Department of Energy
Review Committee Report

on the

Technical, Cost, Schedule, and
Management Review

of the

Nanoscale Science Research Center Project

CENTER for NANOPHASE MATERIALS SCIENCES (CNMS)

July 2004

EXECUTIVE SUMMARY

A Department of Energy (DOE) Office of Science project review of the Center for Nanophase Material Sciences (CNMS) was conducted at Oak Ridge National Laboratory (ORNL) on July 20-22, 2004. The review was conducted at the requested of Dr. Patricia M. Dehmer, Associate Director for Basic Energy Sciences, Office of Science and the project's Acquisition Executive. The purpose of the review was to evaluate the project's technical, cost, schedule, management, and ES&H status.

The CNMS project is a highly collaborative multi-disciplinary research center, co-located with the Spallation Neutron Source and the proposed Joint Institute for Neutron Sciences at ORNL. The CNMS is approximately 80,000 square feet, consisting of a four-story office and laboratory building and a connected single-story, clean-room building. The Total Project Cost was $64.9 million at the time of the review. The project was 24.7 percent complete compared to a planned 25.2 percent complete. Project completion (Critical Decision-4b, Approve Start of Full Operations) is scheduled for September 2006. Overall cost contingency has been reduced since the December 2002 DOE review from $8.9 million to $7.0 million. This is 16 percent of the remaining costs, which is adequate for this stage of the project. There is one month of schedule float for the CD-4a, Approve Start of Initial Operations, date and three and one-half months for the CD-4b date.

Overall, the Review Committee concluded that the CNMS project was being managed effectively. The scope and specifications were sufficiently defined to support the cost and schedule presented, and consistent with the FY 2005 Project Data Sheet and the proposed Revision-2 of the Project Execution Plan. The information in the DOE Project Assessment Reporting System is consistent with physical progress. The ES&H aspects of the project were adequately addressed and Integrated Safety Management Principles are being followed. The project had responded appropriately to the recommendations from past DOE reviews. There were four Committee recommendations resulting from this review:

1. Better integrate the SNS, as a premier, world-class investigative technique for nanoscience and technology into the scientific program;
2. Add additional control milestones from the upcoming critical activities to monitor schedule progress, and include the status of these milestones in future project monthly reports;
3. Finalize the prioritized list of facility and/or scientific equipment needs to obtain with any remaining project funds; and

4. Complete the Transition to Operations plan with clear definition of both Federal and contractor roles in the facility acceptance process.

In summary, the Committee concluded that this project is doing well. As such, there was only one action item resulting from this review: The project is to conduct a status mini-review at DOE Headquarters in the May-June 2005 timeframe.

CONTENTS

1. INTRODUCTION

The Center for Nanophase Materials Sciences (CNMS) will integrate nanoscale research with neutron science; synthesis science; and theory, modeling, and simulation—bringing together four areas in which the United States has clear national research needs, and creating synergies that will have significant impact on scientific research by accelerating the pace of scientific discovery. The tools and scientific expertise of CNMS will be accessible to university, industrial, and laboratory researchers through a peer review process. The external scientific community is an essential partner in developing and operating CNMS so that it is successful in achieving its scientific and technical mission. The first CNMS Planning Workshop was held October 24-26, 2001 at Oak Ridge National Laboratory (ORNL), and was attended by a large number of scientists from university, industry, and national laboratories. The purpose of the workshop was to stimulate participation in the scientific community for planning and operation of the CNMS. A second planning meeting was held June 23-25, 2002, in Knoxville, Tennessee to investigate Candidate Research Focus Areas for CNMS.

The CNMS major scientific thrusts will be in nano-dimensional "soft" materials; complex nanophase materials systems; and theory, modeling, and simulation. The CNMS will provide access to the full cycle of materials design, synthesis, characterization and analysis, and properties-modeling capabilities at the nanoscale in order to rapidly advance understanding and permit tackling problems of a scope, disciplinary breadth, and complexity that is beyond current capabilities. The CNMS will provide the research infrastructure and environment needed to support highly collaborative research and multidisciplinary research education, including resident scientific collaborators, both long- and short-term visiting scientist positions, and technical support personnel.

The CNMS will use the intense neutron beams available at the new Spallation Neutron Source (SNS) and the upgraded High Flux Isotope Reactor to make broad classes of related nanoscale phenomena accessible to fundamental study for the first time. The significance of this neutron science focus is that neutron scattering provides unique information about both static and dynamic nanoscale self-organization that is complementary to data provided by other techniques. The CNMS will play an important role in strengthening the U.S. based neutron science community by helping it to provide scientific leadership in emerging research on nanoscale materials and processes.

The CNMS will be co-located with the SNS and the Joint Institute for Neutron Sciences on ORNL's SNS "new campus". The CNMS will occupy a nearly 80,000 square-foot building containing "wet" and "dry" materials synthesis and characterization laboratories; clean rooms; materials imaging, manipulation, and integration facilities; computer-access laboratories; and office space for staff and visitors. The layout of the office-laboratory complex is designed to maximize collaborative, multidisciplinary, and educational interactions.

The CNMS was selected for construction after an extensive peer review conducted at the end of April 2001. Five proposals from national laboratories were received for the establishment of five Nanoscale Science Research Centers (NSRC). The process for selection of the NSRCs involved review of the proposals by a group of experts having knowledge of both nanoscale science and the operation and management of centers and user facilities. The review included examination of the written proposals and oral presentations by each laboratory proposing an NSRC. The reviewers provided individual evaluations of each proposal. After consideration of their comments, proposals were ranked according to the criteria established.

The Total Project Cost of the CNMS project is $64.9 million. This includes a Total Estimated Cost of $63.9 million and $1 million of Other Project Costs. The TEC includes approximately $25 million, including contingency, allocated to technical instrumentation. Critical Decision 0, Approve Mission Need, was approved and the project validated in June 2001.

2. SCIENTIFIC PROGRAM

2.1 Findings

The technical program proposed for CNMS has been expanded in detail under seven themes, four of which are research directions (macromolecular complex systems, functional nanomaterials, nanoscale magnetism and transport, and catalysis and nanobuilding blocks) and three are enabling facilities with their associated research programs (nanomaterials theory institute, nanofabrication research laboratory and nanoscale imaging, and characterization and manipulation). Each of the themes is managed by two individuals: a scientific leader and an operational leader. Currently, Dr. Linda Horton serves as Project Director for Construction and oversees all other administrative aspects of the project including ES&H. During operations, CNMS will be managed by Director, Dr. Doug Lowndes, and Dr. Horton will serve as Deputy Director (both report to ORNL Associate Laboratory Director, Dr. James Roberto).

Based on internal discussions, recommendations by external reviewers, and two other exercises that sought input from external users, CNMS's instrumental and facilities holdings were refined and a clear understanding has emerged of the Center's equipment priorities. Approximately $22 million will be dedicated to equipment purchases. CNMS leadership has also identified high-field, solid-state nuclear magnetic resonance as the next equipment priority in line should funds become available.

Three advisory committees have been established to provide guidance, project priority, and advice. Two (the Users Executive Committee and the Proposal Review Committee) report to the CNMS Director. A "blue-ribbon" Scientific Advisory Committee (SAC) reports to the Associate Laboratory Director, Dr. Roberto.

2.2 Comments

The Committee was impressed with Dr. Lowndes' scientific leadership and Dr. Horton's management of the construction project. The Committee felt that the process used to prioritize and execute instrumental purchases was a good one and that appropriate choices have been made. The bidding process used to purchase equipment seems to have gone smoothly so far and the prices proposed by vendors appear fair. Indeed, one vendor secured the order for the e-beam writer by bidding competitively and including a scanning electron microscope in the bargain.

A prime component of the CNMS is its external user program that appears to have been appropriately planned, implemented, and staffed. Prudently, participation by users has already begun through the "jump start program" before the completion of the CNMS building, allowing the CNMS to create the user protocols and resolve some of the challenges before it is fully operational.

The plan to tie in the "Nanomaterials Theory Institute" with the much larger computational center at ORNL is potentially a great boon to the ability of CNMS to remain computationally competitive and world-class.

The Committee felt that management has done a credible job in planning the scientific program. However, it felt that the integration of the program with the SNS, arguably the best facility of its kind world-wide, has not been effected as fully and as directly as might have been the case. This is undoubtedly due, in part, to the fact that the SNS will not be fully operational for some four years. Nevertheless, it would be profitable to consider more deeply how neutron-based techniques could be used to advance nanoscience, thereby capitalizing on the unique opportunities provided by the proximity of the SNS.

It was felt that although the SAC has many distinguished members who are, indeed, icons of modern science by virtue of their distinction, the SAC seems to lack sufficient representation by the people who are currently creating and leading the nano field. Management's plan of adding five members to SAC in the near future may offer the opportunity to augment the composition of SAC along these lines.

2.3 Recommendation

1. Better integrate the SNS, as a premier, world-class investigative technique for nanoscience and technology into the scientific program.

3. CONVENTIONAL FACILITIES

3.1 Findings

CNMS conventional facilities consists of an approximately 80,000 square-foot office and laboratory building that includes three clean room areas of progressively higher quality. Baseline cost for the building is $34.9 million, and it is scheduled for completion in April 2005 (CD-4a, Approve Start of Initial Operations and Beneficial Occupancy).

The CNMS building is being constructed under a firm-fixed price construction subcontract to the Caddell/Blaine Joint Venture. Overall construction management is the responsibility of the Knight/Jacobs Joint Venture, the Architect/Engineer-Construction Manager for the adjoining SNS and for the CNMS general construction (excluding all technical equipment and its installation).

As of May 2004, the CNMS building was 29.7 percent complete versus a planned 30.6 percent (cumulative schedule performance index = 0.98), and was running slightly under budget with a cumulative cost performance index = 1.03. The overall project has $7.0 million of contingency remaining, of which approximately $3.3 million is associated with the conventional facilities. Approximately 14.3 percent contingency will be yielded on the remaining conventional facilities work.

Since award of the original construction subcontract, two Baseline Change Proposals (BCP) have been approved that added $1.2 million to the conventional facilities baseline. In addition, there is a pending change of approximately $48K that will be incorporated into a future BCP. The nature of these changes have been for omitted scope, functional improvements of baselined scope, and for new scope identified through new information gained in technical forums that add flexibility for later facility upgrades. Collectively, these changes have amounted to less than five percent in cost growth, and incorporation of the changes did not incur losses due to facility demolition or equipment discard (commonly referred to as “breakage”).

An earned value performance measurement system is in place to monitor progress of the conventional facilities construction. Monthly progress data, at a range of WBS levels from 3-5, is provided from Caddell/Blaine to Knight/Jacobs, and then to UT/Battelle for documentation into the project monthly reports to DOE. Both Knight/Jacobs and UT/Battelle perform progress verification checks of the reported data.

The UT/Battelle project lead has identified 17 control milestones for managing the construction effort. Five have already been completed through June 2004; however, the last milestone completed (Complete Structural Steel) was approximately one and one-half months late. Remaining control milestones for 2004 are in the September-November time-frame, and the construction subcontractor has identified 11 "critical activities" that will complete between June and September.

A formal project risk analyses process is in use that considers an item's probability of occurrence and the consequences of occurrence. Risk items cover design, construction, procurement, safety, and budgetary vulnerabilities; and the spectrum appears to be reasonable.

Safety culture at the construction site is very good, and the contractor identified a few facility design changes (hood sizes, furnace canopy, gas cabinets) that were driven by Integrated Safety Management analyses of operational hazards.

3.2 Comments

Planning and execution of conventional facilities work is going very well. General construction is covered under fixed price contract that has undergone relatively little change since award, remaining procurements supporting construction are nearly complete, and physical construction is nearly one-third complete. These circumstances lead to a high confidence that the conventional facilities will be completed within planned costs. The greatest threat to successful completion appears to be associated with maintaining the construction schedule. Given the delay observed in the most recently completed control milestone (Completion Structural Steel) and the number of near-term critical activities planned; it would appear that UT/Battelle should increase its monitoring of schedule progress, and report that progress to the DOE (monthly reports).

3.3 Recommendations

1. Identify additional control milestones from the upcoming critical activities as control points for monitoring schedule progress, and include the status of these milestones in future project monthly reports.

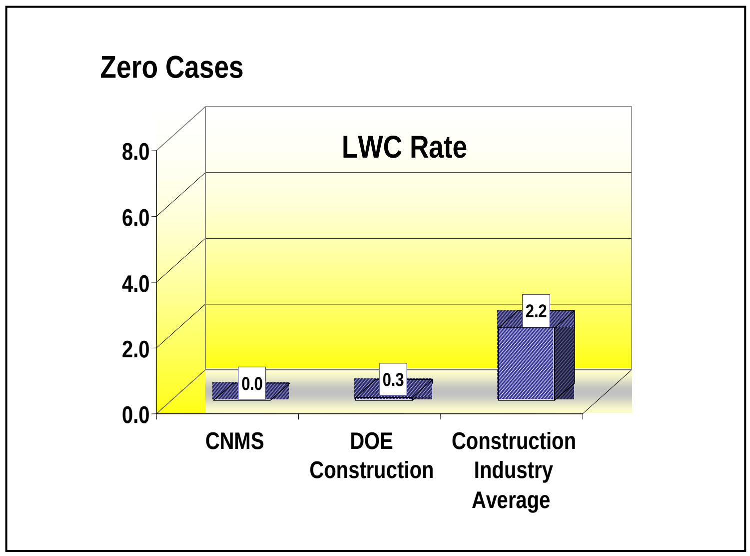
4. ENVIRONMENT, SAFETY AND HEALTH

The review addressed construction safety, facility design details identified in previous reviews, scientific equipment hazards analysis, and Integrated Safety Management (ISM). The CNMS project has clearly given ES&H focused attention.

4.1 Findings and Comments

Three recommendations made during the December 2002 DOE review have been satisfactorily addressed.

No issues were identified in the construction safety program. The SNS construction project's safety philosophy has been effectively applied to the CNMS building construction. At the time of the review, the CNMS project contractors had worked 60,000 construction hours without a lost-time or recordable incident. The apparent attention to detail in housekeeping and layout of the CNMS material observed during the facility site visit reflected the level positive project construction performance.



The project has a process in place to identify hazards associated with new scientific equipment called the "Research Safety Summary." This identifies equipment specific and associated work related hazards for each CNMS laboratory and identifies appropriate safety controls at a high level. This analysis process will provide a baseline for the analysis of proposed experiments when the project commences operations. The CNMS is also adopting proven experiment safety review processes being used by other ORNL divisions to define work/experiment-specific safe work procedures.

In addition to logging laboratory work in a laboratory notebook, it is suggested that the CNMS consider generating a document from the experiment safety review process that can be posted at the door of each laboratory that readily identifies the activities and associate hazard controls underway for the benefit of management and individuals with oversight responsibility.

ISM principles are being applied on the SNS project in construction and preparation for installation and commissioning of technical systems.

4.2 Recommendations

None.

5. COST ESTIMATE

5.1 Findings

The Total Project Cost of the project is $64.9 million as of Baseline Change Proposal (BCP) 07. This includes a Total Estimated Cost of $63.9 million and Other Project Cost of $1 million. A comparison to the original baseline cost estimate at the December 2002 DOE review is shown in Table 5-1.

Table 5-1. Original Baseline Cost Estimate Compated to BCP-07 (million dollars)

	IPR		BCP-07	
WBS 2.1 Technical Equipment	$24,910		$22,015	
WBS 2.2 Conventional Facilities	$30,240		$34,872	
Contingency (% of work to go)	$ 8,850	(16%)	$ 6,995	(16%)
Total TEC	$64,000		$63,882	
Other Project Costs	$ 1,000		$ 1,000	
Total TPC	$65,000		$64,882	

Overall project contingency is currently estimated at $7 million or approximately 16 percent of the remaining costs. A Risk Assessment Plan is in place that identifies major areas of risk for the project and includes mitigating actions—it is reviewed monthly and formally updated as needed. Mitigating actions are underway to minimize consequences of identified concerns on the project. The Technical Equipment Plan includes a prioritized list of additional equipment that could be procured if sufficient funds remain near the end of the construction phase of the project.

5.2 Comments

The project's cost baseline is consistent with the FY 2005 Project Data Sheet and the proposed Revision-2 to the Project Execution Plan.

The Committee concluded that the remaining contingency is adequate, taking into account that 40 percent of the technical equipment cost estimate is based on commitments and that a fixed price contract for the conventional construction is in place. The contingency is supported by and consistent with an appropriate project-wide risk analysis.

5.3 Recommendations

None.

6. SCHEDULE and FUNDING

6.1 Findings

The project schedule of Critical Decision (CD) approvals is as follows:

CD-0	Approve Mission Need	June 13, 2001
CD-1	Approve Preliminary Baseline Range	February 22, 2002
CD-2	Approve Performance Baseline	September 5, 2002
CD-3	Approve Start of Construction	February 3, 2003
CD-4a	Approve Start of Initial Operations	April 30, 2005
CD-4b	Approve Start of Full Operations	September 30, 2006

The overall project is 24.7 percent complete through May 2004 compared to a planned 25.2 percent. The conventional construction is 29.7 percent complete compared to the plan of 30.6 percent. The construction contractor has provided a recovery plan to correct this variance. Technical equipment is on schedule at 7.1 percent complete.

There is one month of schedule contingency for the CD-4a date and three and one-half months for the CD-4b date.

The current funding profile per the FY 2005 Project Data Sheet is shown in Table 6-1.

Table 6-1. Budget Authority Profile (million dollars)

	2001	2002	2003	2004	2005	2006	Total
TEC-PED		1,500	988				2,488
TEC-Construction			23,701	19,882	17,811		61,394
OPC	250	225	100	250	100	75	1,000
Total	250	1,725	24,789	20,132	17,911	75	64,882

6.2 Comments

The overall project schedule, project start, and project completion are consistent with the FY 2005 Project Data Sheet and the proposed Revision-2 to the Project Execution Plan.

The Committee concluded that the schedule and funding are credible and reasonable. The total duration of 21 months for the conventional construction includes one month of schedule contingency. The schedule contingency is supported by and consistent with an appropriate project-wide risk analysis. The information in the DOE Project Assessment Reporting System (PARS) is consistent with physical progress.

6.3 Recommendations

None.

7. MANAGEMENT

7.1 Findings

The CNMS project is being managed appropriately for this stage of the project. The Integrated Project Team is very capable and demonstrates a good working relationship based on frequent communications including routine (weekly and monthly) meetings and reports. The Project Team has presented a credible plan for completion of the project within cost and schedule baselines.

Earned Value Management System (EVMS) performance data appears to reflect actual project conditions and PARS data is accurate and consistent. Monthly and quarterly progress reports are prepared by the Federal Project Director and are provided to DOE management as required.

Project risk analysis and contingency plans are credible and reasonable. Remaining contingency of approximately $7 million represents approximately 16 percent of remaining work, which appears adequate for this stage of the project. Monthly EVMS reports are used by Project Management to identify potential schedule impacts. If necessary, recovery plans are prepared by subcontractors to minimize impacts to project completion.

7.2 Comments

The project continues to benefit from close interface with the SNS project. Continuation of this partnership is recommended. Knight/Jacobs Joint Venture provides continuity between projects and insures safe, consistent site management.

The possibility of delaying CD-4a until October 2005 was discussed, since facility operating funds will not be available until FY 2006. The Committee recommended completing CD-4a in April 2005 as currently planned, and funding building maintenance and operation with line-item funds.

The CNMS project has updated the risk management plan and utilized the results to identify contingency requirements for remaining project components. At this time, it is appropriate to begin planning for the possibility that some contingency funds will remain after project completion. The project should continue development of a prioritized list of facility and/or scientific equipment needs to obtain with any remaining project funds.

The CNMS has prepared a draft Transition to Operations plan that provides a clear roadmap to beneficial occupancy and operations for CNMS. The plan should clearly define both Federal and contractor roles in the facility acceptance process.

7.3 Recommendations

1. Finalize the prioritized list of facility and/or scientific equipment needs to obtain with any remaining project funds. Complete this prior to CD-4a.

2. Complete the Transition to Operations plan, with clear definition of both Federal and contractor roles in the facility acceptance process. Complete this prior to CD-4a.

APPENDIX A

CHARGE MEMORANDUM

United States Government
Department of Energy

memorandum

DATE: May 19, 2004

REPLY TO
ATTN OF: SC-10

SUBJECT: CENTER FOR NANOPHASE MATERIALS SCIENCES STATUS REVIEW

TO: Daniel R. Lehman, Director, SC-81

I would like to request that you organize and lead an Office of Science (SC) status review of the Center for Nanophase Materials Sciences (CNMS) project in Oak Ridge, TN, from July 20th - July 22, 2004. The purpose of this review is to evaluate progress in all aspects of the project: technical, cost, schedule, management, and Environmental Safety and Health (ES&H).

The CNMS project received Critical Decision 3 (Approve Start of Construction) on February 3, 2003. The groundbreaking ceremony took place on July 18, 2003. Erection of structural steel for the building was completion in April 2004, siding is progressing, and technical equipment purchase requests are being prepared. Procurement of the E-beam lithography tool and 2 other major items of technical equipment, the 4-probe Scanning Electron Microscope (SEM) and the High Resolution Spin Polorized Scanning Electron Microscope (SEMPA), are proceeding. Cleanroom construction is forecast for completion in January 2005. Full construction and beneficial occupancy for the building is forecast for completion April 2005 (Critical Decision 4a, Start of Initial Operations). Based on progress to date, comments from the November 2002 Department of Energy (DOE) Independent Project Review, and the project schedule completion date of September 2006, the committee should devote special attention to issues regarding site and schedule risks, cost and scheduled management, contingency management, and documentation of construction, equipment, procedures, and baseline changes. Special issues concern shortages in both steel and electrical commodities.

In carrying out its charge, the review committee is requested to consider the following questions:

1. Are the project's cost, schedule, and technical baselines consistent with those in the FY2005 Project Data Sheet and the current DOE-approved CNMS Project Execution Plan, and is there adequate progress to meet the baseline objectives? Is the information in the DOE Project Assessment Reporting System consistent with physical progress?

2. Is the project being managed as needed for its proper execution?

3. Is there adequate contingency (cost and schedule) to address the risks inherent in the remaining work and is it being properly managed? Is the contingency supported by and consistent with an appropriate project-wide risk analysis?

4. Are ES&H aspects being properly addressed given the project's current stage of development? Are Integrated Safety Management Principles being followed?

5. Has the project responded appropriately to recommendations from prior DOE/SC reviews?

Kristin Bennett, the NSRC Program Manager for CNMS, will serve as the Basic Energy Sciences point of contact for this review. I would appreciate receiving your committee's report within 60 days of the review's conclusion.

Patricia M. Dehmer
Associate Director of Science
for the Office of Basic Energy Sciences

cc:
S. Tkaczyk, SC-81
K. Chao, SC-81
A. Carim, SC-12
J. Hoy, SC-12
K. Bennett, SC-12
P. Montano, SC-12
D. Arakawa, Oak Ridge Site Office
L. Horton, ORNL
D. Lowndes, ORNL
J. Stellern, ORNL
C. Clark, SC-81
L. Cerrone, SC-12
M. Martin, SC-10

APPENDIX B

REVIEW PARTICIPANTS

Department of Energy Review of the
Center for Nanophase Materials Sciences (CNMS) Project at ORNL

REVIEW COMMITTEE PARTICIPANTS

Department of Energy

Daniel Lehman, DOE/SC, Chairperson
Steve Tkaczyk, DOE/SC

Committee

Rich Hislop, ANL
Dean Martin Moscovits, UCSB
Greg Pitonak, DOE/PPPL
David Wilfert, DOE/ORO

Observers

Pat Dehmer, DOE/SC
Kristen Bennett, DOE/SC
Jeff Hoy, DOE/SC
David Arakawa, DOE/ORO

APPENDIX C

REVIEW AGENDA

Department of Energy Review of the Center for Nanophase Materials Sciences (CNMS) Project

AGENDA

Tuesday, July 20, 2004—Doubletree Hotel (Oak Ridge TN)

8:00 am	DOE Executive Session	Lehman
8:45 am	Welcome: DOE	Dehmer/Bennett
	Welcome: ORNL	Roberto
9:00 am	CNMS Overview including cost, schedule, management	Horton
9:45 am	Break	
10:00 am	Conventional Facility Status including site utilities	Stellern
10:45 am	CF: ES&H	Kornegay
11:00 am	Technical Equipment including procurement status	Horton/Geouque
11:25 am	Laboratory Layouts/Operational ESH	Horton/Ogle
11:55 am	Lunch	
1:00 pm	Breakout Sessions	
	ESH (both construction and operational)	Ogle/Kornegay
	Conventional Facility (including cost and schedule)	Stellern et al.
	1. ORNL Earned Value Management – Gerald Scott - 45 minutes	
	2. Knight/Jacobs CM Construction Planning and Scheduling– Steve Tourville - 45 minutes	
	3. Knight/Jacobs Construction Management – Jim Gibson - 30 minutes	
	Technical Equipment	Horton et al.
3:15 pm	Site Tour	Stellern
4:15 pm	CNMS Science Overview	Lowndes et al.
5:00 pm	Executive Session/Report Writing	

Wednesday, July 21, 2004

8:30 am	Breakout Sessions	
	Science (Board Room)	Lowndes et al.
	1. Nanoscience User Program – Tony Haynes -12 minutes	
	2. Macromolecular Complex Systems – Phil Britt -15/16 minutes	
	3. Functional Nanomaterials – Alex Puretzky -15/16 minutes	
	4. Nanofabrication and Nano-Bio – Mitch Doktycz – 15/16 minutes	
	5. Nanoscale Magnetism, Transport, and UHV Scanning Probes – Jian Shen -15/16 minutes	
	6. Nanomaterials Theory Institute: Theory, Modeling and Simulation –Thomas Schulthess -15/16 minutes	
	Conventional Facilities	Stellern et al.
12:00 pm	Lunch	
1:00 pm	CNMS Project Discussion	Horton/Stellern
2:30 pm	Executive Session/Report Writing	
5:00 pm	Executive Session Closeout Dry Run	

Thursday, July 22, 2004

7:30 am	Executive Session/final discussion and any closeout changes
8:00 am	Closeout Briefing
9:00 am	Adjourn

APPENDIX D

COST TABLE

The CNMS Total Project Cost is ~$65M

	IPR ($K)	BCP-07 ($K)
2.1 Technical Equipment	$24,910	$22,015
2.1.1 Equipment	$22,960	$20,065
2.1.2 Procurement	$ 250	$ 250
2.1.3 Installation	$ 565	$ 565
2.1.4 Test & Checkout	$ 195	$ 195
2.1.5 Design Support (Specs)	$ 190	$ 190
2.1.6 Project Management (Design)	$ 55	$ 55
2.1.6 Project Management	$ 695	$ 695
2.2 Conventional Facilities	$30,240	$34,872
2.2.1 Design	$ 2,050	$ 2,067
2.2.2 Construction	$24,180	$28,924
2.2.3 Project Management	$ 400	$ 405
2.2.4 Design Support	$ 300	$ 366
2.2.5 Construction Management	$ 1,800	$ 1,800
2.2.6 Construction Support	$ 1,110	$ 700
2.2.7 AE Title III	$ 400	$ 610
Contingency 16% (IPR); 16% (May 31, 2004)	$ 8,850	$ 6,995
Total TEC	$64,000	$63,882
Other Project Costs	$ 1,000	$ 1,000
Total TPC	$65,000	$64,882

Project Baseline and Cost Status

		Baseline (Based on BCP-07)	Cost to Date Through May 31, 2004	Cost plus Commitments
2.1	**Technical Equipment**			
	2.1.1 Technical Equipment	20,065,000	1,249,941	7,900,177
	2.1.2 Procurement Support	250,000	24,917	24,917
	2.1.3 Installation	565,000	0	0
	2.1.4 Test & Checkout	195,000	0	0
	2.1.5 Specification Development	190,000	79,306	79,306
	2.1.6 Project Mgmt (during Design)	55,000	50,735	50,735
	2.1.6 Project Mgmt (during Construction)	695,000	122,423	122,423
	Technical Equipment Subtotal	***22,015,000***	***1,527,322***	***8,177,558***
2.2	**Conventional Facility**			
	2.2.1 Design	2,067,000	2,046,963	2,046,963
	2.2.2 Construction	28,924,000	8,233,148	20,512,112
	2.2.3 Project Management	405,000	129,488	129,488
	2.2.4 Design Support	366,000	365,672	365,672
	2.2.5 Construction Management	1,800,000	394,601	694,537
	2.2.6 Construction Support	700,000	113,816	214,539
	2.2.7 Title III Service	610,000	524,328	527,228
	Conventional Facility Subtotal	***34,872,000***	***11,808,016***	***24,490,539***
Total	Estimated Cost (TEC):	*56,887,000*	*13,335,338*	*32,668,097*
2.3	**Other Project Costs**			
	2.3.1 CDR/VE Study	378,000	377,142	377,142
	2.3.2 Scientific Scope Development	200,000	96,816	96,816
	2.3.3 ESH Documentation/training	390,000	0	0
	2.3.4 Engineering Support	32,000	32,148	32,148
	Other Project Costs Subtotal	***1,000,000***	***506,106***	***506,106***
Baseline Total:		***57,887,000***	***13,841,444***	***33,174,203***
CONTINGENCY (16%)		***6,995,000***		
Total Project Cost (TPC):		64,882,000		**51%**

APPENDIX E

SCHEDULE CHART

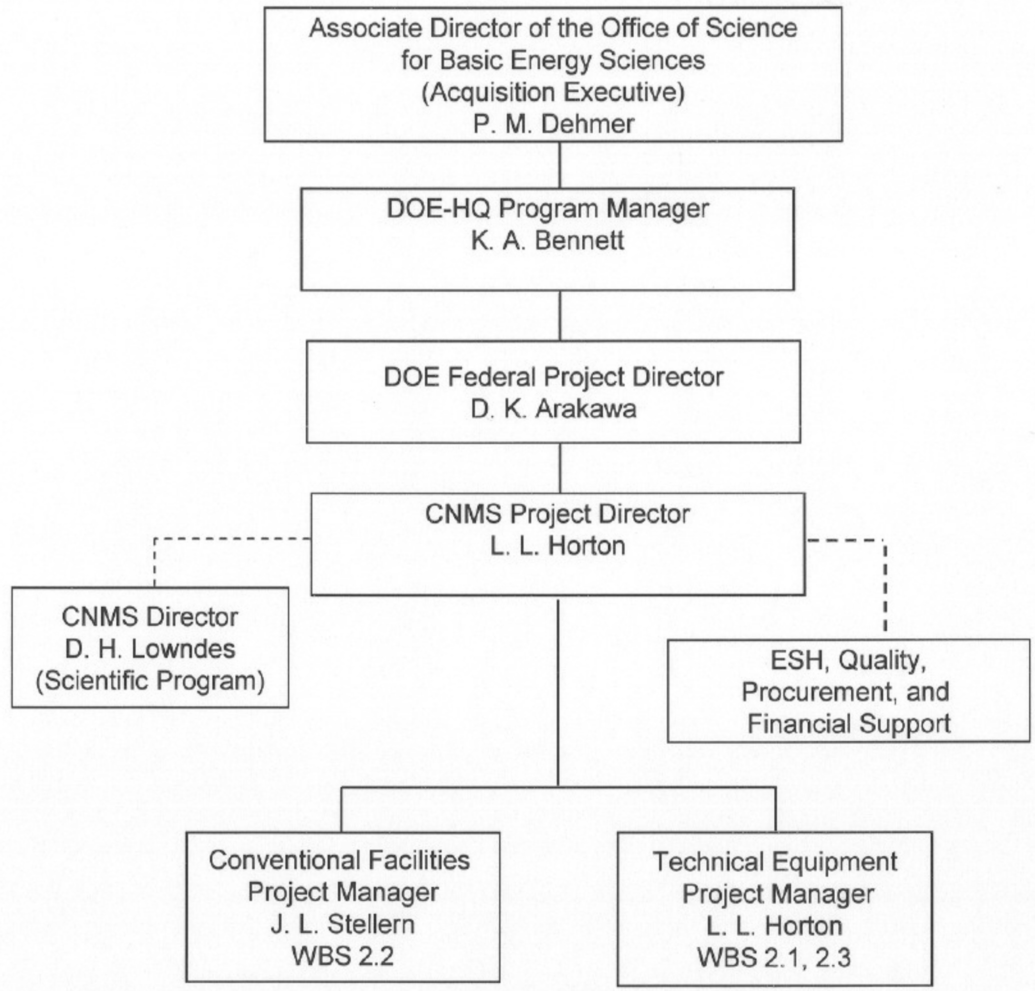
CNMS Schedule – The project is on sched April 2004 BOD and CD-4A

Current Estimated Start	Current Estimated Finish	FY02 Q2 Q3 Q4 · FY03 Q1 Q2 Q3 Q4 · F4 Q1 Q2 Q3 Q4 · FY05 Q1 Q2 Q3 Q-Q4 · FY07 Q1
CS		Center for Nanophase Matl Sciences
	27FEB02A	CD-1 Approve Prelim Baseline
01MAR02A	31MAY03A	2.2.1 Design
03JUN02A	29AUG02A	DOE EIR
	05SEP02A	DOE CD-2 Appr Performance Milestone
01OCT02A	29SEP06	2.1.1 CNMS Technical Equipment
10DEC02A	31JAN03A	DOE IPR
	03FEB03A	DOE CD-3 Approve Start of Const
17MAR03A	25JUL03A	Bid and Award General Constrction
25JUL03A	29APR05	CNMS Conventiona'acility Construction
	29APR05*	Beneficia
	29APR05*	CD-4A Ap
	29SEP06*	f Full Op

APPENDIX F

MANAGEMENT CHART

CNMS Project Organization Structure



Detailed Organization Structure

L. L. Horton
Director
A. S. Benn, Secretary

Financial Support
C. J. Cromwell
G. L. Scott

Environment, Safety, and Health
F. C. Kornegay

Operational Safety
R. B. Ogle

Procurement
J. Geouque

Quality Assurance
Kent Calfee
M. C. Vance

Technical Equipment
L. L. Horton
Project Manager

Technical Equipment Team

Clean Room
R. J. Kasica
Wet Chemistry, Soft Materials, Hoods, and Lab Benches
P. F. Britt
Computing Equipment
P. T. Cummings
X-ray Equipment
J. D. Budai
Laser Synthesis/Characterization
D. B. Geohegan
Scanning Probes
J. F. Wendelken
Installation
Jack Stellern

Conventional Facilities
J. L. Stellern
Project Manager

Conventional Facilities Project Team

C. L. Garren, Team Leader
F. Carden, Electrical
W. L. Collier, HVAC
R. M. Collins, Structural
R. Echols, Scheduler
J. Eckroth, Fire Protection
J. Lollar, AE/CM Cost Estimator
R. C. Peters, Architectural
J. Gibson, AE/CM Construction Engineer
C. Smith, Piping
S. Tourville, AE/CM Scheduler
W. Whitman, AE/CM Design Manger

Other Project Costs
L. L. Horton
Project Manager

Scientific Advisory Group

D. H. Lowndes, **CNMS Scientific Director**
M. V. Buchanan
J. F. Cooke
T. E. Haynes, **CNMS User Coordinator**
D. Joy/I. M. Anderson
E. W. Plummer
M. L. Simpson
J. M. Simonson

APPENDIX G

WBS EQUIPMENT LIST

CENTER FOR NANOPHASE MATERIALS SCIENCES
PROJECT LINE ITEM TECHNICAL EQUIPMENT

Fourier Transform Infrared Spectrometer (FTIR)	130	*	
Matrix–assisted laser desorption/ionization time–of–flight mass spectrometer (MALDI–TOF–MS)-benchtop	255	*	
Physical characterization of polymers: DSC	110	*	
Surface Analysis Equipment: Ellipsometer	77		
Simultaneous Static and Dynamic Light Scattering Spectrometer	130	*	
Nanophase Materials Synthesis And Characterization Equipment			**3,236**
MOPO and YAG Laser Systems	487		
Ti-sapphire Laser	312		
Tunable Raman Spectrometer	400		
4-probe transport Scanning Tunneling Microscope	1,437	F*	
High–resolution Spin–polarized Scanning Electron Microscope (SEMPA)	600	F	
NanoFabrication Research Laboratory			**8,982**
Direct Write Electron Beam Lithography (DWEBL) System	4,900	F	
Double–Sided Contact Mask Aligner and Wafer Bonder System	425		
Laser Pattern Generator/Mask Writer	800		
Electron Beam Lithography and Photolithography Resist Processing Equipment and development tools (Photo Resist Track; spin coaters procured)	440	*	
Plasma Etching and Deposition Equipment (Sputter Depos. Procured)	850		
Oxidation, Annealing, Diffusion and Low Pressure Chemical Vapor Deposition Furnaces	660		
Thin Film Processing Equipment	100		
Metrology and Inspection Tools	310		
Ancillary Equipment	497	*	
Nanomaterials Theory Institute			**467**
32-node Beowulf Cluster	277		
7 SGI Graphic Workstations	105		
16 screen video wall	85		
General Use Equipment			**3,959**
X–ray Diffraction Laboratory for Multi–User Nanoscience	720	*	
Focused Ion Beam (FIB) / Scanning Electron Microscope (SEM) (Dual–Beam System)	1,000	*	
Laboratory Fume Hoods, furnishings, misc. equip.	950		
Furniture, personal computers, and data system equipment	1,289		
Subtotal Equipment List			**17,821**

Blue: order placed (>40% of total projected equipment expenditures)
Potential Foreign Procurements (less than 1/3 of remaining)

CENTER FOR NANOPHASE MATERIALS SCIENCES
EXISTING TECHNICAL EQUIPMENT TO BE MOVED OR MADE AVAILABLE TO CNMS

Soft Materials Characterization	
Gas Chromatograph/Mass Spectrometer (GC/MS), Gas Chromatograph (GC), and High Performance Liquid Chromatography (HPLC)	Affiliated
Raman spectrometer	Affiliated
AFM (if NMR is not purchased) (Lab B1)	
Thermal Characterization Equipment (Lab 25)	
Surface Char. Equip (Lab 26)	
Bench top Freeze Dryer (Lab 31)	
RotoVap/Pump (lab 31)	
Electronic balances (lab 31)	
Annealing Oven (Lab 32) – may be future operating purchase	
Bench top Centrifuge (Lab 35)	
Vise Table (Lab 38)	
Nanophase Materials Synthesis and Characterization	
Glove Box (Lab B2)	
Marble Weighing Bench (Lab B2)	
Tube Furnaces: 1700 C and 1200 C w/ accessories (Lab B2) – may be future purchase	
Optical Microscope (Lab B2)	
UV-Vis-NIR Spectrophotometer (Lab B3)	
Photoluminescence Excitation System (Lab B3)	
Variable Temp. Photoluminescence Excitation (Lab B3)	
Fluorometer on Optical Table (Lab B3)	
Three MBE sources (operating purchases) (B4)	
UHV Transport System with laser MBE, linear MOKE, and VT AFM/STM (Lab B5/6)	
Three MBE sources (operating purchases) (B7/8)	
Ultra-low temperature high magnetic filed STM (under development) (Lab B7/8)	
Furnaces: 2 large box furnaces (1500 C; 2 medium box furnaces (1200 C); 1 large tube furnaces (1500 C); 2 small tube furnaces (1100 C) (Lab 11)	
250 ton press (Lab 11)	
Marble Weighing Bench (Lab 11)	
Laser labs: Curtain plus laser interlock system (Labs 13/14, 15/16, 17/18)	
Double YAG Laser (Lab 13/14)	
CVD Oven, Laser over, and collector on optical tables (lab 13/14)	
Laser diagnostic systems (Lab 15/16)	
Excimer laser Lambda Physik LPX305 (Lab 17/18)	
Excimer laser Lambda Physik LPX325(Lab 17/18)	
Gas processor; (2) (Lab 17/18)	
(2) UHV Thermionics Laser-MBE systems (Lab 17/18)	
(5) PLD systems (Lab 17/18)	
CVD Equipment: Microwave plasma-CVD system (40 kW); 2 DC glow discharge plasma-CVD systems (20 kW); Cold-wall CVD chamber: Cold-wall beam-growth chamber; and hot-wall CVD furnace (Lab 21)	
Surface Characterization Equipment (26)	

Nanofabrication Reserach Laboratory	
Reduction Photolithography System	Future Upgrade desired
Chlorine- and Fluorine-based Reactive Ion Etching Equipment	Future Upgrade desired

CENTER FOR NANOPHASE MATERIALS SCIENCES
OUTYEAR CAPITAL EQUIPMENT PLAN

700 MHz wide bore (Lab B1)				
NanoSims (alternate to NMR – Lab B1)	2,200			
Advanced Polymers Characterization Tools (GC/MS, GC, HPLC, Langmuir Trough, BET Isotherms, DMA, Fluorometer, Elipsometer) (Lab 22)	429			
Glove Boxes (3) – Misc locations	150			
Raman spectrometer (Lab 23)				200
Thermal gravimetric analyzer (TGA)/mass spectrometer (Lab 22)				160
Floor standing centrifuge (Lab 38)				25
Catalysts and Nano-Building Blocks				
Scattering Shear Cells (Lab 25)				350
AFM/SERS System (Lab 25)				??
In-situ FTIR (lab 25)				??
Temporal Analysis of Properties (TAP) Reactor (Lab 26)				??
BET and Specific Gas Adsorption Unit (Lab 26)				??
TPD, TPR, and Pulsed Reaction Unit (Lab 26)				??
Combinatorial Catalytic Reactor System (Lab 27)		139		
Functional Nanomaterials and Nanoscale Magnetism and Transport				
Nanosquid (Lab B3)				200
PPMS with Vibrating Sample Magnetometer (Lab B3)				175
Squid Magnetometer (Lab B3)				100
RHEED System				45
SPM/SEM/SAM (B4)				800
SEMPA Upgrade (B5)				800/1,400
Scanning Near-Field Optical Kerr Microscope (B7/8)				286
High Field, Low Temp Scanning Probe Microscope (Lab B7/8)		942		
Variable Pulse Width Laser (Lab 13/14)				80
High Rep Rate Nd:Yag Laser (Lab 15/16)				110
Femtosecond laser (Lab 15/16)				360
Nanoscale Photonics Laboratory (15/16)				515
Pulsed Laser Deposition System for Ultra-thick Artificially Structured Materials (Lab 17/18)			707	
Hot Wall CVD Furnance (2) (Lab 21)	40			

	FY06 and Contin-gency	FY07	FY08	FY09 and beyond
Nanofabrication Research Laboratory				
Deep UV Stepper				1,000
Substrate Bonding				165
Plasma Vapor Deposition Equipment				250
Soft Materials Lithography			668	
Laser Confocal Microscope				300
RIE, Fluorine based with ICP				300
Nanomaterials Theory Institute				
Access to CCS	500	500	500	
Characterization, Imaging, and Manipulation				
FE-SEM (CR: SEM)	**833**			
Temperature stages for four-circle x-ray diffractometer (Lab 11)	**50**			
CCD area detector for x-ray crystal structure determinations. (Lab 11)	**200**			
Nanomanipulator and Probe for TEM (CR: TEM)				100
FE-TEM for holography/tomography (CR: TEM)				2000
Intermediate voltage FE-S/TEM (CR)	**1,300**			
Neutron Environments: TBD; High Temperature (@60K), High Pressure (@240K), High mag. field, pressure, temp (@625K), Low Temp, high mag. field (@400)		275		
Nano end station for magnetism reflectometer (SNS)				1, 500
Subtotal – Capital Equipment				