PN-ABP-320

PRIDE

Project in Development and the Environment

Technology Review, Assessment and Recommendations for Electrostatic Air Filtering Systems

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The objective of the Project in Development and the Environment (PRIDE) is to help the U.S. Agency for International Development (AID) design and implement programs that foster the agency's environmental and natural resources strategy for sustainable economic growth in the Near East and Eastern Europe.

PRIDE provides AID and participating countries with advisory assistance, training, and information services in four program areas: (1) strategic planning, (2) environmental policy analysis, (3) private sector and NGO institutional strengthening, and (4) environmental information, education, and communication.

The project is being implemented by a consortium selected through open competition in 1991. Chemonics International is the prime contractor; subcontractors include RCG/Hagler, Bailly, Inc.; Science Applications International Corporation; Capital Systems Group, Inc.; Environomics, Inc.; Industrial Economics, Inc.; Lincoln University; and Resource Management International, Inc. In addition, AID has entered into a cooperative agreement with the World Environment Center to support implementation of PRIDE.

The opinions expressed in this paper are those of the author(s) and do not necessarily reflect the positions of the sponsoring agency or contractors.

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INNOVATION
an engineering firm

Technology Review, Assessment and Recommendations

for

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INTRODUCTION:

On December 15, 1992, I visited PEFO Ltd., a manufacturer of air electrostatic filter systems located in Wroclaw, with Dr. Kenneth Macek, the PRIDE Environmental Business Development Specialist for Warszawa. The purpose of the visit was to review and assess PEFO's electrostatic air filtration systems and make technical recommendations for their improvement.

ASSESSMENT:

PEFO manufactures and installs electrostatic air filtration systems to clean the air of fogs, aerosols and smoke. Each system produced is manufactured one at a time, without automation. The company also provides system design, assembly and maintenance services for ventilation plants.

In conversations with PEFO's general manager, with Dr. Macek acting as a translator, I ascertained that PEFO does sheet metal fabrication, mechanical assembly and machining at its own facilities. It purchases most motors, fans and power supplies and integrates them as modules into the final systems.

The operating equipment that I saw was a portable electrostatic air filtration system used to remove welding, grinding or general machining smoke. The system uses a blower motor, which acts like a vacuum cleaner, and high voltage power supplies that are connected to metallic plates. These plates are mounted in the air path of the vacuum assembly and collect the dust and smoke particles. The plates are housed in a removable assembly approximately 2 feet wide by 2.5 feet high by 3 feet long. The assembly houses the plates and, when removed from the system, does not have any active (hot) electrical components. To clean the system the customer must remove the filter assembly and spray the plates with water.

EVALUATION:

The filtration system's design appears to be technically sound and in conformance with the principles and practices of similar systems used in the United States.

The system is effective if the filters are periodically cleaned.

PEFO's system does not have the capability to monitor component failures or the effectiveness of the filters.

The system's effectiveness can be greatly improved by:

(1) incorporating a device that will annunciate system failures that affect performance; and

(2) providing a means to quantify filter performance.

This would significantly improve the system's effectiveness, reliability, fault tolerance and simplicity of operation.

RECOMMENDATION:

I recommended to PEFO's management that the system be modified to display its operating and filter conditions as these directly affect the systems's ability to filter air. I explained that any modifications should be made with an emphasis on cost, maintainability, ease of manufacturing and reliability as design concerns.

I pointed out to Mr. Gaczynski, the general manager, that these small modifications would significantly enhance his products acceptance, and therefore sales, by providing a diagnostic indication that the unit is working properly. Additionally the modifications would, at a small cost, reduce operating problems customers might experience with the system.

For example; If the filter became clogged, the existing system would continue to operate without filtering; the customer would have no way of knowing that the filter was clogged and would simply believe that the unit was not effective. However, if a display were available and appropriately labeled, the customer would know of the problem, call for service and gain confidence with the system.

I believe that the two, most cost-effective, technical areas of improvement for PEFO would be:

(1) to provide a visual means of determining filter status; and

(2) a means of annunciating system failures that affect performance.

These two areas do not require a high level of electrical expertise to implement. The necessary equipment is low in cost, easy to configure, flexible and commercially available.

The products I am recommending are compatible with PEFO's equipment, European electrical standards, are low in cost, reliable, simple to operate and easy reconfigured for different systems.

I recommend using "off the shelf" electrical products that are available in the United States and Europe and have selected Simpson and Allied Electronics products as being the most comprehensive and responsive to PEFO's needs. I am including Simpson's United States catalog, with price lists, and Allied Electronics catalog for PEFO's consideration.

The electrical product companies address' are:

(1) Simpson Electric Company
853 Dundee Avenue
Elgin, Illinois 60120-3090 USA
Tel: (708) 697-2260
Fax: (708) 697 2272

(2) Allied Electronics
International Marketing Dept.
7410 Pebble
Fort Worth, Texas 76118 USA
Tel: (817) 595-3500
Telex: 75-8314

Simpson's master distributor in Europe is:

(3) TET GMBH Elektrotechnik
Bodensee Str. 113
8000 Munchen 60
Attention: Mr. Karl Heim
Tel: (498) 983-9450
Fax: (498) 983-94549

A detailed working design is not possible without knowing system specifics such as voltages, currents and space available for equipment to be mounted. The following design example recommends a visual system status indicator because:

(1) the filter system will most likely be used in a noisy environment;

(2) an audible alarm, with an acceptable sound level and required circuitry, would cost more; and

(3) the circuitry for an audible alarm would require electrical engineering expertise to design.

In reference to figure 2, (Note: There is no figure 1 applicable to PEFO's recommendation) the simplest way to provide a visual means of determining filter status and system failures is to measure and display, by using a meter, the current in the metallic plates. This is easily accomplished by connecting a meter in series with the high voltage lead to the filter's metallic plates.

The meter serves three purposes:

(1) the meter will indicate a low current, thus alerting the operator that something is wrong with the power supply, filter or connections;

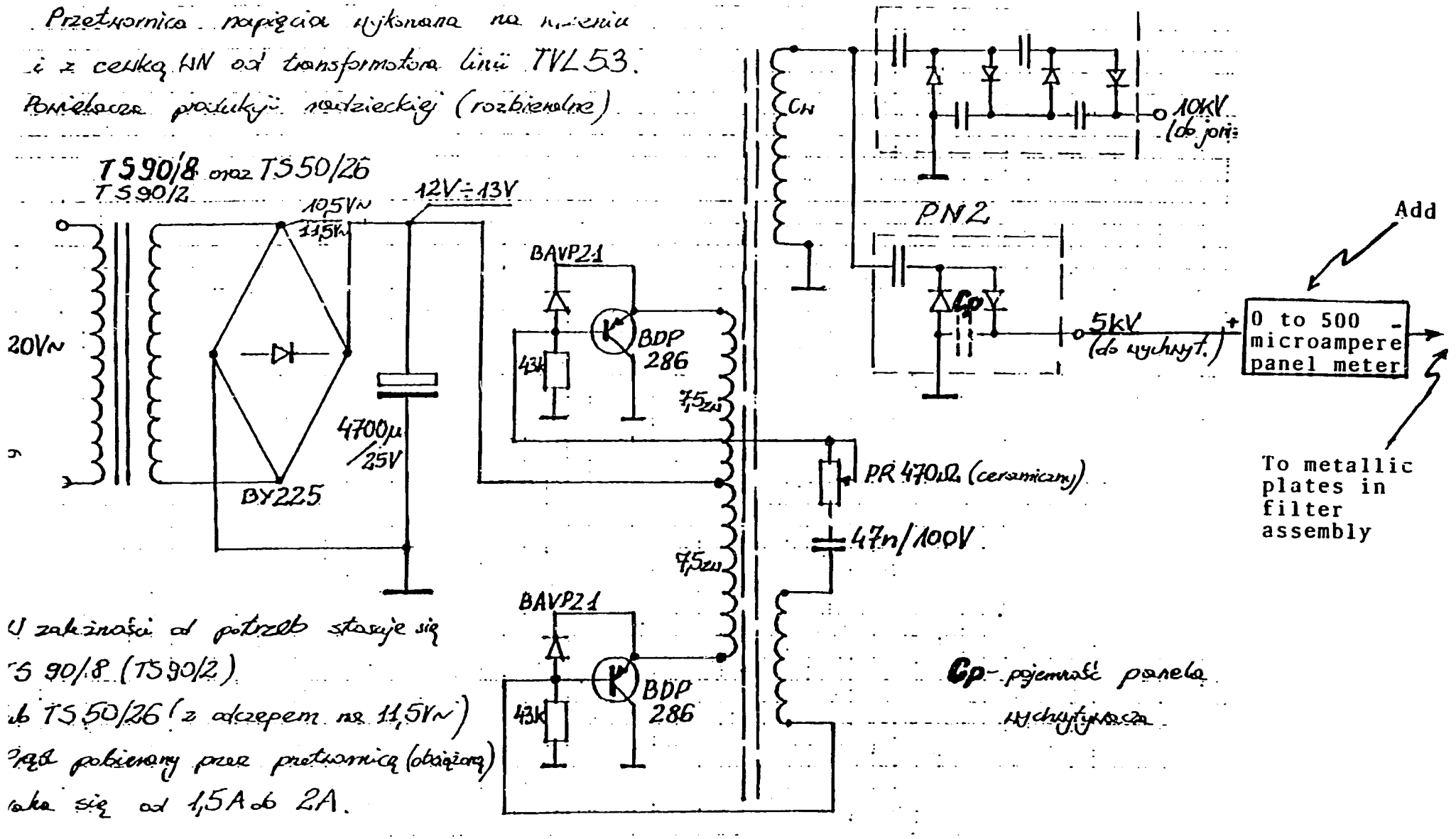
(2) the meter will indicate a high current, thus alerting the operator that the filter is most likely clogged; and

(3) the meter will indicate the status of the filter and the amount of dust or smoke collected by the filter.

To select a meter PEFO should use the Simpson or Allied catalogs and choose a panel meter that meets the specific requirements for space, cost and current range. **Important:** PEFO must provide an electrically insulated transparent plastic enclosure completely around the meter such that the meter cannot be touched either inside or outside the filter assembly. This is to protect the operator from high voltage that, without the enclosure, could arc to either the assembly or operator. As shown in the catalogs there are several possible meter choices. For simplicity, I will assume using a Simpson 2.5 inch, 0-500 microampere meter, Model 17424, at $55 each, that is described on page 8 of the Simpson catalog.

PEFO should mount the meter, with its plastic enclosure, on the removable filter chassis assembly so that an operator can clearly see the meter when operating the machine. Then, observing the meter polarity, it should connect the two leads of the microampere meter in series with the 5 KV lead as shown in Figure 2. If cost permits, it should have the meter faceplate color coded for ease of reading by an operator. As an example; Assume that the current is 80 microamperes when the filter is clean and 400 microamperes when it is dirty. If PEFO has the faceplate (see figure 3) painted red between 0 and 50 microamperes, green between 50 and 300, yellow between 300 and 400 and red from 400 to 500 microamperes it will have a system status indicator that is easy to interpret.

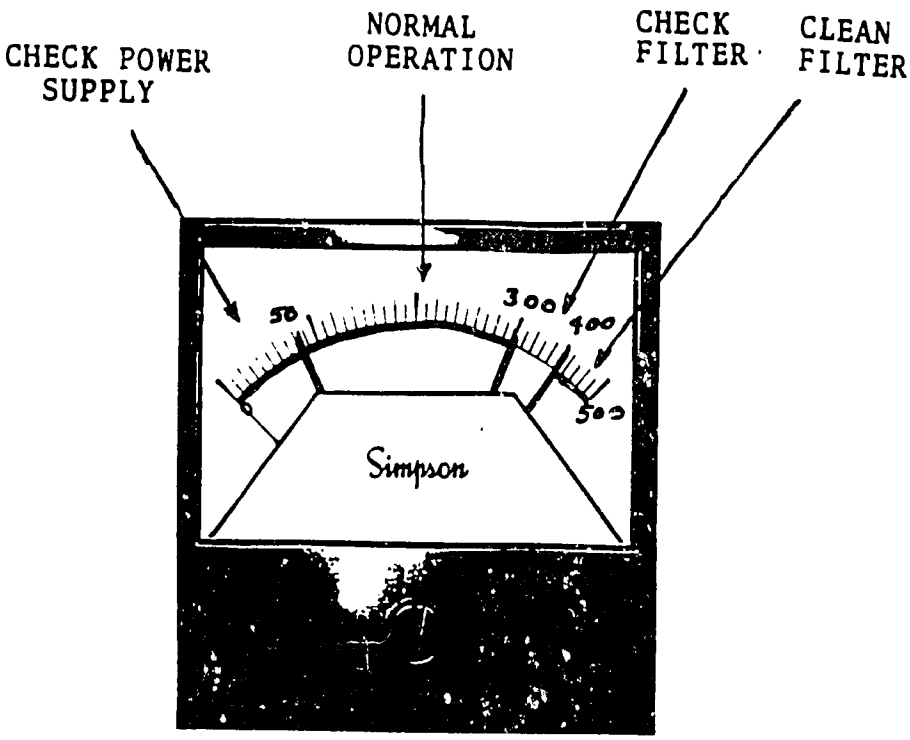
The foregoing recommendations are an attempt to convey to readers whose technical backgrounds are unknow an engineering design and implementation methodology using electrical engineering terminology. It was impossible, in the time alloted, for me to investigate and weigh every possible factor that ought to be considered in developing a final, detailed design for a specific system. Therefore, in implementing these design recommendations, it is important to keep in mind that the general design I have recommended is not intended to be a schematic and that the final designs that are developed must take into account the current availability and cost of components, the local operating environments, the level of expertise of available personnel and other factors that I was not in a position to specifically evaluate.



PEFO MODIFICATION

Figure 2

LABEL FRONT PANEL
IN ENGLISH, POLISH
GERMAN ...ETCETERA



0 TO 500 MICROAMPERE
PANEL METER
STATUS INDICATOR

PEFO MODIFICATION

FIGURE 3