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- project paper amendment -

BAKEL (SENEGAL) SOLAR PUMP

(amendment to Project No. 685-0208, "Bakel Irrigated Perimeters")

February 23, 1978

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PART I - SUMMARY AND RECOMMENDATIONS

A. Recommendations

Grant Amendment: $700,000 increase in funding for Project No. 685-0208, "Bakel Crop Production (Bakel Irrigated Perimeters)," Senegal.

Waivers: On July 5, 1977, the Assistant Administrator for Africa authorized purchase of goods and services for this project on a non-competitive basis from Thermo Electron and SINAES, "subject to confirmation of the project's feasibility and cost-reasonableness." Approval of the Project Paper amendment will constitute such confirmation, allowing procurement to be carried out as proposed.

B. Project Description

In response to an obvious need for alternatives to petroleum-based energy systems, AID has begun to test a variety of renewable energy technologies in rural areas of developing countries. Typically, these experimental projects seek to address such issues as technical performance in the field, reliability, ease of maintenance, social implications, and cost-effectiveness. Where possible, direct comparisons are made with conventional ways of carrying out similar tasks, notably through application of diesel power.

The activity described in this paper provides for such testing of a 30 KW solar pumping system as part of the "Small Irrigated Perimeters" project in eastern Senegal. The pump,

which will be capable of irrigating a 200-hectare area, will be installed near diesel-irrigated perimeters in the Bakel area by June 1979, in time for the principal crop season. Provision has been made for careful monitoring and evaluation of the pump in technical, social/institutional, and economic terms.

The pump will be manufactured jointly by firms in the U.S. (Thermo Electron) and France (SOFRETES). Cost of the pump and related services in Senegal will be shared by AID ($625,000 to Thermo Electron) and the Government of France ($625,000 to SOFRETES). Thermo Electron will absorb $170,000 in costs as its contribution to the project. In addition, AID will pay $75,000 for independent studies of the pump's socio-economic effects.

C. Summary of Findings

The solar pump will replace diesel units of equivalent pumping capacity, in order to supply water to a 200-hectare area already surveyed as part of the irrigated perimeter project. (Two back-up diesel pumps will be available in case of emergency.) The project's overall engineering, agronomic, economic, and environmental analyses therefore remain valid.

The solar pump itself is based on SOFRETES units which have operated for several years in Mexico and in African countries. Independent analysis has confirmed that the design of the Bakel pump is technically sound and that its cost is in line with present solar irrigation experience in the

U.S. and overseas.

In social and institutional terms, the solar pump could relate to its environment in different ways than do diesel pumps within the same project. Any such variances would follow from the pump's sophistication and scale, factors which conceivably could lead to a diminished degree of farmer involvement in perimeter management. In order to observe and evaluate any such effects, special provision is made for extensive monitoring of the solar pump's social impact.

PART II - PROJECT BACKGROUND AND DESCRIPTION

A. Background

1. Small Irrigated Perimeters Project

The irrigated perimeter project in the Bakel Area originally grew out of initiatives on the part of Diabe Sow, a farmer from the village of Khoungani. On his return to Senegal following a period of work in France, Sow requested agricultural assistance directly from the Centre International du Developpement Rural (CIDR), a Paris-based PVO. In 1974, CIDR sent its first expert to the area, with additional volunteers following in 1975. Although CIDR itself subsequently dropped out of the project, its volunteers stayed on as employees of SERDA, a Senegalese consulting group.

Using R&R funds, AID began in 1976 to assist the program in the Bakel area. In 1977, AID provided $124,000 to help the SERDA team maintain its momentum in carrying out

experiments with irrigated agriculture. Through this period, important contributions were also made by other groups, notably Senegal's Societe d'Amenagement et d'Exploitation du Delta (SAED), Oxfam, and War on Want. Between 1975 and 1977, total assistance from all sources amounted to $569,000, excluding labor donated by the farmers themselves.

On August 19, 1977, AID authorized a $5,859,000 grant to help develop irrigated perimeters for residents of 23 villages in the Bakel area. As a result of this project, more than 1,800 hectares of land will be cleared, protected as necessary by low dikes, and irrigated by a series of small diesel pumps. Technical support will be provided by SAED and SERDA.

According to the original project design, individual perimeters were generally to cover no more than 20-50 hectares, and each was to be managed by a groupement made up of farmers from a single village. Each perimeter was to be supplied water by its own diesel pump, operation and maintenance of which was to be the direct responsibility of the groupement. A consistent relationship would therefore have existed between specific groupements and their own perimeters, in terms of major decisions affecting land preparation, land use, water pumping, and so on.

In practice, management of the perimeters has become somewhat more complex. Overall perimeter size continues to be roughly 20-50 hectares, or the area dictated by pump

capacity. As developed by the farmers, however, the basic groupements are organized on a smaller scale, so that several distinct groupements may be involved in the cultivation of a particular perimeter. Each groupement prepares its own sub-perimeter and allocates parcels of land to its own members for cultivation. The various groupements on a given perimeter then arrange to select and pay the gardien who operates and performs simple maintenance on the pump which supplies their water. SAED technicians are available to help when more serious mechanical problems arise.

Actual expansion of specific perimeters to their projected size has proceeded rather deliberately over time, suggesting that several years may be required before a perimeter's potential area is fully cultivated. The two perimeters recently established between Bakel and Tuabou, for example, involved only 15 and 8 hectares of irrigated land during their first crop season, although SAED officials expect these to expand to 20 and 15 hectares, respectively, by next year. Similarly, the extent of perimeter use through the year increases with time. New perimeters may be cultivated only during the major crop season. A better-established perimeter such as those near Khoungani, on the other hand, may be under cultivation for 10 months of the year, lying fallow only while dikes are repaired and other land preparations carried out during May and June.

2. Solar Pump

The possibility of adding a solar pump component to the irrigated perimeter project grew out of a series of discussions held during 1977 among:

- the Government of Senegal, especially the Delegation Generale a la Recherche Scientifique et Technique (DGRST), SAED, the Ministere du Plan et de la Cooperation, the Ministere du Developpement Rural et de l'Hydraulique, the Institut Senegalais de Recherches Agricoles, the Prefect and Mayor of Bakel;
- AID, including officials from both Dakar and Washington;
- France's Mission Francaise de Cooperation (FAC), including officials from both Dakar and Paris;
- Societe Francais d'Etudes Thermique et d'Energie Solaire (SOFRETES), the leading manufacturer of solar pumping systems for LDCs;
- Thermo Electron, a U.S. firm specializing in heat transfer technologies, to which SOFRETES has turned in search of improved solar pump components;
- Societe Industrielle des Applications de l'Energie Solaire (SINAES), a Senegalese company owned by GOS, SOFRETES, and other interests in order to promote and support solar energy projects.

On July 5, 1977, the Assistant Administrator for Africa agreed "in principle" to inclusion of a solar pump component in the Bakel project, "subject to confirmation of the project's feasibility and cost reasonableness, with the understanding that Thermo Electron, SOFRETES, and SINAES would participate in the project on a non-competitive basis."

To gather information necessary for preparation of a formal proposal, as well as to select a possible site near Bakel for installation of the solar pump, representatives of Thermo Electron and SOFRETES spent 10-14 October 1977 in Senegal. Discussions took place during this period with representatives of GOS, SINAES, FAC and ADO/Dakar. In addition, brief visits were made to Bakel and to SOFRETES pumping systems in two villages near Dakar.

On 17-19 November 1977, further meetings were held in Dakar between GOS, AID, FAC, Thermo Electron, SOFRETES, and SINAES in order to consider key issues involved in further development of the project. Among points reviewed were: project objectives, site selection, technical characteristics of the pump, possible contractual and payment arrangements, and perimeter management.

On 15 December 1977, Thermo Electron and SOFRETES submitted a formal "Proposal to the Government of Senegal: A Solar Thermal Water Pumping System for Bakel, Senegal."

On 27 December 1977, the GOS officially requested that AID finance the major portion of Thermo Electron's share of this project; SOFRETES' costs are to be borne by FAC.

B. Description of Solar Pump Component

The solar pumping system proposed for Bakel has the following general characteristics:

- Solar energy will be collected and converted to thermal energy by 1868 m^2 (20,100 ft^2) of flat-plate solar collector panels. At least some of these panels will be mounted on the roof of a local headquarters building being constructed for SAED at the solar plant site.
- A storage subsystem will collect hot water during hours of maximum sunshine, releasing this as needed during cloudy periods or late each afternoon. The result will be to allow up to 10 hours per day of average operating time, rather than the 6-7 hours to which the system would be limited in the absence of this thermal storage unit.
- Conversion of thermal energy into mechanical energy will be carried out by a Rankine-cycle heat engine. In addition to driving a Freon feed pump and the two pumps used by the collector loop, the engine's turbine shaft powers a small electrical generator and the main river water pump. An auxiliary electric motor is used to provide power during the system startup process each morning.

-Net power produced by the system will be 287 KWH/day. This could be used to pump a daily average of 1.7 million gallons (6,400 m^3) of water. In addition, 4.7 KWH of electricity could be produced each day for system use and for power needs at SAED headquarters.

Potentially, water supplied by the solar pump could be used to irrigate a 200-hectare area. The perimeter now earmarked for this purpose is located near the Senegal River approximately halfway between Bakel and the village of Tuabou, 7 km downstream. Since experience shows that local farmers can be expected to adopt irrigated agriculture only in gradual stages, however, it is likely that only a portion of this perimeter will actually be cultivated during the first crop season (June-October 1979) following installation of the pump. It is possible, although by no means certain, that a second irrigated crop will also be grown on part of this land during the flood-recession season that immediately follows (October 1979-February 1980). Eventually, the full 200 hectares may be farmed during the greater part of each year.

According to SAED, management of this area will be structured according to procedures already established on existing perimeters. In principle, SAED would assign sections of land to groupements able to prepare and cultivate them. Each groupement in turn would have responsibility for preparation of its own section, as well as for allocations of land to

particular farmers or to collective uses. Together, the groupements would choose one or more gardiens to do simple tasks connected with the pump. To develop its own capacity for more sophisticated monitoring and maintenance of the solar pump, SAEDintends to send two university-level technicians to Mali and France for specialized training.

As indicated in Section III.C ("Sociological Analysis"), however, management of the solar perimeter in practice may pose issues not raised by the overall project's diesel-irrigated perimeters, each of which is of considerably smaller size. In order to adequately assess any such effects, provision has been made for social monitoring and evaluation services, as described in Section IV.C.2.

PART III - PROJECT ANALYSES

A. Engineering and Agronomic Analyses

Except for technical and cost aspects of the solar pump itself, engineering and agronomic analyses carried out for the original irrigated perimeter project remain valid. The solar pump will simply replace diesel units of equivalent pumping capacity, in order to supply water to a 200-hectare area already surveyed as part of the original project. (Two back-up diesel pumps will be available in case of emergency.) No new issues are therefore raised in terms of topographic surveys, soils, crop varieties, diking, hydrology, construction

methodology, or cost estimates (other than cost of the new pump).

In order to help analyze engineering feasibility and cost-reasonableness of the solar pump, AID's Office of Engineering contracted through the Department of Energy for technical consulting to be provided by Sandia Laboratories of Albuquerque, New Mexico. To do this job, Sandia personnel examined the draft Thermo Electron/SOFRETES proposal of November 1977, accompanied the AID team to Dakar for project discussions over the period 17-19 November, reviewed the final technical proposal submitted by the contractors on 15 December, and held technical discussions in Albuquerque on December 19 with Thermo Electron engineers. Simultaneously, DS/ENGR was carrying out its own review of the Thermo Electron/SOFRETES proposal and of Sandia's analyses.

During January 1978, both Sandia and DS/ENGR reported on their findings. In all cases, the design of the pumping system and its components was determined to be sound. Given the somewhat experimental nature of the system, costs were found to be "quite in line" with solar irrigation experience in the U.S. and overseas. DS/ENGR suggested that more intensive monitoring should be built into the project, an idea that SAED has accepted in proposing to assign two full-time, university-level technicians to monitor the pump and carry out routine maintenance.

B. Economic and Financial Analysis

1. Economic Analysis

Except for the cost of the pump itself, the economic consequences of adding this solar unit to the irrigated perimeter project are negligible. One large solar pump is simply replacing several smaller diesel pumps to supply an equivalent amount of water to an area already set aside for irrigated agriculture. In addition, SAED intends to levy users' charges for solar-supplied water at a level comparable to operating and amortization charges incurred by groupements relying on diesel pumps. The economic estimates reported in the original project paper therefore remain unchanged in terms of these major analytical categories:

- crops, production, and yields (present and future);
- availability and valuation of farm labor;
- availability of draft animals;
- shadow pricing of rice and fertilizers;
- marketing arrangements;
- farmer incomes and cash flows;
- distribution of project benefits.

In terms of economic analysis of the solar pump itself, Thermo Electron and SOFRETES have calculated that the solar unit would have a net present value greater than that of competing (diesel) systems under the following conditions:

-a system life of 20 years;

-a discount rate of 10%;

-10% annual increase in the cost of power produced by alternative systems.

These results would be somewhat more positive if additional pumps were manufactured. According to Thermo Electron, to fabricate 10 systems simultaneously would reduce the cost of each unit to approximately $900,000. Leaving other assumptions unchanged, this would means that a system with an operating life of only 15 years would still have a net present value greater than that of diesel units.

A number of significant imponderables enter into any such calculations, especially when the subject matter concerns alternative energy sources: what in fact will be the eventual price and reliability of experimental systems? what trends will prevail in terms of petroleum costs and availability over the next several decades? Serious uncertainties of this kind mean that the economic analyses cited above can be considered no more than illustrative. Nonetheless, we know in general that oil prices <u>will</u> rise and that costs of renewable energy systems <u>will</u> fall, to the point where at least some alternative systems will soon be competitive with those based on petroleum. Preliminary data suggest that the Thermo Electron/SOFRETES pump could be such a system, and this project in part is designed to determine the accuracy of that assessment.

2. Financial Analysis

a. Financial Requirements: Total cost of the Bakel solar pump project will be $1,495,000, broken down as follows:

	Foreign Exchange	Local Currency	Total
Solar Pump	$1,220,000	$200,000	$1,420,000 (95%)
Studies and Evaluation	25,000	50,000	75,000 (5%)
Total	$1,245,000 (83%)	$250,000 (17%)	$1,495,000 (100%)

b. Financial Plan: Financial requirements will be met by contributions from AID, FAC, and Thermo Electron:

	Foreign Exchange	Local Currency	Total
AID	$ 545,000	$155,000	$ 700,000 (47%)
FAC	530,000	95,000	625,000 (42%)
Thermo Electron (cost-sharing)	170,000	--	170,000 (11%)
Total	$1,245,000 (83%)	$250,000 (17%)	$1,495,000 (100%)

c. Summary:

AID is financing 47% of total project costs of $1,495,000, including 43% of total foreign exchange requirements and 62% of local currency expenses. FAC is financing 42% of the project, or 43% of foreign exchange requirements and 38% of local expenses. Thermo Electron is contributing

11% of the total project budget, all in U.S. dollar costs.

In terms of the $1,250,000 contract between GOS, Thermo Electron, and SOFRETES for provision of the pump itself, AID and FAC will each finance $625,000. AID is financing Thermo Electron's share of the contract, consisting of $520,000 in dollar costs and $105,000 in local costs. FAC is paying SOFRETES' expenses, of which $530,000 are in French francs and $95,000 in local currency.

In addition, AID will pay for $75,000 worth of studies and evaluation. For investigation of social impacts ($60,000), a contractor will establish procedures for monitoring and evaluation; collect base line data; observe working interactions between the groupements, the local peasants' association, SAED, SERDA, etc.; observe and evaluate social and institutional events during the 1979 and 1980 crop years. An energy economist ($15,000) will compile and assess data available at Bakel and elsewhere; provide financial and cost-benefit analyses of the pump; compare the pump with alternative irrigation technologies (diesel or solar cell pumps).

Substantial supporting services will be provided by GOS as part of its own contribution of $2,132,000 to the irrigated perimeter project.

C. Sociological Analysis

In accord with traditional community forms, the original irrigation project anticipated that small-scale, cooperative groupements would serve as basic management units, each having control over a single pump and perimeter within the overall project. Some modifications of this system have appeared, notably in that groupements are smaller than expected, implying that several groupements may actually cultivate a given perimeter. Nonetheless, the size of each perimeter remains small, and the groupements working it draw on people from a common village. Joint action is therefore relatively simple in such matters as selecting the perimeter's gardien or carrying out discussions with SAED.

SAED hopes to integrate the solar pump smoothly into the present system. However, the differences in scale and technology between the existing diesel perimeters and the much larger solar perimeter raise questions worthy of close observation as the project proceeds. For example:

-Operating and amortization costs paid by existing groupements cover visible expenses (fuel, oil, parts) and the actual replacement cost of the pumps themselves. The basis for these charges is therefore clear to the farmers who must pay them. To avoid inequities between groupements on different sorts of perimeter, SAED

intends that farmers receiving water from the solar pump will pay an amount equivalent to diesel costs. To the farmers on the solar perimeter, however, this may seem quite arbitrary -- "operating costs," for example, will be assessed where none appear to exist. At least potentially, this could be grounds for some confusion in the relationship between SAED and the groupements.

-The relationship between particular groupements and the solar pump's gardien will be much attenuated by the fact that a great many groupements will have to be involved in the gardien's selection and payment. Since the gardien is the most significant agent in pump operation and maintenance on a daily basis, individual groupements could feel that their control over these vital functions is less than on diesel perimeters.

-Since two SAED technicians will be assigned full-time to the solar pump, the importance of the gardien himself will be diminished relative to gardiens on diesel perimeters. Farmers could perceive this as a further erosion of their influence over the project.

-Since crops and water needs are closely related, farmers on each perimeter may need to agree on a single pattern of cultivation for their common land, even though different groupements might otherwise wish to grow different things during a given season. Such agreement should be

relatively easy to achieve on small perimeters, where few groupements will be involved. The possibility for discord could be greater on the solar perimeter, where consensus must be achieved among a much larger number of groupements drawn from at least two different villages. SAED might have to intervene to resolve any such differences.

To the extent that they actually materialized, these forces would have a common tendency to move the locus of decision-making on the solar perimeter toward SAED and away from farmers or their groupements. Such effects could prove negligible, but they should be closely watched. Since the solar perimeter will be adjacent to existing diesel perimeters, evaluation should take the form of a comparative look at relationships among these different irrigation technologies, perimeter size, management patterns, farmer participation, and productivity. Provision for such a study is made below under Section IV.C, "Monitoring and Evaluation."

D. Environmental Analysis

The original irrigated perimeter project was subjected to unusually close scrutiny in terms of environmental impact. Ultimately, a full-scale Environmental Assessment was carried out by a team from the American Public Health Association, which investigated the project's implications for disease

patterns, health infrastructures, water supply and quality, and agricultural chemicals. In a report submitted on 4 May 1977, the APHA team concluded that the irrigated perimeter would have only "minimal potential adverse effects" and therefore "strongly recommended" immediate implementation of the project.

Since the solar pump is simply to substitute for diesel pumps, leaving project agricultural practices and water use patterns unchanged, there should be no impact on variables investigated by the APHA. The original project's Environmental Assessment therefore remains valid.

PART IV-IMPLEMENTATION PLANNING

A. Contractual Relationships Between Participating Groups

AID and GOS will negotiate and sign an amendment to the Bakel Irrigated Perimeters Project Agreement to cover AID's contribution ($700,000) to the solar pump and related socioeconomic services. This amendment will:

- describe new elements of the project to be financed through the amendment;
- describe any modifications of provisions of the existing Project Agreement, as applied to the solar pump component (e.g., DGRST will be the GOS agent for evaluation, signing of vouchers, and other matters concerning the solar pump);
- describe any new responsibilities on the part of DGRST, SAED, and other GOS agencies with respect to site preparation, supporting agricultural services, monitoring, and other aspects of project implementation;
- require that the host-country contract between GOS and SOFRETES/ Thermo Electron be acceptable to AID in form and content, with AID to approve this contract prior to its signing;
- establish conditions precedent to disbursement of funds, including a requirement that AID be provided with copies of the following executed documents: the GOS-FAC agreement assuring funding for the SOFRETES portion of the project; the contract between GOS and SOFRETES/Thermo Electron; the sub-contract between SOFRETES/Thermo Electron and SINAES.

In discussions with AID, GOS has already agreed in principle to these provisions.

FAC and GOS will negotiate and sign an agreement under which the Government of France will finance the SOFRETES portion of the project ($625,000).

GOS will negotiate and sign a contract with SOFRETES and Thermo Electron to manufacture, install, monitor and provide warranty services with respect to the solar pump.

Thermo Electron and SOFRETES will enter into a separate understanding specifying the elements of their relationship with respect to this project.

SOFRETES and Thermo Electron will arrange with SINAES to provide necessary services within Senegal.

B. GOS Responsibilities

DGRST will act on behalf of GOS in negotiations concerning the solar pump, and will be responsible for implementing GOS contractual obligations in connection with this activity. The ProAg Amendment itself may be signed on behalf on GOS by the Ministry of Finance.

SAED and SERDA will continue to provide agricultural services to farmers on land irrigated by the solar pump, according to the terms of the original irrigated perimeter project. Specifically, SAED will ensure that land is available as required for installation of the solar pumping system, and that a portion of the 200-hectare perimeter is prepared for irrigation at the time of the pump's provisional acceptance.

C. Monitoring and Evaluation

AID/Dakar will have general responsibility for monitoring progress of the solar pump. A key element of this job will be to work with GOS to ensure that at least part of the 200-hectare perimeter site is prepared for cultivation by May-June 1979, when the pump is scheduled to be installed.

In line with the experimental nature of this activity, additional arrangements will be made to ensure intensive monitoring and evaluation of the pump on technical, social/institutional, and economic grounds:

1. Technical

The pumping unit itself will incorporate instrumentation to measure and record technical performance in terms of critical variables:

- pressures and temperatures in the solar collector and thermal loops, the energy storage subsystem, and the river pumping facility;
- flow rates in the thermal loop and river pump inlet pipe;
- rotational speed of the turbine expander;
- power output of the electrical generator;
- local meteorological information, including temperature, rainfall, wind speed, wind direction, and solar radiation.

Data will be collected frequently by SAED technicians assigned to the solar pump. Using these data, Thermo Electron will provide to GOS, AID, and FAC periodic analyses of the pump's performance.

DGRST will review these analyses on behalf of GOS. If additional technical review is required, AID may call upon DOE under the terms of the AID-DOE cooperative agreement.

No special AID financing will be required for technical monitoring and evaluation.

2. Social/Institutional

Social monitoring and evaluation will preferably be carried out either by a Senegalese research institution such as ENEA (Ecole Nationale de l'Economie Applique) or by SAED itself. This would provide the capacity within a local institution to follow the work on a continuing basis. To get this process underway, AID will contract with a social scientist familiar with Senegal and irrigated agriculture, in order to:

- discuss social monitoring and evaluation procedures with AID/Dakar, DGRST, SAED, and other groups in Senegal;
- advise AID on institutions or individuals in Senegal best able to carry out such work;
- draft a detailed scope of work to serve as the basis for an AID contract with the group chosen to undertake these studies.

Depending on the group selected, considerable time might elapse before field workers could be expected actually to reach Bakel. Recruitment of the social scientist to initiate this process should therefore begin as soon as the Project Agreement Amendment is completed.

Total cost of all social monitoring and evaluation services will be $60,000. AID's contract social scientist will absorb approximately $5,000 of this, with the remainder available for longer-term services to be provided by an appropriate group in Senegal.

3. Economic

An energy economist will visit Bakel in order to collect and evaluate economic data from a variety of sources: project instrumentation, records of maintenance technicians as well as other SAED and SERDA personnel, farmers' observations, etc. For comparative purposes and to acquire additional data, the economist may also visit SOFRETES installations in neighboring areas as well as Thermo Electron and SOFRETES headquarters.

The economist will then prepare thorough financial and cost-benefit analyses of the Bakel solar pumping system.

These analyses would take into account such factors as possible cost reductions through construction of additional pumping units, probable increases in the cost of traditional energy systems, foreign exchange impacts, etc. Comparisons would be made as appropriate with alternative irrigation technologies (diesel or solar cell pumps).

Economic evaluation of the Bakel system will take place during November-December 1980, and will cost approximately $15,000.

D. Schedule

Project implementation will proceed according to the following schedule:

- March 13, 1978 - project paper amendment approved by AID/W;
- March 31, 1978 - Project Agreement amendment signed with GOS;
- March 31, 1978 - contract signed between GOS, SOFRETES, and Thermo Electron;
- April 28, 1978 - contract signed with social scientist to advise on procedures for social monitoring and evaluation;

- February 1, 1979 - all solar plant components at Bakel site;
- June 1, 1979 - solar pump fully operational.

Since planting for the major crop season begins in June, any slippage in this schedule could mean the loss of a year in carrying out the project.