

LCC/LCA Tools

LCP tool AX1-v01.xls

- comparing MV switchgear



AX1 – Medium voltage air insulated switchgear

Dag Ravemark, ABB

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ABSTRACT

This report was made within the project DANTEs that is supported by the EU Life Environment Program.

This Dantes report is one in a series of five describing the LCC tools developed by ABB. The others Dantes reports are:

- DANTEs – Dry fermentation.doc
- DANTEs – Wet fermentation.doc
- DANTEs – LCC-LCA Battery.doc
- DANTEs – Transformer.doc

A summary of the experience of developing these tools is presented in the Dantes report

- DANTEs LCC-LCA tools.doc

The aim of this report is to describe background, input, output and the result presentation of the “LCP tool AX1-v01.xls” tool. As part of the DANTEs project a number of LCC tools have been developed and tested by ABB companies.

The purpose of this excel tool is to allow comparison between a Conventional medium voltage switchgear and the AX1 medium voltage switchgear. The tool evaluates the cost and environmental impact of the two different types of switchgears and supports the systematic evaluation of “soft” (i.e. non economic) values.

The evaluation results can be used in market communication and as sales support, showing the advantages of looking at the lifecycle cost.

The scope of the tool is to calculate the cash flow from the operation of the medium voltage switchgear and evaluate the environmental impact of electricity losses.

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1. INTRODUCTION

This report was made within the project DANTES that is supported by the EU Life Environment Program.

The scope of this report is to describe the LCC/LCA tool “LCP tool AX1-v01.xls”

The purpose of the LCC/LCA tool “LCP tool AX1-v01.xls” is to allow designers to compare the costs and environmental impact of two medium voltage switchgears and do parameter studies. The evaluation results can be used in market communication and sales support, showing the advantages of AX1 switchgear.

The intended users of this report are anyone interested in the LCC/LCA tool or the problem area of lifecycle cost calculation for medium voltage switchgear or other electrical components.

2. ADVANTAGES OF AX1 MV SWITCHGEAR

AX1 MV switchgear has a number of advantages compared to conventional switchgears. The aim of developing the tool was to highlight these advantages to sales people and customers. The advantages are (in no particular order):

2.1 Floor space

AX1 needs less floor space. Selecting AX1 allows for a reduction of total floor space or additional space for other things. This might be most valuable for locations where space is expensive (oil platforms,...)
Input: investment cost of floor area, operation cost/m² floor area

2.2 Relay setting

Setting the parameters for relay protection is faster and customers can change parameters during operation (from control room)
Savings in setup/startup time
Value of changing parameters during operation

2.3 Integrated Self-Supervision

All AX1 are equipped with external and internal self-supervision. Instead of making routine tests and scheduled inspection the relays will automatically indicate if an internal fault has occurred.

2.4 More effective Supervision:

The overview and complete supervision of AX1 from the Bay Computer will shorten the time needed, for example, periodic inspections of electrical and mechanical specialists and other service staff.
Conventional switchgear requires time for periodic inspections.

2.5 Reduced testing

In AX1 testing of settings is not necessary as the Bay computer (REF) has an integrated test program. The time normally spent for testing a conventional relay protection can be saved

2.6 Event reporting

Events and faults can be easily reported in chronological order with time stamps. With an extensive event reporting, future unintentional interruptions can also be avoided. Cost saving due to unintentional interruptions can be avoided.

2.7 Thermovision Test

Thermovision tests are usually performed in conventional switchboards. Due to the design of AX1 and its complete supervision system, no hot spot tests are required.

2.8 Unscheduled and unintentional shut down.

Due to the design of AX1, with among other things, its completely sealed primary encapsulation and supervision, one can almost disregard the risk of unplanned shutdowns.

2.9 Arc Eliminator

Arc fault occur in conventional switchgear
The damage affects directly the neighbor switchgears in the room.
Costs for

- damage
- cleaning
- repairing
- standstill

2.10 Reduced energy losses

The AX1 Switchgear is designed with tubular bus bars and the joints utilize coil spring type connections. This type of jointing gives a larger number of contact points, resulting in lower resistance and thereby lower $R \cdot I^2$ losses when in service. On top of this, the use of sensors for protection and metering, replacing conventional metering transformers, results in lower power losses.

3.2 Tab: Step 2 Soft values

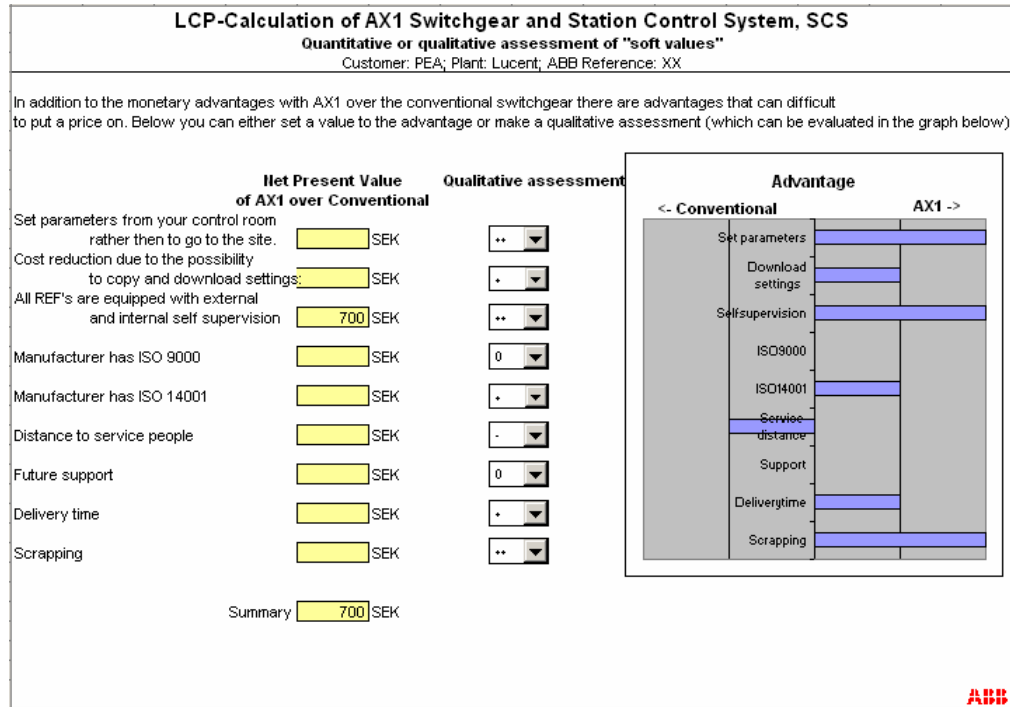


Figure 2 Screen shot of "Step 2 Soft values"

On this tab the user can enter quantitative cost data on features the can be difficult to put values on. If no quantitative evaluation can be performed, a qualitative evaluation of the different criteria's can be done. The qualitative evaluation is in ++, +, 0, -, --.

The overall evaluation of the quantitative criteria can be done by looking at the graph. If most of the bars point to the right the advantage is for AX1.

3.3 Tab: Step 3 Cost result

LCP-Calculation of AX1 Switchgear and Station Control System, SCS			
Value of AX1 over Conventional switchgear			
Customer: PEA; Plant: Lucent; ABB Reference: XX			
Value item	Yearly	Lifetime	Explanation
Value of additional floor space		155 250 SEK	AX1 requires less floor space
Value of energy losses	43 800 SEK/year	502 383 SEK	AX1 has lower losses
Value of complete supervision	13 750 SEK/year	157 711 SEK	AX1 can be inspected faster
Value of reduced testing	6 663 SEK/year	78 418 SEK	AX1 requires less frequent testing
Value of reduced shutdowns		225 000 SEK	AX1 is expected to have less frequent unintentional shutdown
Value of fault reporting		7 500 SEK	AX1 has faster trouble shooting
Value of arc eliminator		307 500 SEK	AX1 can not have arcfaults
Value of thermovision test	3000 SEK/year	34 410 SEK	AX1 does not need thermovision test
Soft values		700 SEK	Perceived values from sheet "Step 2 Soft values"
	Life time profit of AX1:	1 466 172 SEK	Estimated profit of AX1 over Conventional switchgear (see sheet "Cost result explanation")

Figure 3 Screenshot of tab "Step 3 Cost result"

On this tab, all the cost results for the entered data on the switchgears are presented and the final result is the life cycle profit (as net present value) of AX1 over conventional MV switchgear. A short explanation of why the AX1 is advantageous is also given.

3.4 Sheet: Step 4 Environmental result

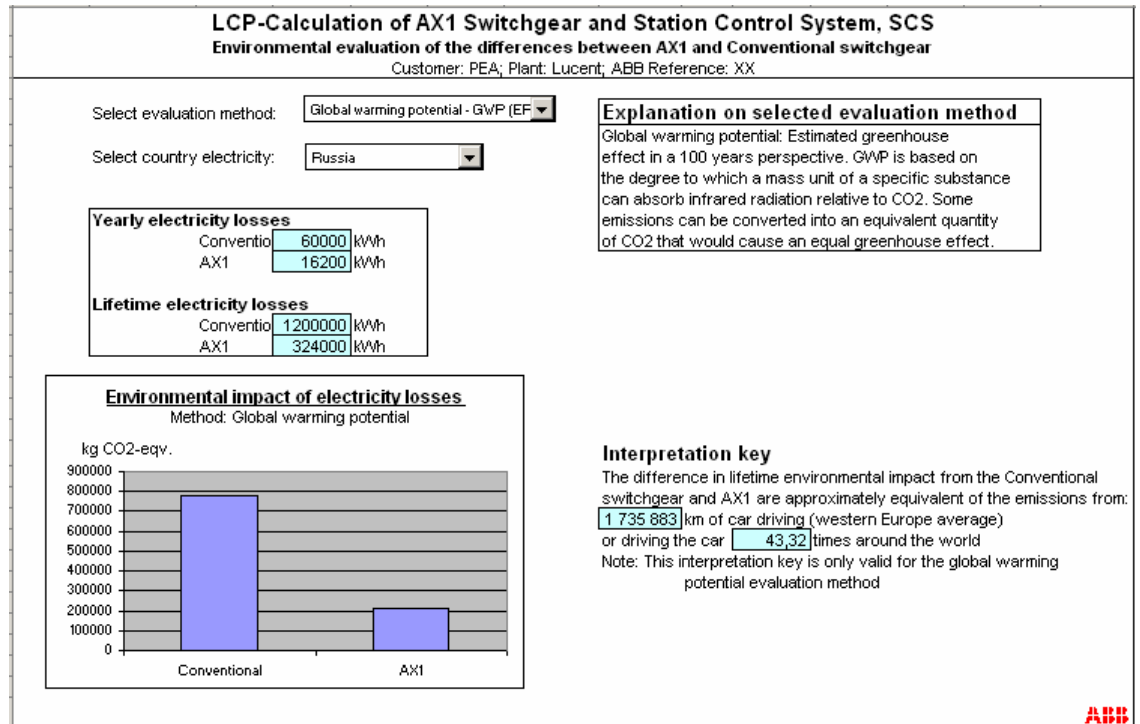


Figure 4 Screenshot of tab "Step 4 Environmental result"

The user can select one evaluation method to evaluate the impact:

- Global warming potential
- Acidification potential
- Nitrification potential
- Eco-indicator 99
- EPS 2000

The user can select electricity from 25 different countries (this has an impact on the environmental evaluation of the electrical losses). For example:

- Austria
- Belgium
- Britain
- Canada
- China
- Czech Republic
- Denmark
- Finland
- etc.

The difference in environmental impact is shown as well as an interpretation key i.e. the emissions are compared to passenger car transport. No materials are included in the environmental evaluation of the switchgear.

3.5 Sheet: Cost result explanation

LCP-Calculation of AX1 Switchgear and Station Control System, SCS More detailed explanation to cost differences between AX1 and Conventional switchgear Customer: PEA; Plant: Lucent; ABB Reference: XX	
Value of additional floor space	With 15 panels the area needed for AX1 is 7,76 m ² smaller than Conventional switchgear. With a value of 20000 SEK/m ² the life time value of reduced floor space of AX1 is 155250 SEK
Value of energy losses	The energy use for one panel of AX1 is 135 W and the energy use for one conventional panel is 500 W With 15 panels and an operating time of 8000 h/year gives yearly losses; for AX1 16200 kWh, and Conventional 60000 kWh With a electricity cost of 1 SEK/kWh and the interest rate of 6 % gives: yearly cost of electricity losses for AX1 are 16200 SEK and the net present value over 20 years are 185813 SEK yearly cost of electricity losses for Conventional are 60000 SEK and the net present value over 20 years are 688195 SEK The lifetime value of the savings in energy with AX1 is 502383 SEK
Value of complete supervision	

Figure 5 Screenshot (part) of "Cost result explanation"

This is an explanation of how calculations are made and what the assumptions are. The text takes input data and makes the calculations for maximum transparency.

4. FUTURE OF THE TOOL

The tool is being presented to the PTMV department (responsible for development and marketing of AX1) and they will test it on customers.