LLNL MBARI ASTEP project update

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To: Chris Scholin, scholin@mbari.org, 831-775-1779.

From: John Dzenitis, john.m.dzenitis@llnl.gov, 925-422-6695, mobile 925-337-1195.

Background

LLNL is working for MBARI on a NASA-sponsored project "An Environmental Sample Processor for Deep-Sea Seep and Hydrothermal Vent Applications" from the solicitation "Astrobiology Science and Technology for Exploring Planets" (ASTEP). The goal is to develop a polymerase chain reaction module for oceanographic microbiology in MBARI's ESP by 3/2008. The work areas are:

Task 1: Design the PCR module, 4/2006 – 9/2006.

Task 2: Fabricate and test a prototype, 10/2006 – 3/2007.

Task 3a: Fabricate and integrate production modules into the ESP, 4/2007 – 9/2007.

Task 3b: Support production modules, 10/2007 – 3/2008.

Summary of recent activity (9/29/2006 – 11/17/2006)

Most of the recent work has gone into iterations between the electronics and mechanical design. Our recent conclusion is that it is best to package the electronics in the PCR optics module housing. There will not be a long controller board that extends from the end of the optics module or could be connected remotely. Instead, the controller is split into a small 6-layer analog board and a small 4-layer digital board that are both approximately the width and height (55 mm X 45 mm) of the optics housing. The functional design and components are basically the same as was discussed in the Preliminary Design Review (PDR).

We closed out the remaining PDR action items by sending MBARI a solid model of the PCR module envelope (ASTEP_package_20061110.sat) for use in fitting for the ESP. As noted above, this envelope includes the entire PCR module; there is no separate controller board.

We continue to work on the thin-film heater design and prototyping. The original prototype has been in service since 9/4/2006 and has run over 375 PCRs in an old APDS-style PCR module. We believe our new design will be as robust as the original prototype but will also be more energy-efficient and require less recalibration over time.

We had a brief telecon. 11/17/2006 to discuss nucleic acid extraction options (microfabricated pillar chip, glass beads, *et cetera*). MBARI is going to pull together information on their desired protocol so we can discuss hardware and fluidics process design to execute the protocol.

Upcoming activity

The next major milestone is demonstration of real-time PCR in a prototype in 1/2007. It will be a special effort to make this on schedule, given where we are and the internal and external delays that are typical during the winter holidays. We must push to finish the electronics design so the mechanical design can be completed, and so we can turn our focus to creating the software.

We also need to finish specifying the probes and filters.

We will set up test fixtures for “dry testing” (electronic, thermal, and initial optical testing) and “wet testing” (optical testing with fluorophore solutions, real-time PCR testing).

Schedule and budget

As of 11/11/2006, the total spent was 127 k$ and 95 k$ remain, including additional funds-in of 100 k$ from late September. We are under-budget and slightly behind-schedule. We are not certain that we will be able to make the prototype demonstration milestone in January, given where we are and the internal and external delays that are typical during the winter holidays.