

Calculo do MTBF dos nobreaks SunbrV1/V2 da RTA

1.Premissas

O calculo do mtbf deve levar em conta a confiabilidade de funcionamento do sistema, de seus componentes críticos para evitar parada e dos componentes gerais passíveis de troca por definição de consumível.

De acordo com a Telcordia standard temos Disponibilidade Intrínseca $A = \text{MTBF}/(\text{MTBF} + \text{MTTR})$, válida para o sistema, ou seja, quanto tempo podemos gerar uma parada no cliente.

Exemplo:

Nobreak:240000 horas, em redundância o stress de temperatura e operação é reduzido em 50%, levando o sistema com duas unidades a dobrar o mtbf para 480000 horas.

Em caso de falha das duas unidades , o sistema de bypass contribui com a continuidade da alimentação em mais 1.000.000 horas.Observar que a falta de rede neste momento inviabiliza o conceito de mtbf considerando o bypass.

Logo $480000/480000 + \text{mtrr} = 0$ (pois se assume o defeito em uma unidade e não gera interrupção para manutenção). Com fator 1 se obtem o maximo de mtbf sem risco de interrupção.

Sob o aspecto dos consumíveis recomenda-se a efetivação da troca dos mesmos afim de manter o mtbf do nobreak, executando as preventivas isoladamente em cada equipamento:

Itens críticos:

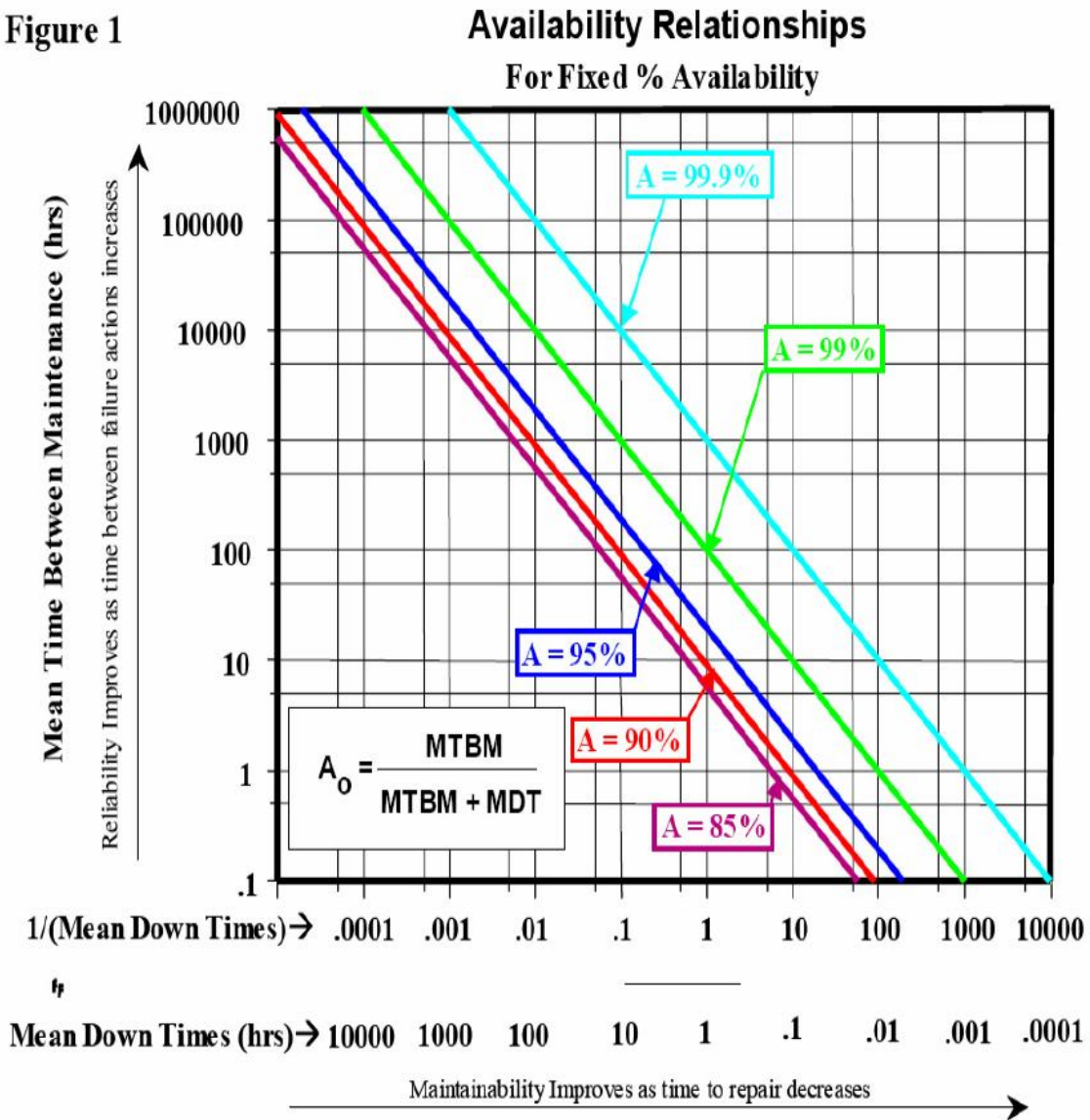
Ventiladores:30000 horas ou 3,5anos

Turbinas:40000 horas ou 4,5 anos

Placas eletrônicas (medição pelo conceito funcionamento em campo):70000horas ou 8 anos.

Abaixo material retirado do site Telcordia, muito usado para metodologia mtbf:

Figure 1



Using Telcordia Calculation Methods to Adjust Failure Rates

Improve the Accuracy of Your Reliability Predictions!

The general purpose of the calculation methods outlined in the Telcordia (Bellcore) document, *Prediction Procedure for Electronic Equipment*, is to take into account additional information about the devices, units, and systems under analysis. These calculation methods consider various burn-in, field, and laboratory test data. They also provide for calculating the infant mortality rate, or first-year drop out, for the systems under analysis. However, this particular topic is beyond the scope of this brief.

Before reviewing the three Telcordia calculation methods, it is important that you understand the basic terminology that is used to describe them. The following table defines terms used within the Telcordia (Bellcore) document.

Term	Definition
Device	An electrical part with well-defined electrical characteristics. Devices include integrated circuits, diodes, resistors, and more.
Unit	An assembly of devices typically at the lowest replaceable level. Units include circuit packs, modules, power supplies, plug-in devices, and more.
System	A complete assembly that performs an operational function.
Steady-State Failure Rate	The constant failure rate after one year of operation, providing information about long-term product performance.
Burn-in	The operation of a device under accelerated temperature or other stress conditions to stabilize its performance.

Your choice of a particular Telcordia calculation method depends upon your analysis requirements and the amount of data available. General descriptions of each method and its different cases are provided in the remaining pages of this brief. For more detailed information, please refer to the Telcordia (Bellcore) document itself.

Note: The terminology from previous Bellcore standards—Method I, Method II, and Method III—is replaced in Telcordia Issue 1 with Black Box Technique, Black Box Technique Integrated with Laboratory Data, and Black Box Technique Integrated with Field Data, respectively. The underlying calculation procedures are the same; only the terminology has been updated to promote better understanding. Although the sections that follow note both sets of terminology in the heading, the Method I, II, and III terminology is used within these topics for succinctness.

Method I (Black Box)

Method I is generally referred to as a Parts Count method because the steady-state failure rate for a unit is assumed to be the sum of the steady-state failure rates for its devices. Because Method I is based on generic failure data for various device types, it is used when specific part data is unavailable.

In the previous Bellcore standards, three different cases of Method I are defined. Case 1 and Case 2, which are very general, both assume that operating temperature is 40 degrees Celsius and rated stress is 50 percent. Case 1 assumes a burn-in of less than or equal to 1 hour, while Case 2 assumes a burn-in of greater than 1 hour. Case 3 provides for the use of variable temperature and stress values. Case 1 is similar to the MIL-HDBK-217 Parts Count methodology, and Case 3 is similar to the MIL-HDBK-217 Parts Stress methodology.

Case	Description
1	Predictions are based on the Black Box option with unit/system burn-in \leq 1 hour. There is no device burn-in. All devices are assumed to be operating at 40 degrees Celsius and at 50 percent rated electrical stress.
2	Predictions are based on the Black Box option with unit/system burn-in $>$ 1 hour. There is no device burn-in. All devices are assumed to be operating at 40 degrees Celsius and at 50 percent rated electrical stress.
3	This is the general case for Method I reliability predictions. It can take into account device burn-in and varying temperature and stress data.

Method II (Black Box Integrated with Laboratory Data)

The purpose of Method II is to adjust the predicted MTBF (Mean Time Between Failures) of a unit or device based on available laboratory or test data. Using Method II, the steady-state failure rate is calculated as a weighted average of the measured laboratory failure rate and the Method I generic failure rate, with the weights determined by the laboratory data.

When laboratory tests are very informative, the Method II base failure rate is heavily influenced by the laboratory data. When laboratory tests are less informative, the Method II base failure rate is heavily influenced by the Method I generic failure rate. The factors taken into consideration in the weighting of laboratory data include the number of device failures during laboratory test, the number of devices tested, the actual time devices were tested, and the temperature acceleration during test.

When laboratory data is included, the calculations for predicting steady-state failure rates are dependent upon whether devices or units have had previous burn-in. In the previous Bellcore standards, four different cases of Method II are defined. The table below describes each of these cases.

Case	Description
L1	Devices are laboratory tested and have no burn-in.
L2	Units are laboratory tested and have no unit/device burn-in.
L3	Devices are laboratory tested and have had burn-in.
L4	Units are laboratory tested and have had unit/device burn-in.

Method III (Black Box Integrated with Field Data)

The purpose of Method III is to adjust the predicted MTBF of a unit or device based on field data. Method III is calculated as a weighted average of the observed field failure rate and the Method I generic failure rate. The number of total operating hours during field testing determines the weights.

When the number of total operating hours is large, the Method III base failure rate is heavily influenced by the field data. When the number of total operating hours is small, the Method III base failure rate is heavily influenced by the Method I prediction.

In previous Bellcore standards, three different cases of Method III are defined. The following table describes each of these cases.

Case	Description
III (a)	Provides failure rate predictions for devices, units, or subsystems based on actual in-service performance.
III (b)	Provides failure rate predictions for devices, units, or subsystems based on in-service performance as part of another system. Adjustments are made to these estimates to take into account differences in operating conditions and environments.
III (c)	Provides failure rate predictions for devices, units, or subsystems based on the in-service performance of similar equipment from the same manufacturer. Adjustments are made to these estimates to take into account differences between the operating conditions and environments of the two systems.

The Telcordia calculation methods described in this document are supported in the Relex Reliability Prediction module. In addition to supporting a wide range of prediction models, including MIL-HDBK-217, Telcordia, RDF, etc., Relex Reliability Prediction allows the Telcordia calculation methods to be applied to any linear-based model. This means that you can adjust the failure rates for virtually any reliability prediction model to account for laboratory and field data by using these Telcordia calculation methods.

Com relação ao MTBF solicitado comumente em especificações, temos que detalhar o conceito e informar que atendemos e excedemos o pedido no projeto:

Conceitos

O tempo médio entre falhas (Mean Time Between Failure - MTBF) de uma instalação ou sistema de nobreaks é igual ao MTBF de um nobreak individual, dividido pelo número de nobreaks na instalação. Por esse motivo, o MTBF de um único nobreak instalado é seu valor intrínseco.

Sobre esta visão, informamos que os nobreaks fabricados pela RTA são projetados para um mínimo de 300.000 horas a plena carga.

Cabe informar que o MTBF é função do nível de carga na saída, por exemplo, em 1/2 carga, o nível de stress dos componentes seria reduzido a um valor

exponencial do projetado. Em linhas gerais os componentes utilizados obedecem a curva exponencial. Experiências práticas podem sugerir de 3 a 4 vezes como o valor incremental do MTBF. Novamente, não só a subjetividade, como análise do contexto deve ficar transparente. Desta maneira cada nobreak no sistema, pode, trabalhando em regime normal de 1/2 carga, chegar a 800.000 horas.

Somando-se a este tempo tempo estimado as seguintes variáveis:

Caminho alternativo de bypass automático em caso de falha do inversor, composto de tiristor autoconduzido, cabos, barra de terminais e disjuntores, podemos adicionar ao sistema, e não somente ao nobreak, um MTBF de fornecimento de energia, ainda que alternativa, de mais de 2.000.000 horas. Ressalta-se que em funcionamento normal este recurso está desativado, não contando para o MTBF como entendido que é pedido pelo projeto. O projeto pede sempre o caminho mais crítico, ou assim deveria ser.

Resumindo, para efeito de dependabilidade do sistema, o **MTBF** requerido é facilmente atingido. Para efeito de unidade principal ou caminho principal via inversor, tem que ser considerado a vida útil dos componentes ao máximo stress, que é de 300.000 horas. Este número excede e atende o projeto.

A RTA comercializa e fabrica este nobreak ofertado há mais de 17 anos no Brasil, totalizando equipamentos instalados sem ocorrências há mais de 120.000 horas, ratificando nosso projeto.

A RTA é conhecida pela alta capacidade de desenvolvimento de produtos nacionais, com elevado grau de customização, afim de atender os mais diferentes requisitos dos clientes, sendo nossa literatura uma referência da enorme gama de possibilidades de projeto e construção de equipamentos.