PROJECT EVALUATION SUMMARY (PES) – PART I

Report Symbol U-447

1. PROJECT TITLE	2. PROJECT NUMBER	3. MISSION/AID/W OFFICE
NASA SPONSORED PHOTOVOLTAIC PROJECT KIONZO MISSION	NASA/DSB 5710-2-79	

4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each FY)

☒ REGULAR EVALUATION ☐ SPECIAL EVALUATION

5. KEY PROJECT IMPLEMENTATION DATES			6. ESTIMATED PROJECT FUNDING	7. PERIOD COVERED BY EVALUATION
A. First PRO-AG or Equivalent FY 82	B. Final Obligation Expected FY 84	C. Final Input Delivery FY 85	A. Total $ 20,000 B. U.S. $	From (month/yr.) August 31, 1982 To (month/yr.) June 30, 1985 Date of Evaluation Review

8. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

A. List decisions and/or unresolved issues; cite those items needing further study. (NOTE: Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., airgram, SPAR, PIO, which will present detailed request.)	B. NAME OF OFFICER RESPONSIBLE FOR ACTION	C. DATE ACTION TO BE COMPLETED
1. Solar energy could be a dependable energy source in rural areas. The biggest disadvantage for employing solar equipment, at present, is the initial investment. A solar powered unit is too expensive for most rural health centers to afford. USAID and other donors could play a useful role by subsidizing solar equipment until it becomes lower priced Alternatively, any way of making credit available for rural photovoltaics would likely find a ready market. 2. More research is required on solar refrigeration. The engineers who examined the SPC R/F during this evaluation believe that the units are unnecessarily complicated. We need more information on solar-powered refrigerators that have been tested, not in Cleveland, but in Africa. We need more research to determine which refrigerator parts are essential and which parts are superfluous for practical operating needs in rural Zaire. 3. We understand little more about solar refrigeration now than before the Kionzo project was implemented NASA's attempt to monitor the pilot project from the U.S. did not work well. To avoid a strain on limited staff time and to have an objective assessment of new ideas, USAID needs to design its pilot projects in a more systematic fashion. One suggestion would be to designate a qualified team that would design, monitor, support, and evaluate pilot projects. continued		

9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS

- ☐ Project Paper
- ☐ Financial Plan
- ☐ Logical Framework
- ☐ Project Agreement
- ☐ Implementation Plan e.g., CPI Network
- ☐ PIO/T
- ☐ PIO/C
- ☐ PIO/P
- ☒ Other (Specify) Limited Scope Grant Agreement
- ☐ Other (Specify)

10. ALTERNATIVE DECISIONS ON FUTURE OF PROJECT

- A. ☐ Continue Project Without Change
- B. ☐ Change Project Design and/or ☐ Change Implementation Plan
- C. ☒ Discontinue Project

11. PROJECT OFFICER AND HOST COUNTRY OR OTHER RANKING PARTICIPANTS AS APPROPRIATE (Names and Titles)

Debra A. Rectenwald, Evaluation Officer
Mulamba-wa-Kabasele, USAID Engineering Consultant

12. Mission/AID/W Office Director Approval

Signature

Typed Name A. Lezin

Date 6/21/85

AID 1330-15 (3-78)

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This team would be responsible for setting up the experiment. It would determine the best place and people for project implementation. The team would assert a hypothesis, test it, and retest it by controlling variables. Such an approach could provide useful information for future project success.

This approach might be more costly than the approach taken in the Kionzo solar project, but it would ensure essential support for the project and would offer a better chance of having useful results at the conclusion of the pilot activity. In the case of Kionzo, the USAID Mission was not sufficiently consulted, or involved, the project budget was too tight to fund adequate backstopping from the U.S., and USAID was not technically equipped to provide needed backstopping locally.

EXECUTIVE SUMMARY
EVALUATION OF PHOTOVOLTAIC POWERED MEDICAL REFRIGERATOR

1. Project Title and Number - Photovoltaic Powered Medical Refrigerator (NASA/DSB 5710-2 79)

2. Project Description - NASA installed a Solar Power Corporation Refrigerator/Freezer at Kionzo Mission to assess the effect of photovoltaic equipment on rural health care.

3. Evaluation Purpose - The evaluation purpose is to describe lessons learned.

4. Evaluation Methodology - The evaluation methodology included on-site interviews.

5. Findings - The SPC R/F unit has not worked well in Zaire. The problems are attributed primarily to the lack of technical assistance and the unit's complexity.

6. Lessons Learned - 1. Any mechanical/electronic equipment installed in rural Zaire will need constant monitoring. 2. To effectively implement a project, an on-site project manager is required.

7. Recommendations - Pilot projects should be designed in a systematic fashion responsive to practical needs of project implemenation.

EVALUATION OF
NASA SPONSORED PHOTOVOLTAIC PROJECT
AT KIONZO MISSION

Debra Rectenwald
Mulamba-wa-Kabasele

I. Project Description

In February 1982, the National Aeronautics and Space Administration (NASA) installed a Solar Power Corporation Refrigerator/Freezer (SPC R/F) at Kionzo Catholic mission in Bas-Zaire. The refrigerator was placed in a rural area to assess the effect of photovoltaic equipment on rural health care. It was intended to facilitate "cold-chain" preservation of vaccines in poor countries. Cold-chain is the system for transporting vaccines in the potent state from the manufacturer to the vaccination site.

II. Evaluation Purpose

This final evaluation of the NASA sponsored project at Kionzo Mission constitutes a Lessons Learned and Development Issues Evaluation. The evaluation first examines the performance of the SPC R/F unit. Secondly, it assesses the appropriateness of photovoltaic refrigerators in rural areas.

III. Evaluation Team

Citoyen Mulamba-wa-Kabasele and Debra Rectenwald of USAID/DEO made up the evaluation team. Mulamba, USAID's Engineering Advisor, has followed the project since its beginning. Citoyen Isengingo, a solar specialist from the "Bureau du Service Presidentiel d'Etudes", was invited to participate as an observer in the evaluation.

IV. Itinerary

The evaluation took place between the 22nd and 25th of April 1985. The team based itself in Matadi and made day trips to Kionzo. The Mother Superior and the mission's nurses were available to answer questions.

Following the Kionzo trip, the team travelled to Kasangulu (also in Bas-Zaire) to visit the Integrated Health Project (660-0093). Under this project the Salvation Army purchased nine SPC R/Fs identical to the unit in Kionzo. The refrigerators were installed in rural health centers near Kasangulu.

In Kinshasa, the team visited Frere Roggeman of the Inter Diocese Community. The Frere has been experimenting with solar energy for several years. He has installed 200 radios, 20 refrigerators, and three water pumps in Zaire - all powered by solar energy and working efficiently. The evaluation team also visited local companies selling solar equipment. These include Fabrique Nationale de Meuble et d'Articles Menagers (FNMA), Melotte, Mercuria Zaire, and Universal Study Company (USCO).

V. Project Background

In the early nineteen eighties, NASA/Lewis Research Center was contracted by AID to develop and test a solar powered medical refrigerator/freezer in several third world countries. The unit eventually developed was manufactured

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under subcontract by the Solar Power Corporation (SPC), an American firm. It was designed to meet rigid specifications set by the World Health Organization (WHO) and Center for Disease Control (CDC).

Kionzo was selected as the testing site in Zaïre for several reasons. First, the mission is located in a remote area and has no access to conventional electrical power. Second, the mission's health unit (directed by four Colombian nuns) has an extension program which vaccinates village children. Finally, the mission was selected because the nuns had previously expressed interest in solar projects.

A SPC engineer accompanied by a NASA/LeRC representative came from the United States to install the SPC R/F. The unit was set up on five batteries, not the suggested six, because one of the batteries was stolen in transit. The scaffolding to support the solar modules was also stolen, so the modules were positioned on a roof. Solar powered lights were installed in the maternity.

Routine maintenance of the solar equipment was placed under the nuns' supervision. The nuns kept the refrigerator clean and free from ice. They dusted the modules during the dry season and recorded the information on the voltage and temperature meters. (These readings were sent to NASA monthly during the first year's test period.) A technician from Ateliers de Construction Electrique de Charleroi (ACEC), a local electrical construction firm, agreed to periodically check the refrigerator for major problems.

Near Kasangulu, also in Bas-Zaire, the Salvation Army installed nine SPC R/F units in rural health centers. The refrigerators were part of a larger photovoltaic power system. At each center, seven (35-watt) modules gave power to 12-volt lights, a two-way radio, and the SPC R/F.

VI. Evaluation

A. Evaluation Questionnaire

NASA asked USAID to complete an evaluation questionnaire on the performance, acceptance, use, and effects of the SPC R/F. The SPC R/F did not function long enough to answer the questionnaire specifically. Hence, this part of the evaluation will generally address the questionnaire's major areas of interest.

1. Performance. The SPC R/F unit conforms with rigid specifications set by WHO and CDC. The unit is a top-opening chest with insulated walls thicker than 12 centimeters. A thermostat shuts off the refrigerator if the temperature becomes too cold and sounds an alarm if the temperature becomes too warm. The unit was designed to operate on six (105 amperes/hour) batteries and ten (35-watt) modules. A regulator prevents the batteries from becoming over or undercharged. Although the SPC R/F appears to have been thoughtfully designed, it has not functioned properly in this country.

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The SPC R/F in Kionzo worked well for most of the first year because the ACEC technician kept the refrigerator in repair (fuses were replaced, routine maintenance was performed, the batteries were cleaned, the temperature gauge was adjusted, etc.). After a year and a half, though, the Mother Superior reported to USAID that the unit had broken down. Because Kinshasa offered no assistance, the nun solicited help from Inga, the national hydroelectric facility. (The ACEC technician had left the area; he was not replaced). An American engineer from Inga filled the refrigerator with freon. The refrigerator worked for three weeks before it puttered out; it has not worked since. The unit remains inoperative because technical assistance is unavailable.

Engineers Mulamba and Isengingo examined the SPC R/F and found that the fuses and wiring to the electric module had burnt. They attempted to replace the electronic module but the spare part (left by the SPC technician) was the wrong model. The engineers believe the break-down is the result of a malfunction in either the electronic module or the voltage regulator.

Problems with the nine SPC R/F units purchased by the Salvation Army developed immediately after they were installed. Three of the refrigerators have completely broken down; four other units do not maintain temperatures cool enough to preserve vaccines. The refrigerators were not repaired, again because technical assistance was unavailable. (The Salvation Army's technician believes the SPC R/F is too complicated for him to repair.)

The evaluation team travelled to Kasangulu with a solar refrigeration specialist (trained by Frere Roggeman) to determine the reason for the SPC R/F breakdowns. The technician examined two SPC R/F units and, by making simple adjustments, repaired the refrigerators. The motor in the first unit started when the technician disconnected the fan cooling the compressor (apparently the fan was consuming too much energy). The second unit was repaired by replacing a fuse. Whether or not these minor problems are the real causes for the breakdowns will be determined with time. (Future plans include trips by the same specialist to Kionzo and the other Salvation Army health centers.)

2. Acceptance and Use. The solar refrigerator was readily accepted by the Kionzo mission staff. The nurses turned off their kerosene refrigerator and stored the vaccines and serum in the SPC R/F. The nuns prefer the solar refrigerator to their kerosene model because it is easier to regulate and less expensive to maintain. In addition, the nuns appreciate the all-night light in the delivery room.

The SPC R/F units purchased by the Salvation Army are being used by village health workers who have had minimal exposure to electronic/mechanical equipment. When a problem develops, the health workers do not know what to do; they require more training and monitoring. The Salvation Army Officers, given their numerous duties, have not had enough time to properly manage the solar component in their health project. Consequently, some of the operating problems may be the result of inadequate routine maintenance.

3. Effects. The SPC R/F unit did not have a dramatic effect on the rural health care services near Kionzo. The mission has had a rural vaccination program for eight years; each month a health team visits the surrounding villages to weigh and vaccinate children. The nuns rely on their kerosene refrigerator to preserve the vaccines. Therefore, with or without solar energy, the mission provides rural health care. The solar refrigerator did, however, allow the vaccination program to be managed more efficiently.

At the Kasangulu health centers there are no other means of refrigeration. A solar powered refrigerator, if it worked efficiently, could have a tremendous effect on rural health care. When the SPC R/Fs functioned, vaccines were sent to the health centers and the children were vaccinated. Since the units have broken down there has been no means of keeping vaccines cold. Thus, there has been no vaccination program.

B. Photovoltaic Refrigerators in Rural Areas

Solar refrigeration is an appropriate means of preserving medicines in rural health centers for several reasons. First, photovoltaic systems offer a dependable source of energy. Zaire has plenty of sunlight. Second, solar power systems are relatively easy to install. A solar system can be installed in a few hours by a qualified technician. Third, maintenance is minimal (if the refrigerator is durable). The local people can be trained to clean the equipment and monitor the unit's temperature. Finally, there are few operating or recurring expenses. Batteries must be replaced every five years; solar modules are estimated to last as long as 20 years.

Frere Roggeman experiments with solar energy in his laboratory at the Inter Diocese Community headquarters. He has imported several European brands of refrigerators, panels, and batteries. Each solar refrigerator is tested before it is sent into the interior. According to Frere Roggeman, Kinshasa is the best place to test solar equipment because the area has the least amount of sunlight in the country.

Solar equipment may be purchased locally at FNMA, Melotte, Mercuria, and USCO. FNMA is assembling refrigerators with parts imported from Photowatt, France. FNMA is the only solar company that employs technicians who travel into the interior for repairs. Three solar panels (38 watt), a 12-volt battery (210 amperes), and a 12-volt refrigerator cost $2,500. OXFAM installed four FNMA refrigerators three months ago. The agency has been so pleased with the unit's performance that it has ordered five more refrigerators. The European Economic Community plans to install 120 FNMA refrigerators in state dispensaries. Melotte, Mercuria, and USCO import European manufactured equipment. USCO is also familiar with American companies manufacturing photovoltaic power equipment.

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VII. Conclusions

A. SPC R/F Unit

1. From an initial inspection, the SPC R/F breakdowns seem to have been caused by minor problems. At Kionzo and Kasangulu no technical assistance is available to solve even these simple problems. Solar refrigeration specialists in Kinshasa, who are willing to travel, should be identified. Their names and organizations should be provided to the health centers using solar powered equipment. The list could start with the technicians working for FNMA and Frere Roggeman.

2. Many of the dispensaries have small vaccination programs. Sometimes less than 50 children are vaccinated each month. At these dispensaries, a unit smaller than the 75 liter SPC R/F would be more appropriate.

3. The engineers who examined the refrigerators during this evaluation believe that the SPC R/F units are unnessarily complicated. Their assumption is that a simpler refrigerator would be more durable and easier to maintain. More research is required to determine which refrigerator parts are essential and which parts are superfluous for practical operating needs in rural Za"re.

B. Photovoltaic Refrigeration

1. If NASA's project goal was to test the effect of photovoltaic powered refrigerators on rural health care, then it would have been more revealing to monitor the project at Kasangulu than at Kionzo. At Kasangulu, there is no alternative means of refrigeration. Thus, the effects of the SPC R/F on the health care system would be clear; any change in the rural health care service could be attributed to the refrigerator. If NASA's project goal was to assess the performance of the SPC R/F unit, however, then it would have been more appropriate to have tested the unit in Kinshasa where there is minimal sunlight and where it would have been easier to monitor the project.

2. More research is required on solar refrigeration. A survey of companies manufacturing 12-volt refrigerators should be done. Solar-powered refrigerators are technologically new. Several questions remain unanswered: How many solar modules are required to cool a 75-liter refrigerator in Kinshasa? How many modules are needed in Bas-Zaire? Does a 75-liter refrigerator need a five day battery reserve? Or is a two-day reserve sufficient? Who manufactures a simple but durable 12-volt refrigerator?

3. Solar energy could be a dependable energy source in rural areas. The biggest disadvantage for employing solar equipment, at present, is the initial investment. A solar powered unit is too expensive for most rural health centers to afford. USAID and other donors could play a useful role by subsidizing solar equipment until it becomes lower priced (a predictable eventuality given present trends). Alternatively, any way of making credit available for rural photovoltaics would likely find a ready market.

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C. Pilot Project

1. We understand little more about solar refrigeration now than before the Kionzo project was implemented - except that the SPC R/F was a not an sound investment. NASA's attempt to monitor the project from the United States did not work well. The Kionzo nuns have an expensive piece of equipment which has been broken kown for almost a year. Spare parts and technical assistance requested by the nuns were never received. Communication between the mission and NASA was poor. The sisters now feel abandoned.

To avoid a strain on limited staff time and to have an objective assessment of new ideas, USAID needs to design pilot projects in a more systematic fashion. One suggestion would be to designate a qualified team that would design, monitor, support, and evaluate pilot projects. This team would be responsible for setting up the experiment. It would determine the best place and people for project implementation. The team would assert a hypothesis, test it, and retest it by controlling variables. Such an approach could provide useful information for future project success.

This approach might be more costly than the approach taken in the Kionzo solar project (although this is not clear, given the substantial development and overhead costs of that project), but it would ensure essential support for the project (almost impossible when tests are U.S.-based), and would offer a better chance of having useful results at the conclusion of the pilot activity. In the case of Kionzo, the USAID Mission was not sufficiently consulted or involved, the project budget was too tight to fund adequate backstopping from the U.S., and USAID was not technically equipped to provide the needed backstopping locally.

2. If the appropriate technology process is identified in phases, (i.e. research, experimental, production, marketing, and distribution), Frere Roggeman would be a useful resource on solar equipment for the experimental phase. He has assembled and tested his own 12-volt refrigerators. He is willing to import and test any refrigerator for USAID or other donors. He also has trained Zairians to repair solar equipment. One of these technicians might be retained to analyze the cause of the SPC R/F breakdown at Kionzo.

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