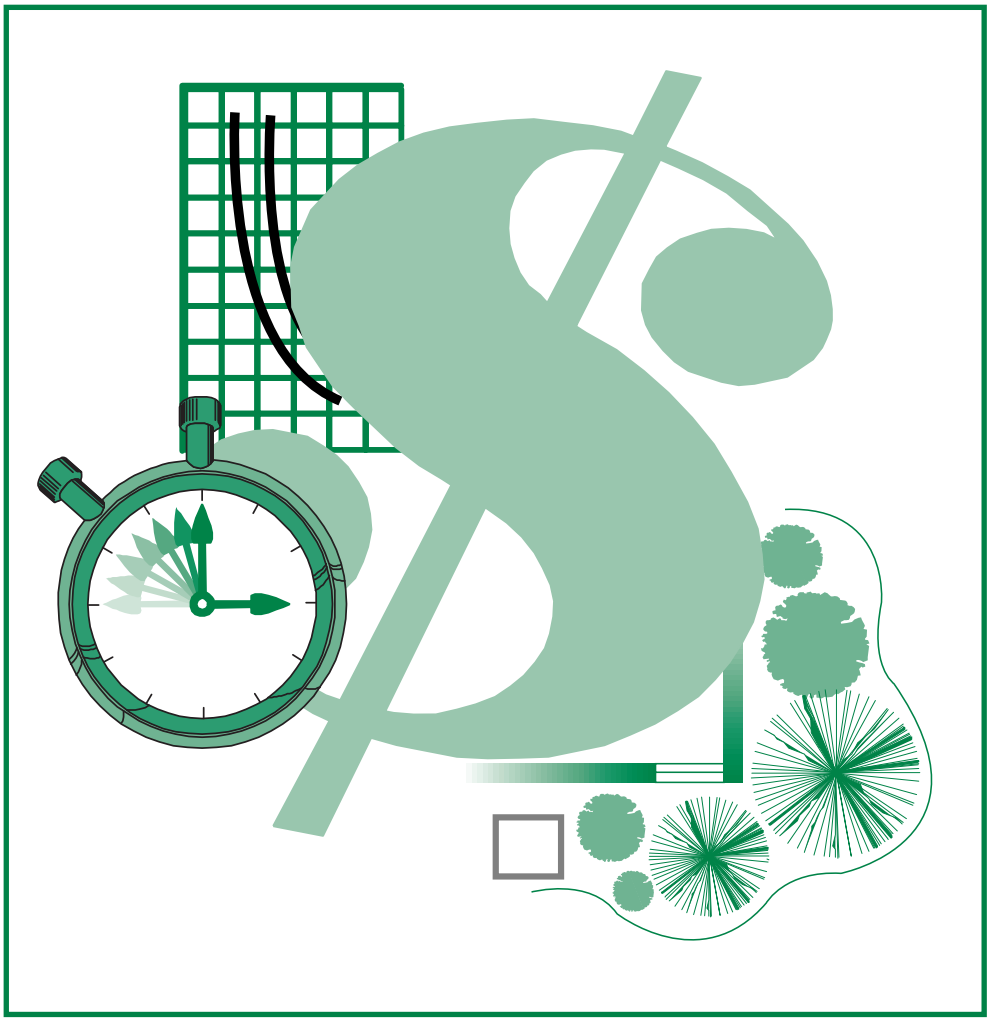
VFI Transformer
Economic Analysis Guide



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Introduction

The cost of system equipment includes more than the initial purchase price. Costs associated with the total life cycle of the equipment are often considered when a purchase decision between competing alternatives is being evaluated. Total Life Cycle Costs include all applicable costs incurred from cradle to grave. These include broad categories like Purchasing, Warehousing, Transportation, Installation, Operation, and Retirement.

In the following example we will consider two competing alternatives: 1) 2500 kVA Three-Phase Pad-Mounted VFI Transformer with integral Vacuum Fault Interrupter, 2) 2500 kVA Three-Phase Pad-Mounted Transformer and a piece of 15 kV 600 A Three-Phase Pad-Mounted Fused Air Switchgear. The cost of the switchgear and the transformer are added together to provide a total package price.
In the example, fused air switchgear was chosen because it meets the minimum requirements of the system and is commonly used. If a different type of switchgear (i.e., circuit breaker, oil-insulated, etc.) is used, many of the costs shown will change. The largest changes in cost will be due to the higher initial cost for the equipment and the added expense for installation and operation.

Example

	VFI Transformer	Transformer & Switchgear
Purchasing:	$ 250	$ 450
Warehousing:	$ 285	$ 705
Transportation:	$ 255	$ 380
Installation:	$ 4,340	$ 9,635
	$ 5,130	$ 11,170
Equipment:		
VFI Transformer	_____	**Transformer** _____
		Switchgear _____
Total Installed Cost:	_____	_____
Operation:	$ 360	$ 1,415
Retirement:	$ 800	$ 1,625
Other:	_____	_____
Total Life Cycle Cost:	_____	_____

Note: This analysis is designed to help quantify the cost of each alternative during its total life cycle. The costs shown are estimates, some costs may be higher or lower depending on specific operating practices. It should be noted that this analysis shows only those costs that are easily quantifiable. It does not attempt to quantify the value of improvement in system reliability, safety, operation and aesthetics.

Purchasing Costs

Costs associated with purchasing the equipment include specifying the equipment, placing the order, acknowledging the receipt of the equipment, and accounting and payment of the equipment invoice.

VFI Transformer $ 250* **Transformer** $ 200 **Switchgear** $ 250*

* The purchasing cost of the VFI Transformer and the switchgear is higher than a standard transformer because it includes the additional engineering time to specify the appropriate overcurrent and fault protection.

Warehousing Costs

Costs associated with warehousing include receiving, unloading and inventorying the equipment; burden for the warehouse, equipment and staff; and the cost to stage, kit and prepare the equipment for shipment to the job site.

VFI Transformer $ 285 **Transformer** $ 285 **Switchgear** $ 420*

* The cost to stage and kit the switchgear is higher due to the added componentry needed for installation.

Note: Equipment carrying costs would normally be considered at this point, but due to the wide variability in inventory turns, interest rates, etc., they have not been included.

Transportation Costs

Transportation costs include the cost of loading the equipment at the warehouse, transporting it to the job site, and unloading it there. These costs would be significantly lower if the equipment is shipped from the factory to the job site.

VFI Transformer $ 255 **Transformer** $ 255 **Switchgear** $ 125*

* The cost to transport the switchgear would be higher if a second trailer or truck is required to transport the equipment to the site.

Installation Costs

The costs associated with installing the equipment include broad categories like direct labor, materials, and equipment. Direct labor costs include engineers to design the system, secure the right-of-way, and oversee the installation and commission of the equipment; crane operators to place the equipment, electricians to wire the equipment, startup engineers to test the equipment prior to commissioning, and contractors to prepare and restore the site. Material costs include concrete pad, conduit, cable, splices, elbows, fuses, fuseholders, etc. (real estate costs have not been included). Equipment costs include crane, trencher, bucket truck, trailer, test equipment and miscellaneous installation tools.

	VFI Transformer	Transformer	Switchgear
Direct Labor	$ 2,150	$ 2,150	$ 2,550
Materials	$ 1,640	$ 1,640	$ 2,070
Equipment	$ 550	$ 550	$ 675
	$ 4,340	$ 4,340*	$ 5,295*

* The additional labor, material, and equipment costs associated with wiring between the transformer and the switchgear have been added to the switchgear costs shown. It is assumed that the transformer and switchgear are located next to each other. For some installations this may not be possible and could result in a significant increase in labor and material costs.

Operation Costs

Costs associated with operation can be categorized as service, maintenance and repair. Service costs include all costs incurred from unplanned outages due to current overload conditions, nuisance tripping, or line, ground or transformer faults. The costs shown only include the labor and materials costs incurred to return the equipment back to service. Maintenance costs include inspection, cleaning, and scheduled equipment testing. Repair costs include painting and any field modifications required to keep the equipment in service.

	VFI Transformer	Transformer	Switchgear
Service*	$ 180	$ 55	$ 510
Maintenance**	$ 90	$ 90	$ 490
Repair	$ 90	$ 90	$ 180
	$ 360	$ 235	$1,180

* The costs shown assume a typical outage caused by an external fault that can be quickly located and cleared. It is assumed that all three fuses of the fused switchgear are on hand and will be replaced per manufacturers recommendations. It also assumes that the customer can be returned to service immediately. If any of these assumptions are not valid the costs shown would be higher, significantly higher for the fused switchgear if the fault cannot be located and cleared on the first try.

** The costs shown are typical for one preventive maintenance visit. Maintenance costs for switchgear can vary significantly depending on type of switchgear purchased (i.e., Circuit Breaker, Air-Insulated, etc.). For many applications a minimum of one annual visit is required.

Note: The costs shown can vary significantly depending on the application, environment, and operating practices of the end user. The costs should be evaluated with these specific criteria in mind. Other costs that should be considered are lost electric revenue and costs incurred by the customer for lost or damaged production due to planned and unplanned outages.

Retirement Costs

The costs associated with retiring a piece of equipment include the cost to de-energize, disconnect, and remove the equipment from service. It also includes all accounting and paperwork to take the equipment off of the books.

VFI Transformer $ 800 **Transformer** $ 800 **Switchgear** $ 825

Note: The costs shown only include the removal of the equipment from the site and do not include costs for disposal or recycling of the equipment after it is removed. In some cases this can be a significant cost if the equipment contains materials that require special handling.

Summary

Improving the operation of the distribution system can sometimes be accomplished without additional expense. Thoughtful comparison of the true costs associated with equipment alternatives can help achieve system improvement while holding down or even reducing capital and operating expenses. The analysis shown, while only including those costs that are easily quantifiable, demonstrates that the VFI Transformer is economically the better alternative. If a more comprehensive analysis were completed, the benefits gained from reduced real estate, superior overcurrent and fault protection, added safety and ease of operation, better coordination and reliabilty, and improved site aesthetics and customer acceptance would prove that the VFI Transformer is the best alternative.

VFI Transformer
Economic Analysis Worksheet

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Total Life Cycle Costs

Purchase

- Specification _____
- Ordering _____
- Receiving _____
- Accounting _____

VFI Transformer: $ _____

Transformer + Switchgear: $ _____ + $ _____

Warehouse

- Unload & Stock _____
- Burden _____
- Stage & Kit _____
- Carrying Cost _____

VFI Transformer: $ _____

Transformer + Switchgear: $ _____ + $ _____

Transportation

- Load _____
- Deliver _____
- Unload _____

VFI Transformer: $ _____

Transformer + Switchgear: $ _____ + $ _____

Installation

- Engineering & Design _____
- Site Preparation _____
- Installation & Testing _____
- Materials _____
- Equipment _____

VFI Transformer: $ _____

Transformer + Switchgear: $ _____ + $ _____

Operation

- Service _____
- Maintenance _____
- Repair _____

VFI Transformer: $ _____

Transformer + Switchgear: $ _____ + $ _____

Retirement

- Disconnect _____
- Remove _____
- Dispose _____

VFI Transformer: $ _____

Transformer + Switchgear: $ _____ + $ _____

Totals

VFI Transformer: $ _____

Transformer + Switchgear: $ _____ + $ _____

Shrubline VFI Transformer

Three-Phase VFI Transformer

Substation VFI Transformer

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