
Substation Maintenance Instruction

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SMI 161 Condition assessment of assets using health index

SECTION 2 - ACTIONS

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2.1 Health index criteria and condition rating

A health index is a method of quantifying complex asset conditions to provide an indication of the overall condition of the asset, with a simple numerical rating on a scale of 0 to 100. The health index can be used as a tool for long term asset management when determining the proximity to the end of life for an asset based on set criteria.

To determine the health index, the condition of the components of an asset is rated using condition rating letters A to E. The generalised letter condition rating meanings are as follows:

Condition Rating	Description
A	The component is in 'as new' condition.
B	The component has some minor problems or evidence of aging.
C	The component has many minor problems or a major problem requiring attention.
D	The component has many major problems and the potential for major failure.
E	The component is about to completely fail or is damaged beyond repair.

The condition assessment and rating of each component is assessed based on the results of field inspections and maintenance diagnostic tests after maintenance has been performed.

Health index criteria can also be utilised for short term asset management. The component condition rating in the health index can determine refurbishment or replacement of a component rather than whole asset replacement. This consequently will result in the increase of the overall health index and life expectancy of the asset.

For example; in the event a health index criterion receives either a condition rating of 'D' or 'E' of a component, the following actions are necessary for short term asset management:

- 'D': Indicating there are major problems with the component. Based on the risk to the network and safety in the event of a failure, the planning process shall commence for an investigation and repair/replacement of the component.
- 'E': Indicating the potential imminent failure of the component, investigation, analysis shall commence immediately for repair/replacement of the component.

2.2 Health index formulation

The formulation of a health index within the overall asset management process can be viewed as a way of prioritising the process. In order to formulate the health index the condition rating letters listed above are given a number as a condition rating factor shown below:

Condition Rating	Factor
A	4
B	3
C	2
D	1
E	0

For every asset the condition rating criteria, each component and test are weighted based on their importance in determining the end-of-life.

#	Condition Criteria	Weight (W_i)	Condition Rating	Factor (S_i)	Maximum Score (T_i)
1	Bushing	4	A, B, C, D, E	4, 3, 2, 1, 0	16
⋮					
N	Oil Analysis	2	A, B, C, D, E	4, 3, 2, 1, 0	8

The condition rating factor is multiplied by the assigned weights to compute weighted scores for each component and test. The weighted scores are totalled for each asset. The final Health Indices are calculated by dividing the total weighted score by the maximum weighted condition score achievable for the asset, and then multiplied by 100. This produces a health index score from 0 to 100. A newly commissioned asset will have a health index of 100.

$$HI = \left(\frac{\sum_{i=1}^N (S_i \times W_i)}{\sum_{i=1}^N T_i} \right) \times 100$$

where:

HI	Health index score
S_i	Rating factor
W_i	Condition weight
$T_i = S_i \times W_i$	Maximum condition weighted score
N	Condition number

2.3 Health index scale and condition assessment

An asset's calculated health index score is assessed based on the health index scale. The scale then provides directional guidance in an overall decision making process of asset management. The following table depicts the health index scale and the corresponding actions:

Health Index	Condition	Actions
100 - 85	Very Good	Normal maintenance
85 - 70	Good	Normal maintenance
70 - 50	Fair	Increase diagnostic testing, possible remedial work or component replacement needed depending on criticality
50 - 0	Poor	Quantified assessment of the risk of failure and consequences with respect to safety, network reliability, response to failure and consequential damage using an approved methodology such as SA/SNZ HB 89:2013. Manager Primary Systems to develop an asset management strategy for the asset.

When using the health index to determine when to replace the asset, the health of critical components that do not necessarily make up a majority of the value of the asset must be considered. However, the failure of these critical components may not always necessitate the replacement of the whole asset. This is dependent on the severity of defects and faults for those components and the costs of their repair or replacement. Maintenance costs and availability of spares must also be considered when developing an asset management strategy. Therefore, the final asset replacement decision must be made in consultation with the Manager of Primary Systems. Photographic evidence and/or site visits should be used in the final decision making process.