HIGH TEMPERATURE LININGS

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June 8, 2009

RE: Commissioning Your New or Refurbished Burn Building

High Temperature Linings would like to offer the following basic advice regarding your use of your new or refurbished burn building. Keep in mind that we are not fire training officers. We are not even firefighters. However, we have been assisting fire training divisions in designing, protecting and repairing live fire training structures for over fifteen years, and have completed work on nearly two hundred training structures. Further, Bill Glover, President of our company, has served on the NFPA Technical Training Committee on Fire Service Training since 2002. We believe our experience offers a unique insight into the use of the facilities that we protect and compels us to make the following suggestions.

STANDARD OPERATING PROCEDURES (GUIDELINES)

Often, training chiefs tell us they follow NFPA 1403, as if that is a SOP. Please understand that 1403 "provides recognized safe practices for conducting live fire training evolutions". However, we do not consider the document to constitute a standard operating procedure for one specific structure. Instead, the standard is very broadly based, addressing general important issues that must be addressed and applied to the particular structure you are using for your training. It addresses acquired structures as well as fixed permanent burn buildings. It addresses Class A fuels used in both acquired structures and permanent structures, as well as gas fired simulators that are used in both permanent and mobile structures.

It is therefore critical that you develop a SOP for your specific structure, applying 1403 to your circumstances and configuration of your structure. Of course, there are many SOPs out there, developed by various training divisions who are generally happy to share them with others. We always encourage you contact your peers with similar structures for ideas and experiences. There is a complete list of all of the projects that HTL has completed on our website. We are sure our customers would welcome the opportunity to exchange information.

Further, we are attaching a template for a SOP that can be amended to apply to your structure. The idea with such a SOP is to tailor the document to reference not only your structure, but each room within the structure, each means of escape, and even each evolution.

Please give us a call if you have any questions, comments or suggestions for improving this template.

TEMPERATURE MONITORING SYSTEMS

If you have a temperature monitoring system, please reference the attached document relative to our concerns with using temperature monitoring systems as safety devices. Simply put, don't do it. Use the system to monitor and record *relative* conditions in the facility while you are following your SOP. If the SOP is followed, the environments developed in the structure will be those that you have anticipated and planned for. If you don't follow your SOP, you're on your own and your training officers, especially, are at risk.

High Temperature Linings
Recommendations for Using New or Refurbished Training Structures
June 8, 2009

YOUR STRUCTURE

If you have constructed one of the new training structures promoted by HTL, with columns located on the outside of the building, your structure is, in our opinion, based upon the best design available for permanent live fire training.

It is helpful that you understand the design concept. This design approach includes a structural concrete frame with flat slabs (hopefully excluding beams) supported by columns that are primarily located on the exterior of the structure. Of course, there will be a few columns on the interior of the structure, and we have protected those with our lining system. The walls are non-load-bearing concrete block. Doors and windows are designed to float on the exterior of the structure, and designed for relatively easy replacement. The advantages of this design are:

a. By using a concrete frame, and non-load-bearing walls, we only have to protect the ceilings with our linings, and the floors with fire pavers.
b. This allows you burn throughout the structure, except stairways.
c. This allows an affordable structure as the linings are the most expensive component of the structure, and if we lined all of the walls the structure would likely be unaffordable. By making the walls non-structural, we do not have to protect them; they are "sacrificial".
d. The sacrificial walls help to dissipate heat much better than fully lined walls which reflect heat. Therefore, your rooms do not become overheated so quickly.
e. Note that these unprotected sacrificial walls will require periodic maintenance and replacement. Most buildings require about $10,000 of maintenance every three years.
f. The door and windows shutters are ¼" mild plate steel. The hinges and latches are stainless steel. The shutters are surface mounted on the outside of the structure so they can expand and contract without binding and trapping personnel in the burn building.
g. The shutters might warp over time. When they need to be replaced, you can reuse the hinges and latches, replacing only the door shutter and the mild steel angles that are welded to the shutter.
h. The floors slope for positive drainage from the center of the structure to the exterior walls and through scuppers. The scuppers are designed to be left open during live fire training, and closed for cold training.
i. The lining system is designed to last about 15 to 20 years with very little maintenance. See the attached document regarding the minimum level of maintenance that is required for the lining system.

PRE-BURN AND CURING RECOMMENDATIONS

New structures or refurbished structures with new concrete block walls should be allowed to cure for two months before you start burning. The idea is to allow the concrete and concrete block walls to dry out as much as practically possible before you burn. High temperatures associated with burning will draw the water out of the mortar joints and concrete. If too much water is still present, concrete can literally explode as the water turns to steam, creating pressures that are greater than the tensile strength of the concrete. Further, as water is drawn out of the block mortar joints, the mortar will lose its' bond with the block. This will eventually occur regardless of how long you wait before burning. In time, the mortar will dry out and crack away from the concrete block in the hottest burn areas.

When you are ready to begin training, follow the Pre-Burn procedures that are attached. This pre-burn procedure should also be followed after replacing a significant number of fire tile plugs.

Burning pallets, allowing them to burn out without extinguishment, develops some heat to allow the bolt hole plugs to harden before you hit them with hose streams.

BASIC MAINTENANCE

It is important to understand that we recommend that you replace missing bolt hole plugs in the lining system every three months. However, it is not a problem to continue training as you lose plugs during the three month period. The plugs seal the bolt hole and restrain the nuts from "backing off". As long as maintenance is performed on a regular basis, we find that the materials and labor required is very minimal. See attached instructions.

Finally, in addition to daily inspections required per your SOP, we encourage you to inspect your building each time you perform tile maintenance. You should look for any cracks that might develop in the concrete structure and pay particular attention to the condition of the door and window shutters. Cracks in the concrete structure can allow water to seep into the insulation behind the linings, which can cause severe problems in freezing weather. This has not been a problem on structures that are designed with the concrete frame promoted by HTL, but has been an issue on some of the older refurbished structures. Any cracks found behind our linings must be repaired as soon as practical.

Doors and windows that might become loose present a particular safety issue for obvious reasons and require immediate repair and/or replacement. Check them on a regular basis to ensure anchors are tight and that shutters and latches swing and operate properly.

If your structure includes a temperature monitoring system, expect thermocouples to require periodic replacement. You should keep a number of spare thermocouples on hand. If you have a temperature recorder (like a Yokogawa or Honeywell unit), the digital display will show a series of asterisks, or an artificially high or low temperature when a thermocouple requires replacement. See maintenance instructions for your particular system.

We hope this information is useful to you. HTL is committed to providing the safest training environments possible. We believe this information, and the attached documentation helps us all to achieve that goal.

Thanks and safe training.

The Staff of High Temperature Linings.

March 23, 2002

TO ALL USERS OF TEMPERATURE MONITORING SYSTEMS IN LIVE FIRE TRAINING STRUCTURES

We wish to advise you of an issue relating to temperature monitoring systems installed in live fire training structures.

Many temperature monitoring systems have been installed over the years in an attempt to provide the fire service with accurate information as to the temperatures being generated in burn rooms. This information is important to the training officer to understand the following:

a) The highest temperature in the room as measured by the thermocouple that is mounted on the ceiling.

b) The temperature at a level of approximately 24-30 inches off the floor to measure the temperature encountered by firefighters crawling into the room.

c) The temperature between the protective linings and the concrete structure to monitor the performance of the lining system over a long period of time.

We have learned over the years that thermocouples mounted to the wall and ceiling surfaces read a temperature that is tempered by the mass of the wall or ceiling. In other words, the wall and ceiling surface temperatures are going to be lower than the air temperature that is trying to heat up the mass of the wall or ceiling. Imagine putting lasagna in an oven set at 350 degrees. The lasagna may take an hour to heat up to the air temperature of the oven. This is the same phenomenon experienced in burn rooms. The walls and ceilings are mass that is absorbing heat similar to the lasagna. We have measured wall and air temperatures that vary by as much as 70-100%. E.g... air temperature of 368 degrees and wall temperature of 230 degrees.

Therefore, during the first several evolutions of a training day the thermocouple will report temperatures that are considerably lower than the temperature of the air. Then, for a while, the thermocouple will report temperatures that are closer to the actual air temperature. However, as the day wears on, the thermocouple will actually begin to report temperatures that are higher than the air temperature. This is the result of cooling the air temperatures with bursts of water while the mass of the wall is storing the extraordinary heat generated in the room during the day of training.

We have consulted with various experts in the field of temperature monitoring and have concluded, at least for the moment, that there is nothing we can do to improve this situation. We are dealing with the laws of nature. The only way to provide more accurate readings would be to dangle thermocouples in the air throughout the room. This is impractical in a training environment.

We still believe the temperature monitoring system is a tool that provides a relative measure of what is occurring in a burn room. However, it is important to understand, particularly with the thermocouple that is mounted near the floor, that the temperatures reported by the temperature monitoring system are inaccurate relative to air temperature and should not be used to measure "safe" air temperatures. Should you still elect to install a thermocouple at this elevation, we very strongly recommend that training officers be repeatedly and firmly advised that such monitoring offers only a "relative" measure of the heat in the room and that such information may be very inaccurate. Install placards on the exterior of all training structures with temperature monitoring systems stating something like this: "Temperature readings displayed and recorded by the temperature monitoring system recorder may be considerably lower than actual air (gas) temperatures. Do not use the temperature monitoring system to determine safe fire loadings. Use only standard operating procedures. The same placard should be installed on the temperature recorder panel housing."

We encourage all training divisions to rely on PASS devices mounted to the firefighter to ensure the firefighter is not exposed to extreme temperatures. We understand these are available with rate of rise measuring capabilities, but do not know of one that measures a set temperature as adjusted by the user. If you know of one, please let us know.

Finally, the thermocouple that is installed between the protective lining system and the concrete structure is measuring the amount of heat that slowly soaks into the structure. This is accurate. This thermocouple is not affected by thermal imbalance that occurs in the confines of the burn room. This concealed thermocouple is an important component of your system.

Please make sure all personnel using your facility are made aware of this condition.

We realize this is an undesirable situation and are still looking for a better way to provide accurate data to the training officer. Your comments, questions and suggestions would be appreciated.

Sincerely,

HIGH TEMPERATURE LININGS

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February 17, 2012

Dear Chief Training Officer:

Bill Glover, President of High Temperature Linings, has been sitting on the NFPA Technical Committee on Fire Service Training for ten years. In his work with the committee, and in his participation as a member of design/construction teams on over one hundred new live fire training structures (burn buildings), he recognized that many in the fire service were using NFPA 1403, Standard on Live Fire Training Evolutions, as a stand-alone Standard Operating Procedure. In fact, NFPA 1403 is a broad standard that addresses many types of training, and different types of fire training structures and/or fire training props. It is imperative that Standard Operating Procedures be developed by each fire training center that applies NFPA 1403 to the particular structure, and to each burn room within the structure, that is being used by the fire department.

Further, it is apparent that most fire training academies are exercising too little control of fuel loads and numbers of evolutions conducted in permanent fire training towers, and that many in the fire service do not have an appreciation for the critical nature of the radiant energy that is developed as multiple successive fire evolutions are conducted. Many in the fire service believe that the installation of a permanent temperature monitoring system in the burn building allows training officers complete control in maintaining safe training environments. However, it is important to understand that a relative rise in temperature does not equate to the same relative increase in radiant energy produced. In fact, as temperatures increase, and as successive fires are conducted, the amount of radiant energy increases exponentially. To date, there is not an effective means of measuring the radiant energy produced in a live fire training structure. Further, permanently installed temperature monitoring systems are only relatively accurate in reporting actual gas temperatures that exist in different parts of a burn room.

Consequently, the NPFA Technical Committee on Fire Service Training has included language in the 2012 edition of NFPA 1403 that addresses this issue. The new standard requires that “burn sequence charts” be developed to define fuel loads and numbers of evolutions that can be safely conducted in each burn room of the live fire training structure. The standard includes the following language:

> **7.3.1** The AHJ shall develop and utilize a safe live fire training action plan when multiple sequential burn evolutions are to be conducted per day in each burn room.
>
> **7.3.2** A burn sequence matrix chart shall be developed for the burn rooms in a live fire training structure.
>
> **7.3.2.1** The burn sequence matrix chart shall include the maximum fuel loading per evolution and maximum number of sequential live fire evolutions that can be conducted per day in each burn room.
>
> **7.3.3*** The burn sequence for each room shall define the maximum fuel load that can be used for the first burn and each successive burn.

7.3.4* The burn sequence matrix for each room shall also specify the maximum number of evolutions that can be safely conducted during a given training period before the room is allowed to cool.

7.3.5 The fuel loads per evolution and the maximum number of sequential evolutions in each burn room shall not be exceeded under any circumstances.

High Temperature Linings encourages our customers to immediately take a pro-active role by taking the following steps:

1. Understand the difference between temperature and radiant energy.

2. Understand that you can create environments in permanent live fire training structures that are a threat to your turn out gear and your safety. Remember, a permanent live fire training structure is designed to withstand thousands of live fire training evolutions without seriously affecting the integrity of the structure. Consequently, if you are not planning and controlling your evolutions, the environments created could be worse than those encountered in actual structure fires. Quite simply, many structures would collapse under the same conditions.

3. Develop Standard Operating Procedures that apply NFPA 1403 to the particular structure that you use for your fire training. We are attaching a sample of what that SOP might look like. Of course, you must develop SOPs that apply to your specific structure. The attachment is intended to simply offer ideas.

We hope this information is useful to you, and we strongly encourage you to contact us with comments and/or recommendations.

Thanks, and please be safe!

Sincerely,

HIGH TEMPERATURE LININGS

William E. Glover

will@firetrain.com

Sample Standard Operating Procedures
February 2011

The following language is a sample standard operating guideline that is offered by High Temperature Linings (HTL) to encourage your thought and action in developing your own SOP to address live fire training evolutions conducted in your specific live fire training structure. This sample may not address all issues that need to be addressed in your structure, and may not even make sense for your particular structure. You must develop your own language. This document is simply intended to offer ideas. HTL disclaims liability for any personal injury, property or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this document. HTL also makes no guaranty or warranty as to the accuracy of completeness of any information published herein.

Welcome to the (name of your training academy). As a training instructor, you are the most important component of our mission to provide an effective, safe and comprehensive training experience for firefighters utilizing our facility. Your participation is greatly appreciated. Of course, your commitment to safety is appreciated most by the families of the men and women that we train. Your professionalism and commitment to our cause to protect lives and property is the foundation of our training program. Thank you for your time, your ideas, and your contributions to our efforts in meeting our goal of providing the best, safest live fire training possible.

Our academy recognizes the National Fire Protection Association (NFPA) 1403 Standard on Live Fire Training Evolutions (1403), latest edition, and is dedicated to ensuring adherence to this standard before, during and after every live fire training exercise conducted. To that end, each of our instructors is required to become thoroughly familiar with this standard, to the degree that he/she understands all aspects of the standard and agrees to enthusiastically advance its' spirit in providing safe, effective live fire training.

Further, we do not believe it is good enough to adopt NFPA 1403 without applying the standard to our specific structure. Each training structure is unique. Some structures are single story; others are multiple stories. One structure may be a poured in place concrete structure with a structural protective lining system (SPLS) only on the ceilings; another might be concrete block with a few rooms that are completely protected with SPLS. One structure could be in Palm Beach County, Florida with sweltering ambient temperatures, while another is in Boston, Massachusetts, dealing with freezing temperatures on the day of training. The following are just some of the factors that will affect how NFPA 1403 would be applied to a specific structure.

a) Number of stories
b) Construction (concrete, concrete block, metal building)
c) Type and quantity of structural protective lining system (SPLS)
d) Type of temperature monitoring system (TMS), if any.
e) Size of burn rooms
f) Number of burn rooms
g) Type, size and number of windows / doors
h) Type, size and number of passive ventilation openings / chop outs

i) Fuel utilized (straw, excelsior, pallets, propane gas, natural gas, or a combination)
j) Type and number of means of egress and means of escape.
k) Prevailing winds
l) Altitude

As you travel to other jurisdictions, you should look for SOPs that apply to the particular training structure you are using.

Consequently, the (enter name of training academy) staff drafted this SOP to apply NFPA 1403 to our specific live fire training structure. It is important to understand that this SOP is a supplement to 1403 and is not intended to revise the standard in any way. Should there be a discrepancy between this document and 1403, you are to apply that requirement which has the more stringent language. This SOP does not address all chapters or paragraphs of 1403. Rather, it only addresses certain paragraphs that need to be clarified to understand how that part of the standard is being applied to our particular structure. Remember, you must be thoroughly familiar with all 1403 language and adhere to the entire standard as you conduct live fire training exercises.

Our live fire training structure (LFTS) is designed to provide a safe training environment for live fire training conducted in strict compliance with NFPA 1403. The LFTS has (enter number) levels. The structure includes (enter number) burn rooms. Each room has its own characteristics and will behave differently than another room in the same structure. We will therefore address the following specific issues as they relate to each room.

A. Construction of the (enter name of training academy) LFTS
B. Pre-burn inspections 1403.6.2.6; 1403.7.2.1.1; 1403.5.2.1
C. Fuel loads for each evolution conducted in the room (see "Sequential Live Fire Burn Evolutions"). NFPA 1403.7.3
D. Maximum number of evolutions for the room in a given training period before allowing the room to cool off (see "Sequential Live Fire Burn Evolutions"). NFPA 1403.7
E. Placement and configuration of fuel
F. Ignition procedures
G. Ventilation techniques and/or issues. NFPA 1403.7.2.3
H. Water supplies NFPA 1403.4.11
I. Post-burn inspection 1403.7.1.2

Burn Sequences: When conducting evolutions in a burn room, one must be aware of the following basic facts:

1. Larger burn rooms and rooms with higher ceilings will have more cubic feet of air than smaller burn rooms.
2. Generally speaking, with a given quantity of fuel, the lower the cubic footage in a room, the higher the temperatures and more rigorous the environment will be.
3. As the number of openings in a burn room increase, the available ventilation area increases, resulting in typically lower temperatures and less severe environments.

4. The construction of the burn room will affect how much hotter the room will become with each successive evolution. All burn rooms will retain a level of heat with each burn. The temperature and radiant heat in the burn room will increase with each additional evolution. At some point, every room will become too hot to safely conduct further training. Outside environmental conditions might also affect the conditions within burn rooms.
5. The burn sequence for each room should define the maximum fuel load that can be used for the first burn and each successive burn. Typically, the fuel load for the second burn should be smaller than the fuel load for the first. The fuel load for the third burn should be smaller than that for the second……and so on.
6. The burn sequence for each room should also specify the maximum number of evolutions that can be safely conducted during a given training period before the room is allowed to cool.
7. The burn sequences for the burn rooms in our structure shall be: (see attached table)

A. Construction of the (enter name of training academy) LFTS

Our LFTS is a rather unique structure that has been specifically designed for Class A live fire training. The construction includes a structural concrete frame (slab, columns, beams and shear walls) that has been protected with a structural protective lining system (SPLS). Most of the walls of the structure are non-load bearing, non-structural infill panels developing both exterior and interior walls. The walls are constructed of concrete masonry units (CMU). The walls contain horizontal reinforcing @ 16" o.c. vertically, and vertical reinforcing bars that have been grouted into the CMU at 32" on center. All of the floors are covered with loose laid fire pavers that absorb much of the heat before it gets to the slab on grade and the structural floor / ceiling slabs. The brick also helps to temper the effects of *thermal shock* to the structural concrete.

Therefore, the structural components of our building should be in great shape through many years of service. However, the non-structural walls are exposed to the heat, water and *thermal shock* that is associated with fire training. Therefore, those walls will slowly deteriorate over time, requiring periodic replacement and/or repairs. We are therefore vigilant about continuously inspecting our walls to ensure that there are no loose blocks, or pieces of block that have become dislodged, presenting a hazard to our personnel should a loose piece fall. This requires all training officers to be aware and to collectively participate as "inspectors" each time they visit the facility. Any block(s) that present a hazard must be reported immediately to (enter name here or position here) by completing the attached form and submitting it to (enter name here or position here). Further, no training shall be conducted in any room containing loose block or portions of block. However, frequently, with permission from to (enter name here or position here), you may remove the loose materials and continue to train in the affected room.

The LFTS also has steel drainage scuppers, and door and window shutters that are designed to expand and contract without binding. Further, they have specially designed latches that allow you to "pin" them in the open position while any live fire training is being conducted. The shutters are intended to be closed, but not latched, during the evolution until the compartments are ventilated by opening the shutters. Though the shutters are constructed with heavy plate steel, and are expected to offer a reasonable service life, it is expected that they will require periodic maintenance and replacement as they tend to warp with time. It is therefore important that each door and window be inspected on a continuous basis before, during and after all training sessions. A warped shutter may be difficult to operate in the cold state, much less when heated during a training session. Further, latches may bind or be difficult to operate or to pin in the open position. Therefore, again, you are expected to report any deficiencies to (enter name here or position here) as soon as they are found. Training evolutions are to be terminated in any room having the

deficient shutter, or any room that would require ingress or egress through the subject shutter while training, or in the event that the RIT should be required.

Make sure you have been trained on the proper operation of all shutters and scuppers.

Our LFTS is also equipped with a temperature monitoring system (TMS). The system includes thermometers (*thermocouples)* that are mounted as follows:

Each burn room has at least one thermocouple mounted on the surface of the ceiling to monitor the theoretical highest temperature in the room. Behind each surface mounted thermocouple is another thermocouple that is concealed between the structural protective lining system (SPLS) and the structural concrete, to monitor the amount of heat that soaks through the SPLS. Finally, there is at least one thermocouple that is mounted on the wall of each compartment that monitors the temperature at that point on the wall (30" above the floor). All thermocouples are connected via low voltage wire running through concealed conduits, to a *temperature data recorder* that displays the temperatures being recorded throughout the structure. The data recorder also stores all data to an internal memory and to a removable memory device. The data can be uploaded to programs in our training offices for viewing, manipulation (charting, historical recordation, etc.) and storage. IT IS ABSOLUTELY CRITICAL TO UNDERSTAND THAT THIS EQUIPMENT IS NOT INTENDED TO REPLACE THE ABSOLUTE REQUIREMENT FOR CONTINUOUS AND VIGILENT OBSERVATION AND MONITORING OF ALL BURNS AND BURN ROOM CONDITIONS BY THE SAFETY AND IGNITION OFFICERS SUPERVISING THE LIVE FIRE TRAINING EXERCISE.

The temperature monitoring system is installed to act as a "watch dog". As long as you are following this SOP, conditions in the LFTS should remain controlled and safe. However, if someone does not follow this SOP, the temperature monitoring system will record conditions that fall outside the range of conditions normally encountered when adhering to the SOP. Therefore, a record of non-compliance will exist to allow us to take appropriate disciplinary action.

It is also important to understand that temperatures in a burn room do not necessarily reflect the level of radiant energy developed. Temperature does not measure radiant energy, and radiant energy is the number one threat to firefighters in any live fire scenario. The simplest way to explain this is to understand that a thermocouple that is placed into the flame of one candle will detect the same temperature as one that is placed into the flame of ten candles. Yet the radiant energy produced by ten candles is ten times higher than that produced by one candle. This radiant energy is absorbed by your turn-out gear, and at some point, your gear will fail. It is very difficult to measure radiant energy in a LFTS. This is the primary reason that we have adopted the aforementioned Burn Sequence Charts. We have experimented with the LFTS and have found that we can safely conduct training evolutions of the size and quantity specified in the chart. DO NOT EXCEED EITHER THE FUEL LOAD OR THE QUANTITY OF EVOLUTIONS SPECIFIED IN THE BURN SEQUENCE CHART.

B. Pre-burn inspection 1403.7.1; 1403.7.2.1; 1403.7.2.1.1; 1403.5.2.4.1

1. As discussed in A, walk through the entire structure looking for loose concrete block and or floor brick. Any block(s) and/or floor brick that present a hazard must be reported immediately to (enter name here or position here) by completing the attached form and submitting it to (enter name here or position here). Further, no training shall be conducted in any room containing loose block or portions of block. However, frequently, with permission

from to (enter name here or position here), you may remove the loose materials and continue to train in the affected room.

2. Inspect all doors and windows to ensure proper operation. Report any deficiencies to (enter name here or position here) as soon as they are found. Training evolutions are to be terminated in any room having the deficient shutter, or any room that would require ingress or egress through the subject shutter while training, or in the event that the RIT should be required.
3. During the walk thru, pay attention to ceilings and walls that are protected with SPLS. Any fire tiles that appear to be loose, or hanging, shall be reported immediately to (enter name here or position here) by completing the attached form and submitting it to (enter name here or position here). No training shall be conducted in any room containing loose fire tiles. Further, report tiles that have missing mortar over the tile anchors (bolt hole filler). Though this is not an issue that will prevent training, it is a maintenance issue that must be addressed periodically by training staff.
4. Make sure that you have been properly trained on the operation of the temperature monitoring system, and that the system is powered up and recording temperatures before commencing with any live fire training. Make sure the recorder has a sufficient quantity of data logging paper in the paper bin and that the pens are recording temperatures (have ink). Report any problems to enter name here or position here).
5. Check hand rails and guardrails, and stair nosings to ensure they are not loose. Report any deficiencies.
6. Means of egress in the room. NFPA 1403.4.13.5 / Means of escape. NFPA 1403.4.13.5 and NFPA 1403.7.2.3

Rescue route (entry and egress) for rapid intervention team. NFPA 1403.4.13.5

   a. Each burn room in the live fire training structure has a minimum of two means of escape. Doorways serve as the means of escape in all burn rooms except burn rooms 202 and 203. In those burn rooms, the window shall serve as the second means of escape. Fires shall not be set in rooms 202 or 203 unless a ladder has been placed and tied off at the window serving as the second means of escape.
   b. The instructor-in-charge shall walk through the live fire training structure before each training session to ensure that all means of egress are clear of debris and/or other obstacles and that all door and window shutters are operable and that latches are pinned in the open position.
   c. The safety officer shall walk through the building prior to each evolution to ensure the means of egress are clear of debris and/or other obstacles.
   d. The safety officer shall ensure that the floor hatch in room 203 has been properly closed before each evolution.
7. Inherent and/or peculiar hazards (floor openings, fall hazards, obstructions, etc.) NFPA 1403.5.2.4.1

   Ensure that any horizontal or vertical means of ventilation are operational and not obstructed. There are chop simulation openings in the ceilings of rooms 202 and 304.

8. Potential drainage issues. NFPA 1403.5.2.4.1

a. Ensure that all drainage scuppers and/or pipes are clear and operational.
b. Look for damage to the floors (spalls and/or missing firebrick pavers) that result in puddles. Report any problems to (enter name here or position here). Note that puddles of water present a hazard as the heated water burns the knees of crawling firefighters.

9. Walk around the exterior of the structure looking for loose blocks, debris and/or equipment that might be on ledges or sills that could be knocked off the building. Take appropriate measures and/or report deficiencies.
10. Inspect burn racks to ensure they are properly placed and in good operating condition and that there is not a chance for a rack to fall over during training. Take appropriate measures and/or report deficiencies.
11. Make sure there are NO stored fuels in the LFTS prior to conducting evolutions.
12. Inspect all fire sets, to ensure they are in compliance with the Burn Sequence Chart with respect to the size of the fuel load and the type of fuels being utilized.
13. Inspect the standpipe system to ensure valves are operational and that there are no obstructions preventing access to the standpipe.
14. Inspect and operate the separate standpipe system for the safety lines utilized during ignition.

C. Fuel loads for each evolution conducted in the room (see "burn sequences"). NFPA 1403.4.12 and NFPA 1403.7

The Burn Sequence Chart (BSC) specifies the maximum fuel loads for each fire set conducted in each burn room. Further, the BSC specifies the maximum number of evolutions that may be conducted in each burn room during any training session, before the rooms are allowed to cool for a minimum of four hours. Further, all ignition officers are to adhere to the following guidelines:

1. Never use fuels other than those specified in the BSC.
2. Only Class A fuels are specified. No Class B fuels are allowed in the structure.
3. Always use burn racks provided, and only load the fuel as directed in the instructor training course.
4. When racks are not provided, only configure fuel loads as directed in the instructor training course.
5. Ensure that pallet wall hooks, used for concealed fire evolutions, are secure.
6. Ensure that the Safety Officer inspects every burn room prior to every evolution and that an Ignition Officer and a second person with a charged safety line ignite each and every evolution.
7. The Ignition Officer and the second person shall carefully follow NFPA 1584 Standard on the Rehabilitation Process for Members During Emergency Operations and Training Exercises, 2008 Edition to avoid overheating turn-out gear and/or themselves.

D. Maximum number of evolutions for the room in a given training period before allowing the room to cool off (see "burn sequences"). NFPA 1403.7.3

1. The number of consecutive evolutions conducted in any burn room shall not exceed the maximum number of evolutions allowed per the Burn Sequence Chart during any one training session before allowing the room to cool.

E. Placement and configuration of fuel

1. Fuel loads shall be limited to that specified in the Burn Sequence Chart for the particular evolution.
2. Fuel shall be arranged in the burn rack provided.
3. Fuel loads may also be placed in designated burn areas indicated on the attached floor plans of the live fire training structure.
    a. Fuel loads shall be configured per the attached typical fire set configuration.

F. Ignition procedures

1. One person who is not a student shall be designated as the "ignition officer" to control the materials being burned.
2. The ignition officer shall wear full protective clothing, including SCBA, as required by NFPA 1043.4.8, when performing this control function.
3. A charged hose line shall accompany the ignition officer when he or she is igniting any fire.
4. Each evolution shall be ignited only by the ignition officer, in the presence of and under the direct supervision of the safety officer.
5. The decision to ignite the training fire shall be made by the instructor-in-charge in coordination with the safety officer.
6. Fires will not be ignited in rooms deemed to be overheated as determined by the instructor-in-charge in coordination with the safety officer.
7. The only fuel that is allowed in rooms 103 and 202 is hay or excelsior which is to be placed in racks provided.

G. Ventilation techniques and/or issues. NFPA 1403.7.2.3

1. Each training officer shall have received training on the proper ventilation techniques that are unique to this live fire training structure. See (enter name here or position here) for training.
2. After each evolution in rooms 103 and 202, the positive pressure ventilation (turbo blade) fan shall be positioned and operated for a minimum of 180 seconds to cool the room.
3. Vertical ventilation drills shall be conducted with a minimum of two students and one safety officer. The live fire training structure is equipped with removable safety railings and operable gates at the roof eve to allow for placement of roof ladders. After roof ladders have been placed and students have advanced to the sloped roof above rooms 202 and 304, the access gate shall be closed for the duration of the exercise. New plywood and joists (if necessary) shall be installed after each vertical ventilation drill to prepare for the next use of the prop. At the end of the training session, the weather cover for the ventilation penetration shall be placed over the fresh plywood / joists.

H. Water supply NFPA 1403.4.11

We wish to emphasize the following critical components of 1403 with respect to water supply.

1. 1403.4.11- The instructor-in-charge and the safety officer shall determine the rate and duration of water flow necessary for each individual live fire training evolution, including the water necessary for control and extinguishment of the training fire, the water supply necessary for backup line(s) to protect personnel, and any water needed to protect exposed property.
2. 1403.4.11.3 - Backup lines shall be provided to ensure protection for personnel on training attack lines.

3. 1403.4.11.2 - Each hose line shall be capable of delivering a minimum of 95 gpm (360 L/min).
4. 1403.4.7.5 - A charged hose line shall accompany the ignition officer when he or she is igniting any fire.

I. Post-burn inspection 1403.7.1; **1403.7.1.2; 1403.5.2.1**

Inherent and/or peculiar hazards (floor openings, fall hazards, obstructions, etc.) NFPA 1403.5.2.1

1. The safety officer and the instructor in charge shall both walk the structure at the end of the training session.
   a. Walk through the entire structure looking for loose concrete block and or floor brick. Any block(s) and/or floor brick that present a hazard must be reported immediately to (enter name here or position here) by completing the attached form and submitting it to (enter name here or position here).
   b. Inspect all doors and windows to ensure proper operation. Report any deficiencies to (enter name here or position here) as soon as they are found.
   c. During the walk thru, pay attention to ceilings and walls that are protected with SPLS. Any fire tiles that appear to be loose, or hanging, shall be reported immediately to (enter name here or position here) by completing the attached form and submitting it to (enter name here or position here).
   d. Make sure the recorder has a sufficient quantity of data logging paper in the paper bin and that the pens are recording temperatures (have ink). Report any problems to enter name here or position here).
   e. Check hand rails and guardrails, and stair nosings to ensure they are not loose. Ensure that removable roof railings are properly replaced and that gates are closed and pad-locked. Report any deficiencies.
   f. Ensure that all unused fuel is removed from the structure. Ensure that all fires have been knocked down sufficiently, but do not completely douse and remove embers. Leave embers to burn themselves out. (This procedure helps to minimize thermal shock to the training structure, contributing to the life of the structure.)
   g. Ensure that all corridors, stairs and means of ingress/egress have been cleared and cleaned.
   h. Ensure that the roof ventilation cover is in place along with fresh plywood and joist in rooms 202 and 304.
   i. Ensure that the floor hatch in room 203 has been properly closed.
   j. Inherent and/or peculiar hazards (floor openings, fall hazards, obstructions, etc.) NFPA 1403.5.2.1
      a. Ensure that any horizontal or vertical means of ventilation are operational and not obstructed. There are chop simulation openings in the ceilings of rooms 202 and 304.
   k. Ensure that all drainage scuppers and/or pipes are clear and operational.
   l. Look for damage to the floors (spalls and/or missing firebrick pavers) that result in puddles. Report any problems to enter name here or position here).
   m. Walk around the exterior of the structure looking for loose blocks, debris and/or equipment that might be on ledges or sills that could be knocked off the building. Take appropriate measures and/or report deficiencies.

SAMPLE TO BE REVISED TO APPLY TO YOUR STRUCTURE

Maximum Fire Loads and Maximum Number of Evolutions for Burn Building								
	Room 1	Room 2	Room 3	Room 4	Room 5	Room 6	Room 7	Room 8
Burn Sequence 1 - Pallets	4	4	3	6	2	3	4	4
Burn Sequence 1 - Bales	1	1	1	1	1	1	1	1
Burn Sequence 2 - Pallets	4	3	2	4	2	2	3	3
Burn Sequence 2 - Bales	1	1	1	1	1	1	1	1
Burn Sequence 3 - Pallets	3	2	2	3	2	2	2	2
Burn Sequence 3 - Bales	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Burn Sequence 4 - Pallets	2	1	1	2	1	1	1	1
Burn Sequence 4 - Bales	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Burn Sequence 5 - Pallets	1			1			1	1
Burn Sequence 5 - Bales	0.5			0.5			0.5	0.5
Burn Sequence 6 - Pallets				1				
Burn Sequence 6 - Bales				0.5				
Maximum # of Evolutions	5	4	4	6	4	4	5	5

Notes:

1 Maximum pallet size = 50 pounds of clean (untreated and uncontaminated) dry, rough oak pallets.
Pallets made of anything other than solid wood components (no particle board, etc.) may not be used.

2 Bales are clean, dry, untreated, straw weighing no more than 70 pounds, from an approved source.
Consult with Chief Training Officer.

3 See SOP for approved lighting devices.

4 Assumes 20 minute invervals between evolutions.

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