

HIFAN 1748

Neutralized Drift Compression Experiment (NDCX) - II
DE-AC02-05CH11231
OFES Project Manager: Dave Goodwin
Quarterly Progress Report Issued: 10/08/2009 Recovery
Act Project: High Energy Density Laboratory Plasma -
Neutralized Drift Compression Experiment (NDCX-II)

by
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Covering the Period: 7/01/09 through 9/30/09

Recovery Act Project:	High Energy Density Laboratory Plasma -Neutralized Drift Compression Experiment (NDCX-II)
TAFS:	89-09/10-0227
Project Identification Code:	2005341
Recovery Act Bill Reference:	P.L. 111-5, American Recovery and Reinvestment Act of 2009, Division A, Title IV, Energy and Water Development, Department of Energy, Science

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1. Program Overview

LBNL has received American Recovery and Reinvestment Act (ARRA) funding to construct a new accelerator at Lawrence Berkeley National Laboratory (LBNL) to significantly increase the energy on target, which will allow both the Heavy Ion Fusion (HIF) and Warm Dense Matter (WDM) research communities to explore scientific conditions that have not been available in any other device.

For NDCX-II, a new induction linear accelerator (linac) will be constructed at Lawrence Berkeley National Laboratory (LBNL). NDCX-II will produce nano-second long ion beam bunches to hit thin foil targets. The final kinetic energy of the ions arriving at the target varies according to the ion mass. For atomic mass unit of 6 or 7 (Lithium ions), useful kinetic energies range from 1.5 to 5 or more MeV. The expected beam charge in the 1 ns (or shorter) pulse is about 20 nanoCoulombs. The pulse repetition rate will be about once or twice per minute (of course, target considerations will often reduce this rate).

Our approach to building the NDCX-II ion accelerator is to make use of the available induction modules and 200 kV pulsed from the retired ATA electron linac at LLNL. Reusing this hardware will maximize the ion energy on target at a minimum cost. Some modification of the cells (e.g., reduce the bore diameter and replace with higher field pulsed solenoids) are needed in order to meet the requirements of this project.

The NDCX-II project will include the following tasks:

(1) Physics design to determine the required ion current density at the ion source, the injector beam optics, the layout of accelerator cells along the beam line, the voltage waveforms for beam acceleration and compression, the solenoid focusing, the neutralized drift compression and the final focus on target.

(2) Engineering design and fabrication of the accelerator components, pulsed power system, diagnostic system, and control and data acquisition system.

(3) Conventional facilities

(4) Installation and integration

The project will be considered completed when the accelerator and pulsed power systems are in place and tested, and we begin beam production and acceleration. The period of performance for this project is July 7, 2009 to Mar 31, 2012, and the total funding, including contingency, is \$11.0 M.

2. Summary of Activities in This Quarter

We made significant progress in several areas this quarter. The main task was detailed engineering design and testing related to modifying the ATA induction cells that are the basic building blocks of the machine. NDCX-II will reuse accelerator hardware from the previous ATA experiment at LLNL; the transfer of this hardware from LLNL to LBNL is approaching completion. Modeling calculations and test data obtained from a mock-up magnetic solenoid confirmed that the solenoids' stray magnetic field must be kept away from the induction cores. An improved induction cell design is underway. We have also finalized the accelerator beamline layout and produced a preliminary structural design of the elevated platform for mounting the pulsed power system.

The pulsed power system for the solenoid prototype was designed and the parts ordered for fabrication. The high voltage trigger generator requirements were determined and vendors identified. We have also sent out the request-for-quote for the accelerator control system design. A purchase order was sent to PPPL for the plasma source neutralizer task.

Computer simulations determined the solenoid alignment tolerance to be ± 0.5 mm in order for the beam to transit the entire accelerator. We have started a magnetic measurement program to ensure the quality of the finished products. To correct for errors, the machine is designed to allow periodic beam sensing and steering, generally at every fourth lattice period. Using computer simulations, the accelerator performance was optimized for various numbers of induction cells and voltage waveforms.

A detailed WBS project plan was produced. We identified the project's risk areas and developed mitigation strategies. A detailed Baseline Plan cost estimate was made, consistent with cost and schedule constraints. A Lehman Review is now scheduled for January 2010. At the end of this quarter, we estimate that the fraction of completion for the NDCX-II project is about 3%.

3. Technical Progress

3.1 Physics Support

There are two main purposes for physics support in this project: one is to provide guidance and specifications for the construction of the induction linac, and the other is to provide information and methods for beam diagnostics (steering and alignment) as well as acceleration and compression schemes. One of the major challenges is to produce physics designs and operating points that can make best use of the limited project funding, such that the accelerator components (e.g. the induction cells) installed during this project can be used to generate the

most useful variety of beams (with regard to, e.g., the final ion kinetic energy, pulse length and total charge at the target).

During this quarter, the physics support group has made significant progress in several areas to move the project ahead, including:

- Developed, using 2D Warp simulations, injector configurations that use Li sources emitting 2.5, 2.0, and 1.0 mA/cm². With the reduced emission rate for the last case, a longer initial pulse, and hence greater compression early in the machine, is required. Ongoing experiments suggest that an emission density exceeding 1 mA/cm² may be possible, so we believe this range to be conservative.
- Examined, using simulations, the performance of machines with varying numbers of induction cells. In order to preserve a significant cost contingency, the project baseline design will have fewer than the ~30 cells ultimately desired for maximal operating flexibility and the full range of scientifically interesting ion kinetic energies.
- Examined the consequences of misaligned solenoids, with regard to beam offset and "corkscrew" distortions. Establishment of a nominal alignment accuracy with errors in transverse placement of solenoid ends up to 0.5 mm (flat distribution) should allow almost all of the beam ions to transit the accelerator, though on-target brightness is diminished moderately by corkscrew spreading.
- Examined the feasibility of beam "steering" to reduce offset and corkscrew effects; there appears to be little or no benefit in having an (x,y) correction-dipole pair in every cell, so the baseline design now assumes that both centroid sensing and active correction via dipoles take place only in the inter-cell blocks, i.e., in every fourth lattice period.
- Made major improvements to the ASP (Acceleration Schedule Program) simulation code, which is a fast-running 1-D particle-in-cell code used for longitudinal beam dynamics with space charge, coupled with a set of equations describing the evolution of the centroid for each slice of the beam. The improvements include facilities for obtaining the beam initial conditions from the output of 2-D Warp simulations of the injector, and a better algorithm for estimating near-optimal "ear" waveforms that afford beam-end confinement near the front end of the machine.

3.2 Mechanical Design of the Accelerator System

The building blocks of the induction linac are the induction cells. We have acquired more than 40 cells, together with the Blumlein (pulse-forming network) from the previous ATA experiment at LLNL. The process of property transfer from LLNL to LBNL has been completed.

The original ATA cells have dc low-field solenoids embedded within the induction cell housing. Figure 1 is a schematic diagram of the ATA cell. These solenoids must be replaced by high-field (about 2 Tesla) solenoids for focusing ion beams in NDCX-II. Furthermore, due to the high current required to produce high magnetic field, the dissipated power is too high for dc operation and therefore the solenoid must be energized with pulsed power. In order to further limit the required pulsed power to the solenoid, the diameter of the beam pipe (equivalent to the inner diameter of the cell housing) was reduced to allow using a smaller diameter solenoid, but large enough to provide clearance for beam transport. This reduced diameter also serves to reduce the axial extent of the fringing field near the accelerating gaps, thus reducing the beam transit time through the gap and enabling more efficient use of the induction core's Volt-seconds.

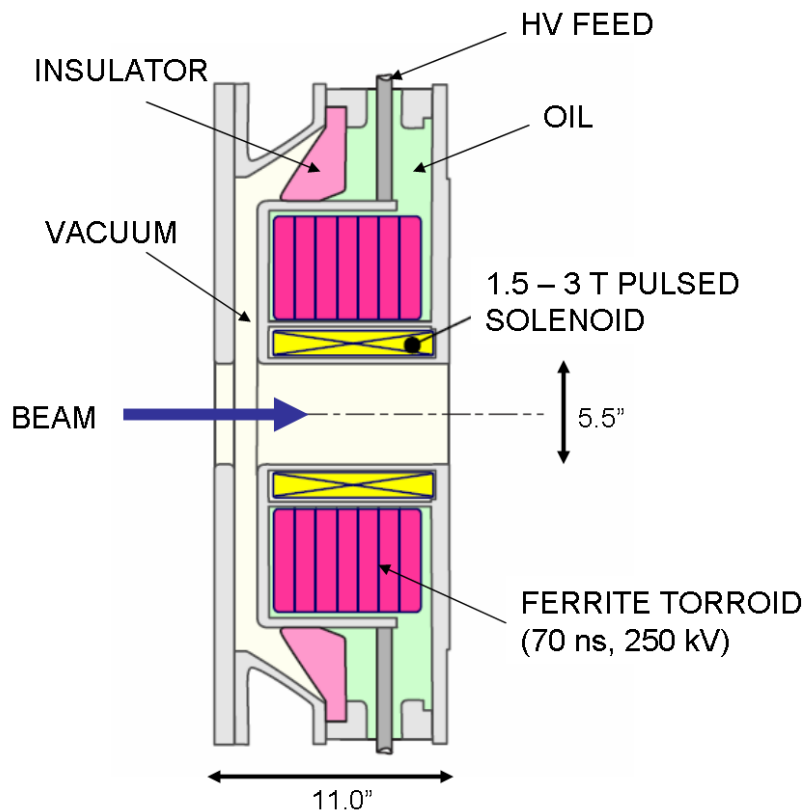


Fig. 1. Schematic diagram of the ATA cell.

We noted another effect of the “pulsed nature” of the strong solenoid field: the induced eddy currents at the end flanges of the cell housing. These currents, if not minimized, would have several adverse impacts. First, they increase the power load on the circuit driving the solenoid. Second, they produce mechanical stress on the flanges, possibly transmitting shocking forces to the main insulator (within each cell). Third, with the superposition of the “reverse” magnetic field generated by the eddy current, more field extends into the region where the ferrite cores are located. This stray magnetic field was found to reduce the available flux swing (“Volt-seconds”) of the cores, thus adversely limiting the maximum pulse length of the induction cells.

Two approaches will jointly mitigate the eddy current problem. First, the inner region of each end flange will be modified to reduce its thickness—the increased electrical resistance will

reduce the eddy current. Second, a shield will be added outside the solenoid in order to trap the stray magnetic field and keep it away from the ferrite cores. There are several options for this shield: a simple copper pipe with the proper thickness positioned outboard of the solenoid and inboard of the cores; the combination of a ferromagnetic iron pipe and a copper pipe; or a controllable reverse-field “bucking” coil. Recent engineering model calculations (using ANSYS) indicated that the passive method should be adequate. A detailed design of the prototype cell was completed by the end of Sept. 2009.

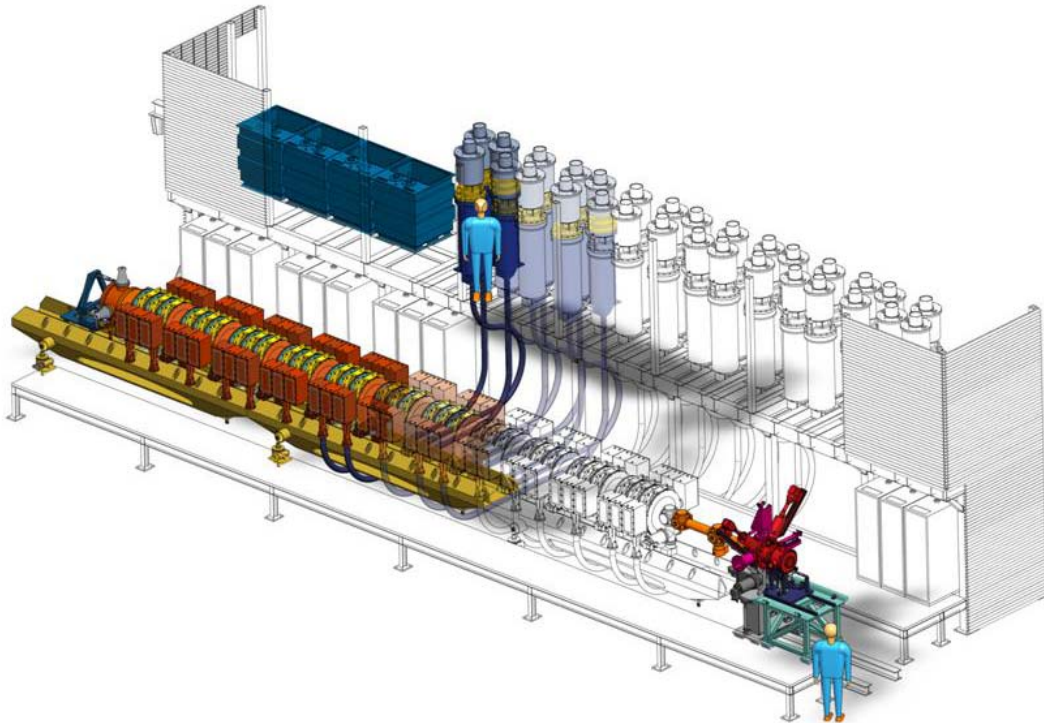


Fig. 2. NDCX-II layout, showing 12 Compression Cells, 3 Accelerator Cells, 5 Diagnostics Cells, 5 Steering Coil Sets, 5 Beam Position Monitors, Injector and Drift Compression. Cost of machine assumes \$8.5M with additional \$2.5M kept in contingency reserve.

We are conducting prototype tests on a test stand that was constructed using the actual ATA parts. The tests will confirm whether the passive method is adequate or not, and if so, whether we need only the copper shield or both the copper and the ferromagnetic shields. The test stand is located at the site of NDCX-II in Building 58 at LBNL, and is currently in operation.

The required modifications of the cell housing, the solenoid, and the magnetic shield are somewhat more extensive than was originally expected before the NDCX-II project start. Their associated cost reduces the number of induction cells that can be fabricated within the fixed project funding. We plan to build enough cells to enable meaningful Warm Dense Matter physics experiments that go well beyond those possible on NDCX-I, and an infrastructure that

can readily accommodate additional cells in the future. Depending upon the availability of contingency reserve funds, more cells will be added near the end of the project schedule and the modules appropriately re-arranged for maximal performance and flexibility.

A layout for the NDCX-II facility, as it will appear in bldg 58 at LBNL, was completed. Figure 2 shows the components, the rails, the pulsed power system and the support structures.

3.3 Electrical Designs and Control Systems

The electrical system for NDCX-II consists of several subsystems including:

- High voltage pulsed power for the injector
- High voltage pulsed power for the induction cores to compress and accelerate the beam pulse (first stage uses spark gap switched lumped element or transmission line pulsed power, second stage uses ATA Blumleins with shaping elements at cells)
- High current pulsed power to the focusing solenoids
- Pulsers to the steering dipoles,
- Pulsers for the plasma source at the neutralized drift compression section.

Amongst these systems, the high voltage pulsed power to the induction cores and the high current pulsed power to the solenoids are the critical ones driving the cost and schedule. We have done preliminary designs, produced cost estimates, and identified available vendors. We produced a floor plan layout with the locations of the various power systems, the cabling, and their support structures.

A test stand has been set up to measure the performance of the ATA induction cells in accordance with the ways they will be used for NDCX-II experiments. The measured waveforms were in agreement with our expectations. More work is needed to custom-shape the waveforms to match that specified by the beam dynamic simulations for compression and acceleration. The high voltage trigger generator requirements were determined and vendors identified. Preliminary noise measurements were made inside the induction cell. This data will be used to evaluate different beam diagnostic designs and maximize the signal to noise ratio.

As mentioned above, the ferrite cores were found to be prematurely saturated by the stray magnetic field from the solenoids, thus confirming the results from modeling calculations. After installing a copper shield to block off the stray field, the measurement will be repeated to determine the required thickness and design of the shield and the required pulsed power to the solenoids in order to produce a 2-Tesla field on axis. The pulsed power system for the solenoid prototype was designed and the parts ordered for fabrication.

The control system is specified to provide digital controls for 200 power supplies, their trigger and timing, as well as up to 300 channels for data acquisition. The will also be a safety

interlock system using 100 status monitors. Specifications have been written up and sent to vendors as part of the process in requisition for bids.

3.4 Conventional Facilities and Safety

The NDCX-II accelerator installation requires adjustments to existing LBNL building infrastructure hardware in the following three areas:

1. Electrical AC power distribution: Additional AC power distribution lines and panels must be designed and installed in order to meet the NDCX-II electrical power needs.
2. Building structural system: A mezzanine structure must be built in order to house the NDCX-II pulsed power system.
3. Building life safety and fire safety: Building code compliance of the NDCX-II accelerator installation has to be evaluated.

During the last quarter, we have made progress in the following areas accordingly:

1. Electrical AC power distribution: We have completed a contract with an engineering company to monitor building power usage over a period of a month. We are now able to evaluate leftover capacity of the existing building electrical sub-station. In addition, we have issued a conceptual design contract to an engineering company for designing any supplementary electrical power distribution system.
2. Building structural system: We have finished a conceptual design contract for the NDCX-II mezzanine structure. We have received conceptual design drawings, structural calculations, and a conceptual cost estimate. Based on the conceptual design, we will initiate a final design contract in October. We are currently planning to build the mezzanine structure in late spring 2010.
3. Building life safety and fire safety: We have organized a building walk-through with the LBNL fire marshal and have evaluated any fire safety implications of the NDCX-II installation. No major additional building work is currently anticipated in that area. In addition, we have contacted a building code consulting company to provide a cost estimate for evaluating any California building code compliance issues of the NDCX-II installation. We are currently evaluating their cost proposal.

4. Key Issues

Impact type: T/B/S means Technical, Budget and/or Schedule;

Severity Color Code: R=Project likely at risk, Y= Milestones/Deliverables likely at risk,

G=Milestones/Deliverables slightly at risk, B=Issue resolved.

Issues		Response	T/B/S	Impact
1	Work scope adjustment to meet budget envelope	CLOSED – Reduce the number of induction cells and associated cost to allow for ~ 30% contingency reserve	T,B	Reduce final kinetic energy and beam charge
2	Stray magnetic field prematurely saturates the ferrite cores	Add copper and/or ferromagnetic shielding in the cell design and perform prototype test	T,B, S	If uncorrected would reduce the usable volt-seconds & thus accelerator capability
3	Beam steering correction	CLOSED – Simulation confirmed that making correction every 4 th cell is sufficient, thus defines the size of each cell block.	T,B	Eliminate cost of installing steering in each cell
4	Ion source current density affecting injector design	Continue to develop the Lithium ion source and confirm the emission current density of $> 1 \text{ mA/cm}^2$	T,B	Injector cost, and final beam charge on target
5	Utility power available to the building	Hired vendor to survey the utility power availability and the nominal power consumption currently used in the building	B	require a new power substation to the building

5. Planned Activities for the Next Quarter

1. Optimize physics design and use of ATA cells as the uncertainty in the need for contingency funds diminishes.
2. Complete detailed engineering design of the induction cell solenoid and magnet shielding.
3. Complete detailed engineering design of the dipole magnet in between cell blocks for beam steering.
4. Conduct preliminary injector design.
5. Complete detailed engineering design of the magnet pulsers.
6. Complete the preliminary design of the custom cell pulsers.
7. Continue to generate cell voltage waveforms on the test stand that are used in the physics design.
8. Complete the requirements document for the control and data acquisition system.
9. Begin initial plasma source review and analysis.
10. Quarterly review by NDCX-II Project Advisory Committee.

6. Project Management

6.1 WBS

A detailed (level 4) work breakdown structure (WBS) has been established for the project baseline. Estimates of costs by major WBS tasks are shown in Table 1. The WBS can be found in the Appendix section.

	Budgeted Total Cost	Labor	Material	Subcontract
NDCX-II TOTAL	\$8,856,513	\$2,763,933	\$4,895,001	\$1,197,579
1.0 ACCELERATOR HARDWARE	\$1,965,896	\$944,690	\$1,021,206	\$0
2.0 ACCELERATOR PULSED POWER	\$2,254,127	\$487,124	\$1,767,004	\$0
3.0 DRIFT COMPRESSION & FINAL FOCUS	\$292,968	\$0	\$0	\$292,968
4.0 SUPPORT AND ALIGNMENT	\$506,857	\$202,781	\$304,075	\$0
5.0 MECHANICAL UTILITIES	\$177,094	\$0	\$177,094	\$0
6.0 ELECTRICAL UTILITIES	\$136,863	\$46,899	\$89,964	\$0
7.0 DATA ACQUISITION & CONTROL SYSTEMS	\$874,591	\$120,685	\$753,906	\$0
8.0 FACILITIES	\$681,651	\$90,880	\$590,771	\$0
9.0 PHYSICS SUPPORT AND R&D	\$904,611	\$0	\$0	\$904,611
10.0 INTEGRATION	\$0	\$0	\$0	\$0
11.0 PROJECT MANAGEMENT	\$1,061,855	\$870,874	\$190,982	\$0
CONTINGENCY (24.2%) RESERVE	\$2,143,487			
TOTAL PROJECT COST	\$11,000,000			

6.2 Project Schedule and Status

The Gantt Chart for the overall project schedule is shown below. At present, the most critical task is the fabrication of the prototype induction cell. We estimated that at the end of this first quarter of the project, we have approximately completed 3% of the total project effort.

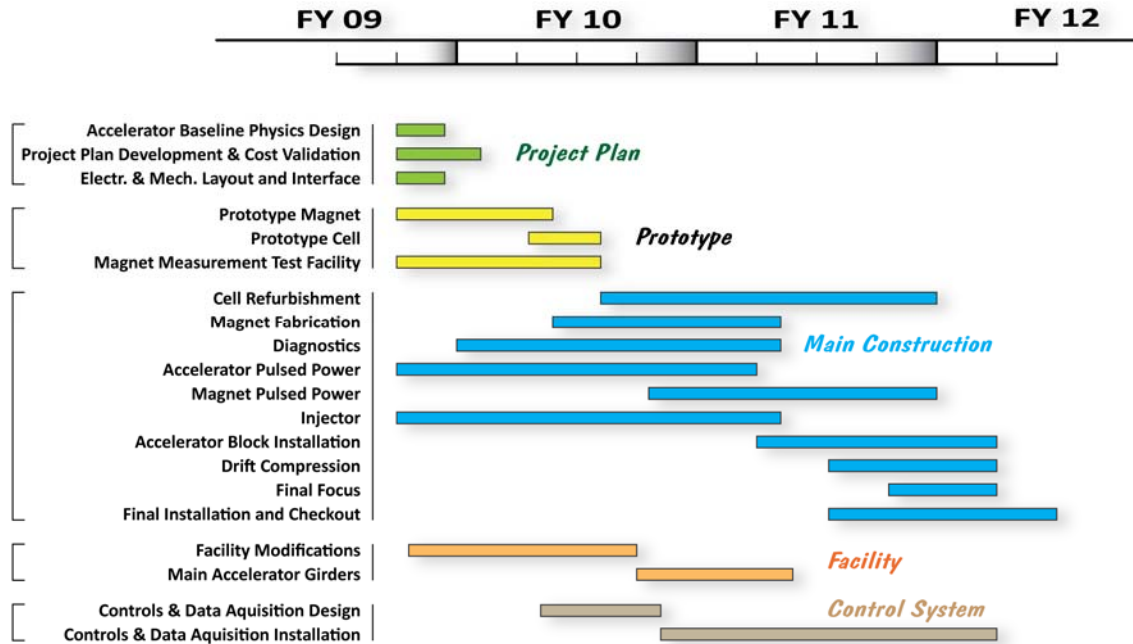


Fig. 3. NDCX-II overall project schedule

6.3 Project Expenditure

The following table shows the total expenditure for NDCX-II during this first quarter of the project:

Jul 09	Aug 09	Sep 09	Total
\$81,959	\$172,609	\$130,916	\$385,483

6.4 Milestones

We have fulfilled the 3 milestones for this quarter (according to the NDCX-II Project Operating Plan):

1. CFO releases Recovery Act funding
2. Complete detailed engineering design (of the prototype induction cell)
3. Begin equipment procurement

6.5 Project Review

An informal Advisory Committee of senior accelerator scientists and engineers was invited to a one-day meeting at LBNL on May 27, 2009 (after we have learned that NDCX-II was to be funded as an ARRA project but before the funding was officially released). The members of this committee included experts with detailed knowledge of the ATA machine hardware being reused in the NDCX-II project, and other experts with extensive experience in large scale accelerator development and construction projects. Valuable suggestions were made by the committee providing guidance for the NDCX-II team members to establish work scope, priorities, expectations, and strategies to deal with technical issues.

A Lehman Review that was originally scheduled to occur on Oct. 6th, 2009 at LBNL, is now postponed to Jan 13-14, 2010 per DOE/OFES request.

7. Publications and Technical Notes (from this quarter)

7.1 List of Publications and Presentations

W.L. Waldron, L.L. Reginato, and M. Leitner, “NDCX-II Pulsed Power System and Induction Cells”, Proceedings of the 17th International Pulsed Power Conference, Washington D.C. (2009).

W.L. Waldron, et al., “Plans for Warm Dense Matter and IFE Target Experiments on NDCX-II”, Proceedings of the 18th Topical Meeting on the Technology of Fusion Energy, San Francisco, CA, (2008), published in Fusion Science and Technology, vol. 56, pp. 452-455, July 2009.

A. Friedman, J. J. Barnard, R. H. Cohen, D. P. Grote, S. M. Lund, W. M. Sharp, A. Faltens, E. Henestroza, J-Y. Jung, J. W. Kwan, E. P. Lee, M. A. Leitner, B. G. Logan, J.-L. Vay, W. L. Waldron, R. C. Davidson, M. Dorf, E. P. Gilson, I. Kaganovich, “Developing the Physics Design for NDCX-II, a Unique Pulse-compression Ion Accelerator”, Proceedings of the 2009 International Computational Accelerator Physics Meeting, August-September 2009, San Francisco.

A. Friedman, et al., “Physics Design for the NDCX-II, A Short-pulse Ion Beam Driver for Near-term WDM and Target Physics Studies,” selected oral presentation, IFSA 2009, San Francisco, September 2009.

M. Leitner, F. Bieniosek, J. Kwan, G. Logan, W. Waldron, J.J. Barnard, A. Friedman, B. Sharp, E. Gilson, R. Davidson: “NDCX-II, A New Induction Linear Accelerator For Warm Dense Matter Research”, Proceedings of the 11th International Conference on Heavy Ion Accelerator Technology, Italy, 8-12 June 2009, to be published on JACoW, the Joint Accelerator Conference Website for the Asian, European and American Particle Accelerator Conferences (<http://www.jacow.org>)

7.2 *List of Technical Notes*

NDCX2-TN00002	M. Leitner	ATA/LLNL Drawing Package, as of May 2009
NDCX2-TN00003	M. Leitner	ATA/LLNL Drawing Package, as of September 2009
NDCX2-TN00005	JY Jung	NDCX-II Test Solenoid Parameters and Heat Transfer Calculations
NDCX2-TN00006	JY Jung	Cell Prototype Baseline Definition

8. Appendix

8.1 Project WBS

Activity ID	Activity Name	Budgeted Total Cost	Budgeted Labor Cost	Budgeted Material Cost	Budgeted Nonlabor Cost
NDCX-II		\$8,856,513	\$2,763,932	\$4,895,000	\$1,197,579
1.0 ACCELERATOR		.19	.88	.96	.35
HARDWARE		.66	8	.67	\$0.00
1.1 GENERAL ENGINEERING		\$0.00	\$0.00	\$0.00	\$0.00
1.1.1 Mech Layout & Interface		\$0.00	\$0.00	\$0.00	\$0.00
AH11010	3D CAD Concept Development Upper Floor	\$0.00	\$0.00	\$0.00	\$0.00
AH11020	3D CAD Concept Lower Floor	\$0.00	\$0.00	\$0.00	\$0.00
AH11030	Artists's Renderings	\$0.00	\$0.00	\$0.00	\$0.00
1.2 INJECTOR		\$333,351.45	\$129,807.20	\$203,544.25	\$0.00
1.2.1 Inj. Engineering & Design		\$80,800.00	\$80,800.00	\$0.00	\$0.00
AH21010	3D CAD Design Development	\$35,200.00	\$35,200.00	\$0.00	\$0.00
AH21020	Design Review	\$0.00	\$0.00	\$0.00	\$0.00
AH21030	Alignment	\$4,000.00	\$4,000.00	\$0.00	\$0.00
AH21060	Analysis	\$0.00	\$0.00	\$0.00	\$0.00
AH21040	Detail Design	\$35,200.00	\$35,200.00	\$0.00	\$0.00
AH21050	Drawing Approval	\$0.00	\$0.00	\$0.00	\$0.00
AH21070	Ion Source Storage Vessel Design	\$2,400.00	\$2,400.00	\$0.00	\$0.00
AH21080	Gate Valve / Chamber Unit	\$4,000.00	\$4,000.00	\$0.00	\$0.00
1.2.2 Injector Fabrication		\$197,728.70	\$0.00	\$197,728.70	\$0.00
AH21110	Long Lead Procurement	\$58,155.50	\$0.00	\$58,155.50	\$0.00
AH21120	Procurement / Fabrication	\$116,311.00	\$0.00	\$116,311.00	\$0.00
AH21140	Fabricate Ion Source Storage Vessel	\$11,631.10	\$0.00	\$11,631.10	\$0.00
AH21150	Fabricate Gate Valve / Chamber Unit	\$11,631.10	\$0.00	\$11,631.10	\$0.00
1.2.3 Injector Installation		\$54,822.75	\$49,007.20	\$5,815.55	\$0.00
AH21205	Injector Envelope	\$26,851.55	\$21,036.00	\$5,815.55	\$0.00
AH21215	Start Injector Assembly	\$0.00	\$0.00	\$0.00	\$0.00
AH21220	Source	\$0.00	\$0.00	\$0.00	\$0.00
AH21230	Ion Source and Aperture	\$6,020.00	\$6,020.00	\$0.00	\$0.00
AH21240	Fiducialization and Alignment	\$4,054.00	\$4,054.00	\$0.00	\$0.00
AH21245	Install Solenoid Pack	\$8,668.80	\$8,668.80	\$0.00	\$0.00
AH21250	Gate Valve Unit	\$1,806.00	\$1,806.00	\$0.00	\$0.00
AH21260	HV Systems	\$3,010.00	\$3,010.00	\$0.00	\$0.00
AH21270	Vacuum, Plumbing, Enclosures, etc.	\$3,010.00	\$3,010.00	\$0.00	\$0.00
AH21280	Q&A and Wrap Up	\$1,402.40	\$1,402.40	\$0.00	\$0.00
AH21225	Finish Injector Assembly	\$0.00	\$0.00	\$0.00	\$0.00
1.3 CELL REFURBISHMENT		\$308,769.4	\$177,544.6	\$131,224.8	\$0.00

		8	2	7	
1.3.1 Cell Refurb - Des & Eng		\$31,680.00	\$31,680.00	\$0.00	\$0.00
CR11010	Cell 3D CAD Development	\$5,544.00	\$5,544.00	\$0.00	\$0.00
CR11020	Design Review	\$0.00	\$0.00	\$0.00	\$0.00
CR11025	Analysis Cell Modifications	\$2,376.00	\$2,376.00	\$0.00	\$0.00
CR11030	Cell Detail Drawings	\$7,920.00	\$7,920.00	\$0.00	\$0.00
CR11040	Cell Block Support 3D CAD Development	\$5,544.00	\$5,544.00	\$0.00	\$0.00
CR11035	Drawing Approval	\$0.00	\$0.00	\$0.00	\$0.00
CR11045	Analysis Support	\$2,376.00	\$2,376.00	\$0.00	\$0.00
CR11050	Design Review	\$0.00	\$0.00	\$0.00	\$0.00
CR11060	Cell Block Support Detail Design	\$7,920.00	\$7,920.00	\$0.00	\$0.00
CR11065	Drawing Approval	\$0.00	\$0.00	\$0.00	\$0.00
1.3.2 LLNL Cell Removal		\$0.00	\$0.00	\$0.00	\$0.00
CR21010	LLNL Cell Removal	\$0.00	\$0.00	\$0.00	\$0.00
1.3.3 Cell Refurb Prototype (Cell 1)		\$30,761.37	\$22,946.40	\$7,814.97	\$0.00
CR31100	Insulator	\$5,244.88	\$217.70	\$5,027.18	\$0.00
CR31020	Disassemble / Cleaning Shop Oversight/Detail Engineering/Q&A/Procurement	\$2,596.94	\$1,454.40	\$1,142.54	\$0.00
CR31010	Oversite	\$0.00	\$0.00	\$0.00	\$0.00
CR31030	Refurbish Hardware	\$0.00	\$0.00	\$0.00	\$0.00
CR31040	Open Ferrite Subassembly	\$758.60	\$758.60	\$0.00	\$0.00
CR31050	Refurbish Ferrite Subassembly Fabrication Items	\$4,765.72	\$4,080.20	\$685.52	\$0.00
CR31060	Ferrite Subassembly Final Welding and Machining	\$4,354.00	\$4,354.00	\$0.00	\$0.00
CR31070	Solenoid Assembly	\$5,817.56	\$5,429.10	\$388.46	\$0.00
CR31110	Al-casting	\$435.40	\$435.40	\$0.00	\$0.00
CR31120	SS spool	\$435.40	\$435.40	\$0.00	\$0.00
CR31130	Comp Boxes and Covers	\$646.40	\$646.40	\$0.00	\$0.00
CR31140	Subassembly Cell	\$2,187.27	\$1,616.00	\$571.27	\$0.00
CR31150	Solenoid Realignment	\$484.80	\$484.80	\$0.00	\$0.00
CR31160	Leak-check Cell	\$2,388.00	\$2,388.00	\$0.00	\$0.00
CR31170	Subassembly Cell Test Stand	\$646.40	\$646.40	\$0.00	\$0.00
CR31180	Prototype Cell Complete	\$0.00	\$0.00	\$0.00	\$0.00
1.3.4 Disassembly and Cleaning		\$6,902.00	\$1,279.25	\$5,622.75	\$0.00
CR41020	Disassembly / Cleaning	\$6,902.00	\$1,279.25	\$5,622.75	\$0.00
1.3.5 Cell Modifications & Assembly		\$239,426.11	\$121,638.97	\$117,787.14	\$0.00
CR51030	Refurbish Hardware	\$16,338.32	\$0.00	\$16,338.32	\$0.00
CR51040	Open Ferrite Subassembly	\$12,978.02	\$12,978.02	\$0.00	\$0.00
CR51050	Refurbish Ferrite Subassembly Fabrication Items	\$21,270.24	\$2,989.60	\$18,280.64	\$0.00
CR51110	Al-casting	\$4,027.45	\$4,027.45	\$0.00	\$0.00
CR51120	SS spool	\$2,068.15	\$2,068.15	\$0.00	\$0.00
CR51130	Comp Boxes and Covers	\$1,535.20	\$1,535.20	\$0.00	\$0.00
CR51060	Ferrite Subassembly Final Welding and Machining	\$39,138.50	\$39,138.50	\$0.00	\$0.00
CR51070	Solenoid Assembly	\$33,531.67	\$25,971.45	\$7,560.22	\$0.00
CR51100	Insulator	\$72,012.61	\$1,062.90	\$70,949.71	\$0.00
CR51140	Subassembly Cell	\$11,394.50	\$11,394.50	\$0.00	\$0.00
CR51150	Solenoid Realignment	\$5,697.25	\$5,697.25	\$0.00	\$0.00

CR51160	Leak-check Cells	\$1,665.35	\$1,665.35	\$0.00	\$0.00
CR51170	Subassembly Cell Block	\$17,768.86	\$13,110.60	\$4,658.26	\$0.00
1.4 CELL INSTALLATION		\$150,537.46	\$81,728.00	\$68,809.46	\$0.00
1.4.1 Block 1		\$85,155.06	\$16,345.60	\$68,809.46	\$0.00
CI41010	Hardware, Tools, Fixtures	\$5,931.85	\$0.00	\$5,931.85	\$0.00
CI41020	Fabricate Parts for all Blocks	\$62,877.61	\$0.00	\$62,877.61	\$0.00
CI41030	Cell Block 6-strut system	\$1,402.40	\$1,402.40	\$0.00	\$0.00
CI41040	Cell Block Brackets	\$701.20	\$701.20	\$0.00	\$0.00
CI41050	Cell Block Base Plate	\$1,402.40	\$1,402.40	\$0.00	\$0.00
CI41060	Move in Transmission Lines	\$4,207.20	\$4,207.20	\$0.00	\$0.00
CI41070	Adapter Flanges, bellows Assemble Cell Bock including inter-cell unit	\$701.20	\$701.20	\$0.00	\$0.00
CI41080		\$2,103.60	\$2,103.60	\$0.00	\$0.00
CI41090	Install manifolds	\$1,402.40	\$1,402.40	\$0.00	\$0.00
CI41100	Leak Check	\$701.20	\$701.20	\$0.00	\$0.00
CI41110	Align	\$3,724.00	\$3,724.00	\$0.00	\$0.00
1.4.2 Block 2		\$16,345.60	\$16,345.60	\$0.00	\$0.00
CI41120	Cell Block 6-strut system	\$1,402.40	\$1,402.40	\$0.00	\$0.00
CI41130	Cell Block Brackets	\$701.20	\$701.20	\$0.00	\$0.00
CI41140	Cell Block Base Plate	\$1,402.40	\$1,402.40	\$0.00	\$0.00
CI41150	Move in Transmission Lines	\$4,207.20	\$4,207.20	\$0.00	\$0.00
CI41160	Adapter Flanges, bellows Assemble Cell Bock including inter-cell unit	\$701.20	\$701.20	\$0.00	\$0.00
CI41170		\$2,103.60	\$2,103.60	\$0.00	\$0.00
CI41180	Install manifolds	\$1,402.40	\$1,402.40	\$0.00	\$0.00
CI41190	Leak Check	\$701.20	\$701.20	\$0.00	\$0.00
CI41200	Align	\$3,724.00	\$3,724.00	\$0.00	\$0.00
1.4.3 Block 3		\$16,345.60	\$16,345.60	\$0.00	\$0.00
CI41210	Cell Block 6-strut system	\$1,402.40	\$1,402.40	\$0.00	\$0.00
CI41220	Cell Block Brackets	\$701.20	\$701.20	\$0.00	\$0.00
CI41230	Cell Block Base Plate	\$1,402.40	\$1,402.40	\$0.00	\$0.00
CI41240	Move in Transmission Lines	\$4,207.20	\$4,207.20	\$0.00	\$0.00
CI41250	Adapter Flanges, bellows Assemble Cell Bock including inter-cell unit	\$701.20	\$701.20	\$0.00	\$0.00
CI41260		\$2,103.60	\$2,103.60	\$0.00	\$0.00
CI41270	Install manifolds	\$1,402.40	\$1,402.40	\$0.00	\$0.00
CI41280	Leak Check	\$701.20	\$701.20	\$0.00	\$0.00
CI41290	Align	\$3,724.00	\$3,724.00	\$0.00	\$0.00
1.4.4 Block 4		\$16,345.60	\$16,345.60	\$0.00	\$0.00
CI41300	Cell Block 6-strut system	\$1,402.40	\$1,402.40	\$0.00	\$0.00
CI41310	Cell Block Brackets	\$701.20	\$701.20	\$0.00	\$0.00
CI41320	Cell Block Base Plate	\$1,402.40	\$1,402.40	\$0.00	\$0.00
CI41330	Move in Transmission Lines	\$4,207.20	\$4,207.20	\$0.00	\$0.00
CI41340	Adapter Flanges, bellows Assemble Cell Bock including inter-cell unit	\$701.20	\$701.20	\$0.00	\$0.00
CI41350		\$2,103.60	\$2,103.60	\$0.00	\$0.00
CI41360	Install manifolds	\$1,402.40	\$1,402.40	\$0.00	\$0.00
CI41370	Leak Check	\$701.20	\$701.20	\$0.00	\$0.00
CI41380	Align	\$3,724.00	\$3,724.00	\$0.00	\$0.00
1.4.5 Block 5		\$16,345.60	\$16,345.60	\$0.00	\$0.00
CI41390	Cell Block 6-strut system	\$1,402.40	\$1,402.40	\$0.00	\$0.00

CI41400	Cell Block Brackets	\$701.20	\$701.20	\$0.00	\$0.00
CI41410	Cell Block Base Plate	\$1,402.40	\$1,402.40	\$0.00	\$0.00
CI41420	Move in Transmission Lines	\$4,207.20	\$4,207.20	\$0.00	\$0.00
CI41430	Adapter Flanges, bellows	\$701.20	\$701.20	\$0.00	\$0.00
CI41440	Assemble Cell Bock including inter-cell unit	\$2,103.60	\$2,103.60	\$0.00	\$0.00
CI41450	Install manifolds	\$1,402.40	\$1,402.40	\$0.00	\$0.00
CI41460	Leak Check	\$701.20	\$701.20	\$0.00	\$0.00
CI41470	Align	\$3,724.00	\$3,724.00	\$0.00	\$0.00
1.5 BEAM DIAGNOSTICS		\$452,295.3	\$199,406.5	\$252,888.7	
UNITS		2	7	5	\$0.00
1.5.1 Beam Diagnostics Des. & Engr.		\$126,612.9	\$126,612.9		
		2	2	\$0.00	\$0.00
BD51010	3D CAD Concept Development	\$48,009.36	\$48,009.36	\$0.00	\$0.00
BD51020	Design Review	\$0.00	\$0.00	\$0.00	\$0.00
BD51030	Detail Design	\$48,009.36	\$48,009.36	\$0.00	\$0.00
BD51040	Drawing Approval	\$0.00	\$0.00	\$0.00	\$0.00
BD51050	Analysis	\$9,413.60	\$9,413.60	\$0.00	\$0.00
BD51180	Detailed Design Diagnostics	\$21,180.60	\$21,180.60	\$0.00	\$0.00
1.5.2 Intercell Prototype Fabrication		\$41,558.50	\$12,995.00	\$28,563.50	\$0.00
BD51060	Procure Vacuum Chamber	\$11,425.40	\$0.00	\$11,425.40	\$0.00
BD51070	Fabricate Parts	\$23,669.10	\$6,531.00	\$17,138.10	\$0.00
BD51080	Install Encapsulated Solenoid	\$3,232.00	\$3,232.00	\$0.00	\$0.00
BD51090	Install Diagnostics Flanges	\$1,292.80	\$1,292.80	\$0.00	\$0.00
BD51100	Assemble Diagnostics Units and Install	\$1,292.80	\$1,292.80	\$0.00	\$0.00
BD51110	Install vacuum Pumps and Manifolding	\$646.40	\$646.40	\$0.00	\$0.00
BD51190	Prototype Compete	\$0.00	\$0.00	\$0.00	\$0.00
1.5.3 Intercell Fabrication (Unit 1 to 5)		\$142,203.6		\$108,107.7	
		0	\$34,095.85	5	\$0.00
BD51120	Vacuum Chambers	\$24,413.20	\$0.00	\$24,413.20	\$0.00
BD51130	Fabricate Parts	\$83,694.55	\$0.00	\$83,694.55	\$0.00
BD51140	Install Solenoids	\$20,071.85	\$20,071.85	\$0.00	\$0.00
BD51150	Assemble Units	\$14,024.00	\$14,024.00	\$0.00	\$0.00
1.5.4 Beam Diagnostics Fabrication		\$141,920.3		\$116,217.5	
		0	\$25,702.80	0	\$0.00
		\$116,217.5		\$116,217.5	
BD51160	Parts Fabrication	0	\$0.00	0	\$0.00
BD51170	Assembly	\$25,702.80	\$25,702.80	\$0.00	\$0.00
1.6 MAGNETS		\$625,085.6	\$311,853.7	\$313,231.9	
		5	1	4	\$0.00
1.6.1 Magnet Des. & Engr.		\$114,728.2	\$114,728.2		
		5	5	\$0.00	\$0.00
MAG1010	Accelerator Cell Magnet Analysis	\$20,003.90	\$20,003.90	\$0.00	\$0.00
MAG1020	Accelerator Cell 3D CAD Design Development	\$16,473.80	\$16,473.80	\$0.00	\$0.00
MAG1030	Accelerator Cell Magnet Design Review	\$0.00	\$0.00	\$0.00	\$0.00
MAG1040	Accelerator Cell Magnet Detail Design	\$16,473.80	\$16,473.80	\$0.00	\$0.00
MAG1050	Accelerator Cell Magnet Drawing Approval	\$0.00	\$0.00	\$0.00	\$0.00
MAG1110	Intercell Magnet Analysis	\$4,706.80	\$4,706.80	\$0.00	\$0.00
MAG1120	Intercell 3D CAD Design Development	\$5,295.15	\$5,295.15	\$0.00	\$0.00
MAG1130	Intercell Magnet Design Review	\$0.00	\$0.00	\$0.00	\$0.00

MAG1140	Intercell Magnet Detail Design	\$2,824.08	\$2,824.08	\$0.00	\$0.00
MAG1060	Injector Magnet Analysis	\$9,413.60	\$9,413.60	\$0.00	\$0.00
MAG1150	Intercell Magnet Drawing Approval	\$0.00	\$0.00	\$0.00	\$0.00
MAG1070	Injector 3D CAD Design Development	\$18,827.20	\$18,827.20	\$0.00	\$0.00
MAG1080	Injector Magnet Design Review	\$0.00	\$0.00	\$0.00	\$0.00
MAG1090	Injector Magnet Detail Design	\$20,709.92	\$20,709.92	\$0.00	\$0.00
MAG1100	Injector Magnet Drawing Approval	\$0.00	\$0.00	\$0.00	\$0.00
1.6.2 Magnet Pulsing Test Stand		\$8,632.75	\$3,010.00	\$5,622.75	\$0.00
M621010	Design	\$0.00	\$0.00	\$0.00	\$0.00
M621020	Build	\$8,632.75	\$3,010.00	\$5,622.75	\$0.00
1.6.3 Cell 1 Solenoid (Prototype)		\$139,995.75	\$25,856.00	\$114,139.75	\$0.00
1631030	Potting Step #1 Fabrication Items	\$23,993.34	\$0.00	\$23,993.34	\$0.00
1631050	Potting Step #2 Fabrication Items	\$26,278.42	\$0.00	\$26,278.42	\$0.00
1631070	Lead Connections Fabrication Items	\$1,713.81	\$0.00	\$1,713.81	\$0.00
1631010	Solenoid Winding Pack Fabrication Items	\$60,554.62	\$0.00	\$60,554.62	\$0.00
1631020	Solenoid Winding Pack	\$6,388.87	\$5,817.60	\$571.27	\$0.00
1631040	Potting Step #1	\$8,099.56	\$7,756.80	\$342.76	\$0.00
1631060	Potting Step #2	\$9,069.16	\$8,726.40	\$342.76	\$0.00
1631080	Lead Connections	\$2,928.36	\$2,585.60	\$342.76	\$0.00
1631090	Solenoid Test Shots	\$969.60	\$969.60	\$0.00	\$0.00
1631100	Prototype Solenoid Complete	\$0.00	\$0.00	\$0.00	\$0.00
1.6.4 Cell Solenoid Fabrication (15 units)		\$168,401.31	\$99,941.96	\$68,459.35	\$0.00
192	Solenoid Winding Pack Fabrication Items	\$14,281.75	\$0.00	\$14,281.75	\$0.00
194	Potting Step #1 Fabrication Items	\$23,993.34	\$0.00	\$23,993.34	\$0.00
196	Potting Step #2 Fabrication Items	\$19,423.18	\$0.00	\$19,423.18	\$0.00
198	Lead Connections Fabrication Items	\$9,140.32	\$0.00	\$9,140.32	\$0.00
193	Solenoid Winding Pack	\$29,751.04	\$29,174.12	\$576.92	\$0.00
195	Potting Step #1	\$29,854.00	\$29,506.98	\$347.02	\$0.00
197	Potting Step #2	\$30,221.09	\$29,873.11	\$347.98	\$0.00
199	Lead Connections	\$6,477.59	\$6,128.75	\$348.85	\$0.00
200	Solenoid Test Shots	\$5,259.00	\$5,259.00	\$0.00	\$0.00
1.6.5 Intercell Solenoid Fabrication (7 units)		\$68,594.89	\$30,677.50	\$37,917.39	\$0.00
202	Solenoid Winding Pack Fabrication Items	\$4,652.44	\$0.00	\$4,652.44	\$0.00
204	Potting Step #1 Fabrication Items	\$12,794.21	\$0.00	\$12,794.21	\$0.00
206	Potting Step #2 Fabrication Items	\$10,467.99	\$0.00	\$10,467.99	\$0.00
208	Lead Connections Fabrication Items	\$8,141.77	\$0.00	\$8,141.77	\$0.00
203	Solenoid Winding Pack	\$8,820.66	\$8,239.10	\$581.56	\$0.00
205	Potting Step #1	\$8,820.66	\$8,239.10	\$581.56	\$0.00
207	Potting Step #2	\$8,588.03	\$8,239.10	\$348.93	\$0.00
209	Lead Connections	\$3,066.08	\$2,717.15	\$348.93	\$0.00
210	Solenoid Test Shots	\$3,243.05	\$3,243.05	\$0.00	\$0.00
1.6.6 Injector Solenoid Fabrication (2 Units)		\$68,607.62	\$16,946.00	\$51,661.62	\$0.00
212	Solenoid Winding Pack Fabrication Items	\$5,815.55	\$0.00	\$5,815.55	\$0.00

214	Potting Step #1 Fabrication Items	\$17,446.65	\$0.00	\$17,446.65	\$0.00
216	Potting Step #2 Fabrication Items	\$15,120.43	\$0.00	\$15,120.43	\$0.00
218	Lead Connections Fabrication Items	\$11,631.10	\$0.00	\$11,631.10	\$0.00
213	Solenoid Winding Pack	\$3,736.96	\$3,155.40	\$581.56	\$0.00
215	Potting Step #1	\$5,875.12	\$5,520.60	\$354.52	\$0.00
217	Potting Step #2	\$5,941.91	\$5,586.00	\$355.91	\$0.00
219	Lead Connections	\$1,286.91	\$931.00	\$355.91	\$0.00
220	Solenoid Test Shots	\$1,753.00	\$1,753.00	\$0.00	\$0.00
1.6.7 Steering Coils		\$56,125.08	\$20,694.00	\$35,431.08	\$0.00
222	Design and Engineering	\$14,120.40	\$14,120.40	\$0.00	\$0.00
223	Prototype	\$3,427.62	\$0.00	\$3,427.62	\$0.00
224	Fabrication	\$28,563.50	\$0.00	\$28,563.50	\$0.00
225	Subassembly	\$10,013.56	\$6,573.60	\$3,439.96	\$0.00
1.6.8 Magnet Auxillary Systems		\$0.00	\$0.00	\$0.00	\$0.00
A1330	Magnet Auxiliary Systems	\$0.00	\$0.00	\$0.00	\$0.00
1.7 ACCELERATOR - MISCELLANEOUS		\$95,856.29	\$44,349.89	\$51,506.40	\$0.00
1.7.1 Beam Position Monitors		\$67,220.72	\$38,565.12	\$28,655.60	\$0.00
230	Engineering and Design	\$38,565.12	\$38,565.12	\$0.00	\$0.00
231	Procurements	\$28,655.60	\$0.00	\$28,655.60	\$0.00
1.7.2 Flanges, Bellows, Hardware		\$28,635.57	\$5,784.77	\$22,850.80	\$0.00
1.7.3 Procurements		\$22,850.80	\$0.00	\$22,850.80	\$0.00
1.7.4 Oversight		\$5,784.77	\$5,784.77	\$0.00	\$0.00
2.0 ACCELERATOR PULSED POWER		\$2,254,127.48	\$487,123.51	\$1,767,003.97	\$0.00
2.1 GENERAL ENGINEERING		\$0.00	\$0.00	\$0.00	\$0.00
2.2 INJECTOR		\$195,284.55	\$50,217.60	\$145,066.95	\$0.00
2.2.1 PP Injector Des. & Engr.		\$11,552.00	\$11,552.00	\$0.00	\$0.00
221.1005	Engineering and Design	\$11,552.00	\$11,552.00	\$0.00	\$0.00
2.2.2 PP Inj. Procurement		\$145,066.95	\$0.00	\$145,066.95	\$0.00
221.101	Procurement	\$145,066.95	\$0.00	\$145,066.95	\$0.00
2.2.3 PP Inj. Fab & Installation		\$38,665.60	\$38,665.60	\$0.00	\$0.00
221.102	Fabrication and Testing	\$18,016.00	\$18,016.00	\$0.00	\$0.00
221.103	Installation	\$20,649.60	\$20,649.60	\$0.00	\$0.00
2.2.4 Power Supplies		\$0.00	\$0.00	\$0.00	\$0.00
2.2.4.1 Filament PS & Isolation Transformer		\$0.00	\$0.00	\$0.00	\$0.00
224.101	Des. & Engr	\$0.00	\$0.00	\$0.00	\$0.00
224.102	Material Proc.	\$0.00	\$0.00	\$0.00	\$0.00
224.103	Assembly & Test	\$0.00	\$0.00	\$0.00	\$0.00
224.104	Installation	\$0.00	\$0.00	\$0.00	\$0.00
2.2.4.2 + 200kV Pulser		\$0.00	\$0.00	\$0.00	\$0.00
224.105	Des. & Engr	\$0.00	\$0.00	\$0.00	\$0.00
224.106	Material Proc.	\$0.00	\$0.00	\$0.00	\$0.00
224.107	Assembly & Test	\$0.00	\$0.00	\$0.00	\$0.00
224.108	Installation	\$0.00	\$0.00	\$0.00	\$0.00
2.2.4.3 + 150kV PS		\$0.00	\$0.00	\$0.00	\$0.00
224.109	Des. & Engr	\$0.00	\$0.00	\$0.00	\$0.00

224.11	Material Proc.	\$0.00	\$0.00	\$0.00	\$0.00
224.111	Assembly & Test	\$0.00	\$0.00	\$0.00	\$0.00
224.112	Installation	\$0.00	\$0.00	\$0.00	\$0.00
2.2.4.4 - 200kV Pulser		\$0.00	\$0.00	\$0.00	\$0.00
224.113	Des. & Engr	\$0.00	\$0.00	\$0.00	\$0.00
224.114	Material Proc.	\$0.00	\$0.00	\$0.00	\$0.00
224.115	Assembly & Test	\$0.00	\$0.00	\$0.00	\$0.00
224.116	Installation	\$0.00	\$0.00	\$0.00	\$0.00
2.3 COMPRESSION SECTION PULSERS		\$876,343.16	\$183,717.84	\$692,625.32	\$0.00
2.3.1 Cell Pulser		\$438,647.51	\$110,395.77	\$328,251.74	\$0.00
2.3.1.1 Prototype & Refurbish		\$42,530.13	\$17,280.00	\$25,250.13	\$0.00
231.101	Prototype Design & Eng.	\$8,664.00	\$8,664.00	\$0.00	\$0.00
231.102	Material Procurement	\$25,250.13	\$0.00	\$25,250.13	\$0.00
231.103	Prototype Assembly & Test	\$5,728.00	\$5,728.00	\$0.00	\$0.00
231.105	Finalize Design	\$2,888.00	\$2,888.00	\$0.00	\$0.00
2.3.1.2 Production		\$396,117.38	\$93,115.77	\$303,001.61	\$0.00
231.11	Material Procurement	\$303,001.61	\$0.00	\$303,001.61	\$0.00
231.111	Production & Test	\$72,264.81	\$72,264.81	\$0.00	\$0.00
231.113	Installation	\$20,850.96	\$20,850.96	\$0.00	\$0.00
2.3.2 Cell Pulser Trigger Generator		\$333,448.95	\$27,002.14	\$306,446.80	\$0.00
2.3.2.1 Prototype & Refurbish		\$30,928.32	\$7,392.00	\$23,536.32	\$0.00
232.101	Prototype Design & Eng.	\$5,544.00	\$5,544.00	\$0.00	\$0.00
232.102	Material Procurement	\$23,536.32	\$0.00	\$23,536.32	\$0.00
232.103	Prototype Assembly & Test	\$0.00	\$0.00	\$0.00	\$0.00
232.105	Finalize Design	\$1,848.00	\$1,848.00	\$0.00	\$0.00
2.3.2.2 Production		\$302,520.62	\$19,610.14	\$282,910.48	\$0.00
232.111	Material Procurement	\$282,910.48	\$0.00	\$282,910.48	\$0.00
232.112	Production & Test	\$0.00	\$0.00	\$0.00	\$0.00
232.114	Installation	\$19,610.14	\$19,610.14	\$0.00	\$0.00
2.3.3 Cell Reset Pulser		\$104,246.71	\$46,319.93	\$57,926.78	\$0.00
2.3.3.1 Prototype & Refurbish		\$13,326.31	\$8,870.40	\$4,455.91	\$0.00
233.101	Prototype Design & Eng.	\$5,544.00	\$5,544.00	\$0.00	\$0.00
233.102	Material Procurement	\$4,455.91	\$0.00	\$4,455.91	\$0.00
233.103	Prototype Assembly & Test	\$1,478.40	\$1,478.40	\$0.00	\$0.00
233.105	Finalize Design	\$1,848.00	\$1,848.00	\$0.00	\$0.00
2.3.3.2 Production		\$90,920.40	\$37,449.53	\$53,470.87	\$0.00
233.111	Material Procurement	\$53,470.87	\$0.00	\$53,470.87	\$0.00
233.112	Production & Test	\$17,740.80	\$17,740.80	\$0.00	\$0.00
233.114	Installation	\$19,708.73	\$19,708.73	\$0.00	\$0.00
2.4 BLUMLEIN SECTION PULSERS		\$236,183.88	\$60,210.16	\$175,973.72	\$0.00
2.4.1 Thyatron Switch Chassis		\$52,626.50	\$22,488.56	\$30,137.94	\$0.00
2.4.1.1 Prototype & Refurbish		\$41,168.90	\$11,030.96	\$30,137.94	\$0.00
241.102	Material Procurement (all)	\$30,137.94	\$0.00	\$30,137.94	\$0.00

241.101	Prototype Design & Eng.	\$6,814.96	\$6,814.96	\$0.00	\$0.00
241.103	Prototype Assembly & Test	\$1,848.00	\$1,848.00	\$0.00	\$0.00
241.105	Finalize Design	\$2,368.00	\$2,368.00	\$0.00	\$0.00
2.4.1.2 Production		\$11,457.60	\$11,457.60	\$0.00	\$0.00
241.112	Production & Test	\$5,544.00	\$5,544.00	\$0.00	\$0.00
241.114	Installation	\$5,913.60	\$5,913.60	\$0.00	\$0.00
2.4.2 Thyatron Switch Chassis Trigger Generator		\$18,954.28	\$12,924.00	\$6,030.28	\$0.00
2.4.2.1 Prototype & Refurbish		\$8,584.77	\$7,010.40	\$1,574.37	\$0.00
242.101	Prototype Design & Eng.	\$5,162.40	\$5,162.40	\$0.00	\$0.00
242.102	Material Procurement	\$1,574.37	\$0.00	\$1,574.37	\$0.00
242.103	Prototype Assembly & Test	\$0.00	\$0.00	\$0.00	\$0.00
242.105	Finalize Design	\$1,848.00	\$1,848.00	\$0.00	\$0.00
2.4.2.2 Production		\$10,369.51	\$5,913.60	\$4,455.91	\$0.00
242.111	Material Procurement	\$4,455.91	\$0.00	\$4,455.91	\$0.00
242.112	Production & Test	\$0.00	\$0.00	\$0.00	\$0.00
242.114	Installation	\$5,913.60	\$5,913.60	\$0.00	\$0.00
2.4.3 Blumlein Trigger Generator		\$126,394.05	\$9,858.50	\$116,535.55	\$0.00
2.4.3.1 Prototype & Refurbish		\$32,733.38	\$3,944.90	\$28,788.48	\$0.00
243.101	Prototype Design & Eng.	\$2,904.90	\$2,904.90	\$0.00	\$0.00
243.102	Material Procurement	\$28,788.48	\$0.00	\$28,788.48	\$0.00
243.103	Prototype Assembly & Test	\$0.00	\$0.00	\$0.00	\$0.00
243.105	Finalize Design	\$1,040.00	\$1,040.00	\$0.00	\$0.00
2.4.3.2 Production		\$93,660.67	\$5,913.60	\$87,747.07	\$0.00
243.111	Material Procurement	\$87,747.07	\$0.00	\$87,747.07	\$0.00
243.112	Production & Test	\$0.00	\$0.00	\$0.00	\$0.00
243.114	Installation in Racks	\$5,913.60	\$5,913.60	\$0.00	\$0.00
2.4.4 Blumlein Refurbishment		\$38,209.06	\$14,939.10	\$23,269.95	\$0.00
A3460	Hardware Procurement	\$23,269.95	\$0.00	\$23,269.95	\$0.00
A3470	Blumlein Refurbishment	\$14,939.10	\$14,939.10	\$0.00	\$0.00
2.5 BEAM DIAGNOSTICS UNITS		\$23,262.20	\$0.00	\$23,262.20	\$0.00
2.5.1 Beam Diagnostics Unit Procurement		\$23,262.20	\$0.00	\$23,262.20	\$0.00
2.6 MAGNET PULSERS		\$873,141.72	\$192,977.90	\$680,163.82	\$0.00
2.6.1 Transport Solenoid Pulser		\$791,206.32	\$154,002.01	\$637,204.31	\$0.00
2.6.1.1 Prototype		\$78,207.32	\$18,774.85	\$59,432.47	\$0.00
261.101	Prototype Design & Eng.	\$6,614.85	\$6,614.85	\$0.00	\$0.00
261.102	Material Procurement (2 Units)	\$59,432.47	\$0.00	\$59,432.47	\$0.00
261.103	Prototype Assembly & Test	\$9,792.00	\$9,792.00	\$0.00	\$0.00
261.105	Final Design	\$2,368.00	\$2,368.00	\$0.00	\$0.00
2.6.1.2 Production		\$712,999.00	\$135,227.16	\$577,771.84	\$0.00
2.6.1.1100	Material Procurement	\$577,771.84	\$0.00	\$577,771.84	\$0.00
2.6.1.1110	Production & Test	\$100,917.36	\$100,917.36	\$0.00	\$0.00
2.6.1.1130	Installation	\$34,309.80	\$34,309.80	\$0.00	\$0.00
2.6.2 Steering Coil Pulsers		\$81,935.40	\$38,975.89	\$42,959.50	\$0.00
2.6.2.1 Prototype		\$10,675.04	\$6,790.40	\$3,884.64	\$0.00
262.101	Prototype Design & Eng.	\$3,984.00	\$3,984.00	\$0.00	\$0.00

262.102	Material Procurement	\$3,884.64	\$0.00	\$3,884.64	\$0.00
262.103	Prototype Assembly & Test	\$1,478.40	\$1,478.40	\$0.00	\$0.00
262.105	Finalze Design	\$1,328.00	\$1,328.00	\$0.00	\$0.00
2.6.2.2 Production		\$71,260.36	\$32,185.49	\$39,074.87	\$0.00
262.1095	Material Procurement	\$39,074.87	\$0.00	\$39,074.87	\$0.00
262.11	Production & Test	\$14,784.00	\$14,784.00	\$0.00	\$0.00
262.112	Installation	\$17,401.49	\$17,401.49	\$0.00	\$0.00
2.7 MISCELLANEOUS		\$49,911.96	\$0.00	\$49,911.96	\$0.00
2.7.1 Compensation Box Components		\$27,420.96	\$0.00	\$27,420.96	\$0.00
2.7.2 Diala Oil		\$22,491.00	\$0.00	\$22,491.00	\$0.00
3.0 DRIFT COMPRESSION & FINAL FOCUS		\$292,968.47	\$0.00	\$0.00	\$292,968.47
3.1 PLASMA SOURCES		\$292,968.47	\$0.00	\$0.00	\$292,968.47
A3410	Source Review and Analysis	\$0.00	\$0.00	\$0.00	\$0.00
A3480	Ongoing Contract	\$292,968.47	\$0.00	\$0.00	\$292,968.47
A3420	Prototype Engineering & Dessign	\$0.00	\$0.00	\$0.00	\$0.00
A3430	Prototype Fabrication, Assembly & Test	\$0.00	\$0.00	\$0.00	\$0.00
A3440	Final Engineering & Design	\$0.00	\$0.00	\$0.00	\$0.00
A3450	Fabrication, Assembly & Test	\$0.00	\$0.00	\$0.00	\$0.00
3.2 FINAL FOCUS CHAMBER		\$0.00	\$0.00	\$0.00	\$0.00
3.2.1 Move NDCX-I Magnet and Chamber		\$0.00	\$0.00	\$0.00	\$0.00
3.2.2 HEPA Enclosure Target Chamber		\$0.00	\$0.00	\$0.00	\$0.00
4.0 SUPPORT AND ALIGNMENT		\$506,856.62	\$202,781.44	\$304,075.18	\$0.00
4.1 SUPPORT GIRDERS		\$223,259.08	\$77,013.96	\$146,245.12	\$0.00
4.1.1 Engineering and Design		\$53,657.52	\$53,657.52	\$0.00	\$0.00
411.101	3D CAD Development	\$0.00	\$0.00	\$0.00	\$0.00
411.105	Deflection Analysis	\$9,413.60	\$9,413.60	\$0.00	\$0.00
411.102	Design Review	\$0.00	\$0.00	\$0.00	\$0.00
411.103	Detail Design	\$41,419.84	\$41,419.84	\$0.00	\$0.00
411.106	Earthquake Analysis	\$0.00	\$0.00	\$0.00	\$0.00
411.104	Drawing Approval	\$0.00	\$0.00	\$0.00	\$0.00
411.107	Procurement Specification	\$2,824.08	\$2,824.08	\$0.00	\$0.00
4.1.2 Fabrication and Procurements		\$141,674.96	\$0.00	\$141,674.96	\$0.00
412.101	Main Girders	\$57,127.00	\$0.00	\$57,127.00	\$0.00
412.102	6 Strut Systems & Pedistals	\$34,276.20	\$0.00	\$34,276.20	\$0.00
412.103	Accelerator Mount	\$5,712.70	\$0.00	\$5,712.70	\$0.00
412.104	Injector Mount	\$7,997.78	\$0.00	\$7,997.78	\$0.00
412.105	Alignment Mounts	\$2,285.08	\$0.00	\$2,285.08	\$0.00
412.106	Sleepers & Anchor Plates	\$17,138.10	\$0.00	\$17,138.10	\$0.00
412.107	Attachements	\$17,138.10	\$0.00	\$17,138.10	\$0.00
4.1.3 Installation		\$27,926.60	\$23,356.44	\$4,570.16	\$0.00
413.101	Anchor Holes	\$4,224.28	\$1,939.20	\$2,285.08	\$0.00
413.102	Install Sleepers and Anchor Plates	\$2,327.04	\$2,327.04	\$0.00	\$0.00
413.103	Install 6-strut System	\$1,939.20	\$1,939.20	\$0.00	\$0.00
413.104	Girder Transportation and Rigging	\$9,740.08	\$7,455.00	\$2,285.08	\$0.00

413.105	Attachments	\$6,464.00	\$6,464.00	\$0.00	\$0.00
413.106	Accelerator and Injector Mounts	\$3,232.00	\$3,232.00	\$0.00	\$0.00
4.2 COMPONENT ALIGNMENT		\$35,869.32	\$21,912.00	\$13,957.32	\$0.00
4.2.1 Engineering and Design		\$21,912.00	\$21,912.00	\$0.00	\$0.00
421.101	Detail Drawings	\$17,529.60	\$17,529.60	\$0.00	\$0.00
421.102	Drawing Approval	\$0.00	\$0.00	\$0.00	\$0.00
421.103	Fiducials Database	\$4,382.40	\$4,382.40	\$0.00	\$0.00
421.104	Procurement Documents	\$0.00	\$0.00	\$0.00	\$0.00
421.105	Alignment Procedure Documents	\$0.00	\$0.00	\$0.00	\$0.00
4.2.2 Laser Tracker		\$6,978.66	\$0.00	\$6,978.66	\$0.00
422.101	Tracker Stands	\$0.00	\$0.00	\$0.00	\$0.00
422.102	2nd Tracker	\$0.00	\$0.00	\$0.00	\$0.00
422.106	Additional Targets	\$4,652.44	\$0.00	\$4,652.44	\$0.00
422.107	Party Hats	\$2,326.22	\$0.00	\$2,326.22	\$0.00
4.2.3 Alignment and Network		\$6,978.66	\$0.00	\$6,978.66	\$0.00
423.101	Building Network Magnet Measurement Teststand Support	\$6,978.66	\$0.00	\$6,978.66	\$0.00
423.102		\$0.00	\$0.00	\$0.00	\$0.00
423.103	Ongoing Installation Support	\$0.00	\$0.00	\$0.00	\$0.00
423.104	Final Injector Alignment Alignment & Network Documentation	\$0.00	\$0.00	\$0.00	\$0.00
423.106		\$0.00	\$0.00	\$0.00	\$0.00
423.105	Final Accelerator Alignment	\$0.00	\$0.00	\$0.00	\$0.00
4.3 MAGNET MEASUREMENT FACILITY		\$247,728.22	\$103,855.48	\$143,872.74	\$0.00
4.3.1 Preliminary Design		\$5,625.40	\$0.00	\$5,625.40	\$0.00
431.101	Determine Measurement Method (Initial Experiments)	\$5,625.40	\$0.00	\$5,625.40	\$0.00
4.3.2 Engineering & Design		\$85,385.08	\$85,385.08	\$0.00	\$0.00
432.108	Magnet Engineer Oversight	\$48,777.08	\$48,777.08	\$0.00	\$0.00
432.101	3D CAD Model Development	\$0.00	\$0.00	\$0.00	\$0.00
432.102	Electronics Schematics Dev.	\$18,304.00	\$18,304.00	\$0.00	\$0.00
432.103	Design Review	\$0.00	\$0.00	\$0.00	\$0.00
432.104	Detail Design Drawings	\$0.00	\$0.00	\$0.00	\$0.00
432.105	Detail Electronics Package Document Measurement Procedures	\$18,304.00	\$18,304.00	\$0.00	\$0.00
432.107		\$0.00	\$0.00	\$0.00	\$0.00
432.106	Drawing Approval	\$0.00	\$0.00	\$0.00	\$0.00
4.3.3 Fabrication & Proc.		\$137,104.80	\$0.00	\$137,104.80	\$0.00
433.101	Fabrication	\$91,403.20	\$0.00	\$91,403.20	\$0.00
433.102	Electronics Procurement	\$34,276.20	\$0.00	\$34,276.20	\$0.00
433.103	Electronics Fabrication	\$11,425.40	\$0.00	\$11,425.40	\$0.00
4.3.4 Installation		\$17,102.47	\$16,531.20	\$571.27	\$0.00
434.101	Prepare Teststand Area	\$2,510.47	\$1,939.20	\$571.27	\$0.00
434.102	Installation & Checkout	\$9,696.00	\$9,696.00	\$0.00	\$0.00
434.103	Safety Approval	\$1,664.00	\$1,664.00	\$0.00	\$0.00
434.104	Alignment Check	\$3,232.00	\$3,232.00	\$0.00	\$0.00
4.3.5 Commissioning		\$2,510.47	\$1,939.20	\$571.27	\$0.00
435.101	Install Prototype Solenoid Take Measurements & Evaluate System	\$2,510.47	\$1,939.20	\$571.27	\$0.00
435.102		\$0.00	\$0.00	\$0.00	\$0.00
5.0 MECHANICAL UTILITIES		\$177,093.7	\$0.00	\$177,093.7	\$0.00

		0		0	
5.1 GENERAL ENGINEERING		\$0.00	\$0.00	\$0.00	\$0.00
A1990	Utilities Engineering and Design	\$0.00	\$0.00	\$0.00	\$0.00
		\$171,381.0		\$171,381.0	
5.2 VACUUM		0	\$0.00	0	\$0.00
A2010	Vacuum Layout and Calculations	\$0.00	\$0.00	\$0.00	\$0.00
		\$171,381.0		\$171,381.0	
A2030	Procurement and Fabrication	0	\$0.00	0	\$0.00
A2020	Engineering and Design	\$0.00	\$0.00	\$0.00	\$0.00
A2040	Installation	\$0.00	\$0.00	\$0.00	\$0.00
5.3 UTILITIES		\$0.00	\$0.00	\$0.00	\$0.00
A2060	Engineering and Design	\$0.00	\$0.00	\$0.00	\$0.00
A2070	Cooling Water	\$0.00	\$0.00	\$0.00	\$0.00
A2080	Pressurized Air	\$0.00	\$0.00	\$0.00	\$0.00
A2090	Clean Air	\$0.00	\$0.00	\$0.00	\$0.00
A2100	HighPressure Gas	\$0.00	\$0.00	\$0.00	\$0.00
A2110	Oil Recirculation System	\$0.00	\$0.00	\$0.00	\$0.00
A2120	DI Water System	\$0.00	\$0.00	\$0.00	\$0.00
5.4 FLOORING, CABLE TRAYS & PATHWAYS		\$0.00	\$0.00	\$0.00	\$0.00
A2140	Layout and Calculations	\$0.00	\$0.00	\$0.00	\$0.00
A2150	Engineering and Design	\$0.00	\$0.00	\$0.00	\$0.00
A2160	Procurement and Fabrication	\$0.00	\$0.00	\$0.00	\$0.00
A2170	Installation	\$0.00	\$0.00	\$0.00	\$0.00
5.5 LIGHTING		\$0.00	\$0.00	\$0.00	\$0.00
A2190	Layout and Calculations	\$0.00	\$0.00	\$0.00	\$0.00
A2200	Engineering and Design	\$0.00	\$0.00	\$0.00	\$0.00
A2210	Procurement and Fabrication	\$0.00	\$0.00	\$0.00	\$0.00
A2220	Installation	\$0.00	\$0.00	\$0.00	\$0.00
5.6 OIL CONTAINMENT		\$5,712.70	\$0.00	\$5,712.70	\$0.00
5.6.1	Layout and Calculations	\$0.00	\$0.00	\$0.00	\$0.00
5.6.2	Engineering and Design	\$0.00	\$0.00	\$0.00	\$0.00
5.6.3	Installation	\$0.00	\$0.00	\$0.00	\$0.00
5.6.4	Procurement and Fabrication	\$5,712.70	\$0.00	\$5,712.70	\$0.00
		\$136,862.8			
6.0 ELECTRICAL UTILITIES		0	\$46,898.80	\$89,964.00	\$0.00
6.1 GENERAL ENGINEERING		\$0.00	\$0.00	\$0.00	\$0.00
610.101	Utilities Engineering and Design	\$0.00	\$0.00	\$0.00	\$0.00
6.2 CONTROL ROOM PARTITION		\$0.00	\$0.00	\$0.00	\$0.00
620.101	Mech Layout and Calculations	\$0.00	\$0.00	\$0.00	\$0.00
A2330	Electr Layout and Calculations	\$0.00	\$0.00	\$0.00	\$0.00
A2340	Engineering and Design	\$0.00	\$0.00	\$0.00	\$0.00
A2350	Procurement and Fabrication	\$0.00	\$0.00	\$0.00	\$0.00
A2360	Partition Installation	\$0.00	\$0.00	\$0.00	\$0.00
A2370	Partition HVAC and Other	\$0.00	\$0.00	\$0.00	\$0.00
A2380	Racks, Cable Trays, and Cable Routing	\$0.00	\$0.00	\$0.00	\$0.00
6.3 MISC. RACKS, CABLE TRAYS AND CABLE ROUTING		\$85,112.60	\$17,639.60	\$67,473.00	\$0.00
A2400	Layout and Calculations	\$0.00	\$0.00	\$0.00	\$0.00
A2410	Engineering and Design	\$7,746.40	\$7,746.40	\$0.00	\$0.00
A2420	Procurement and Fabrication	\$69,409.60	\$1,936.60	\$67,473.00	\$0.00

A2430	Installation	\$7,956.60	\$7,956.60	\$0.00	\$0.00
6.4 INTERLOCKS		\$25,875.10	\$14,629.60	\$11,245.50	\$0.00
A2450	Engineering and Design	\$7,746.40	\$7,746.40	\$0.00	\$0.00
A2460	Procurement and Fabrication	\$13,182.10	\$1,936.60	\$11,245.50	\$0.00
A2470	Installation	\$4,946.60	\$4,946.60	\$0.00	\$0.00
6.5 ELECTRONICS EQUIPMENT		\$0.00	\$0.00	\$0.00	\$0.00
A2490	Specification	\$0.00	\$0.00	\$0.00	\$0.00
A2500	Procurement	\$0.00	\$0.00	\$0.00	\$0.00
6.6 GROUNDING SYSTEM		\$25,875.10	\$14,629.60	\$11,245.50	\$0.00
6.6.1 Engineering and Design		\$7,746.40	\$7,746.40	\$0.00	\$0.00
6.6.2 Procurement and Fabrication		\$13,182.10	\$1,936.60	\$11,245.50	\$0.00
6.6.3 Installation		\$4,946.60	\$4,946.60	\$0.00	\$0.00
7.0 DATA ACQUISITION & CONTROL SYSTEMS		\$874,591.23	\$120,685.21	\$753,906.02	\$0.00
7.1 GENERAL ENGINEERING		\$0.00	\$0.00	\$0.00	\$0.00
71.1001	General Layout and Specification	\$0.00	\$0.00	\$0.00	\$0.00
7.2 HARDWARE		\$228,142.00	\$3,232.00	\$224,910.00	\$0.00
72.102	Specification	\$0.00	\$0.00	\$0.00	\$0.00
72.103	Bid and Award	\$224,910.00	\$0.00	\$224,910.00	\$0.00
72.104	Fabrication	\$0.00	\$0.00	\$0.00	\$0.00
72.105	Rack Installation and Wiring	\$3,232.00	\$3,232.00	\$0.00	\$0.00
7.3 SOFTWARE DEVELOPMENT		\$551,938.81	\$94,922.81	\$457,016.00	\$0.00
73.101	Obtain Bids and Review	\$0.00	\$0.00	\$0.00	\$0.00
73.102	Issue RFP	\$0.00	\$0.00	\$0.00	\$0.00
73.103	Award Contract	\$0.00	\$0.00	\$0.00	\$0.00
73.104	Software Development	\$457,016.00	\$0.00	\$457,016.00	\$0.00
73.106	Develop Specifications	\$0.00	\$0.00	\$0.00	\$0.00
73.107	Top Level Design	\$0.00	\$0.00	\$0.00	\$0.00
73.108	Detailed Hardware Design	\$0.00	\$0.00	\$0.00	\$0.00
73.109	Detailed Software Design	\$0.00	\$0.00	\$0.00	\$0.00
73.111	Detailed User Interface	\$0.00	\$0.00	\$0.00	\$0.00
73.105	Software Development Engineer Support	\$94,922.81	\$94,922.81	\$0.00	\$0.00
73.111	Delivery	\$0.00	\$0.00	\$0.00	\$0.00
73.112	Installation	\$0.00	\$0.00	\$0.00	\$0.00
7.4 CONTROL ROOM		\$0.00	\$0.00	\$0.00	\$0.00
7.5 TIMING SYSTEM		\$94,510.42	\$22,530.40	\$71,980.02	\$0.00
75.101	System Design	\$7,746.40	\$7,746.40	\$0.00	\$0.00
75.102	Procurement Paperwork Complete	\$0.00	\$0.00	\$0.00	\$0.00
75.103	Issue RFP	\$0.00	\$0.00	\$0.00	\$0.00
75.104	Obtain Bids and Review	\$0.00	\$0.00	\$0.00	\$0.00
75.105	Award Contract	\$0.00	\$0.00	\$0.00	\$0.00
75.106	Fabrication	\$71,980.02	\$0.00	\$71,980.02	\$0.00
75.107	Installation	\$14,784.00	\$14,784.00	\$0.00	\$0.00
8.0 FACILITIES		\$681,650.92	\$90,880.00	\$590,770.92	\$0.00
8.1 BLUMLEIN FRAME AND FLOORING		\$500,805.86	\$40,800.00	\$460,005.86	\$0.00
8.1.1 Prelim Framing Concept		\$30,664.65	\$4,800.00	\$25,864.65	\$0.00

811.101	Preliminary Design Request	\$0.00	\$0.00	\$0.00	\$0.00
811.102	Preliminary Design work by AE	\$25,864.65	\$0.00	\$25,864.65	\$0.00
811.103	Fac. Oversight	\$4,800.00	\$4,800.00	\$0.00	\$0.00
811.104	Proposal Eval by Proj Staff	\$0.00	\$0.00	\$0.00	\$0.00
8.1.2 Detail Design		\$103,379.21			
		1	\$12,000.00	\$91,379.21	\$0.00
812.101	Dev Contract specifications	\$0.00	\$0.00	\$0.00	\$0.00
812.102	Structural Design Final Submittal incl Cost Estimate	\$91,379.21	\$0.00	\$91,379.21	\$0.00
812.103	Fac Oversight	\$12,000.00	\$12,000.00	\$0.00	\$0.00
8.1.3 Facilities Fabb & Install		\$366,762.00		\$342,762.00	
		0	\$24,000.00	0	\$0.00
813.101	Finalize Subcontract	\$0.00	\$0.00	\$0.00	\$0.00
813.102	Install Mezzanine & False Flooring	\$342,762.00		\$342,762.00	
		0	\$0.00	0	\$0.00
813.103	Fac. Oversight	\$24,000.00	\$24,000.00	\$0.00	\$0.00
8.2 BUILDING CODE WORK		\$0.00	\$0.00	\$0.00	\$0.00
8.2.1 Calculations & Spec.		\$0.00	\$0.00	\$0.00	\$0.00
8.2.1 Installation		\$0.00	\$0.00	\$0.00	\$0.00
8.3 AC POWER DISTRIBUTION		\$180,845.00		\$130,765.00	
		6	\$50,080.00	6	\$0.00
8.3.1 Prelim Power Dist. Concept		\$23,165.66	\$18,080.00	\$5,085.66	\$0.00
831.101	Buliding Monitoring	\$10,685.66	\$5,600.00	\$5,085.66	\$0.00
831.102	develop Power Requirements	\$4,160.00	\$4,160.00	\$0.00	\$0.00
831.103	Develop Single Line Diagram for Subcontractor	\$8,320.00	\$8,320.00	\$0.00	\$0.00
8.3.2 AC Power Detail Design		\$42,276.20	\$8,000.00	\$34,276.20	\$0.00
832.101	Develop Contract Specs	\$0.00	\$0.00	\$0.00	\$0.00
832.102	Elec. & Ventilation Final Design	\$34,276.20	\$0.00	\$34,276.20	\$0.00
832.103	Oversight	\$8,000.00	\$8,000.00	\$0.00	\$0.00
8.3.3 AC Power Fab & Install		\$115,403.20			
		0	\$24,000.00	\$91,403.20	\$0.00
833.101	Finalize contract Specs	\$0.00	\$0.00	\$0.00	\$0.00
833.102	Install Power Distribution	\$57,127.00	\$0.00	\$57,127.00	\$0.00
833.103	Install Ventilation Equip	\$34,276.20	\$0.00	\$34,276.20	\$0.00
833.104	Oversight	\$24,000.00	\$24,000.00	\$0.00	\$0.00
8.4 UTILITIES		\$0.00	\$0.00	\$0.00	\$0.00
8.4.1 Utilities Calc & Spec.		\$0.00	\$0.00	\$0.00	\$0.00
8.4.2 Utilites Install		\$0.00	\$0.00	\$0.00	\$0.00
9.0 PHYSICS SUPPORT AND R&D		\$904,610.88			\$904,610.88
		8	\$0.00	\$0.00	8
9.1 ION OPTICS		\$904,610.88			\$904,610.88
		8	\$0.00	\$0.00	8
A2830	Physics Support	\$904,610.88			\$904,610.88
		8	\$0.00	\$0.00	8
A2840	NDCX II 21 Cell Design Baseline	\$0.00	\$0.00	\$0.00	\$0.00
A2870	NDCX II 33 Cell Design Baseline	\$0.00	\$0.00	\$0.00	\$0.00
A2900	NDCX II Steering Algorithms	\$0.00	\$0.00	\$0.00	\$0.00
9.2 ONGOING TESTSTAND WORK		\$0.00	\$0.00	\$0.00	\$0.00
A2850	Physics and Engineering Support	\$0.00	\$0.00	\$0.00	\$0.00
A2860	Experimental Hardware	\$0.00	\$0.00	\$0.00	\$0.00
A2930	Blumlein Wave shaping experiments	\$0.00	\$0.00	\$0.00	\$0.00
9.3 ION SOURCE R&D		\$0.00	\$0.00	\$0.00	\$0.00
A2880	NDCX II Injector Baseline	\$0.00	\$0.00	\$0.00	\$0.00

Determined

9.4 MAGNET FERRITE R&D		\$0.00	\$0.00	\$0.00	\$0.00
A2910	Test Solenoid Ferrite Interaction	\$0.00	\$0.00	\$0.00	\$0.00
9.5 DIAGNOSTICS R&D		\$0.00	\$0.00	\$0.00	\$0.00
A2940	Physics and Engineering Support	\$0.00	\$0.00	\$0.00	\$0.00
A2950	BPM Design Validated	\$0.00	\$0.00	\$0.00	\$0.00
10.0 INTEGRATION		\$0.00	\$0.00	\$0.00	\$0.00
10.1 FACILITY PREPARATION		\$0.00	\$0.00	\$0.00	\$0.00
A3000	Installation Support	\$0.00	\$0.00	\$0.00	\$0.00
A3020	NDCX-I Modifications	\$0.00	\$0.00	\$0.00	\$0.00
A3030	Facility Final Touch-Up	\$0.00	\$0.00	\$0.00	\$0.00
A2990	Basement Preparation	\$0.00	\$0.00	\$0.00	\$0.00
A3010	ATA Teststand Move	\$0.00	\$0.00	\$0.00	\$0.00
A3040	STS Move	\$0.00	\$0.00	\$0.00	\$0.00
A2980	Highbay Preparation	\$0.00	\$0.00	\$0.00	\$0.00
10.2 INJECTOR		\$0.00	\$0.00	\$0.00	\$0.00
A3050	Installation	\$0.00	\$0.00	\$0.00	\$0.00
A3060	Check-out	\$0.00	\$0.00	\$0.00	\$0.00
10.3 ACCELERATOR		\$0.00	\$0.00	\$0.00	\$0.00
A3080	Compression Section Installation	\$0.00	\$0.00	\$0.00	\$0.00
A3090	Accelerator Section Installation	\$0.00	\$0.00	\$0.00	\$0.00
A3100	Check-out	\$0.00	\$0.00	\$0.00	\$0.00
10.4 DRIFT COMPRESSION AND FINAL FOCUS		\$0.00	\$0.00	\$0.00	\$0.00
A3120	Drift Compression Installation	\$0.00	\$0.00	\$0.00	\$0.00
A3130	Final Focus Chamber Installation	\$0.00	\$0.00	\$0.00	\$0.00
A3140	Check-out	\$0.00	\$0.00	\$0.00	\$0.00
10.5 CONTROLS		\$0.00	\$0.00	\$0.00	\$0.00
A3160	Controls Installation	\$0.00	\$0.00	\$0.00	\$0.00
A3170	Check-out	\$0.00	\$0.00	\$0.00	\$0.00
11.0 PROJECT MANAGEMENT		\$1,061,855.44	\$870,873.95	\$190,981.50	\$0.00
11.1 MANAGEMENT		\$1,061,855.44	\$870,873.95	\$190,981.50	\$0.00
A3200	PEP Development	\$0.00	\$0.00	\$0.00	\$0.00
A3210	Cost Validation	\$0.00	\$0.00	\$0.00	\$0.00
A3220	Project Controls	\$0.00	\$0.00	\$0.00	\$0.00
A3230	Budget Oversight	\$0.00	\$0.00	\$0.00	\$0.00
A3240	Management	\$1,061,855.44	\$870,873.95	\$190,981.50	\$0.00