported via a generic interface from the geographical information system into the PiReM database. This includes inventory data of all assets. In case of assets that are cables the inventory data include the cable type (which encodes wire material, insulation material, armouring material, sheath material, cross-section area, nominal voltage etc.) as well as cable length, year of installation, traffic volume of the related street and much more. Furthermore, also fault and damage records belong to inventory data. In case there are additional sources that provide useful information (like SAP or network calculation systems), the inventory data can be supplemented and combined with such information. This makes possible the incorporation of cost-relevant information from business accounting, weighting according to network zones and other network topology criteria. The level of detail of the existing data pool provides the foundation for planning with PiReM - i.e., the higher the data density, the more informative the results!

All data are normalized and subjected to a plausibility check, and then divided into logical equipment groups. The equipment groups are individually recorded according to the regional network conditions and further processed depending on the type as either a number of units or a length in the calculations carried out using PiReM.

## Strategic planning with PiReM

- Age-related damage
- Faults due to external influences
- Equipment failure performance
- Measure risks, evaluate and control
- Consideration of consequential fault costs
- Key figure average annual down-time

Initial analyses with PiReM indicated the network-specific plant structures and provide an overview of the state of the supply network. Equipment such as power transformers, circuit breakers, power poles or cable distributors are evaluated in advance using individual network, condition-orientated factors in a grading system but also due to faults that have occurred. PiReM describes the failure behaviour of equipment laid underground on the basis of damage records and knowledge of material aging.
Taking into account the aging behaviour, the technical service life and costs for the procurement of equipment PiReM forecasts the failure rate trends, the renewal requirement per equipment group and the long-term future rehabilitation and investment requirement. In making its calculation PiReM relies on the one hand on statistical methods, and on the other simultaneously on the long-term experience and network know-how of the company's experts who can make fine adjustment via PiReM's flexible user interface. The various treatment options are evaluated both in tabular and graphical format and thus the development of the asset value of the entire supply network, both in terms of sub-networks or per equipment group is visualised.
Strategic planning using PiReM considers the key figure average annual down-time. The Association of Network Operators (VDN) in Germany sets guidelines for the allocation formula, which are stored as a help source in PiReM. The "average annual down-time" trend and the effects of set rehabilitation measures can be displayed in the scenario analysis, taking into consideration budget-friendly planning.
Using condition transition forecasts, the information from inspections of equipment such as (power) transformers, switches or pylons can be used and, based on them, their future behaviour described.

## Operational planning with PiReM

The results of the long-term planning on projected damage, rehabilitation and cost trends are now operationalized in a list of priorities for concrete action. The forecasting model for medium-term replacement planning answers the following important questions:

**How much will the repair cost in the future?**
**Is it more cost-effective to replace or repair?**
**How great is the risk of a failure?**

Alongside the optimum economic rehabilitation time point, multiple technical and economic criteria as well as further results from maintenance logs are incorporated in the priority list calculation. The equipment is sorted by risk class and "average annual down-time" and an indication given, through use of an integrated traffic light system, of which equipment requires urgent treatment. In addition, the interdependence of the equipment is presented which can be a valuable source of information for the practical implementation of measures.

Alongside the condition-based factors which describe a supply network, further safety assessments are incorporated in PiReM as part of the risk assessment. PiReM, presents the risk classification for all equipment in a powerful risk matrix, which arises from an assessment of the condition class and the importance of the systems.

Medium-term rehabilitation planning using PiReM factors in the following evaluations:

| | MV/LV (power) transformers | Circuit breakers | Power lines | Cable | Other installations* |
|---|---|---|---|---|---|
| Failure statistics | x | x | x | x | |
| Rehabilitation time | | | x | x | |
| Number of short circuits | x | x | x | x | |
| Refillable paper insulated earthing cable | | | | x | |
| Condition assessment | | | | | x |
| Duty cycle of transformers | x | | | | |
| Risk assessment | x | x | x | x | x |

** Buildings, pylons, cable distributors*

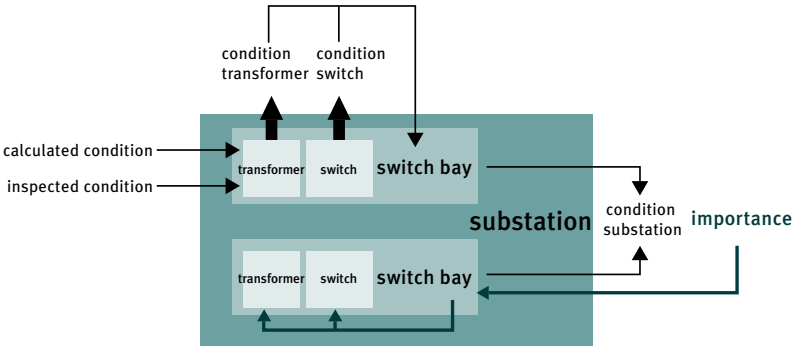
## Condition forecast in PiReM

The condition assessment in PiReM integrates external data that is collected through site inspections and administered in plant maintenance systems, such as SAP PM. These can be combined with the results of the PiReM condition analysis which in its calculation considers both the aging behaviour and the condition changes of equipment, as well as failure and fault statistics. Through the integration of external inspection and valuable experience about material behaviour, load indicators and damage records PiReM forecasts, based on the actual condition of the plant or on the basis of defined condition classes, its long-term change over time.

PiReM combines the 2 pillars of condition forecasting:

1. Data from inspection
2. Data from statistical investigations of an equipment population

The practical forecasting tool records and forecasts the conditions of individual equipment, which are typically allocated to substations in the power network. Through weighting of the individual equipment items a substation condition index is generated, which is entered into replacement planning as an important criterion. The impact of the replacement of a substation is thus also made visible at the equipment level and the strong interdependence of individual equipment items is readily interpreted.

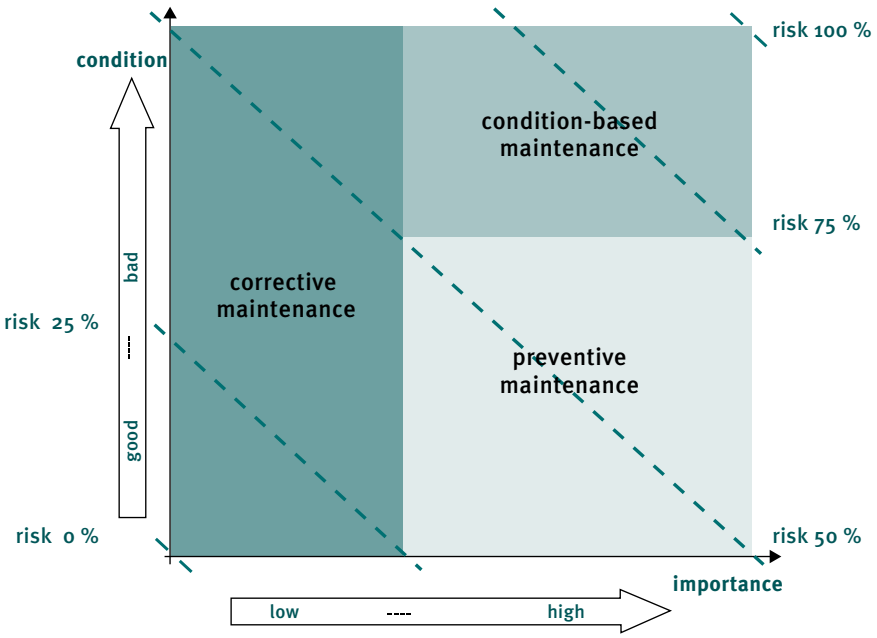



## Risk-orientated maintenance

In PiReM, a valuable decision support system for selection of an appropriate rehabilitation strategy for power network equipment has been developed. Its integrated “risk-orientated maintenance” is the strategic approach, taking into account the importance and the condition of individual equipment items, to formulating a comprehensive strategy, which, combined with inspection measures, uncovers condition deterioration and then counteracts it by equipment renewal at an economical ideal time. Criteria such as security of supply, importance of purchasers, but also danger for man and environment are just some of the criteria that are used to assess the importance of network zones in PiReM.

What consequences arise from the unplanned outage of a line section for the supplier?

Different maintenance strategies define different maintenance and inspection cycles and therefore involve different costs. Through the dynamic allocation of maintenance tasks according to importance and condition and the representation of the risk for an individual equipment item, allocated in the risk matrix provided by PiReM, it is demonstrated which costs can be accepted dependent on the risk, so that equipment condition deterioration can be detected and remedied. The safety assessment takes place dynamically through allocation in the risk matrix by the asset manager. This shows which costs can be accepted in relation to the risk, in order to detect an equipment condition deterioration and then counteract it. In practice, this often results in a different equipment technical service life. For this reason PiReM offers the formulation of several depreciation options, which can be calculated in the system through the saving of acquisition and production costs.



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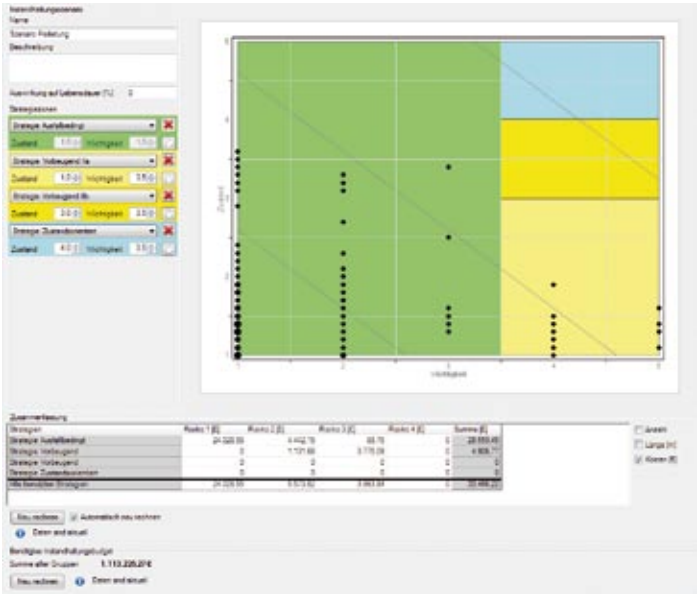
## Cost efficiency with PiReM

In a power supply network continuous aging and wear processes entail on-going investment. Budgets are limited and must be properly targeted to ensure a maximum network lifetime. The time value of equipment is an important orientation guide for planning.
PiReM indicates in the scenario forecast how investments affect the network lifetime and how the book value of plant assets changes over time. The condition class model not only forecasts the physical deterioration of the network equipment, but also indicates, through the saved commercial criteria, such as materials, labour and other costs as well as maintenance and inspection costs, the financial resources required, which are added to the medium-term planning of investment over the defined period. As well as operating costs due to maintenance activities (materials, labour and storage costs), consequential fault costs (penalties) may also need to be considered.
Another interesting aspect in PiReM is the comparison of scenarios, such as consideration of debt financing to cover the necessary investment.



## Advantages of PiReM delivered by experts

### Network charge simulation

When agreeing network charge, network operators are faced by incentive regulation decree, in which revenue caps are set for network operators, the result of which are fixed upper limits on network charge. Through the network charge simulation, PiReM supports the network operator in the calculation of the revenue cap, in which the effects of proposed replacement measures according to the prepared budgets are simulated. Interruption frequency and duration are drawn upon as important key figures for the calculation of network quality; amongst other things the cost-accounting depreciation of network equipment is included in the calculation of network costs. The latter is made available in PiReM under the book value of the equipment.

NEW: Value consulting concept based on **PiReM** Systems!

To determine the optimum investment option for the supply network, the expert team for network rehabilitation planning supports the strategic planning of the network operator using PiReM.

### Site coordination through multi-sector rehabilitation planning

Equipment is exposed to different environmental conditions in the various electricity, gas, heat and water supply sectors. Both the medium and the material behaviour of the equipment used in the network influence its service life. Expert analyses using PiReM offer multi-utility companies a significant cost advantage through the exploitation of synergies and know-how transfer between the supply networks. In particular, potential cost savings through targeted-site coordination using PiReM are used, which can be achieved both within the company and also through cooperation with external network operators.

## Decision support using PiReM - Pipe Rehabilitation Management

- Safety assessment using risk analysis
- Rehabilitation at the economical ideal time
- Efficient replacement planning using cost forecasting
- Objectivity and transparency due to software-supported planning
- Security, quality and reliability of supply
- Synergies for multi-utility providers through all-in-one rehabilitation planning
- Know-how transfer by means of cross-industry rehabilitation planning

Online Demo at www.pirem.net

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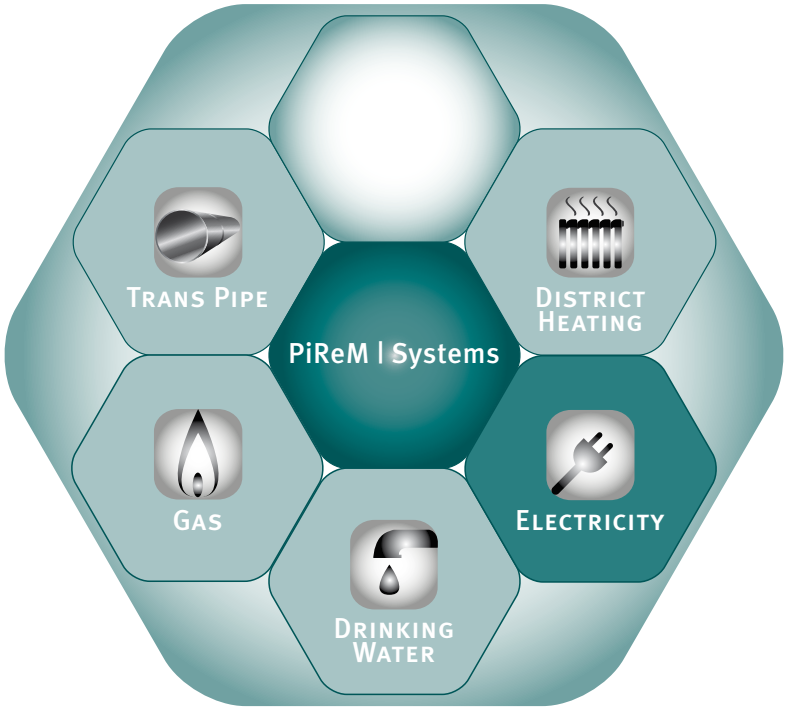


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