

# QUARTERLY REPORT

Report Date: **3/31/2009**  
 Project Number: **07-SC-02**  
 Report Period: **Jan-Mar 2009**

U. S. DOE Federal Project Director's Progress Report  
 Title: **EBIS Project**  
 Location: **Brookhaven National Laboratory**

Office of Science  
 Program: **NP**  
 Project Office: **BHSO**

## SUMMARY ASSESSMENT

	<u>Current Quarter</u>	<u>Previous Quarter</u>
Cost:	<b>Satisfactory</b>	<b>Satisfactory</b>
Schedule:	<b>Satisfactory</b>	<b>Satisfactory</b>
Technical:	<b>Satisfactory</b>	<b>Satisfactory</b>
Overall:	<b>Satisfactory</b>	<b>Satisfactory</b>

## PROJECT MANAGEMENT

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## PROJECT COST/FUNDING (\$K)

	<u>Baseline</u>	<u>Current Estimate</u>	<u>Funding Received</u>
DOE TEC	<b>13,700</b>	<b>13,700</b>	<b>12,479</b>
DOE TPC	<b>14,800</b>	<b>14,800</b>	<b>13,279</b>
Non DOE	<b>4,500</b>	<b>4,500</b>	<b>4,500</b>

## CRITICAL DECISIONS

	<u>Number</u>	<u>Title</u>	<u>Baseline</u>	<u>Actual/Forecast</u>
	0	Mission Need	<b>08/04</b>	<b>08/04 (A)</b>
	1	Preliminary Baseline Range	<b>Q4 FY05</b>	<b>09/05 (A)</b>
	2	Performance Baseline	<b>Q4 FY06</b>	<b>09/06 (A)</b>
	3	Construction	<b>Q1 FY07</b>	<b>09/06 (A)</b>
	4	Start of Operations	<b>Q4 FY10</b>	<b>Q3 FY10 (F)</b>

## FUNDING PROFILE

Latest DOE Budget Profile (FY09 Appropriation) (\$K)

DOE info: cumulative through: **Mar 31, 2009**

	<u>FY05</u>	<u>FY06</u>	<u>FY07</u>	<u>FY08</u>	<u>FY09</u>	<u>Total</u>
TEC		<b>1,980</b>	<b>5,120</b>	<b>4,162</b>	<b>2,438</b>	<b>13,700</b>
OPC	<b>700</b>	<b>100</b>			<b>300</b>	<b>1,100</b>
TPC	<b>700</b>	<b>2,080</b>	<b>5,120</b>	<b>4,162</b>	<b>2,738</b>	<b>14,800</b>

	<u>TEC</u>	<u>OPC</u>	<u>TPC (\$)</u>
Remaining Contingency:	<b>1317</b>	<b>0</b>	<b>1317</b>
Costs Accrued:	<b>10781</b>	<b>728</b>	<b>11509</b>
Uncosted Commitments:	<b>352</b>	<b>71</b>	<b>423</b>

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## SCHEDULE SUMMARY

Subsystem	Start Date		Completion Date		Percent Complete <sup>1</sup>	
	Baseline	Forecast/Actual	Baseline	Forecast/Actual	Baseline	Actual
Design	Q1FY06	Q1FY06 (A)	Q1FY07	Q4FY07 (A)	100	100
Procurement	Q1FY07	Q3FY07 (A)	Q1FY10	Q1FY10 (F)	100	98
Construction	Q1FY07	Q3FY07 (A)	Q4FY10	Q3FY10 (F)	93	85 <sup>2</sup>

1. Percent complete is calculated using data from the Microsoft Project Schedule and Cost Reports. Procurement is calculated based on planned and actual obligations (burdened commitments). Construction includes Procurement.
2. Late delivery of the solenoid has allowed some EBIS tasks to be delayed with no impact to the CD-4 date, so that extra resources could be allocated to other Collider Accelerator Department shutdown work. A PCR will be processed in 3QFY09 to reschedule the delayed tasks.

<u>Milestones Accomplished Since Last Report</u>	<u>Baseline Date</u>	<u>Actual Date</u>
L2 – Drift Tube Structure complete	1QFY09	2QFY09
L2 – RFQ tested to full power	3QFY09	2QFY09

  

<u>Upcoming Milestones</u>	<u>Baseline Date</u>	<u>Planned Date</u>
L1 – SC Solenoid Factory / Acceptance Test	1QFY09	3QFY09
L2 – EBIS Preassembly complete	2QFY09	3QFY09

## NARRATIVE HIGHLIGHTS

The RFQ was installed on Test EBIS for beam testing in this quarter. The beamline from the Test EBIS to the RFQ, including the collector, high voltage break, LEPT chamber, and pulsed solenoid, are exactly as on the RHIC EBIS. A current transformer, fast (GHz) Faraday cup, and emittance head were installed at the exit of the RFQ. Helium and copper beams were successfully accelerated through the RFQ in January. Observation of the bunch structure of the output beam confirmed proper acceleration. The emittance of output beam was measured for He<sup>1+</sup>, He<sup>2+</sup>, and Cu<sup>10+</sup>, and although reasonable values were measured, one cannot precisely determine emittance growth because the output contains multiple charge states. In the next quarter, we plan to install a dipole magnet to energy analyze the output beam.

Good progress continued to be made on the manufacturing of the linac by Institute of Applied Physics (IAP), Frankfurt, through a subcontract with PINK GmbH. The linac cavity machining was completed. A dummy drift tube was made for the one which is to contain the quadrupole triplet, and all drift tubes were then installed in the cavity. Low power rf measurements were made, including field distribution using bead pull down the axis. The field strength met the requirements, and the resonant frequency was within the desired range, so the next steps are now to vacuum leak check the cavity, and then send it to GSI for copper plating.

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Bruker, the manufacturer of the internal quadrupole triplet for the linac, has ordered materials for the magnets, and are in the process of preparing detailed design drawings. The MEBT buncher cavity and internal spiral resonator structure, also from IAP, were completed, and low level rf measurements were made at IAP. The results of these measurements met requirements. Following vacuum leak testing, this cavity will be shipped to BNL in early April. Weekly conference calls with IAP to discuss progress and technical issues on both the linac and buncher cavities continued.

At the end of the last quarter, the misalignment and heat leak in the ACCEL superconducting solenoid magnet had been repaired. Fortunately, during the repair the magnet was converted to a flanged system, rather than welding it shut again. In January, a BNL engineer travelled to ACCEL for the factory acceptance test. The magnet passed the remaining items of the acceptance tests (field alignment and helium evaporation rate), and was then shipped to BNL, arriving on February 10. Two engineers from ACCEL arrived on February 23 to unpack the magnet and prepare it for acceptance testing. The magnet was installed on its stand, and following the required safety reviews, cooldown was started. Very quickly, a cold spot in the magnet bore was observed, indicating a problem. The magnet was warmed up and opened, and it was found that the internal support rods which suspend the cold mass were broken on one end. The engineers returned to Germany, and ACCEL is in the process of manufacturing new support rods, as well as an intermediate bore heat shield, which had been dented by the weight of the fallen cold mass. Subsequent analysis by ACCEL of data from a shock recorder that had been mounted inside the shipping crate indicated that the magnet experienced excessive shocks at both the airport in Amsterdam and at JFK in New York. Technicians from ACCEL are scheduled to come to BNL in April to repair the magnet, followed by the engineers for final acceptance testing.

The manufacturing of the Be-Cu electron collector by Brush-Wellman was completed in this quarter, and the finished unit was shipped to BNL in early March. The unit was vacuum tested, and the water manifolds are now being installed on the unit at BNL.

Final alignment of the EBIS drift tube structure occurred in January, completing this level 2 milestone. The center bore vacuum pipe was installed on the EBIS stand between the electron gun transition chamber and the electron collector transition chamber. This 2 meter vacuum pipe includes the chamber bakeout heaters, heat shields and cooling to protect the superconducting solenoid, and transverse magnetic steering coils. This main trap region was pumped down and leak checked. The heating rods on the center bore vacuum pipe were then energized, and the center bore baked at the desired temperature of 450 C, while the outside of this pipe was maintained at room temperature. This successful test marked the completion of the center bore vacuum pipe, and it is now ready for installation of the drift tubes.

The hookup of the output power combiners and circulators for the 350 kW rf systems for the RFQ and linac was finished during this quarter. Manufacturing of the rf amplifiers for the three bunchers was completed during this quarter. They have been delivered to BNL, and are now in their final location, with electrical connections in progress. The cooling water system was installed for all rf amplifiers.

Bids were received for the pulsed power supplies for the Linac and MEBT quadrupole magnets. Following the technical evaluation of the proposals by a committee of experts, the best vendor was selected. An engineer and representative of the QA group visited the factory of the

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preferred vendor, and we are now in the final stages of awarding the contract.

Early in this quarter manpower availability for assembly and installation had been a concern. As discussed during the NP review of EBIS in January, C-AD resources had been tied up longer than expected in RHIC shutdown activities, but at the review the Collider-Accelerator Department Chair had committed to ensuring that the required resources for the project would be made available. This has occurred, and manpower is no longer considered an issue. Electrical work this quarter included the ongoing installation of cable tray, and ac power distribution. The electron collector HV platform and cage were completed, and the collector power supply was installed. Fabrication of the pulsed solenoid power supply continued in-house. Work continued on controls, diagnostics, and fabrication of remaining room temperature pulsed and dc solenoid and quadrupole magnets.

The DOE Annual Progress Review of the EBIS project was held on January 21-22. A draft of final report was received and checked for factual accuracy. The high level bi-weekly project status meetings and the monthly telecon meetings between the DOE-HQ Program Office and the site continue. EBIS status meetings with all sub-project leads continue.

Contingency in the amount of \$212k was approved by the Federal Project Director for two PCRs. The changes made to the Microsoft Project file were: the G&A rate used during the PreOps phase was corrected to reflect the rate that will be applied, plus additional hours were added to Structural Components WBS to account for hours spent on major equipment items as they exceeded the baseline estimates.

### **BACKUP INFORMATION**

#### Baseline Document

Document Title: **EBIS Project Execution Plan, Rev.1**

Date of Document: **May 2008**

Approving Official: **Jehanne Simon-Gillo, Associate Director (Acting), Office of Nuclear Physics, Office of Science**