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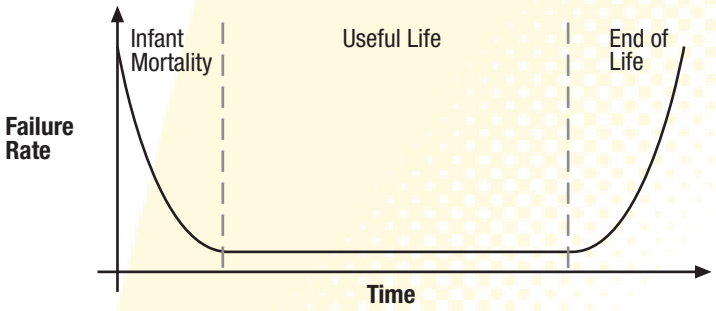
Predicting ERT Module Life

How long does a gas ERT module last? This is a complex question without an easy answer, however life expectancy in an electronic hardware product can be predicted and represented by Mean Time Between Failures (MTBF) -calculated statistically & by analyzing field performance data.

Reasons for Failure

Hardware failures are typically illustrated by a bathtub curve such as the one shown below. The chance of failure is high during the infant life of the module. The failure rate during the rated useful life of the product is fairly low. Once the end of the life is reached, failure rate of modules increases again.



Failures during an ERT module's life can usually be attributed to the following causes:

Design failures

This class of failures takes place due to inherent flaws in an electronic design. In an Itron's gas ERT module, this class of failure is practically non-existent. Itron's enormous field experience of millions of ERTs are a testimony to Itron's efforts to design a truly world class product.

Infant Mortality

This class of failure includes newly manufactured hardware and can be attributed to manufacturing issues. Itron's state of the art manufacturing facilities and its best in the class manufacturing practices helps ensure that any infant mortality failures rarely occur, in our products that are shipped to customers.

Random Failures

Random failures can occur at any point during the life of an ERT module. Redundancy in design and several Accelerated Life Tests (ALT) conducted by Itron's product development group, ensures that these failures are very rare in Itron's Gas ERT modules.

Wear Out

Once an ERT module has reached the end of its useful life, general degradation of components may cause the modules to fail. It is usually prudent, before this stage arrives, to analyze if any maintenance, including changing the battery, would be useful. It is important that this analysis is done before an ERT module reaches this stage so that system and performance degradation are avoided. A comparison of a battery change program vs. an ERT change out program with extended life will determine the best solution from both an operational and a financial standpoint.

Predicting Future Failures

Mean Time Between Failure calculations are done using two different methodologies: statistical and field data.

Statistical MTBF: This is the process used to determine the MTBF of a product based upon its design, choice and behavior of components, their layout, and the design threshold levels. This is achieved by performing a prediction analysis based upon the performance of the product in simulated accelerated test environments and temperature cycling. Itron has one of the best-equipped test facilities in the nation and follows one of the most stringent testing regimens of any industrial electronics designer and manufacturer.

Itron's test facility in Minnesota is a dedicated test laboratory. Design Verification Testing (DVT) is performed on all new products and anytime a significant change is made to the design, materials or manufacturing process of an existing product. Some of the tests performed during DVT assess the product's conformance to customer requirements, design requirements and regulatory agency requirements (UL, ANSI, FCC, etc.). At the same time, the new or significantly changed products are subjected to several types of accelerated life tests. These tests include temperature cycling (with or without added humidity), steady-state elevated temperature and humidity testing, and multivariate, highly accelerated life testing (HALT). Most programs include controlled samples of existing product to verify the validity of the tests.

Itron's Gas ERT modules are designed for a useful life of 20 years. Various DVT ensures that these products meet these criteria.

Statistical MTBF analysis is a useful tool to evaluate whether the product is adequately designed to meet the requisite performance criteria.

Field MTBF. The real proof of reliability is the analysis of field performance data. Field MTBF is the result of determining the reliability of a product based upon its operational performance in the field in real life conditions. Itron has proven track record of exceptional, ever improving high field performance over last two decades. It has a well-established process, designed to collect regular field data and perform regression analysis of the failure data of ERT modules.

As a part of the field MTBF analysis, Itron Quality Assurance in Minnesota analyzes a sample of ERT modules returned under warranty. The analysis of returned modules is used to track and report the annual failure rate of early-life units. Reliability models and predictions are developed from this data. Itron performs complete, root-cause failure analysis of the first thirty (30) units returned from each customer and product combination and 5% of all subsequent returns.

Using these two MTBF methodologies, Itron calculates an expected return estimate for its current Gas ERT modules.

The field data shows that current ERT failure rate continues to be well within 0.5% per year.

It is clear from this analysis that Itron's Gas ERT modules consistently perform in the field and are designed to work reliably, without failure for years. This is backed up by solid field analysis data.

Ensuring Quality Products

At Itron, statistical & field MTBF analysis is coupled by a strong, in-house, long term continuous product testing in real life conditions.

In order to monitor the quality of ERT modules, Itron field-tests endpoints during the product development process and through out the product life .

Outside of Itron's manufacturing facility in Minnesota there is a huge collection of gas meters and other meters that is referred to as the "Meter Farm". The Meter Farm serves a vital testing ground for Itron's ERT Modules. ERT modules are taken off the production line, at a rate of one gas module per shift and one electric module per week, and placed on these meters – exposed to real life conditions.

The meters are then read periodically and the ERTs checked for accuracy, providing a near real-world indication of how they will perform over time. Some of these ERT Modules have been part of these tests since 1991. If an inaccuracy or failure is detected, technicians immediately investigate the cause of the inaccuracy or failure.

Since the introduction of the Meter Farm in August of 1991, 3,005 40G ERTs have been installed and monitored. These 3,005 meter/ERT combinations have accumulated a total usage of over 696 million counts.

The modules were read quarterly, with only 12 units identified as being inaccurate. Inaccurate, for the purpose of this stringent testing, is defined as a discrepancy of 2 or more counts regardless of the total consumption measured by the meter/ERT combination.

The 12 units identified as inaccurate exhibit a total inaccuracy of 4,208 counts (absolute value of deltas), therefore the overall inaccuracy of the AMR test site population is approximately 0.000604%, or approximately 6 counts per million. The demonstrated accuracy of 40G ERTs on the AMR test site can thus be reported as 99.999396%, using the absolute inaccuracy of the entire population

Operational Considerations

Because Itron is able to predict the life of an ERT module with a fairly high degree of accuracy, our customers can make informed operational and financial decisions regarding their AMR system.

Our data indicates that the first generation of ERT modules, the 25G, had a life expectancy (including the life of the battery) of about 9 years. When the first generation 40G was introduced in 1992, it was expected to have a useful life (including the life of the battery) of about 14 years. Our current generation 40G has a predicted life (including the life of the battery) of 17 to 20 years. Of course Itron's reliability data and life expectancy predictions must be balanced with the specific customer environment. Batteries tend to last longer in colder climates; therefore, if ERT modules are deployed in a warmer climate or on an indoor meter, the battery in the module may last at the lower range of the life expectancy range. If ERT modules are deployed in colder regions they are likely to last at the higher end of the range. The important thing is to use Itron's data to develop an operational program that ensures continued high performance of your AMR system. You must consider your individual installed base profile and determine if and when a battery change out program is applicable or an ERT replacement program may be more cost-effective to ensure performance. Itron representatives will be able to help develop a program to meet your needs.

Conclusion

Very few industrial electronic products in the world have a 20 year designed life. To ensure that Itron's ERT modules continue to perform at a reliable rate for their useful life we design, develop, manufacture and monitor our products carefully. In addition, we field test our products and continue to monitor them in real world weather conditions. All of this quality design and testing ensures our customers that they are purchasing quality products that have proven reliability and can be sure that Itron ERT modules and batteries are the most thoroughly tested and durable in the industry. A fact that has been proven through years of field experience, with millions of ERT modules installed in some of the toughest real-world conditions for almost two decades.

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