



**BUILDING AMERICA CONSORTIA
AND
NATIONAL LABORATORY
STATUS REPORT**

**FOURTH QUARTER FY09
July 1, 2009 – September 30, 2009**

IBACOS[®]
| Home Quality + Performance |

QUARTERLY STATUS REPORT, Q4 FY09

Cooperative Agreement DE-FC26-08NT 02231

Prepared by IBACOS

I. CURRENT PROGRESS AT EACH GATE LEVEL

Task 2

Gate 1A – *Expected Whole House Energy Savings and Cost Targets*

- IBACOS began to develop a TRNSYS model for the home plan S&A Homes will use for the lab home. The model of the home structure components is almost complete. Once completed, the mechanical systems components will be added, resulting in a full system design model. Information obtained at a TRNSYS workshop at NREL was used to make the model more accurate.
- IBACOS recommended using the Gorell StarView® Series window in the lab home design. The Gorell unit exhibited the best cost vs. energy savings value among all of the windows researched, and it scored high for constructability due to its continuous nailing fin and integral j-channel.
- IBACOS selected double-glazed low emissivity windows for the basement sliders. The frame for the basement windows is part of a window well system that accepts only certain window configurations. The window that was chosen has thermal performance values of $U= 0.34$ and $SHGC= 0.31$, and it represents the most energy efficient choice the manufacturer could offer.

Gate 1B – *Systems Evaluations and Specifications*

- The field test at The New American Home® 2009 in Las Vegas, NV continued to take measurements related to the gas engine-fired mini-split heat pump system, as well as the gas-fired tankless water heater.
- The wall mock-up research continued in the IBACOS facility with the construction of a mock-up of the basement foundation wall system advocated for the lab home. The mock-up is a full-scale representation of the front corner of the home, including the porch, and features a portion of the above grade wall system. The mock-up was used to:
 - Determine the best approach and materials for an exterior air barrier detailing at the band joist area. Flashing membrane was used to mimic a sill sealer product with the ability to flash above and below the sill plate at the exterior. The above grade wall's housewrap layer was extended over the band joist and taped to the exterior insulation board on the foundation wall.
 - Evaluate the use of a flexible membrane, through-wall flashing material. The material was used at the brick façade.
 - Evaluate the installation of the brick and vinyl wall cladding systems that meet at the home's corner.

- Evaluate water management and insulation techniques for the porch area. The porch has its own concrete foundation wall extending from the main concrete foundation wall. Due to construction sequencing, insulating around the entire exterior perimeter of the porch foundation wall appeared to be the best option for eliminating thermal breaks in this area. But the need for porch steps meant a significant height of the porch foundation wall perimeter could not be insulated at the exterior. As a result, the area where the porch foundation wall is attached to the main concrete foundation wall will not be insulated on the exterior. However, this area will continue to be insulated on the interior.
- IBACOS finalized the mechanical equipment specifications for the lab home; the drawings are almost complete. High-efficiency hot water storage tanks were selected despite the initial economical analysis, which indicated that the marginal cost vs. energy ratio exceeded the current cost of electricity. Upon closer examination, it was determined that the high first cost was ultimately offset by the fact that the product had a lifetime warranty, whereas other products would need to be replaced at least once during a 30-year mortgage.
- IBACOS reevaluated the sub-slab heat exchanger piping for the ground source heat pump (GSHP); TRNSYS simulations do indeed indicate that burying the piping deeper beneath the slab results in additional energy savings. IBACOS received cost information from the contractor and structural engineer indicating that substantial additional costs would be incurred for extra excavation.
- IBACOS continued to work on the lighting demonstration area in its facility. Three prototype assemblies for cove lighting systems using T5 and LED technologies were constructed to work out designs that are simple to build using off-the-shelf materials and minimize the cove size. The cove assemblies will allow multiple mounting locations to show the light distribution on the wall and ceiling at different mounting heights. The cove area evaluates ambient lighting and energy benefits in context with the construction details and process. Various light fixtures and lamps have been installed and evaluated, including a low-cost LED floodlight available at a mainstream wholesale store.
- IBACOS explored photographic techniques for documenting fixture light character. A rigid, medium-gray board and manual settings on a digital camera were used to show beam spread, cutoff, and other attributes of the presentation of light from a fixture.
- A lighting analysis was conducted at a model home built by S&A Homes in the same community where IBACOS' first lab home will be located. The model home includes an upgraded lighting package that is a standard offering by the builder. With a few important exceptions, the light levels in most areas of the home were adequate for circulation and tasks (where appropriate) per IESNA guidelines. The kitchen counter task surfaces showed the most significant deficiency in light levels relative to accepted minimum levels. The lab home's lighting will be compared to this work.
- Discussions continued with Progress Lighting to participate in the lighting demonstration area and the lab home, as well as offer builder-positive designs using their products.

- The lighting plan for the lab home was developed and approved by the builder.

Task 3

Gate 2 – *Prototype House Evaluations*

- **American Heritage Homes – Carroll, OH, 50%, Cold.** Initial discussions have begun with this builder regarding a 50% prototype home. American Heritage Homes is a semi-custom, production-focused, “build-on-your-lot” homebuilder in the Columbus, OH market.
- **Ecological Construction Laboratory – Champaign, IL, 50%, Cold.** Monitoring and data collection continued in Q4 FY09.
- **Harvard Communities – Denver, CO, 50%, Cold.** Data acquisition is underway and will continue for the rest of 2009. IBACOS completed the second three months of data analysis prior to the end of September in order to have the information available for the EEBA home tour. The prototype home was toured by approximately 50 participants from the EEBA conference in Denver, CO on September 28th. For Harvard Communities, the standard practice is to build to approximately a 38% level of energy savings. Due to the state of the housing market, moving to 50% is not practical at this time.
- **Imagine Homes – San Antonio, TX, 50%, Hot-Humid.** Research continued to identify solar thermal water heating systems for the 50% prototype home. Experts at NREL were contacted to help identify the appropriate system, and additional technical and cost information was gathered from different manufacturers. Efforts to redesign the framing plan for the 3177 model to achieve a 2x6 24” o.c. stacked layout continued. IBACOS anticipates that plans will be complete by late 2009 with construction beginning late 2009 or early 2010. Analysis continued on design strategies relative to the G2 “Must Meet” criteria.
- **Insight Homes – Greenwood, DE, 50%, Mixed-Humid.** Efforts with Insight Homes focused on finalizing HVAC designs for two of its home types. IBACOS was waiting for the builder to develop preliminary floor framing plans so the plans could be revised to allow for integration with the HVAC system layout and ductwork. The builder’s current ductwork and register/diffuser supplier does not offer some of the material specified in the high performance HVAC design. IBACOS plans to schedule a meeting with both the builder and the supplier during the last quarter of 2009 to identify possible alternative material and product selections from their offerings that will allow the high performance design to be achieved.
- **Pine Mountain Builders – Pine Mountain, GA, 50%, Mixed-Humid.** IBACOS continued to monitor the two completed 50% prototype homes. Typical hot water use is being simulated in these homes to determine the effect of the desuperheater on hot water energy consumption. Discussions continued around developing a strategic plan for community-scale implementation of the outlined 50% specifications; these discussions have included other more cost-effective design strategies that still meet the 50% savings milestone. Specific consideration has been given to the cost and energy saving tradeoffs of a ground source and high-efficiency air source heat pump.

- **Robson Communities – Phoenix, AZ, 50%, Hot-Dry/Mixed-Dry.** Due to the prolonged downturn in the housing market, this division is unable to pursue the construction of a 50% prototype home at this time.
- **Wathen-Castanos – Fresno, CA, 50%, Hot-Dry.** IBACOS recently formed a partnership with Wathen-Castanos. The builder plans to start construction on a 50% prototype in late 2009. Wathen-Castanos is interested in moving toward 50% on a community scale. This builder is undergoing significant changes in senior management as the current president retires at the end of the year, and Mike Nimon, Director of Construction, takes the helm. IBACOS has been involved, along with Denis Lenard of Business Excellence Consulting, in helping Wathen Castanos with its strategic planning during this transition. Plan development for the 50% prototype home is underway.

Task 4

Gate 3 – *Initial Community-Scale Evaluations*

- **ELDI/S&A Homes – Pittsburgh, PA, 40%, Cold.** Progress in the community has been extremely slow during FY09 Q4 due to the lack of homes sales and interest from buyers. S&A Homes has been working to close out construction on the first seven homes by completing a series of detached garages adjacent to them. ELDI remains committed to constructing homes at the 40% level of savings but is holding off on beginning construction on any additional lots until sales pick up for the completed homes. IBACOS plans to continue to support the developer and builder as they reevaluate the energy efficient building specifications and costs associated with the 40% level of energy savings.
- **Imagine Homes – San Antonio, TX, 40%, Hot-Humid.** IBACOS continued to help the builder evaluate and document G3 criteria for 40% whole house energy savings on a community scale.
- **Insight Homes – Greenwood, DE, 40%, Mixed-Humid.** Insight Homes worked steadily to both improve the exterior aesthetics of its homes and develop marketing materials that would allow it to effectively communicate the cost and energy performance advantage over competing new homebuilders in its market. With the focus moving from scattered lot development to involvement in two new communities, Insight Homes' home sales have been improving. There were twelve housing starts in two communities during August; however, it is expected that sales may begin to slow during the fall and winter seasons. IBACOS continued to help create construction details and documentation in order to pass all G3 "Must Meet" and "Should Meet" criteria.
- **K Hovnanian/Landover Group – Clinton, MD and Woodbridge, VA, 40%, Mixed-Humid.** No additional work is planned at the 40% level at this time.
- **Pine Mountain Builders – Pine Mountain, GA, 40%, Mixed-Humid.** The builder met all G3 "Must Meet" and "Should Meet" criteria and more than 10 homes are complete. This work will be delivered as part of the 2010 Mixed-Humid Joule Milestone report.

- **Tindall Homes – Mansfield, NJ, 40%, Mixed-Humid.** The builder met all G3 “Must Meet” and “Should Meet” criteria and more than 10 homes are complete. This work will be delivered as part of the 2010 Mixed-Humid Joule Milestone report.

II. SUMMARY OF TECHNICAL HIGHLIGHTS

Task 1 – *Building America System Research Management and Technical Support*

- IBACOS participated in an expert meeting held by the National Association of Home Builders (NAHB) Research Center on July 15. The meeting focused on quality management systems for builders of high performance homes. It validated many of the short and long-term research needs identified and documented in the 5-year plan for quality management of high performance homes.
- IBACOS attended the August DOE Quarterly meeting and presented on our modeling work with EnergyGauge USA, BEopt, and TRNSYS, focusing specifically on gaps and inconsistencies between EnergyGauge and BEopt.
- IBACOS attended the 2009 EEBA conference on September 28-30, 2009. A total of seven presentations were given. Each presentation title is listed in Section IV of this report and PDFs of the full presentations are included in the appendices.

Task 2

Stage 1 – *Integrated Solutions for Specific Climate Regions and System Performance Evaluations*

IBACOS continued to work with the National Renewable Energy Laboratory (NREL) on the Building America Benchmark process for 2009. IBACOS also worked on the review of proposed detailed analysis methods for the lighting and miscellaneous electric loads categories.

Task 3

Stage 2 – *Prototype Houses*

- **Wathen-Castanos.** IBACOS completed an initial assessment of the builder’s current construction practices. IBACOS is preparing to model several potential solutions for a prototype home that will achieve a 50% energy savings level. Possible technical solutions include modeling 2x6 framing with 1” expanded polystyrene foam (EPS), moving the ducts and forced air unit (FAU) into conditioned space, and upgrading the tankless water heater to a higher efficiency unit. Plan development for the prototype is underway, although the exact specification package has not been established yet.
- **Imagine Homes.** Construction on the prototype home is expected to begin in late 2009 or early 2010. The primary technical solutions under investigation for this Hot-Humid home include 2x6 advanced framing, solar thermal water heating, improved HVAC equipment, and

energy recovery ventilation (ERV). IBACOS is having discussions with the builder and its trade partners on transitioning to advanced framing practices. IBACOS is also researching cost-effective and efficient solar thermal products for the builder.

- **The New American Home 2010.** The construction of The New American Home 2010 in Las Vegas, NV has progressed slowly due to financing issues encountered by the builder with key lenders. Finishing work continued at the end of FY09 Q4. The home needs to be complete by October 15th to accommodate photography shoots.
- IBACOS continued to actively collect monitoring data from ten homes.

Task 4

Stage 3 – *Initial Community-Scale Evaluations*

- **Insight Homes.** IBACOS and Insight Homes decided to continue to use their standard design and equipment selections for the plan type when it is built as a single-story unit. This was in lieu not being able to identify an appropriately sized mini-split system to condition the second floor zone of the 1-1/2 story plan types. However, for the 1-1/2 story plan type, Insight Homes will increase its two ton system to a two and a half ton system and will need to route additional ductwork to the second floor from the crawlspace. Investigation into the source of high humidity levels in some of its homes revealed that the dip switch control settings for the air handlers' blowers were left at factory default settings (800 CFM in low stage cooling), rather than being adjusted for the fan speed and air flow the homes required (660 CFM for peak cooling). Based on the manufacturer's installation manual, IBACOS provided Insight with new settings for the dip switches that would adjust the air flow to 560 CFM in low stage cooling and 800 CFM in high stage cooling. Initial feedback from the builder two weeks after the switches had been adjusted was that the humidity levels in the home had dropped to approximately 55%. While changing the dip switch settings on the air handler was necessary for the proper performance of the system, it is unclear if that was the only solution to decrease the indoor humidity levels, since weather conditions changed and outdoor humidity levels decreased due to the change in seasons. A HOBO monitoring device is being installed in one of the homes to track temperature and relative humidity for the next six to eight months in order to compare that data to the temperature and relative humidity set points the homeowner programmed into the thermostat. In addition, IBACOS is currently working with Insight Homes to investigate the source of high humidity levels in some of its newly constructed homes. Relative humidity levels are reaching nearly 75% in some of the homes, but it is unclear at this point if those levels are due to moisture from typical new construction materials or if the HVAC systems are not operating properly to dehumidify the homes. Additional work is needed to diagnose the problem.

Task 5

Stage 4 – *Project Closeout, Final Evaluations of BA Communities*

No 2009 activity planned.

Task 6 - Other Research Activities

IBACOS does not currently have work in this Task.

III. PROJECT MANAGEMENT ISSUES

It is an exciting time as the budget request for Building Technologies has been increased and the scope of research is changing and expanding. While it is understood that such changes require time and attention at the management level of the program, IBACOS needs to be working on planning for Budget Period 3 (BP3) during the first quarter of FY10 in order to stay on schedule. In addition, IBACOS also needs to add staff to accommodate an increased work effort and needs to create detailed budgets in this timeframe. Further delay in feedback and guidance may slow our ability to stay on schedule for BP3 planning and could hinder our ability to ramp up effectively.

IV. INPUT ON UPCOMING EVENTS FOR EERE'S 30-60-90 DAY REPORT

Event Date: October 19-20, 2009; 6:00 – 9:00 pm and 8:00 am – 3:00 pm
Event: **Best Practices Research Alliance Welcome Dinner and Annual Meeting**
Location: Pittsburgh, PA; with limited access via webinar
Description: Welcome dinner for in-person attendees at IBACOS' office on October 19, the evening before the meeting. Alliance Annual Meeting for members with updates and discussions regarding Research, Outreach, Policy and Education activities—including presentations from builders, IBACOS, and business experts.
Participants: builders, select industry suppliers, business experts, and media partners
Action: Dane Christensen of NREL is planning to attend.
Program Contact: Elizabeth Scott, 412-325-1514

CONFERENCE PRESENTATIONS

IBACOS gave seven presentations at the EEBA 2009 Excellence in Building Conference & Expo in September 2009.

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| Energy Efficient Lighting Strategies: Sharing a Vision of | Brad Oberg |
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| High Performance Lighting in the Pursuit of Zero Energy | |
| Thermal Enclosure Challenges in Building a Net Zero Energy House in a Cold Climate | John Broniek |
| Construction Documents That Reduce Your Risk and Turn the Tide on Construction Defects | Graham Davis |
| Watch Out for the Cowboys with IR Guns and Tips on How Best to Work with a 3rd Party Forensic Expert | Arlan Burdick |
| Miscellaneous Electric Loads: Saving Energy Where It's Challenging | Brad Oberg |
| Quality Management for High Performance Homes | Duncan Prahl with Vern McKown, Ideal Homes |
| Establishing Design Criteria for the Selection of Residential Water Heaters | Bill Rittelmann |