

# ESAAB-Equivalent Review

**Office of Basic Energy Sciences**

**CD-2, Approve Performance Baseline**

for the

**Center for Nanophase Materials Sciences**

**A Nanoscale Science Research Center**

**at ORNL**

**September 2002**

**ORNL Site Office**

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# Mission Need

- **The mission of the Office of Science is**  
***“To advance basic research and the instruments of science that are the foundations for DOE’s applied missions, a base for U.S. technology innovation, and a source of remarkable insights into our physical and biological world and the nature of matter and energy.”***

## Mission Need (con't.)

- **Nanoscale Science Research Centers (NSRC) were recommended by the NSTC Interagency Working Group on Nanoscale Science, Engineering, and Technology (IWGN) as part of DOE's contribution to the National Nanotechnology Initiative.**
- **IWGN recognized importance of establishing NSRCs with facilities having x-ray and neutron scattering capabilities.**

## Mission Need (con't.)

- **The CNMS will be a highly collaborative and multi-disciplinary user facility that provides a unique resource for nanoscale science research.**
- **The CNMS will integrate nanoscale research with neutron science, synthesis science, and theory/modeling/simulation.**

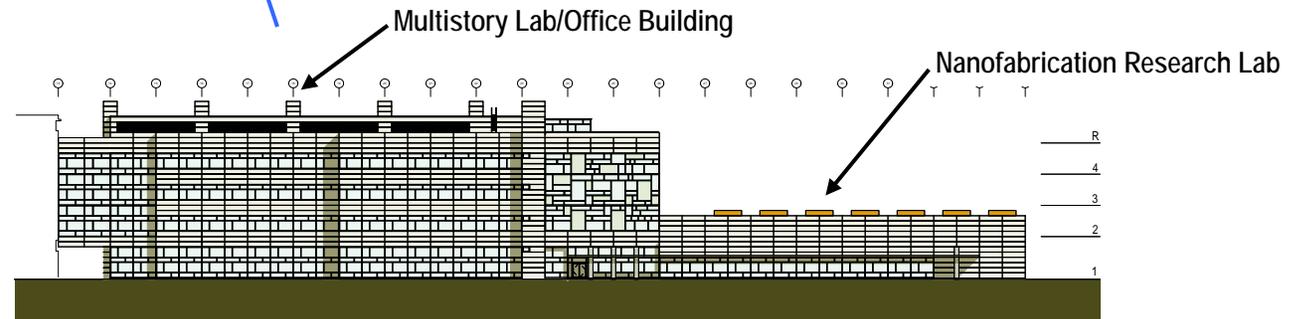
# Project Scope

- **The CNMS is composed of a multi-story building approximately 80,000 gsf, including a four story office and lab building and a connected single story clean room building and it will be located at the SNS Complex.**
  - **The Nanofabrication Research Laboratory is approximately 10,000 gsf, including clean rooms and support spaces.**
  - **The four story portion of the facility includes wet and dry research labs, the Nanomaterials Theory Institute, and offices for staff and visiting researchers.**
- **The baseline list of technical equipment is included in the Systems Requirements Document X-OE-905 Revision 2**

# Center for Nanophase Materials Sciences



- **CNMS will be located adjacent to the Central Lab and Office Building on the SNS campus**



# Nanofabrication Research Lab (NRL)

- **Clean rooms and service chases comprise 10,000 gsf and include class 100, class 1,000 and class 10,000 space depending on the equipment located in the space.**
- **Design features were provided to meet the EVA (Electromagnetic fields, vibration, and acoustic) requirements for the technical equipment.**

# CNMS Technical Equipment Capabilities

- **Technical equipment capabilities were defined by the technical community at two nanoscience workshops.**
- **CNMS will provide:**
  - **Synthesis equipment for soft, hard and hybrid nanoscale materials**
  - **Nanofabrication equipment for patterning and synthesis on the nanoscale**
  - **Nanophase characterization (molecular, structural, chemical, magnetic) equipment**
  - **Dedicated computational resources**

# CNMS Technical Equipment

- **Soft Materials Characterization**
  - **Gel Permeation Chromatography (GPC) and High Temperature GPC with Light Scattering Detector**
  - **UV–Vis Spectrophotometer**
  - **Fourier Transform Infrared Spectrometer (FTIR)**
  - **Nuclear Magnetic Resonance Spectrometer (NMR) - 600 MHz**
  - **Matrix–assisted laser desorption/ionization time–of–flight mass spectrometer (MALDI–TOF–MS)-benchtop**
  - **Physical characterization of polymers**
  - **Surface Analysis Equipment: Ellipsometer**
  - **Simultaneous Static and Dynamic Light Scattering Spectrometer**

# CNMS Technical Equipment

- **Nanophase Materials Synthesis and Characterization Equipment**
  - **MOPO and YAG Laser Systems**
  - **Continuous Wave (CW) Ti-sapphire Ring Laser**
  - **Tunable Raman Spectrometer**
  - **4-probe transport Scanning Tunneling Microscope**
  - **High-resolution Spin-polarized Scanning Electron Microscope (SEMPA)**

# CNMS Technical Equipment

- **Nanofabrication Research Laboratory**
  - **Direct Write Electron Beam Lithography (DWEBL) System**
  - **Double-Sided Contact Mask Aligner and Wafer Bonder System**
  - **Laser Pattern Generator/Mask Writer**
  - **Electron Beam Lithography and Photolithography Resist Processing Equipment and Development Tools**
  - **Plasma Etching and Deposition Equipment**
  - **Oxidation, Annealing, Diffusion and Low Pressure Chemical Vapor Deposition Furnaces**
  - **Thin Film Processing Equipment**
  - **Metrology and Inspection Tools**
  - **Ancillary Equipment**

# CNMS Technical Equipment

- **Nanomaterials Theory Institute**
  - 32-node Beowolf Cluster
  - 7 SGI Graphic Workstations
  - 16 screen video wall
- **General Use Equipment**
  - X-ray Diffraction Laboratory for Multi-User Nanoscience
  - Focused Ion Beam (FIB) / Scanning Electron Microscope (SEM) (Dual-Beam System)
  - Laboratory Fume Hoods, furnishings, misc. equip.
  - Furniture and computers

# Funding Profile

FY	BA	Commitment	Cost	OPCs
<b>PED</b>				
2001	\$ 0	\$ 0	\$ 0	\$ 0.250 M
2002	\$ 1.5 M	\$ 1.5 M	\$ 1.5 M	\$ 0.225 M
2003	\$ 1.0 M	\$ 1.0 M	\$ 1.0 M	
<b>Construction</b>				
2003	\$ 24.0 M	\$ 24.0 M	\$ 14.0 M	\$ 0.100 M
2004	\$ 20.0 M	\$ 20.0 M	\$ 20.0 M	\$ 0.250 M
2005	\$ 17.5 M	\$ 17.0 M	\$ 21.5 M	\$ 0.100 M
2006	\$ 0	\$ 0.5 M	\$ 6.0 M	\$ 0.075 M
<b>Total</b>	<b>\$ 64.0M</b>	<b>\$ 64.0M</b>	<b>\$ 64.0 M</b>	<b>\$ 1.000 M</b>

# Performance Baseline Cost Estimate

<b>PED</b>	<b>\$ 2,300,000</b>
<b>Construction</b>	<b>27,900,000</b>
<b>Technical Equipment</b>	<b><u>24,750,000</u></b>
<b>Subtotal</b>	<b>54,950,000</b>
<b>Contingency (16.5% of subtotal)</b>	<b><u>9,050,000*</u></b>
<b>Total Estimated Cost</b>	<b>\$ 64,000,000</b>
<b>Other Project Costs</b>	<b>1,000,000</b>
<b>Total Project Costs</b>	<b>\$ 65,000,000</b>

**\*Includes \$200K of PED funds**

# Performance Baseline Schedule

<u>Task/Milestone</u>	<u>Start</u>	<u>Finish</u>
CD-0 (Approve Mission Need)	Jun 01	Jun 01 C
CD-1 (Approve Prelim. Baseline Range)	Feb 02	Feb 02 C
Title I & II Design	Mar 02	Nov 02
External Independent Review	Jul 02	Aug 02 C
CD-2 (Approve Performance Baseline)	Sep 02	Sep 02
Independent Project Review	Dec 02	Jan 03
CD-3 (Approve Construction Start)	Feb 03	Feb 03
Construction	Apr 03	Nov 04
CD-4a (Initial Equip. Operations)	Dec 04	Dec 04
CD-4b (Full Operations)	Sep 06	Sep 06

# CD-2 Prerequisites

- **CD-0 (Approve Mission Need)** 6/01
- **NEPA Review** 6/01
- **Safety Assessment** 11/01
- **CD-1 (Approve Preliminary Baseline Range)** 2/02
- **Preliminary Design** 6/02
- **Performance Baseline External Independent Review** 8/02
- **Independent Cost Review** 8/02
- **Review of Contractor Project Management System** 8/02
- **Final Project Execution Plan and Perf. Baseline** 9/02
- **FY 2003 Budget Project Data Sheet is in the President's Budget Request**

# External Independent Review (EIR)

- **JUPITER Corporation conducted the External Independent Review (EIR) in July 2002.**
- **The EIR team (6 members) reviewed project documents and performed an Independent Cost Review (ICR).**
- **Overall, “the CNMS project is needed, supports the overall Office of Science mission, and, therefore, is justified.”**
- **The cost estimate is “reasonable and realistic.”**

# EIR Essential Findings

- **Escalation included in the cost estimate did not use the best process and was based on fiscal year (FY) 03, rather than FY 04 guidance.**
  - **Per BES, FY03 escalation rates used and escalation calculated to mid-point of construction and capital equipment schedule.**
- **Life Cycle Costs (LCC) have not been developed for the total project.**
  - **LCC estimate completed and issued.**
- **The current schedule has not been cost and resource loaded.**
  - **Cost/Resource loaded scheduled completed.**

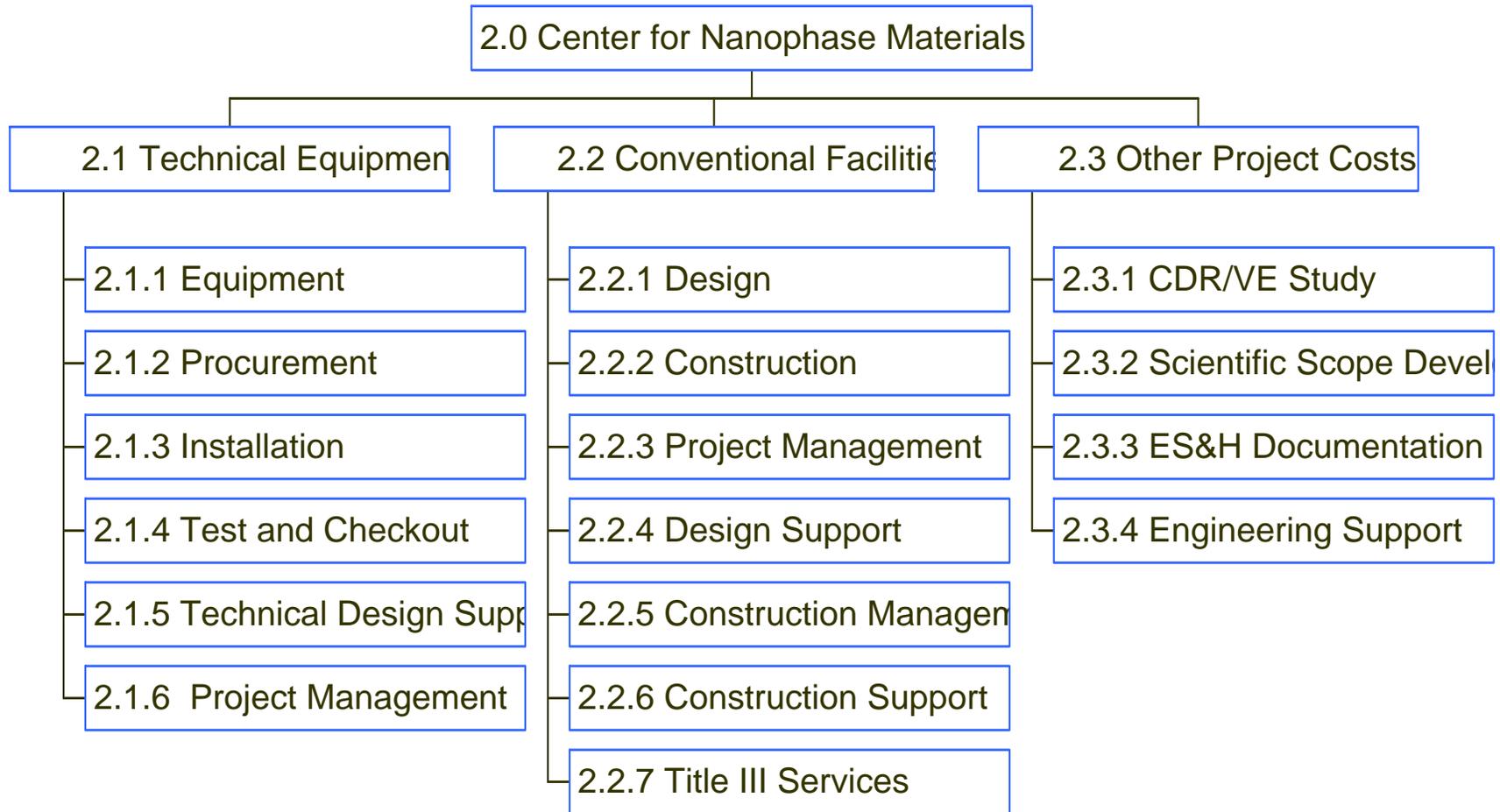
# EIR Essential Findings

- **The ES&H Plan at the UT-Battelle level has not been formally adopted.**
  - **CNMS ES&H Plan issued.**
- **The Project Execution Plan has not been finalized.**
  - **PEP finalized.**
- **An overarching Quality Assurance Plan at the UT-Battelle level, which covers both equipment for the CNMS, and construction of the CNMS, has not been established.**
  - **CNMS QA Plan issued.**

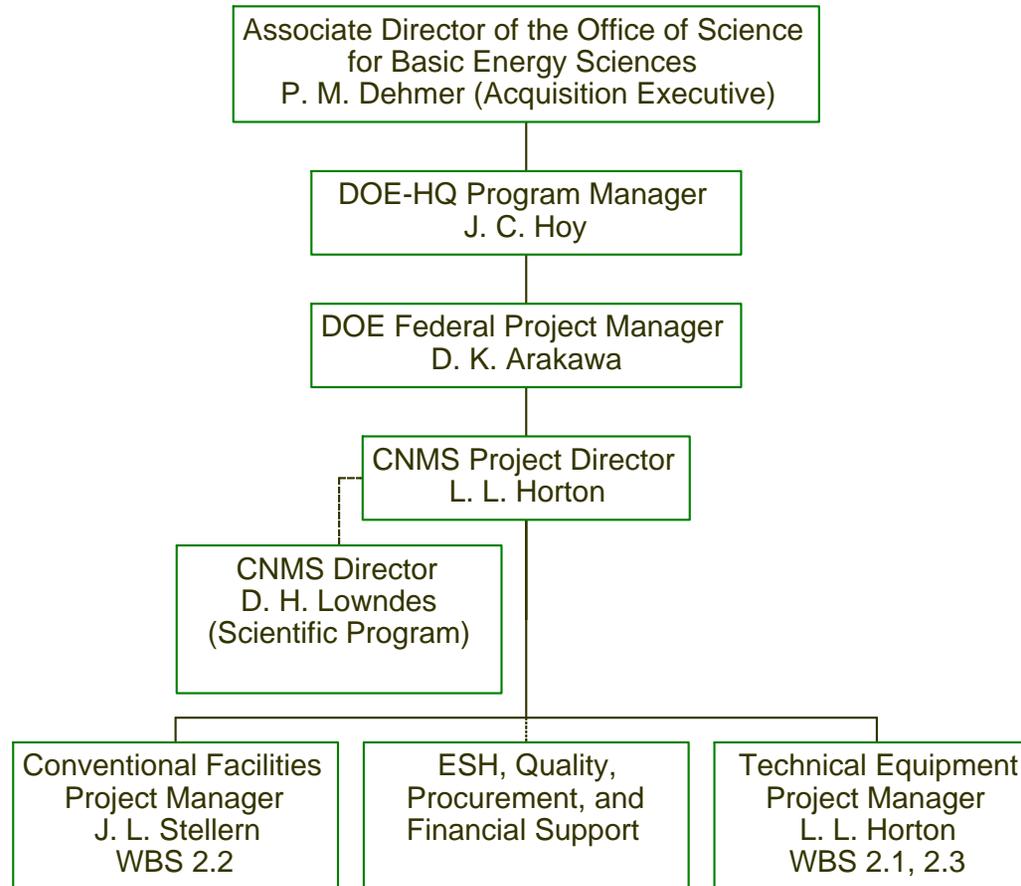
# EIR Corrective Action Plan

- **The CNMS project team has addressed all the recommendations made by the review team and the responses are in the EIR Corrective Action Plan.**
- **The EIR Corrective Action Plan is attached to the CD-2 approval document.**

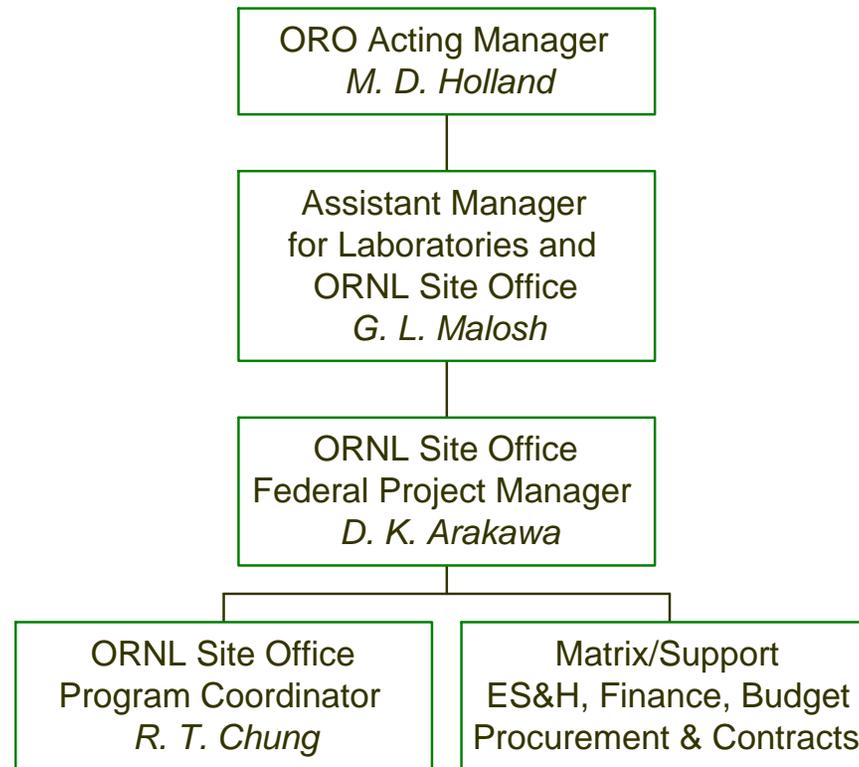
# Work Breakdown Structure



# CNMS Project Organization Chart



# ORO Organizational Interfaces



# CNMS Project Interfaces

- **The ORNL Site Office and the DOE SNS Project Office are participating in monthly coordination meetings with the CNMS project team and the SNS project team.**
- **An Implementation Plan for construction of the CNMS has been approved to describe how the interfaces between the CNMS and the SNS will be managed.**

## Transition to Operations Planning

- **Transition to operations planning has been initiated**
- **For the conventional construction part of the project, transition will include a readiness assessment and the preparation of facility ESH documentation, including ISM hazard screening documentation. These activities will be completed prior to the scheduled CD-4a milestone in December of 2004.**
- **For the technical equipment, transition will include Acceptance Criteria Listing, ESH training and documentation, and a final readiness assessment prior to the scheduled CD-4b milestone in September of 2006.**

# CNMS Operations Budget

- **Proposed budgets**

**FY05                      \$10.8M**

**FY06                      \$18.0M (Full Operations)**

# ESAAB-Equivalent Review

- **Questions?**

# ESAAB-Equivalent Review

## Backup Slides

**ORNL Site Office**

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SCMS Rev. 2.0/CDM\_Exh22.pdf



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(10/2011)

# Contingency/Risk Analysis

- **Contingency Analysis was performed for the individual WBS elements to determine the required amount of contingency**
- **Design**
  - **Title I is complete, Title II is awarded as a fixed-price contract. Changed requirements due to identification of errors, omissions and changes due to development of research focus.**
  - **15% contingency has been assigned on the remaining design work.**

# Contingency/Risk Analysis (contd.)

- **Construction**

- **Construction contract will be competitively bid and the contractors will be required to meet specified criteria, including successful experience with similar construction projects. Risks of changing market conditions could result in bids exceeding the estimate; however, this reduced because the Title I estimate used pricing from the recent CLO bids as a basis. There are additional risks of changes during construction due to errors in the design, differing site conditions and possible conflicts with other construction activities at the SNS site.**

# Contingency/Risk Analysis (contd.)

- **Construction (contd.)**
  - **The risk of increased construction bids is reduced because much of the equipment and material will be procured through existing SNS directed procurement contracts, which have firm prices.**
    - **Unit Substations**
    - **Structural Steel (includes erection)**
    - **Motor Control Centers**
    - **Uninterruptible Power Supply Equipment**
    - **Pipes, Valves and Fittings**
    - **Electrical Commodities (wiring, conduits, etc.)**
  - **19.2% contingency has been assigned to construction.**

## Contingency/Risk Analysis (contd.)

- **Technical Equipment (Equipment and supporting activities, including Project Management)**
  - Over 90% of the technical equipment cost estimates were obtained within the past two months.
  - No “design to order” procurements.
  - 15% contingency has been assigned.
- **Construction Support, Construction Management, Project Management and Title III Support**
  - The same risk of changes during construction will also impact the amount and duration of construction support, Title III support, etc. required.
  - 15% contingency has been assigned.

# Environmental Strategy

- **CNMS was evaluated in the Environmental Assessment (EA) for the ORNL Facilities Revitalization Project.**
- **A Finding of No Significant Impact was issued June 2001.**
- **The CNMS scope proposed in the Conceptual Design Report was evaluated and it was determined that the FONSI remains valid.**

# Preliminary Safety Assessment

- **Conducted a Facility and Project Safety Assessment, including initial hazard screening to identify potential hazards associated with construction and operation of CNMS**
- **Concluded that the CNMS is determined to be an “Other Industrial” facility**
- **Use ORNL R&D Work Control Process to evaluate and develop controls for research activities**

# Acquisition Execution Plan

- **DOE Under Secretary approved the Acquisition Execution Plan (AEP)**
- **UT-Battelle will use Knight/Jacobs for Title I and II engineering design, construction inspection, and construction management**
- **UT-Battelle will provide Architect-Engineer support, project management, procurement support, and construction support and utility tie-ins**
- **Knight/Jacobs will award fixed-price, subcontracts for construction activity**
- **UT-Battelle will procure technical equipment**

# Energy Conservation and Sustainable Design

- **Design and construction of the CNMS will comply with 10 CFR 435. The project will prepare a compliance analysis report at the end of design.**
- **Sustainable building design principles are being applied to the design and construction of the CNMS. Standard practices will include using recycled content products, purchasing energy efficient and water efficient equipment and substituting less hazardous construction materials.**
- **Project waste disposal and recycle requirements will be incorporated into the CNMS procurement documents.**