Chimanco, Inc.
USA

This is a hypothetical case study, but the events described and associated cost data are based on factual cases and data.

1. CASE STUDY BACKGROUND

Chimanco, Inc. is a mid-sized manufacturer in the U.S. The company has a number of electrical transformers on-site that contain varying levels of Polychlorinated Biphenyls (PCBs) in the dielectric fluid. A recent failure and fire involving a PCB Transformer at Chimanco provided an incentive for the company to consider Replacement or Retrofill of its other PCB Transformers. Although the previous fire did not involve any PCB dispersal to waterways or to neighboring buildings, future PCB-related liability is of concern because most of Chimanco's transformers are older units that contain varying levels of PCBs, and because the Chimanco facility is located in a dense urban area, near many residences and a school (within 400 feet).

This case study describes the analysis for one of the company's transformers.

2. KEEP VS. REPLACE VS. RETROFILL

The first PCB Transformer selected for analysis was a 1000 KVA power transformer viewed as critical to production. This transformer contains 400 gallons of mineral oil dielectric fluid containing 1000 ppm PCBs. Installed in 1962, the unit has been fairly reliable to date, but a similar unit of approximately the same age was involved in the previous fire at Chimanco. The transformer is located inside a 20 x 20 foot vault on the first floor of the manufacturing building. The concrete floor of the vault and containment lips on the door provide spill containment more than sufficient to contain the full volume of dielectric fluid in the transformer. There is no drain. The vault has no fire suppression system or smoke detector system, but has ceiling vents.

Chimanco decided to analyze the costs of both Replacing and Retrofilling the current PCB transformer, as well as Keeping the transformer and operating it as usual The scenarios are described in a bit more detail below:

2.1 Keep the PCB Transformer

Under this scenario, Chimanco first confirmed that the current PCB transformer was in compliance with federal, state, and local regulations regarding PCB labeling, PCB transformer registration and recordkeeping, installation of electrical protective equipment, PCB storage, PCB spill containment, PCB transformer inspections, etc. Chimanco then estimated a few investment costs and annual operating costs associated with keeping the unit and operating it as usual. In addition, Chimanco generated cost estimates for the following possible one-time events that might occur:

- A PCB fluid spill (50 gallons)
- A transformer fire, with potential PCB dispersal via smoke/soot

2.2 Replace the PCB Transformer

For the Replacement scenario, Chimanco contacted equipment vendors to obtain quotes for new transformer units. The unit selected for consideration in this financial scenario was a unit of the same rating as the current transformer, but the new unit was filled with 300 gallons of a plant-based oil, containing no PCBs. Chimanco also obtained estimates for removal of the current PCB transformer and management of all waste – primarily the transformer carcass and the PCB dielectric fluid. The cost of a mobile power generator to keep the manufacturing operations running for the 24 hour time period required for transformer replacement was also included in the analysis. And finally, Chimanco estimated the costs associated with the following incidents that might occur with a new, non-PCB transformer.

- A non-PCB fluid spill (50 gallons)
- A transformer fire involving no PCBs

2.3 Retrofill the PCB Transformer

For the Retrofill scenario, Chimanco contacted vendors to obtain quotes for Retrofill procedures. It was determined that the current transformer, containing dielectric fluid of concentration 1000 ppm, could be successfully retrofilled and achieve regulatory reclassification as "non-PCB" with two Retrofill cycles of 24 hours each. The Retrofill vendor would also handle all waste management associated with the Retrofill procedure. The cost of a mobile power generator to keep the manufacturing operations running for the 48 hour time period required for transformer replacement was also included in the analysis. And finally, Chimanco estimated the costs associated with the following incidents that might occur with the retrofilled, non-PCB transformer.

- A non-PCB fluid spill (50 gallons)
- A transformer fire involving no PCBs

3. SPILLS AND FIRES

Even though the likelihood, timing, and severity of future dielectric fluid spills or transformer fires is uncertain, Chimanco and its emergency response and waste management contractors had enough experience to design reasonable spill and fire assumptions, and enough data to come up with reasonable estimates of most of the costs relevant in such events. The end goal was to develop accurate enough estimates to allow a comparison between the costs of potential PCB spills or fires and the costs of unit Replacement or Retrofill, which might not prevent spills or fires, but would eliminate the involvement of PCBs. It was recognized from the start that the PCB concentration of the original dielectric fluid would be a key cost driver, as well as the assumed magnitude, radius and impact of the spill or fire.

3.1 Spill (of Dielectric Fluid)

For spills of dielectric fluids (PCB or non-PCB), Chimanco evaluated its previous experience with spills and had a number of conversations with emergency response and waste management contractors. A hypothetical future spill of moderate volume, radius, and impact was then defined as follows:

- About 50 gallons of dielectric fluid are spilled
- Spill radius is about 20 feet around the transformer, i.e., impacting the entire vault floor, which is made of concrete. Spill is contained within the vault.
- The transformer is shut down for 1 day to allow initial spill cleanup and transformer repair
- Potential spill-related costs include
    - Regulatory Notification
    - Regulatory Penalty
    - Other Notification
    - Cleanup
    - Waste Management
    - Equipment Repair
    - Interruption of Power/Operations
    - Legal & Liability

3.2 Transformer Fire

For transformer fires, (with or without PCB involved), Chimanco evaluated its experience with the recent PCB transformer fire, and had a number of conversations with emergency response and waste management contractors. A hypothetical future fire of moderate impact was then defined as follows:

- The municipal fire department is able to put out the fire fairly easily (extinguished via water nozzle within 3 minutes of start)
- No fluid spill
- Smoke/soot exits transformer vault via ceiling vents, into the manufacturing building. Facility is shut down for 3 days by state regulatory agency.
- Some smoke also reaches a nearby apartment building. No injuries or other medical problems are reported by residents, but the building is evacuated for 24 hours and analytical testing is done to ensure that no PCBs are present.
- Potential fire-related costs include
    - Regulatory Notification
    - Regulatory Penalty
    - Other Notification (of apartment building residents, local press, etc.)
    - Cleanup
    - Waste Management
    - Equipment Repair
    - Interruption of Power/Operations
    - Legal & Liability

SUMMARY RESULTS

3.3 Dielectric Fluid Spill in Year 5

The tables below give the summary results for the case in which a hypothetical future spill of dielectric fluid occurs in year 5. In this particular case study, for a spill of moderate radius and impact, the potential spill costs outweigh the cost of Retrofilling the PCB Transformer, but do not quite outweigh the cost of Replacing the PCB Transformer. A spill of higher PCB concentration, spill volume, spill radius, or environmental impact (e.g., if the spill were to reach a waterway) could be more costly, in which the Replacement of the PCB Transformer would also be financially desirable.

SUMMARY RESULTS

P2F-PCB Beta version 10.0 CASE STUDY - SPILL

Summary of Cost Data Input for the Three Scenarios	Scenarios		
	Keep	Replace	Retrofill
Investment Costs	$1,440	$25,619	$21,290
Recurring Operating Costs	$720	$360	$450
Non-recurring Operating Costs	$47,080	$13,610	$13,360
Year of the Non-recurring Event	5	5	5

Financial Indicators		Discounted Payback (years)	3 years NPV	5 years NPV
	Replace vs. Keep	#N/A	($19,933)	($5,754)
	Retrofill vs. Keep	4.97	($12,642)	$421
	Replace vs. Retrofill	#N/A	($7,291)	($6,175)

3.4 Transformer Fire in Year 5

The tables below give the summary results for the case in which a hypothetical future transformer fire occurs in year 5. The results illustrate that the potential costs of a transformer fire that involves PCBs, even one that does not impact waterways or have a wide radius of other significant impact can be quite high, and can easily outweigh the costs of replacing or retrofilling the PCB transformer in order to avoid fires involving PCBs.

SUMMARY RESULTS

P2F-PCB Beta version 10.0 CASE STUDY - FIRE

Summary of Cost Data Input for the Three Scenarios	Scenarios		
	Keep	Replace	Retrofill
Investment Costs	$1,440	$25,619	$21,290
Recurring Operating Costs	$720	$360	$450
Non-recurring Operating Costs	$565,599	$153,827	$153,827
Year of the Non-recurring Event	5	5	5

Financial Indicators		Discounted Payback (years)	3 years NPV	5 years NPV
	Replace vs. Keep	4.12	($19,302)	$137,022
	Retrofill vs. Keep	4.08	($12,519)	$143,103
	Replace vs. Retrofill	#N/A	($6,783)	($6,081)