Chemical Management Services: Outsourcing the Headache

Implementation of CMS at Stanford Linear Accelerator Center

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Outline

- Stanford Linear Accelerator Center
- The CMS Model
- CMS @ SLAC
  - History
  - Scope
  - Implementation
- Program performance metrics
- The Business Case
- The Future
Stanford Linear Accelerator Center

- Operated by Stanford University for the US Dept. of Energy – established 1962
- Mission:
  - Mission: Discovery, Training, Safety
  - Photon Science Discoveries
    • To make discoveries in photon science at the frontiers of the ultrasmall and ultrafast in a wide spectrum of physical and life sciences
  - Particle and Particle Astrophysics Discoveries
    • To make discoveries in particle and astroparticle physics to redefine humanity’s understanding of what the universe is made of and the forces that control it
  - Operate Safely; Train the Best
    • To operate a safe laboratory that employs and trains the best and brightest, helping to ensure the future economic strength and security of the nation
Photon Science

- Use of the linear accelerator to study the ultra-small and ultra-fast
  - Use of synchrotron radiation for x-ray spectroscopy study for energy and biological research

- LCLS: Linac Coherent Light Source
  - New $350M project to build an x-ray laser
    - Brightness $10^9$x any other x-ray source on Earth
    - 1.5-15 Å diameter photons; <0.1 nm-10 nm range
  - Be able to capture images of individual molecules reacting...works like a “strobe” flash
    - 1 – 100 femtoseconds ($10^{-15}$)
      - Light travels only 1 μm in 3 fs
Particle & Particle Astrophysics

Accelerate electrons and anti-electrons to nearly the speed of light, down a 2.5 mi (4.1 km) tube, into rings, and slam them together and...presto!

- Photons
- Bosons/Mesons
- Gluons
- Leptons
- Quarks
- Antimatter

SLAC/LBL/LLNL
SLAC-Based B Factory: PEP-II and BABAR

Both Rings Housed in Current PEP Tunnel

Stanford Linear Accelerator Center
The Linac

there are 2.5 MILES of this...60 feet below ground...
The Linac

...and 2.5 miles of this, above ground
End of the line...

End Station B, “The Beam Stops Here”
Chemical Management Lifecycle

- Procurement
- Inspection
- Inventory
- Delivery
- Storage & Use
- Recovery, Reuse, Recycle
- Collection & Disposal

ESH

Emergency Preparedness & Response

Liability

Scrap/spoilage
SLAC Chemical Operations

- Initially only 2 elements of the lifecycle were being effectively tracked
  - Inventory, Collection/Disposal
- 200+ purchasers, 250+ suppliers, on-site stores (and risks)
- Chemical Management isn’t core to SLAC’s mission...physics research and doing it safely is
- Costs and Liabilities exist at each stage of chemical life cycle management
- How to make it better?
SLAC Chemical Operations, pre-2005

250+ Chemical Suppliers, Buy ~$1.3M (basis: CY04)

200+ SLAC Requestors/Receivers

- BULK CRYOGENS and GASES (~53%)
  - LIQUID NITROGEN
  - LIQUID HELIUM
  - BULK HELIUM
  - BULK HYDROGEN
- SPECIALTY GASES (~7%)
  - H-134a
  - SF6
  - ISOBUTANE
  - OTHER RESEARCH GASES
- RESEARCH and SHOP CHEMICALS (~17%)
  - PLATING SHOP
  - PAINT SHOP
  - TRANSPORTATION
  - KLYSTRON GROUP
  - HEAVY FAB
  - VACUUM ASSEMBLY
  - LABORATORIES
  - FLUORINERT
  - IPA, ETHANOL
- WATER TREATMENT CHEMICALS (~11%)
  - COOLING TOWERS
  - BOILER CORROSION
- FUELS and OILS (~4%)
  - GASOLINE
  - DIESEL
  - PROPANE
  - HYDRAULIC OILS
  - MOTOR OILS
  - LUBE OILS
  - VACUUM OILS
- OTHER CHEMICALS (~8%)
  - NON-SPECIALTY GASES
    - Ar, CO2, He, N2, O2
    - Compressed Air
    - Acetylene
    - STORES CHEMICALS
    - FACILITY SUPPORT
      - Paints
      - Epoxies
Cost of Chemical Ownership

- Estimates of $1-$10 of indirect cost per $1 chemical spend*
  - @ SLAC: >$1.25M/yr chemical spend
  - Indirect estimate = 6.2:1

- Factors below the water line:
  - Cost of storage space
  - Impact on staff productivity for chemical mgmt tasks
  - Employee safety risks
  - Disposal costs
  - Regulatory compliance costs for reporting / risks of non-compliance
  - Costs of knowledge resources
  - Accidents
  - Pollution liability

Why a Chemical Management System?

Alignment of formerly conflicting drivers

Traditional relationship:
Conflicting incentives

Supplier

Wants to increase

Material
(cost, volume)

Buyer

Wants to decrease

Lifecycle costs
(material, labor, waste management)

Service provider

Wants to decrease

Changing the supply chain model results in potential costs savings and environmental gains

CMS model:
Aligned incentives

Buyer

Wants to decrease
Major Benefits to CMS Users

Greatest benefits from:
- **Improved data management**
- **Inventory management**
- **Reduced chemical purchase costs**
  - Hard savings up to 20%; avg = 6% Y₁, 5% Y₂; 2% Y₅
  - Due to:
    - Volume
    - Unit Price
    - Process improvements
  - Additional “soft” savings
    - Time
    - Liabilities

Reported financial benefits

- First 3 years has the greatest savings in hard costs
  - Reduction in volume of chemicals
  - Reduction in price of chemicals
  - Process improvements
- “Soft” savings estimated at 5-40%
  - Time savings
  - Liabilities

# CMS Market Trends

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Automotive</td>
<td>50-80%</td>
<td>75-80%</td>
</tr>
<tr>
<td>Automotive Suppliers</td>
<td>Incl. above</td>
<td>30-40%</td>
</tr>
<tr>
<td>Heavy Equipment</td>
<td>15-25%</td>
<td>15-25%</td>
</tr>
<tr>
<td>Aerospace Mfg</td>
<td>5-15%</td>
<td>25-30%</td>
</tr>
<tr>
<td>Air Transport Mtce</td>
<td>10-20%</td>
<td>40-50%</td>
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<td>Electronics</td>
<td>30-40%</td>
<td>30-40%</td>
</tr>
<tr>
<td>Steel Mfg</td>
<td>---</td>
<td>20-30%</td>
</tr>
<tr>
<td>Energy/Utilities</td>
<td>---</td>
<td>&lt;10%</td>
</tr>
<tr>
<td>Misc. Manufacturing</td>
<td>---</td>
<td>&lt;10%</td>
</tr>
<tr>
<td>Food/Beverage</td>
<td>---</td>
<td>&lt;10%</td>
</tr>
<tr>
<td>Research/Laboratory</td>
<td>---</td>
<td>&lt;10%</td>
</tr>
</tbody>
</table>

Industry Example: Raytheon

- $20B+, 80,000 employees
- Pilot at Tucson plant in 1996, company-wide initiative in 1999
- Covers 45 plants in US, 98% of total chemical, gas and waste spend
- Drivers:
  - Reduce chemical lifecycle costs
  - Outsource non-core competencies
  - Strategic supplier alliances
  - Reduce costs of materials
  - Reduce waste
  - Improve data management
  - “One company” across multiple systems & procedures
- Scope:
  - Supply side mgmt and sourcing of everything
  - Inspection
  - QC
  - “Standardized” custom labeling
  - Inventory management (offsite)
  - Just-in-time delivery
  - Delivery to point of use
  - Data mgmt & EH&S reporting
  - Tech support and process optimization
  - Process efficiency improvement

Source: Case Study Raytheon, Chemical Strategies Partnership
## Industry Example: Raytheon

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commodity Cost Savings</td>
<td>Minimal</td>
<td>15.5%</td>
</tr>
<tr>
<td>Accounts Payable</td>
<td>5</td>
<td>1</td>
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<tr>
<td>Purchase Orders per Year</td>
<td>43,000</td>
<td>0</td>
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<tr>
<td>Sites in program</td>
<td>0</td>
<td>45</td>
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<tr>
<td>Suppliers</td>
<td>1,300</td>
<td>1</td>
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<tr>
<td>MSDS processed per year</td>
<td>2,000</td>
<td>0</td>
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<tr>
<td>Inventory turn per year</td>
<td>3</td>
<td>52</td>
</tr>
<tr>
<td>Inventory value</td>
<td>$7.0 MM</td>
<td>$0.5 MM</td>
</tr>
<tr>
<td>Warehouse floor space (sq. ft)</td>
<td>&gt;120K</td>
<td>&lt; 9K (-93%)</td>
</tr>
<tr>
<td>Inventory spoilage, per year</td>
<td>$3.7 MM</td>
<td>$0.28 MM</td>
</tr>
<tr>
<td>Acceptance rate</td>
<td>96.93%</td>
<td>99.90%</td>
</tr>
<tr>
<td>Headcount</td>
<td>75*</td>
<td>35 (mostly contract)</td>
</tr>
</tbody>
</table>

* Most moved to over areas/roles

**Source:** Case Study Raytheon, Chemical Strategies Partnership
Academia Example:

- 10,800 undergrads + 2,000 grad students
- rural Durham, NH
- no central chemical control...all researchers / staff purchased own materials
- First campus wide inventory not until 1998

Drivers:
- Regulatory compliance
  - 1997 EPA inspection/fines
- Minimize stockpiling of outdated chemicals
- Optimize purchase and disposal
- Improve laboratory safety and emergency preparedness
- Increase awareness of chemical use and substitution

Scope:
- Web-based Chemical Environmental Management System (CEMS)
  - UNH EH&S + Research Computing Center
- Inventory of 50K chemical containers
- Procurement tracking (not single provider)
- Allows for transfer between departments
- Automated waste disposal tracking
- Door signs + MSDS
- FD access to data

$322K to build; $160K to operate & Maintain

Source: Case Study UNH, Chemical Strategies Partnership
Recommended CMS Process

Conduct pilot programs to assess total lifecycle costs and likely impact of CMS on operations

Decision Point: Is CMS right for my company?

I. Planning
   - Form team
   - Select champion

II. Baseline chemical costs
   - Map processes
   - Cost accounting

III. Develop scope of program
   - Select chemical/lifecycle scope
   - Develop RFP
   - Create compensation/incentive options

IV. Engage a chemical service provider
   - Distribute RFP
   - Select CMS provider
   - Negotiate contract

Source: Chemical Strategies Partnership
CMS @ SLAC: History

- New Regulatory Requirements for Facility-wide Tracking of Chemical Usage (1999 – 2001)
- Participation in Silicon Valley CMS Pilot Project
- The Decision (December 2002)
  - Internal System Development
  - Transfer from an existing DOE Facility
  - Commercial Off-the-Shelf (COTS)
  - Chemical Management Services (CMS)

“Moving ahead is unanimously supported by the Chemical User Team. Given the constraints, full CMS is the only way possible”
CMS @ SLAC: History

- **2003**: The RFP, Owner Site Visits, and Vendor Selection
  - Haas TCM selected as the vendor
- **2004**: Master Services Agreement and Pilot Project
- **Nov 2004 – July 2005**: Pilot Project Morphs Into Extended Rollout
- **Feb 2005 – July 2005**: Formal tcmIS training of over 90 SLAC users
- **June 2005**: SLAC stores inventory transferred to Haas hub over single weekend
- **June-December 2005**: gas cylinder management & clean up; chemical mapping program; bulk nitrogen system evaluation; integration of tcmIS into new ESH Manual Chapter
- **August 1, 2005**: Formal “Transfer Date”; Haas TCM assumes all responsibilities
- **January 31, 2006**: first 6 months complete – Formal Management Reviews in March
CMS @ SLAC: Scope

- **Haas e-commerce business system (tcmIS)**
  - Electronic cataloguing, ordering, order tracking, data tracking, MSDS management, electronic invoicing, cost reporting and EHS reporting

- **Haas central warehouse**
  - Maintains min/max inventory of chemicals commonly used by SLAC; provides next business day just-in-time (JIT) delivery

- **Haas Supply Management**
  - All sourcing, purchasing, expediting, and Tier 2 vendor management support for all non-radioactive chemicals and gases used by SLAC

- **Special projects**
  - Tank decommissioning
    - e.g., nitric tank, isobutane tank, H2SO4, etc
SLAC Process

1. Requester IDs desired material
   - Add to Haas TCM Catalog
   - ESH Notification
   - ESH review
   - Review issues with requester (e.g., material, use, quantity, etc.)
     - ESH issues resolved?
     - ESH denies request and documents
   - Special hazards?
     - ESH Notification
     - ESH review
     - Review issues with requester (e.g., material, use, quantity, etc.)
       - ESH issues resolved?
       - ESH denies request and documents
   - Min/Max or OOR?
     - Order processed by Haas Gilroy Hub; Pick & Ship
     - Order processed by Haas Purchasing; Order placed w/supplier
     - Min/Max or OOR?
       - Order processed by Haas Gilroy Hub; QA/QC; Labeled
       - Ship to SLAC Requester drop location
       - Order closed
     - Order approved?
       - Bulk or direct shipment material?
         - yes
         - Bulk or direct ship item delivered directly to SLAC
       - Bulk or direct shipment material?
         - yes
         - Ship to SLAC Requester drop location
         - Order closed
       - yes
         - Order processed by Haas Gilroy Hub; QA/QC; Labeled
         - Ship to SLAC Requester drop location
         - Order closed
     - yes
       - Order processed by Haas Gilroy Hub; QA/QC; Labeled
       - Ship to SLAC Requester drop location
       - Order closed
     - yes
       - Order processed by Haas Gilroy Hub; QA/QC; Labeled
       - Ship to SLAC Requester drop location
       - Order closed
     - yes
       - Order processed by Haas Gilroy Hub; QA/QC; Labeled
       - Ship to SLAC Requester drop location
       - Order closed
     - yes
       - Order processed by Haas Gilroy Hub; QA/QC; Labeled
       - Ship to SLAC Requester drop location
       - Order closed
     - no
       - Notified order denied
       - Order closed

2. Material in tcmIS?
   - yes
     - Add to Haas TCM Catalog
     - Requester submits NSDS
   - no
     - Notified order denied
     - Order closed

3. OOR items arrive within 24 hrs of receipt/acceptance by Haas

4. Integration with environmental and financial systems

- Designed to minimize interruption and maximize information
- ESH Review if there are special hazards
- Otherwise rapid automation of the procurement process
- Min/Max items delivered within 24 hrs
- OOR items arrive within 24 hrs of receipt/acceptance by Haas
- Integration with environmental reporting and financial systems

Notes:
1. Approval by second party and/or order limitation business rules set up in tcmIS.
2. Bulk gases and compressed gas cylinders.
3. LN2 to be on telemetry, so orders to be placed automatically.
4. M/M = Min/Max Inventory; OOR = Order on Request

Refer to Chapter 17 & 22 for Hazardous Waste and Waste Minimization
CMS Website

Chemical Information System (CMS) Website

System Links

- MSDS database: contains all MSDS for chemicals found on site. Should be used for any inquiries.
- For potential purchase reference for chemicals not yet on site, use these MSDS database.

- Buildings on site with chemical locations (restricted access to SLAC).

- Chemical Information System (CMS): Link 2, 5, and 6 describe the financial integration between Haas and SLAC.

- System administration: Link 2 describes the system administration tasks.

- POTASSIUM CYANIDE

  1. Product Identification
  2. Composition/Information on Ingredients
Physical Inventory

Plating Shop Photo A
Room115
Building025
## Performance Metrics

<table>
<thead>
<tr>
<th><strong>METRIC</strong></th>
<th><strong>GOAL</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost</strong></td>
<td></td>
</tr>
<tr>
<td>Commodity cost reduction</td>
<td>5%</td>
</tr>
<tr>
<td>Management Cost Savings</td>
<td>tbd</td>
</tr>
<tr>
<td><strong>Quality/Service</strong></td>
<td></td>
</tr>
<tr>
<td>On-time Delivery Min/Max</td>
<td>95%</td>
</tr>
<tr>
<td>On-time Delivery OOR</td>
<td>90%</td>
</tr>
<tr>
<td>Mission Critical (He &amp; LN$_2$)</td>
<td>100%</td>
</tr>
<tr>
<td>Acceptance rate</td>
<td>99%</td>
</tr>
<tr>
<td>Shrinkage rate</td>
<td>5%</td>
</tr>
<tr>
<td>Scrap/Obsolescence rate</td>
<td>10%→5%</td>
</tr>
<tr>
<td><strong>ESH</strong></td>
<td></td>
</tr>
<tr>
<td>Injuries/Illness</td>
<td>0</td>
</tr>
<tr>
<td>Chemical spills/releases</td>
<td>0</td>
</tr>
<tr>
<td>Training</td>
<td>100%</td>
</tr>
<tr>
<td>Participation in Infrastructure Improvement/ISMS</td>
<td>On-going</td>
</tr>
<tr>
<td>Hazardous Waste Reduction</td>
<td>tbd</td>
</tr>
</tbody>
</table>

`tbd = to be determined`
## SLAC/Haas TCM Program 6 month Quality & Service Metrics

<table>
<thead>
<tr>
<th>Quality/Service</th>
<th>Goal</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>YTD Avg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. On-time Delivery MM</td>
<td>95%</td>
<td>95.2%</td>
<td>89.3%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>87.5%</td>
<td>95.3%</td>
</tr>
<tr>
<td># of MM Deliveries</td>
<td>n.a</td>
<td>21</td>
<td>25</td>
<td>6</td>
<td>6</td>
<td>11</td>
<td>8</td>
<td>12.8</td>
</tr>
<tr>
<td>2. On-time Delivery OOR</td>
<td>90%</td>
<td>99.2%</td>
<td>80.0%</td>
<td>94.2%</td>
<td>98.8%</td>
<td>93.7%</td>
<td>96.3%</td>
<td>93.7%</td>
</tr>
<tr>
<td># of OOR Deliveries</td>
<td>n.a</td>
<td>126</td>
<td>149</td>
<td>87</td>
<td>83</td>
<td>95</td>
<td>108</td>
<td>108.0</td>
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<tr>
<td>3. Mission Critical LN2/He</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
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<tr>
<td>4. Acceptance Rate</td>
<td>99%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>5. Shrinkage Rate</td>
<td>&lt;5%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>6. Scrap &amp; Obsolescence Rate</td>
<td>&lt;10%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>3.0%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

1. **Delivery next business day of MM items stocked in Gilroy Hub.**
2. **Delivery of non-stocked Order On Request (OOR) items as measured against original Haas promise date to the customer.**
3. **Bulk gas deliveries and Helium dewars.**
4. **Acceptance Rate is the measure of delivering the right product to the right location without any problems reported by end user related to product quality and spec.**
5. **Shrinkage rate is the measure of materials damaged or lost in storage or shipment**
6. **Scrap and Obsolescence is the measure of expired materials stocked at the Gilroy Hub vs. total value of the inventory held for SLAC.**
## SLAC/Haas TCM Program 6 month EHS Metrics

<table>
<thead>
<tr>
<th>ESH</th>
<th>Goal</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>YTD Avg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Injury/Illness</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>2. Chemical Spills Releases</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3. Training</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>4. Infrastructure Improvement Projects</td>
<td>Ongoing</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5. Hazardous Waste Reduction</td>
<td>tbd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. **No Injuries or Illness** related to chemical management activities on site.
2. **No chemical spills or releases** by Haas TCM personnel or contractors during the period.
3. **All employees and subcontractors** trained to meet SLAC contractual requirements.
4. **Conversion from bulk H2SO4** to bottles and removal of propane tanks for seismic problems.
5. **Waste not currently in scope** but tcmlS waste module under consideration for implementation.
CMS @ SLAC: Statistics

- 1,662 active chemicals currently set up in the catalogue
- 122 are Min/Max items and 1,540 are “Order on Request” (OOR) items
- 2,044 Material Requests have been filled during first 6 months
- $445,628 chemical/gas spend total from Aug 2005 thru Jan 2006
  - Running at 5.4% reduction, but total spend is only at 74% of target
- $52+K in Haas owned inventory stocked for JIT delivery
- 171 SLAC users in 35 work areas with access to tcmIS
Accomplishments

- First government facility to successfully implement the CMS model
- First truly paperless “e-business” system @ SLAC
- PO cycle time for chemicals averages < 1 day
- Elimination of annual hazardous materials inventory
- Development of CMS Mapping Tool
- Elimination of out of date/orphaned gas cylinders (evaluated more than 1,500 cylinders)
- Overall streamlining of chemical supply chain
Challenges/Solutions

- Selling the concept
  - Convince Purchasing...some of ESH
- Familiarization of contractor with all operations...learning curve
- Manpower demands during implementation
  - Use of third party for integration & project management (owner’s agent)
- IT issues (PeopleSoft ↔ tcmIS)
  - Integration between SLAC IT & Haas IT
- Elimination of alternative procurement means (e.g., P-cards)
  - Enforcement
- Insurance liability with subcontractors
  - Negotiations
Business Case

- Annual service fee
- Hard cost savings:
  - ESH Savings (Requisition approval, MSDS, HMBP)
  - BSD Savings (Purchasing, Stores, A/P)
  - Material purchase cost savings (min. 5%)
  - Stores inventory carrying costs
  - Elimination of annual Haz Mat inventories
  - Ongoing regulatory compliance reports (TRI, Title V, SMOP)
- Estimated annual savings: ($73K) to $88K
  - Excluding liability reduction (how to measure?)
- Break-even probably at about $1.1M annual spend (2005 $’s)
The Future

- Continue to monitor against metrics
- Infrastructure Improvement Projects
  - Liquid Nitrogen Bulk Tanks
    - Safety upgrades (process piping, seismic, Pb paint)
    - Telemetry deployment
  - Cooling Tower Chemicals & Treatment Monitoring
  - Waste Management
    - IT/data management
    - Services
  - Metals Management?
  - Radiological Materials Management?
References

- www.slac.stanford.edu (search for “CMS”)
- www.cmsforum.org
- www.chemicalstrategies.org
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