Agenda

- Brief overview of refrigeration systems found in hotels
- Typical issues that seem to happen at the worst times
- Perishable product loss due to spoilage
- Case studies – TD Garden, Pebble Beach & Harvard Dining
- Proven strategies and solutions for hotel cold rooms
- Self funding – optimizing and monitoring cold rooms
- Real time view of operation and trending
- Q&A
Compressor Operation
Refrigeration Principles

- Compression, Expansion, Evaporation, Condensation & Heat Transfer
- Liquid-to-gas “state change” and Heat Transfer
Hot (high pressure) and cold (low pressure) sides
TXV/expansion valve and Superheat

Expansion valve is designed to regulate flow of refrigerant to maintain correct rate of heat transfer
Biggest Issues in Hotel Cold Rooms

- Cause - frozen coil is near top of the list
  - Coolers use air to defrost by running fans
  - Freezers use electric heaters to melt ice on coils
  - A frozen coil can eventually lead to compressor failure

- High temperature due to:
  - Door left open
  - Loss of refrigerant
  - Dirty evaporator coils restricting air flow
  - Loading warm product

- Properly configured alarms/alerts can minimize issues
  - We appreciate the “check engine light” for cars – coolers?
Common Refrigeration Problems & Symptoms

- The following should be an easy fix!
  - Dirty Coils – Clean at least every 3 Mo.
  - Frozen Coils – defrost from smart phone

- The following can be corrected by a technician
  - Refrigerant Gas Leaks
  - Valves out of Adjustment
  - Incorrect Pressure/Superheat
  - Replace defective controls and parts
A History of Innovation
Fan Management and Cycling
Friday Jan 30, 2016 TD Garden:
Neither Celtics nor Bruins have had a home game for two weeks.
Celtics play at home tonight.
Pebble Beach resort has 2 hotels with a total of 32 cold rooms in both basement and first floor.

- Monitoring and staying on top of the health of this many rooms was a challenge… there was never a time when there were no problems with at least one room.
- In 2010 NRM installed remote management allowing real time monitoring and control.
- Technicians receive alerts to their smart phones and can view issues before responding thus also saving time as in many cases all they have to do is start a defrost.
### Summary Page for Pebble Beach Hotel

#### NRM CoolTrol MC Series 4

<table>
<thead>
<tr>
<th>Description</th>
<th>Notes</th>
<th>Status</th>
<th>Temperature °F</th>
<th>Status</th>
<th>Amps</th>
<th>Starts 24 Hr.</th>
<th>% Run 24 Hr.</th>
<th>% Run 7 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>WALKFB Frozen Seafood</td>
<td>12 4 -3 1</td>
<td>Run Off On On</td>
<td>8.2</td>
<td>45 48 48</td>
<td>71.9</td>
<td>67.5 73.8 63.5</td>
<td>58.1 65.3</td>
<td></td>
</tr>
<tr>
<td>WALKFC Bakery Freezer</td>
<td>4 1 6.6</td>
<td>Run Off On On</td>
<td>5.8</td>
<td>12 16 17</td>
<td>94 49.8 89.4</td>
<td>85.7 47.8 81.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WALKFR Freezer Misc.</td>
<td>6 3 8.5</td>
<td>Run Off On On</td>
<td>68.6</td>
<td>76 86 79</td>
<td>56.2 62.9 63.5</td>
<td>66.8 70.7 71.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WALKRF Floral/Dock</td>
<td>38 39 37.7</td>
<td>Run On Off Off</td>
<td>0</td>
<td>79 12 116</td>
<td>16.8 0.1 53.5</td>
<td>9.2 7.8 35.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WALKRH Seafood</td>
<td>36 32 34 35.8</td>
<td>Run Off Off Off</td>
<td>0.1</td>
<td>79 80 77</td>
<td>39.2 19.9 61.3</td>
<td>26.7 13.6 47.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WALKRK Meat</td>
<td>38 34 36 38.9</td>
<td>Run Off On On</td>
<td>5.5</td>
<td>52 55 54</td>
<td>67.9 40.9 81.8</td>
<td>57.7 34.5 71.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WALKRL Dairy</td>
<td>37 34 35 36.5</td>
<td>Run Off Off Off</td>
<td>-0.0</td>
<td>47 47 112</td>
<td>17.5 17.9 42.9</td>
<td>14 14.4 37.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WALKRM Beer/Wine</td>
<td>38 36 36 37.4</td>
<td>Run Off Off Off</td>
<td>0.3</td>
<td>35 35 116</td>
<td>14.7 14.8 40.5</td>
<td>14 14.1 37.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WALKRN Bakery Cooler</td>
<td>42 40 40 41.4</td>
<td>Run Off Off Off</td>
<td>0.3</td>
<td>63 64 100</td>
<td>29.7 28.6 51.9</td>
<td>25.9 24.7 47.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WALKRQ Produce</td>
<td>42 21 37 40.9</td>
<td>Run Off On On Closed</td>
<td>5</td>
<td>8 32 10</td>
<td>82.2 61.1 94.4</td>
<td>72.9 60.7 86.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WALKRV Deli/Misc.</td>
<td>37 36 37 38.6</td>
<td>Run Off Off Off</td>
<td>0</td>
<td>75 125 81</td>
<td>31.5 38.6 56</td>
<td>24.2 40.5 58.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Harvard Dining

- Harvard Dining manager came to NRM as he had lost a large freezer over a holiday weekend and had to discard $25,000 worth of spoiled food causing a lot of scrambling to meet the posted menu items.

- Harvard Dining has 55+ cold rooms spread out over 13 locations on the campus with many staff needing to know when issues arise.
  - In 2008, with the help of NSTAR and their sustainability funds, they began a retrofit program to address every cold room.
  - NRM is also helping them with medical school cold rooms.

- With this success, Boston College, U-Mass Amherst, Wesleyan, WPI and others have implemented controls for energy savings and remote management.
# Harvard Main Dining

## Energy Trend

<table>
<thead>
<tr>
<th>Description</th>
<th>Notes</th>
<th>Status</th>
<th>Temperature °F</th>
<th>Space</th>
<th>Evap</th>
<th>SP</th>
<th>24hr</th>
<th>Mode</th>
<th>Dfirst</th>
<th>Sol</th>
<th>Fan</th>
<th>Door</th>
<th>Amps</th>
<th>Starts 24 Hr.</th>
<th>% Run 24 Hr.</th>
<th>% Run 7 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>CF-1</td>
<td>_</td>
<td>Run</td>
<td>-1</td>
<td>3</td>
<td>-1</td>
<td>0</td>
<td>3.9</td>
<td>Run</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Closed</td>
<td>0.3</td>
<td>32</td>
<td>44</td>
<td>73.2</td>
</tr>
<tr>
<td>CR-1</td>
<td>_</td>
<td>Run</td>
<td>33</td>
<td>38</td>
<td>33</td>
<td>36</td>
<td>37.2</td>
<td>Run</td>
<td>Off</td>
<td>On</td>
<td>On</td>
<td>Closed</td>
<td>7.9</td>
<td>77</td>
<td>79</td>
<td>34.4</td>
</tr>
<tr>
<td>F-1</td>
<td>_</td>
<td>Run</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>5</td>
<td>7.9</td>
<td>Run</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Open</td>
<td>0.5</td>
<td>41</td>
<td>42</td>
<td>41.7</td>
</tr>
<tr>
<td>F-2</td>
<td>_</td>
<td>Run</td>
<td>-7</td>
<td>0</td>
<td>-7</td>
<td>-5</td>
<td>1.2</td>
<td>Run</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Closed</td>
<td>0.6</td>
<td>91</td>
<td>97</td>
<td>46.6</td>
</tr>
<tr>
<td>R-3</td>
<td>_</td>
<td>Run</td>
<td>32</td>
<td>35</td>
<td>32</td>
<td>34</td>
<td>35.4</td>
<td>Run</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Closed</td>
<td>0.1</td>
<td>45</td>
<td>46</td>
<td>25</td>
</tr>
<tr>
<td>R-4</td>
<td>_</td>
<td>Run</td>
<td>32</td>
<td>33</td>
<td>32</td>
<td>32</td>
<td>33.2</td>
<td>Run</td>
<td>Off</td>
<td>On</td>
<td>On</td>
<td>Closed</td>
<td>0.6</td>
<td>41</td>
<td>43</td>
<td>14.2</td>
</tr>
<tr>
<td>R-5</td>
<td>_</td>
<td>Run</td>
<td>35</td>
<td>37</td>
<td>35</td>
<td>37</td>
<td>37.6</td>
<td>Run</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Open</td>
<td>0.2</td>
<td>47</td>
<td>63</td>
<td>12.7</td>
</tr>
<tr>
<td>R-6</td>
<td>_</td>
<td>Run</td>
<td>36</td>
<td>35</td>
<td>36</td>
<td>34</td>
<td>35.3</td>
<td>Run</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Closed</td>
<td>0.1</td>
<td>71</td>
<td>72</td>
<td>31.8</td>
</tr>
<tr>
<td>R-9</td>
<td>_</td>
<td>Run</td>
<td>36</td>
<td>37</td>
<td>36</td>
<td>36</td>
<td>36.3</td>
<td>Run</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Closed</td>
<td>0.6</td>
<td>37</td>
<td>37</td>
<td>9.7</td>
</tr>
<tr>
<td>T-1</td>
<td>Kettle Station</td>
<td>Run</td>
<td>32</td>
<td>35</td>
<td>32</td>
<td>35</td>
<td>37.2</td>
<td>Run</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Open</td>
<td>0.4</td>
<td>38</td>
<td>47</td>
<td>39.2</td>
</tr>
<tr>
<td>T-7</td>
<td>Cook Chill Storage</td>
<td>Run</td>
<td>32</td>
<td>33</td>
<td>32</td>
<td>32</td>
<td>33.3</td>
<td>Run</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Open</td>
<td>0.3</td>
<td>114</td>
<td>123</td>
<td>45.2</td>
</tr>
</tbody>
</table>
Run Time Report – 52 Weeks

Harvard Dining 80 JFK Main - HVD0001 R-3 - DN13

Temperature - °F

Runtime Percent

*Period Average*
EMS - Integrated Temp, Fan & Defrost

- Temperature control features including
  - Scheduling of temps or other loads
  - Cooler shut down for loading, inventory or cleaning

- Typical Alarm/Monitoring Systems
  - Fault detection and diagnostic capability
  - Alerts sent via email or text message to multiple users
  - Remote monitoring of temperatures and performance
  - Equipment performance alarms like: short cycling compressor down
  - Coil icing alerts that can be cleared by starting defrost remotely

- Multiple temperature zones per cold room when redundant systems are installed
Data Analytics from History

- All temperature and operational data available since date of installation
- Operating trends of each cold room including
  - Temperature of space and evaporator coil
  - Controller status including call for cooling & defrost
  - System amps
  - Run times of compressor and evaporator fans
  - Weighted average temperature
EC (Electronically Commutated) Motors

Example #1 – Replace 1/20 HP Shaded Pole Motor with EC Motor in Medium Temp Walk-in Cooler.

Before Usage = 118 watts
After Usage = 38 watts
kWh Savings = 80 watts X 8,760 hours/1,000 = 700 kWh

Example #2 – Replace 9W (HP) Shaded Pole Motor with EC Motor in Low Temp Frozen Line up.

Before Usage = 46 watts
After Usage = 18 watts
kWh Savings = 28 watts X 8,030 hours/1,000 = 224 kWh
Installation of Glass Doors in Open Front Refrigerated Cases

- French open, zero energy door & frame with torsion spring
- Double pane insulated glass
- PVC, aluminum & stainless steel door frame
- LED Lighting
- Reduces energy up to 80%
Before & After
Audit, Installation and Project Management

How NRM’s proven process delivers consistent value

- **Steps for successful cold room retrofit**
  - Perform site audit, energy analysis and propose solution
  - NRM systems qualify for utility incentives and will pursue for client

- **Upon authorization to proceed**
  - NRM schedules installation
  - Installs in “live” cold rooms during business hours: this is what we do for a living and work does not interfere with business operations
  - Cold rooms are typically shut down for no more than 15-20 minutes at a time while we cut into the temperature control circuit. Product is not affected.

- **Electricians need to access the evaporator at the back of the cold room. Installers will work in a neat and professional manner.**

- **Contact NRM through [www.nrminc.com](http://www.nrminc.com) to request an audit.**
QUESTIONS?

Emre Schveighoffer 800-377-5439 ext 101
emrejs@nrminc.com

www.nrminc.com