principia SOLAR CAR 2001

Progress report

As we begin the Winter 2001 academic quarter, team momentum has shifted from design to construction. With just over six months until Ra IV takes to the race route, there is no time for complacency. But a comparison of our current 2001 project calendar with our 1999 project calendar over the same period shows an accelerated timeline that gives every project manager a reason to smile. We are effectively four months ahead of our 1999 car schedule.

The most significant leads have been realized in body, chassis, and electrical areas. In 1999, the body designs didn't clear the drawing boards until late March, with construction following in April. In contrast, we announce in this January 2001 issue of RA News the completion of the body design and the beginning of the belly pan, the first stage of body construction. In regards to the chassis, two years ago we were struggling as late as mid-April to design a rear suspension and to produce designs of the mechanical components of the chassis. Today, all designs are finished for the 2001 chassis and construction efforts will meet a rolling date of April 1. Finally, an electrical system crunch in 1999 taught us to plan ahead for 2001. Consequently, this year we have already ordered, received, and begun testing our solar cells and batteries, the two major components of our electrical system.

Allison Wiegand simulates the egress test in an effort to size the driver opening in the body.

Allison and Matt test combinations of epoxy in preparation for body construction.

Our four month lead will translate into a competitive edge as we are forced to make fewer tradeoffs between time and quality craftsmanship and as we gain weeks of road testing opportunities once construction is complete.

Bud Hardman, Nate Dudley, and Collin review mechanical plans while construction goes on around them in the machine shop.

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Lithium ion batteries lighten the load

You would be hard-pressed to find a team member who doesn't know the account of the day our 1999 solar car died at the bottom of the Elsah Hill. For those readers who have been to the Colllege campus, you are familiar with the long, steep grade from the village of Elsah to the gatehouse. For those readers unfamiliar with the Elsah Hill, let it suffice to say that bicyclists ride it in low gear, runners walk it, and the last thing you would ever want to do is to push a 1300 pound solar car up it. But that is precisely what the 1999 racing team did one humid testing day last spring when our overbuilt Ra3 ran out of battery power at the base of the hill.

The episode of the stalled car at the base of the hill is significant for two reasons. First, the event has served as a rallying cry to innovate a lighter, more efficient solar car for 2001. Second, the challenge of the Elsah Hill is not unlike that posed by terrain at the end of the upcoming America Solar Challenge race.

Team leader, Nate Dudley, was one of the members pushing on the bumper that notorious day, and he recounts the incident to new members in an effort to explain why a bathroom scale now holds a prominent position on the shop floor. His point is that the team must be committed to cutting the weight of our 2001 solar car by effectively half if we are to be competitive.

The team has actively worked toward this goal of building a 650 pound car, with the first tangible milestone being the completion of a 30 pound aluminum frame this past spring. The second major victory came last week when we gained approval and subsequently ordered a lithium battery pack for our 2001 car.

After months of searching for suppliers, testing battery samples, questioning experienced users, riding a roller coaster of regulatory indecision, and finally waiting for America Solar Challenge (ASC) approval, our battery pack is being assembled as you read.

Our lithium ion battery modules have arrived from NRG Cells of Singapore.

We chose as our prized power pack, a set of recharge-able lithium batteries. The set is comprised of 648 individual cells that approximate the size of a AA cell. Six of these cells are grouped into a module and wired in parallel. Twenty-seven of these six-pack modules are then wired together in series. Finally, four of these series strings form the pack. Our lithium battery pack weighs in at 29.4 kg, just within the 30 kg limit set by ASC regulations. What a weight savings over the 240 kg of lead acid batteries that we have used in previous three solar races!

Nate Dudley sets up the Bitrode battery cycler, in an effort to test our new batteries.

Eric Silver works his way through cycling 27 lithium ion modules in an effort to match them when wiring the pack.

Where there were once nine lead acid battery modules that comprised our pack, we now have an exiciting opportunity posed by the nearly 108 modules that constitute our new lithium pack. Using a Bitrode battery cycler, a piece of equipment donated by that company, we will be able to determine which modules could reduce the capacity of the pack as a whole and consequently match, or if necessary discard, these modules.

Our pack will have a nominal voltage of 99.9 volts, the level necessary to power our New Gen motor.

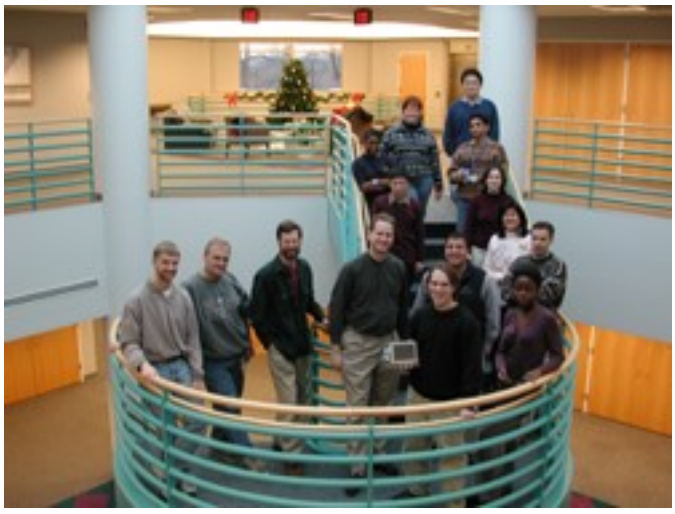
Members develop onboard application

"How fast can we go today?" In essence, that is the only question that the software focus group on the solar car team needs to answer. However, in order to answer competitively (that is, in a manner that will make us competitive with other teams), the group must deploy a software solution comprised of light-weight hardware, robust code, and efficient logic.

To carry out this solution, the software group is making use of, among other components, Microware Systems Corporation's OS9. OS9 is an operating system designed for embedded systems. It is used in more on-board automobile GPS units than any other operating system. Microware donated one developer's license to our solar car team.

To gain a better understanding of the issues involved in developing applications for OS9, members of the software group traveled to Des Moines, Iowa, for the day to meet with personnel of Microware. Solar car members received troubleshooting and software design ideas from Microware programmers, and returned to campus prepared to begin developing their software.

In the end, the onboard computer that the software group will program will process input from battery, temperature, and array sensors, along with speed and amp draw values from the motor, and transmit this data to the chase vehicle. Analysis of this data, combined with GPS information about the terrain, will allow us to make decisions about how fast we should go that racing day.



Members of the software team, including Jonathan Hess, Kemi Mohammed Mo Castillo and adviser Steve Shedd visited the Microware office in Indianapolis to get advice on the caveats of OS9.

"Why I joined solar car…"

My name is Esmeralda Yitamben and I am from Cameroon, in Central Africa. I am a transfer student here at Principia and I have already done two years in the Physics department at the University of Buea, in Cameroon. My dream right now after Principia is to enter an engineering school. I am interested in Civil or Mechanical engineering and that is why I have decided to join the solar car team. I was searching for everything that could give me experience or focus me into the engineering field. I have decided to join the solar car team to gain practical experience into a field that I may join some time later; the most important thing is that I enjoy being in the solar car team.

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Esmeralda Yitamben, Freshman

I first knew about Principia's solar car team during my freshman year of high school. It always intrigued me, but as a ninth-grader, college and all of its activities seemed extremely remote. It was when I read about Principia's participation in SunRayce 1999 that my interest sparked. I couldn't wait to come to Prin and join the solar car team. I was inspired by the team's accomplishment in earning a place in a race with the top engineering schools, awed by the fact that a 550 student school could designed and built a car that raced with those of big-name universities such as MIT.

My curious mind craved the *hows* and *whats* of this amazing contraption of solar cells, chromalloy steel, and computer chips. I needed to know right away how the car worked and what each part did. I was so inspired by this group of determined engineers, programmers, and business people that I yearned to join immediately, curious of what I could to as part of this underdog team.

My need for immediate membership put itself on hold until it was time to come to college. Now I've joined

New members (cont.)

the team, and I am beginning to unravel the mystery of how the car works, the strategy involved in designing it, and what my contributions to the project will be. I look forward to building and racing a car that might inspire and excite others as much the 1999 car did for me.

-Amanda Bishop, Freshman

As a non-science student I decided to join solar car because I saw this as an opportunity to be introduced to new technical skills and ideas. In the beginning I thought I had made a wrong choice since I did not know any thing to do with engineering and mechanics. When I talked to the facilitator, Steve Shedd, he only encouraged me to sign up for it, saying that there was a lot of things I could do to help in building the solar car even if I did not know any physics or math. This is

what drove me in joining this wonderful project. I realize now that I am really having fun doing some practical work, as well as learning new things.

-Sam Ssengonzi

Ra IV Club Donation: $1000	**Adopt-A-Battery** Donation: $500	**Solar Six Pack** Donation: $132 *32 is the solar car's official race number	**Adopt-A-Cell** Donation: $25
Rewards: • Your name or organization's name on our solar car trailer • Subscription to *Ra News* • Receive blue/gold team shirt	Rewards: • Adopts one battery • Subscription to *Ra News* • Receive 2 t-shirts	Rewards: • Adopts six solar cells • Subscription to *Ra News* • Receive a t-shirt	Rewards: • Adopts one solar cell • Subscription to *Ra News*

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