Lab Safety Officer Meeting
October 27 1:00-3:00 pm
Today’s Agenda

- Richard Galbraith, VP of Research
- Updates/Regulatory News, Francis Churchill (UVM RM&S)
- What’s it Like Responding to a Laboratory Fire, Deputy Chief Peter Brown (BFD)
- Lab Energy Audit, Tim Agan (UVM TSP)
- Maintaining Refrigerators and Freezers, Dave Watson & Allen Myers (VHV)
- Sensaphone Alarm System, Lynn Johnston (UVM PPD)
- Minus 80 Monitoring System, Elayna Mellas-Hulett (UVM RM&S)
- 3D Printers Safety Considerations, Lee Diamond (UVM RM&S)
- Respirator Program Update, Shari Langlois (UVM RM&S)
Richard Galbraith
Vice President of Research
Updates and Regulatory News
WHAT IT’S LIKE

Responding To A Laboratory Fire

Deputy Chief Peter Brown, CFI
Burlington Fire Department

(John P. Marcus, CFPS
University of Vermont)
Delehanty Hall

Geology Department Offices, Classrooms, Labs
“The lab has four fully exhausting laminar flow hoods, an acid recapture system and all the centrifuges and Teflon wear necessary to separate microgram quantities of Be and Al from 20-60 g of purified quartz.” -UVM Geology Web Page
It’s a lab full of rocks. What could possibly go wrong???
ALARM: Photo Detector LEVEL #3 COSMOGENIC LAB #306E 10:01:54
ALARM: Photo Detector LEVEL #3 COSMOGENIC LAB #306E 10:02:18
ALARM: Photo Detector LEVEL #3 CHLORINE LAB #306D 10:02:52
ALARM: WaterFlow Sw LEVEL #3 NORTH 10:03:10 ALARM:
WaterFlow Sw WATERFLOW IN CLOSET ROOM 101A 10:03:14
ALARM: Photo Detector LEVEL #3 RADIOGENIC LAB #306D 10:03:18
ALARM: Photo Detector LEVEL #3 ICP LAB ROOM #306B 10:03:34
ALARM: Photo Detector LEVEL #3 AIRLOCK #306F
Emergency Response

– UVM Police Department
– UVM Environmental Safety
– Burlington Fire Department
– UVM Rescue (student organization)
– Vermont Hazardous Materials Response Team
A fire resulting from unattended heating operations in a polypropylene fume hood
LAB IS CLEAN

NO STREET SHOES!!!

STOP
NO SHOES

NO ENTRY
CLEAN ROOM

YOUR SHOES ARE NOT
VH Gas off
BED off
OFF

Eng.2
 Hyde
 Hydrofluoric acid—danger as gas
 Pernicious
 Nitric acid
 Acetic acid
<table>
<thead>
<tr>
<th>Room: A104</th>
<th>Contact people:</th>
<th>Chemical Quantities</th>
<th>Laboratory Comments:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Cylinders</td>
<td>Laboratory Safety Officer: Anthony Wetherby Emergency Phone: (802) 999-1783</td>
<td>Flammables: 165 gals.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Toxics: 275 lbs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gas Cylinders: 13</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Room: A105</th>
<th>Contact people:</th>
<th>Chemical Quantities</th>
<th>Laboratory Comments:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last chemical inventory: 2010-12-17</td>
<td>Laboratory Supervisor: John Sharp Emergency Phone: 862-3941</td>
<td>Corrosives: 0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Laboratory Safety Officer: Travis Verret Emergency Phone: 802-522-9660</td>
<td>Flammables: &lt; 1 gal.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Toxics: 0</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Room: A107</th>
<th>Contact people:</th>
<th>Chemical Quantities</th>
<th>Laboratory Comments:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last chemical inventory: 2010-11-17</td>
<td>Laboratory Supervisor: Rory Waterman Emergency Phone: 510-225-5494</td>
<td>Corrosives: 9 gals.</td>
<td></td>
</tr>
<tr>
<td>Gas Cylinders</td>
<td>Laboratory Safety Officer: Anthony Wetherby Emergency Phone: (802) 999-1783</td>
<td>Flammables: 87 gals.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Toxics: 47 lbs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gas Cylinders: 6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Room: A110</th>
<th>Contact people:</th>
<th>Chemical Quantities</th>
<th>Laboratory Comments:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last chemical inventory: 2010-12-20</td>
<td>Laboratory Supervisor: Dwight Matthews Emergency Phone: 802/985-5798</td>
<td>Corrosives: 0</td>
<td>This is an instrument room that contains one nitrogen tank.</td>
</tr>
<tr>
<td>Gas Cylinders</td>
<td>Laboratory Safety Officer: Dwight Matthews Emergency Phone: 802/985-5798</td>
<td>Flammables: &lt; 1 gal.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Toxics: 0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gas Cylinders: 1</td>
<td></td>
</tr>
</tbody>
</table>
2 holiday fires keep area departments busy

15 sent to ER after blaze at UVM lab

By Ashley Matthews

By Candace Paga
14 Firefighters and one police officer were evaluated in the Emergency Department for burning eyes and skin and later returned to duty.

It is unknown whether this was due to acids in the lab (hydrofluoric, perchloric) or the byproducts of burning Teflon products.

Repair and cleaning of the lab and replacement of equipment totaled nearly $3 million dollars and stopped work in the lab for almost two years.
Wrap Up

• Firefighters conduct periodic walk-throughs and inspections of UVM buildings to become familiar with them and identify code violations.
• They won’t know the layout and contents of every lab on campus.
• Responder safety is a primary concern during emergency response.
• UVM is committed to enhancing the safety of responders.
• Keep your lab safe – update information and respond to audits.
• Build trust & respect with our response partners.
A Joint Project Between

CLEAN ENERGY FUND
A STUDENT INITIATIVE

IMF Instrumentation & Model Facility

The University of Vermont

TSP Technical Services Partnership

The University of Vermont
Phase I

Lab Equipment Inventory & Energy Audit
Hypothesis:

Campus Laboratories are filled with expensive capital equipment.
Hypothesis:

The laboratory equipment consumes significant energy.
Hypothesis:

The equipment requires routine preventative maintenance to increase longevity
The Pilot Project

Sample 20 UVM labs of the 500+ on campus

- **Inventory** all electrical equipment
- **Measure** equipment electrical usage
- **Identify** equipment in need of repair and overall utilization
- **Analyze** the results and establish future outcomes
Inventory

Sampled 16 labs and identified 294 equipment items

• 8 devices were reported as not used by end user

• 49 equipment items (refrigerators, freezers & water baths) were on 24 hours a day / 7 days a week

• 1 item was found to be in an unsafe condition
Measure

- The Kill A Watt™ was modified by the UVM Instrumentation and Model Facility to effectively measure equipment electrical consumption
- Interviews with Lab personnel provided equipment usage
- Where direct measurement was not feasible the equipment UL ratings were used
Analysis

WHY?

The National Renewable Energy Laboratory report:

• Energy efficiency standards will save 250 billion KWh or 6.5% of estimated energy use

• A Report issued by S. Nadel (2003) and cited by Rosenfeld (2008) shows that from 1972 to 2001 the impact of new appliance standards has driven a 75% decline in energy consumption on refrigerators alone.
Analysis

WHY?

• A Report issued by S. Nadel (2003) and cited by Rosenfeld (2008) shows that from 1972 to 2001 the impact of new appliance standards has driven a 75% decline in energy consumption on refrigerators alone.
Phase II & III

Refrigerator and Freezer Inventory & Replacement Planning
Hypothesis:

Active management of the Campus Laboratory Refrigerators and Freezers can drive energy savings for UVM.

Replacement of High Energy Appliances will result in a positive return on investment.
The Project

Systematically scan UVM labs by building for refrigerators and freezers:

• **Inventory** Refrigerators and Freezers in Labs
• **Measure** Refrigerator and Freezer electrical usage
• **Identify** Refrigerators and Freezers in need of repair
• **Analyze** the results and establish future outcomes
Inventory

Sampled 5 Buildings:

• Colchester Research Facility
• Terrill
• Stafford
• HSRF (Partial)
• Given (Partial)
Inventory

318

Refrigerators & Freezers
Inventoried
Phase III

Comprehensive Refrigerator and Freezer Inventory
Inventory

Completed the Inventory in 22 Buildings:

<table>
<thead>
<tr>
<th>Building</th>
<th>Facility Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aiken</td>
<td>Marsh Life Sci</td>
</tr>
<tr>
<td>Bioresearch lab</td>
<td>Miller Complex</td>
</tr>
<tr>
<td>Colchester Research Facility</td>
<td>Perkins</td>
</tr>
<tr>
<td>Delehanty Hall</td>
<td>Proctor Maple Research Facility</td>
</tr>
<tr>
<td>Dewey</td>
<td>Rowell</td>
</tr>
<tr>
<td>Forestry Sciences Lab</td>
<td>Rubenstein</td>
</tr>
<tr>
<td>Given</td>
<td>Stafford</td>
</tr>
<tr>
<td>Hills</td>
<td>Terrill Hall</td>
</tr>
<tr>
<td>Horticultural Farm</td>
<td>Torrey</td>
</tr>
<tr>
<td>HSRF</td>
<td>Ungulate Facility</td>
</tr>
<tr>
<td>Jeffords Hall</td>
<td>Votey Hall</td>
</tr>
</tbody>
</table>
Inventory

997

Refrigerators & Freezers
Inventoried
Refrigeration Inventory Style Profile

Refrigeration devices by Style

1. Upright freezer
2. Chest freezer
3. Top freezer/refrigerator
4. Bottom freezer/refrigerator
5. Side by side
6. Single door
7. Single door with freezer
8. Upright ULT
9. Chest ULT
10. Compact refrigerator
11. Compact Freezer
Refrigeration Inventory Age Profile

Devices by manufacturing/acquisition date

Number of devices

Year

Department of Risk Management and Safety
Analysis

- The refrigerator & freezer inventory resulted in:

  - Research on prior refrigerator & freezer energy studies as reference data
  - Defined body of projects at other institutions
  - Identified Rules for Replacement
  - Profile of the Refrigerators inventoried by Rule
  - Recommended inventory for replacement
Research Results - Replacement

Stanford – Annual Savings 208,031kWh

A 2002 survey of two large biology buildings revealed one laboratory with particularly old, inefficient refrigerators and freezers. The Primary Investigator did not intend to replace them as he is uncertain how much longer he will be using the lab. Stanford’s Utilities Division covered the full cost of replacing twelve units (and scrapping three) with an estimated simple payback period of 4.8 years. Laboratory-grade equipment would have cost at least 40% more.

Innovation – Eliminate Student Refrigerators / Share

http://www.stanford.edu/dept/rde/cgi-bin/drupal/housing/sites/default/files/SLG.pdf
If every lab in McGill started storing their biological specimens in energy efficient units today, McGill could save up to an estimated $200 in energy costs per freezer by May, 2013.

If every lab in McGill started storing their biological specimens in ambient temperature storage today, McGill could save up to an estimated $500 in energy costs per freezer by May, 2013.
Research Results

Yale – Yale University 2013-2016 Sustainability Strategic Plan

Reduce energy consumption and greenhouse gas emissions 5% below 2013 levels by June 2016.

Expand existing inventory of freezers and refrigerators to establish age and presence of service contracts; develop options for standardized service and maintenance, and evaluate potential cost-benefit of replacement schedule based upon energy savings.
The results of our research show…

Maintenance is also Cool!
Research Results – Maintenance

Studies have proven that freezer maintenance is critical, as significant energy savings can be achieved when freezer coils and filters are free of dust.

Reference:
http://www.laboratoryequipment.com/articles/2014/04/collaborative-sustainability
Research Results – Maintenance

Duke –

Freezers and fridges have a regular maintenance schedule.

In a typical lab, refrigerators and freezers are a large component of the total energy consumption. Keeping freezers free of ice build-up is an easy way to reduce waste in your lab. When an ice layer builds, covering the coils, the compressor must run longer to maintain cold temperatures. If the ice is more than $\frac{1}{4}$ inch thick, then it needs to be defrosted. Defrosting regularly will save energy and possibly extend its life. Also, minimizing ice buildup will maximize your storage space, and boxes and racks will sit flat instead of precariously perched on lumpy icy surfaces.
Research Results – Maintenance

Colorado University – Winner of UC Davis Freezer Challenge

10 new labs signed up for the CU Green Labs freezer maintenance program (to bring our total to 27 labs in the program)

44 units received preventative maintenance attention (defrosting, cleaning filters/coils)
Research Results – Maintenance

University of Pennsylvania – Maintenance Saves Energy

When an ice layer builds up covering the coils, the compressor must run longer to maintain temperature, using more energy. Consider making this a regularly scheduled task to ensure it is completed. Defrost and clean out your freezer coils each time you organize an annual freezer cleanout in your lab. Cleaning allows boxes and racks to lay flat instead of sitting on lumpy icy surfaces, saving space. It takes 2 half-hour shifts to defrost a freezer and five minutes to vacuum the coils.
Research Results – Maintenance

Harvard

– freezer maintenance is often overlooked

A study was conducted in the summer of 2011 that proved significant energy savings were associated with keeping freezer coils and filters free of dust, allowing for proper heat exchange.
Research Results – Maintenance

Harvard – freezer maintenance is often overlooked

A study was conducted in the summer of 2011 that proved significant energy savings were associated with keeping freezer coils and filters free of dust, allowing for proper heat exchange. The study also revealed that routine freezer care is often overlooked due to competing priorities in research labs and a lack of understanding of the importance of these measures. In response, the FAS Freezer Preventative Maintenance Program was developed by the FAS Office.
Summary – Maintenance

A comprehensive maintenance program for refrigerators and freezers...

Makes financial $ense$e
Phase IV

Pilot Effect of Maintenance on Refrigerators
Energy Savings Related to Maintenance

Effect of Cleaning

- 1972 Coldspot (Non-Climatic Climate Controlled): 44.7%
- 1975 Frigidaire (Non-Climatic Climate Controlled): 44.5%
- 1996 White Consolidated (Climate Controlled): 9.7%
- 2004 Frigidaire (Climate Controlled): 9.7%
Energy Savings Related to Maintenance

32% = 15 kW Hours
Tips for Maintaining Refrigerators & Freezers

10-27-15

Presented By:
Dave Watson
Question?

Dave Watson

802-655-8805
Web600 Sensaphone Alarm Monitoring
Web600 Sensaphone Alarm Monitoring

- A stand alone alarm system that allows the research department to be alerted if there is an equipment failure
- A low cost solution to monitoring -80 freezers, incubators, and other lab equipment
- Allows multiple units to be monitored within a lab
- Sends text messages and emails in an alarm event
- Internal Web Page for local and remote access
- Can bring it with you in the event of lab relocation
- Procedure for support from CHP
6 Zones
### Individual Zone Setup

**Sensaphone Web600**

#### Zones

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Status</th>
<th>Type</th>
<th>Min Value</th>
<th>Max Value</th>
<th>Last Alarm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>On</td>
<td>OK</td>
<td>Internal Power</td>
<td>N/A</td>
<td>N/A</td>
<td>4/15/2014 6:14:23am</td>
</tr>
<tr>
<td>Battery</td>
<td>100.0%</td>
<td>OK</td>
<td>Internal Battery</td>
<td>48.0%</td>
<td>100.0%</td>
<td>None</td>
</tr>
<tr>
<td>Future</td>
<td>Closed</td>
<td>OK</td>
<td>Normally Closed</td>
<td>N/A</td>
<td>N/A</td>
<td>8/7/2013 2:34:30pm</td>
</tr>
<tr>
<td>Zone 2 Surgery Freezer #4 62649</td>
<td>Closed</td>
<td>OK</td>
<td>Normally Closed</td>
<td>N/A</td>
<td>N/A</td>
<td>4/29/2015 6:49:48am</td>
</tr>
<tr>
<td>Zone 3 Medicine Freezer #5 62648</td>
<td>Open</td>
<td>Alarm</td>
<td>Normally Closed</td>
<td>N/A</td>
<td>N/A</td>
<td>3/11/2015 9:10:36am</td>
</tr>
<tr>
<td>Zone 4 Biochem Freezer #6 62649</td>
<td>Closed</td>
<td>OK</td>
<td>Normally Closed</td>
<td>N/A</td>
<td>N/A</td>
<td>4/18/2014 6:10:25am</td>
</tr>
<tr>
<td>Zone 5 Neurology Freezer 62649</td>
<td>Closed</td>
<td>OK</td>
<td>Temp 2.8K C</td>
<td>-85.0°C</td>
<td>57.0°C</td>
<td>5/7/2015 6:20:51am</td>
</tr>
</tbody>
</table>

- **Reset Min/Max**
- **Reset Last Alarm**
8 Separate Notification Groups
Creates a History Log
Budget Pricing

- Sensaphone Cost $355
- Battery Back-up $50
- Typical -80 has alarm contact but some freezers may need a sensor $50-$100
- One time ethernet port activation by UVM Telecom $150
- Installation and Programming $150-275
- No on-going monthly fees

Budget install costs $800
Thank you

Contact Info:

Lynn Johnston
lynn.johnston@uvm.edu
• Real time cloud-based monitoring
• Variety of equipment
  – -80 and -20 Freezers
  – Refrigerators
  – Incubators
  – LN2 dewars
  – Animal care options
• Lab workers control parameters
• Can determine notification method (text, email, voice calls)
• There’s an app for that
<table>
<thead>
<tr>
<th>Location</th>
<th>Equipment</th>
<th>Temperature</th>
<th>Condition</th>
<th>Status</th>
<th>Last Report</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>UVM Krag Lab</td>
<td>Krag -20 Freezer (Given E310)</td>
<td>-18 C</td>
<td>Probe: -18 C</td>
<td>Closed (30 Mins)</td>
<td>Mon 10:41 EDT</td>
<td>Text (802) 233-3844</td>
</tr>
<tr>
<td></td>
<td>Krag -80 Sanyo (Given E303)</td>
<td>-82 C</td>
<td>Probe: -82 C</td>
<td>Closed (17 Days)</td>
<td>Mon 10:41 EDT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Krag CO2 Incubator (Given E310)</td>
<td>22 C</td>
<td>Ambient: 22 C</td>
<td>Closed (13 Days)</td>
<td>Mon 10:47 EDT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Krag LN2 (Given E303)</td>
<td></td>
<td>Alarm: OK</td>
<td>Level: OK</td>
<td>Mon 10:47 EDT</td>
<td></td>
</tr>
<tr>
<td>UVM Vaccine Testing Center</td>
<td>-20C Freezer BK#1 (Given C201)</td>
<td>-16 C</td>
<td>Probe: -16 C</td>
<td>Closed (21 Mins)</td>
<td>Mon 10:39 EDT</td>
<td>Text (802) 233-3643</td>
</tr>
<tr>
<td></td>
<td>-80 BK#1 Forma (Given C201A)</td>
<td>-81 C</td>
<td>Probe: -81 C</td>
<td>Closed (13 Days)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>32C CO2 Incubator UMASS#2 (Given C201)</td>
<td>23 C</td>
<td>Ambient: 23 C</td>
<td>Lower Door: Closed (13 Days)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Refrigerator BK#2 Bottom 4C (Given C201A)</td>
<td>32 C</td>
<td>Probe: 32 C</td>
<td>Upper Door: Closed (51 Mins)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Department of Risk Management and Safety
### Critical Temperature Monitoring

#### Action | Contact | Description | No Call/Text after 10PM | Ignore | Alert Test
---|---|---|---|---|---
Text | (802) 233-3844 | Stephanie cell | | | Test
Email | spemo@uvm.edu | Stephanie | | | Test
Text | (804) 229-3410 | Laura at M80 | | | Test
Start Over In | 30 Minutes | | | | Test

- Notify Action List On System Communication Errors
- Restart confirmed alarms after 60 Minutes

**Update**
<table>
<thead>
<tr>
<th>Unit</th>
<th>Device</th>
<th>Send Alarms</th>
<th>Current</th>
<th>Cold Alarm</th>
<th>Warm Alarm</th>
<th>Recovery/Door Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Krag -20 Freezer (Given E)</td>
<td>Probe</td>
<td>✔</td>
<td>-16 C</td>
<td>-35</td>
<td>-5</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Ambient</td>
<td>✔</td>
<td>23 C</td>
<td>0</td>
<td>35</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Door</td>
<td>✔</td>
<td>Closed (22 Hours)</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Krag -80 Sanyo (Given E3)</td>
<td>Probe</td>
<td>✔</td>
<td>-82 C</td>
<td>-95</td>
<td>-65</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Ambient</td>
<td>✔</td>
<td>23 C</td>
<td>0</td>
<td>35</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Door</td>
<td>✔</td>
<td>Closed (5 Days)</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Krag CO2 Incubator (Given E)</td>
<td>Alarm</td>
<td>✔</td>
<td>OK</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Door</td>
<td>✔</td>
<td>Closed (40 Mins)</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Krag LN2 (Given E303)</td>
<td>Level</td>
<td>✔</td>
<td>OK</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>
Average Probe Temperature Starting Oct 01 2015

Temperature: [Graph with temperature readings and limit indicators]
<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Event</th>
<th>Action</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun</td>
<td>10/04/2015 09:09</td>
<td>Alarm Detected</td>
<td>Confirm</td>
<td>Unit alarm detected</td>
</tr>
<tr>
<td>Sun</td>
<td>10/04/2015 09:09</td>
<td>(802) 233-3643</td>
<td>Text</td>
<td>Queue immediate text to (802) 233-3643</td>
</tr>
<tr>
<td>Sun</td>
<td>10/04/2015 09:09</td>
<td><a href="mailto:cvetrton@uvm.edu">cvetrton@uvm.edu</a></td>
<td>Email</td>
<td>Queue email to <a href="mailto:cvetrton@uvm.edu">cvetrton@uvm.edu</a></td>
</tr>
<tr>
<td>Sun</td>
<td>10/04/2015 09:09</td>
<td>c <a href="mailto:spinvitron@gmail.com">spinvitron@gmail.com</a></td>
<td>Email</td>
<td>Queue email to <a href="mailto:cvetrton@uvm.edu">cvetrton@uvm.edu</a></td>
</tr>
<tr>
<td>Sun</td>
<td>10/04/2015 09:09</td>
<td>10 Minutes</td>
<td>Wait</td>
<td>Wait 10 Minutes for next action</td>
</tr>
<tr>
<td>Sun</td>
<td>10/04/2015 09:09</td>
<td><a href="mailto:cvetrton@uvm.edu">cvetrton@uvm.edu</a></td>
<td>Email</td>
<td>Email delivered to - <a href="mailto:cvetrton@uvm.edu">cvetrton@uvm.edu</a></td>
</tr>
<tr>
<td>Sun</td>
<td>10/04/2015 09:09</td>
<td>(802) 233-3643</td>
<td>Text</td>
<td>Text to (802) 233-3643 - -86 B&amp;H Firma (Given C201A) ALERT Probe: -86C -Alarm Ambient: 23C Lower Door: Closed (17 Hours) Upper Door: Closed (2 Days)</td>
</tr>
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<td>10/04/2015 09:09</td>
<td>c <a href="mailto:spinvitron@gmail.com">spinvitron@gmail.com</a></td>
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</tr>
<tr>
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<td>10/04/2015 09:09</td>
<td>(802) 233-3643</td>
<td>Confirm</td>
<td>SMS Reply Received = Confirmed</td>
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<tr>
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<td>10/04/2015 09:09</td>
<td>(802) 233-3643</td>
<td>Text</td>
<td>Alarm confirmed via SMS from (802) 233-3643</td>
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<tr>
<td>Sun</td>
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<td>Alarm Clear</td>
<td>Confirm</td>
<td>Unit alarm cleared</td>
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<td>10/04/2015 09:14</td>
<td>cassandra venbrige (c <a href="mailto:spinvitron@gmail.com">spinvitron@gmail.com</a>)</td>
<td>Confirm</td>
<td>Email confirmation received for alarm that is already clear</td>
</tr>
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</table>
• Three components:
  – Collection Appliance
  – Repeaters
  – Control Units
    (per device)
• COSTS
  – Collection device $2000
    • 4-5 collection devices for entire university system
  – Repeaters $450
    • Would need many of these located throughout campus buildings to send data throughout buildings to collection device
  – Control units (per equipment) $250
  – Control units w/ ambient humidity sensor $300
  – Control units w/ light/dark sensors $450
  – Initial set-up fee $50
  – Monthly subscription $6 per unit
    • Based on number of devices at UVM, monthly cost per device
3D Printers
Safety Considerations

Lee Diamond
UVM Risk Management & Safety
CALS/CEMS Lab Safety Coordinator
We know they are coming...

HUMAN CELLS. Could replace need for animal testing.
3D Printing: What Is It?

A procedure of constructing things printed in layers. Also called *Additive Manufacturing*.

To get started, you need:
- A 3D printer
- A computer
- Special 3D modeling software (CAD)
Types of 3D Printing

- Stereolithography (SLA)
- Fused Deposition Modeling (FDM)
- Selective Laser Sintering (SLS)
- Selective Laser Melting (SLM)
- Electronic Beam Melting (EBM)
- Laminated Object Manufacturing (LOM)

Source: http://3dprintingfromscratch.com
How Does it Work?
Basics of Fuse Deposition Modeling

Filament Feedstock

A heated nozzle melts the thermoplastic feedstock and deposits streams of extruded plastic in thin layers across a moving baseplate.
Items made by UVM 3D printers
Examples: Existing 3D printers on campus

MakerBot

Stratasys: Dimension

IMF: Objet30

Alkaline Bath for Dimension
Materials Used in 3D Printing

- Nylon (polyamide)
- ABS (Acrylonitrile Butadiene Styrene)
- PLA (polyactic acid: biodegradable plant starch)
- PVA (polyvinyl alcohol: water soluble)
- Resin (cured with UV light)
What Can Make 3D Printing Hazardous?

- **Heating of Thermoplastics**
  Materials must be heated to be extruded.
  Heating plastics can release chemical vapors or gases.
  **Example**: ABS plastics are known to emit carbon monoxide and hydrogen cyanide, as well as a variety of volatile organics

- **Temperature** to which the material needs to be extruded.

- **Chemical Bath**, may be required: removes waste material

- **Emissions of ultra fine particles (UFPs)** *
  elevated UFP concentrations associated with adverse health effects

  * UFPs: particles less than 100 nm
Contact Safety staff to help you assess the risks

- Location, location, location
- Ventilation requirements
- Electrical needs (known to be “energy hogs”)
- Does it require a chemical bath?
- Are there cooling requirements for the location?
- What materials will be heated? off-gassing?
- At what temperature must materials be heated?
- How often will printer be used? By whom?
- Will there be more than one running at a time?
Summary

• 3D printing may have some inherent risks, just like woodworking or soldering

• Request that Safety staff conduct a risk assessment with you before purchasing and installing a 3D printer. safety@uvm.edu
Questions?

safety@uvm.edu

www.uvm.edu/safety
Respirator Program Update

Environmental Health and Safety at UVM

General Information

The content of the general safety page is intended to offer tools and guidance for implementation of safety program elements that may be needed in a wide variety of working and learning environments across campus.

Personal Protective Equipment

- Eye and Face Protection
- Footwear
- Hand Protection
- Hearing Protection
- Skin Protection/Proper Clothing
- Respiratory Protection Program
QUESTIONS

“What do you mean you don’t think our insurance will cover this?!”