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PHALK 500 – CONCEPT AND IMPLEMENTATION

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BACKGROUND

In the wake of the Yom Kippur War in 1973, Arab members of the Organization of the Petroleum Exporting Countries declared oil production cuts, causing the price of oil to quadruple. In response to the oil crisis that ensued, the International Energy Agency (IEA) launched the SSPS (Small Solar Power Systems) project in 1975, developing two solar thermal power plants each with an output of 500 kW. The trial plants were commissioned in 1981 in southern Spain with the involvement of engineers from Elektrowatt Engineering (EWI). Several issues with generating solar thermal power came to light while operating these plants. One particular concern was the difficulty of harnessing solar radiation at sites with a high proportion of diffuse light.

At the time, the EWI had already been working with photovoltaic technology, which provided good results even with diffuse light. Drawing on this knowledge, it began by developing a concept study in 1986 for a 500-kW photovoltaic power plant, involving the federal government in its work. The team primarily set their sights on high-altitude locations and therefore named the project PHALK 500 – short for “500-kW alpine photovoltaic power plant” in German.

The study showed that photovoltaics could offer a number of advantages compared to solar thermal energy, in particular the fact that the technology was simpler, safer and better value for money. As a result, the team continued with the project on two trajectories: assessing various mountainous locations for suitability and contacting interested parties at the federal and cantonal level, in the electricity sector and within the wider industry to gain sponsorship for the project.

In early 1988, Bernische Kraftwerke AG (BKW) and Elektrowatt Ltd. founded the PHALK 500 consortium. By involving BKW, the location search focused on the mountainous regions in the Canton of Bern. Mont-Soleil quickly emerged as an eminently suitable site. Important criteria for the location included accessibility, availability of a power line and interest from local authorities and residents. In late 1988, the citizens’ commune of Saint-Imier provided the consortium with a suitable parcel of land. The basic elements for preparing a preliminary project were now in place. In May 1989, the consortium conducted a general site visit and presented the project to the media. In the meantime, they were joined by more partners from the energy sector and industry.

PROJECT OBJECTIVES

The project was defined as a Swiss research, development and demonstration project in photovoltaic power generation. It involved the planning, construction and operation of a power plant optimized in line with the state of the art, providing a peak output of 500 kW. The project was designed to offer extensive and longer-term options for research and development work both on the system as a whole and on individual components. It was also intended to provide training opportunities.

The consortium partners wanted to gain an understanding of the possibilities and limits of solar power generation through a concrete project and in doing so make a tangible contribution to discussions on Switzerland’s future energy mix.

THE MONT-SOLEIL SITE

The Mont-Soleil site was chosen based on several criteria. The following aspects were particularly important:

- Altitude: the location needed to be typical of average mountain altitudes.
- Insolation: the area needed to be exposed to optimum levels of sunlight (meaning it had to have an uninterrupted horizon, be south-facing and above the fog line).
- Accessibility, infrastructure: the location needed to be well connected, accessible all year round and close to a medium-voltage line.
- Acceptance: the project needed to be regarded in a positive light by the local residents and authorities.
- Landscape protection: the landscape needed to be suitable for integrating the plant.

TECHNICAL CONCEPT

The basic concept for the plant – solar array with a central inverter and feed-in to the medium-voltage grid – was a given based on the local conditions and the technical components available at the time. Choosing the solar module and inverter were among the most important decisions. In 1990, manufacturers that were able to deliver the quantity of solar modules needed for the project were few and far between. Ultimately, the consortium opted for Californian company Siemens Solar Industries as they offered high-quality technology at a suitable price. The choice of inverter supplier was simple: industrial partner Asea Brown Boveri Ltd. (ABB) fit the bill. At the time, solar inverters offering the required range of performance were not available as standard products. ABB developed the inverter in collaboration with ETH Zurich; it operated for 21 years without any major problems, which is excellent value for an electronic device.

COSTS AND COST-EFFECTIVENESS

Constructing the solar power plant cost CHF 8.4 million. A further CHF 1.5 million (approx.) was budgeted for research costs. The solar modules comprised 44% of the construction costs, and CHF 950,000 was spent on the inverter. Comparing the costs for both key components at the time with today's market prices shows that there is a reduction factor of around 20 when adjusted for inflation.

Based on the construction costs, the electricity production costs were estimated at CHF 1.10/kWh.

CONCLUSION: THE OBJECTIVE WAS ACHIEVED

As is often the case with pioneering projects, the team had to overcome a long period of difficulty. In the late 1980s, photovoltaic systems were often seen as an expensive aerospace technology with little chance at succeeding on the mass market. Although an investment of around CHF 10 million is considered relatively modest in the electricity sector, it took many discussions and meetings to establish a set of sponsors who were willing to finance the project. Once the contracts were signed, the enthusiasm and support of all involved became palpable. It was also motivating to hear of all the positive feedback from visitors to the site. There were only a few from outside the local area who criticized the use of grazing land for generating solar power.

The technical realization of the plant was a challenge, too. There was barely anyone with experience of similar facilities, and it was difficult to source suitable, well-tested electrotechnical components and devices. Almost 30 years later, the solar power plant is still in operation and serves as a testament to the dedication of Société Mont-Soleil and its partners.