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Reviewed for Code Compliance
Inspections Division
Approved with Conditions
Date: 04/27/17

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Memo Report

From: W. Mark Cummings, P.E.

To: Mr. Ian Michaud; Liquid Riot Bottling Co.

Subject: **Updated Fire Hazards Assessment of the Liquid Riot Bottling Company at 250 Commercial St., Portland, ME.**

A review has been conducted of the updated layout/construction for Liquid Riot Bottling Company facility, which includes a small distilling operation, along with the addition of a new storage area for distilled spirits that are being aged in wood barrels. The new barrel storage space is to be located on the 2nd floor level of the facility, which is located at 250 Commercial Street in Portland, ME. The primary purpose of this updated review is to evaluate the current (as-built) configuration of the brew pub facility and evaluate any potential code compliance issues associated with the addition of the new barrel storage area on the 2nd floor level.

Background

The brew pub and distilling facility was initially constructed at this location in 2012 under the name of *In'finiti Fermentation & Distillation*. This report represents an updated code and hazards assessment of this facility; albeit under its new name, Liquid Riot Bottling Company, and encompassing the additional space on the 2nd floor level of the building.

The brew pub and distillery occupy approximately 5900 ft^2 of the 1st floor of the facility; with the distillery portion only occupying approximately 650 ft^2. The distilling operations produce quantities of a number of different alcoholic beverages (spirits). To produce these various beverages, a small still is installed in the distilling space, which is used to distill various liquid mixtures, producing a range of alcoholic beverages with alcoholic contents that will likely range from 40% to 60% by volume. At this level of alcoholic content, these beverages are considered to be flammable liquids. In addition to the new barrel storage room on the 2nd floor level, a portion of the distilling space will continue to be used to store some of the finished products, including some that will be stored in small wooden barrels as part of the overall aging process. Those products that will not require the "aging" process will only be stored temporarily, until being shipped to a State-authorized distribution facility. Subsequent to completing the distillation process, the products may be initially stored, temporarily, in a stainless steel holding tank(s) located inside the distillation area; which has a capacity of approximately 200 liters (55 gal). When ready for shipping, the product that does not require "aging" will be transferred into individual glass bottles; 750 ml each. These bottles will be packaged into cardboard cases, six (6) bottles to a case, in preparation for shipping.

Based on the parameters outlined in the International Building Code (IBC), the brew pub would be generally classified as an "Assembly, A-2", occupancy. If the portion of this facility used for the distillery operations is to be considered as a separate occupancy, it should be classified as that of a "Factory, F-1, Moderate-hazard" occupancy. The distillery portion of the facility is isolated from the rest of the building with barriers that have a fire-resistance rating of at least one (1) hour. The 2nd floor level of this facility would generally be classified as being a Storage (S-1) occupancy; including both frozen and dry storage areas, along with the new barrel storage room. The barrel storage room is to be separated from the rest of the floor areas by barriers having a fire resistance rating of at least one hour.

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The building appears to generally meet the requirements of a Type IIB construction, as defined by the IBC. exterior walls are all listed as being of masonry construction; nominally 8 inches thick. The floor/ce assembly that separates the 1st and 2nd floors consists of a concrete slab that is supported by exposed steel b and columns. The space that is to be dedicated for the distilling operations is located along a portion of the northwest exterior wall; that adjacent to Commercial St. The barrel storage room is to be located at the northeast corner of the 2nd floor area.

Primary access and egress to/from the brew pub is through the main entrance installed near the north corner of the facility. Additional exits are located at the southeast and southwest corners of the facility's 1st floor. Egress from the 2nd floor level is provided by a couple of stairways located on the west side of the 2nd floor area. The facility is fully protected with both installed fire sprinkler and fire alarm/notification systems.

Fire / Explosion Hazards

In general, all the individual constituent materials used to support the brewing, distillation, and packaging processes do not, by themselves, represent significant fire hazards. The primary fire fuel loading that may be present in the spaces used for brewing and distilling operations may be any empty wood barrels and the cardboard cases that will ultimately be used in storing the finished products. Unlike the distilling operations, the "brewing" operations do not involve the use or production of any combustible or flammable liquids. Although it is unclear if the codes would consider this brewing operation to be "incidental" to the assembly (A-2) occupancy; even if it is to be treated as a separate occupancy, it would be considered a Low Hazard Factory (F-2) occupancy and would result in no additional requirements for fire separation from the remainder of the pub area(s) or any other additional fire suppression requirements beyond what is already installed.

The final stages of the distillation process are that which represent the greatest potential for a fire/explosion hazard; when the liquid has been distilled and the alcohol content is increased to the point that the beverage becomes a "flammable liquid" and the ethanol (vapor) that is being produced by the distillation (boiling) process could result in the development of an ethanol/air mixture that is within its lower flammability limit (LFL). The still design being used is very basic and employs steam, which is produced in the facility's mechanical room, to generate the heat necessary to boil the liquids. At ambient atmospheric pressure, ethanol will boil at just over 78°C (172°F). Should the boiling rate within the still increase beyond that for which the still was designed, it might result in excessive pressure within the still, causing the relief valve(s) to operate; possibly releasing the ethanol vapor into the space. With an auto-ignition temperature of approximately 426°C (800°F), it is unlikely that the surface temperatures of the still will ever approach the point that it might be expected that contact by an ethanol/air mixture with the still's hot surfaces could result in fire initiation. Other than the electrical systems, no other ignition sources are present within this area.

Due to the alcoholic content, 40% to 60% by volume, of the final products (liquids) being produced by the distillation process, these will primarily be classified as being Class IC flammable liquids, as defined by NFPA 30, the *Flammable and Combustible Liquids Code*. This classification stems from the fact that beverages with alcoholic contents in the range specified above will have flash points between 22.8°C and 37.8°C (73°F and 100°F). Another potential fire hazard that will be associated with the distillery's operation is that of a potential spill of these flammable liquids, such that they, and any vapor that might then be produced, could then be exposed to a potential ignition source. It is reported[1] that the evaporation rate for ethanol at "standard" ambient temperatures of approximately 25°C (77°F) is relatively low, such that even the presence of natural ventilation should be sufficient to prevent the development of an ethanol vapor cloud that would exceed its lower flammability limit. However, if a spill was of significant volume (quantity) or if the area where a spill occurred was subject to "stagnant" air, the potential still exists that the LFL could be achieved. It is beyond the scope of this evaluation to attempt to determine a specific spill volume(s) that could result in such an occurrence.

[1] *Potential Explosion Hazards due to Evaporating Ethanol in Whiskey Distilleries*, HSL/2003/08, H.S. Ledin, Health & Safety Laboratory, Buxton, England.

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The presence of other stored materials, such as the cardboard for the shipping cases and empty wood barrels also cause an increase in the overall fire fuel loading (fire potential) within this facility. Given that the wood has a relatively high ignition energy requirement, this represents a very low potential as being an "initial source. The cardboard is much more readily "ignitable", but must still have another ignition source to result in fire initiation.

Research into historical data regarding fires involving distilling facilities indicate that, in general, fires resulting from the distillation processes themselves are extremely rare. Most of the historical data indicates that the greatest risk of fires involving distilled beverages is primarily that resulting when these beverages are exposed to the effects of fires that originated from other sources not directly involving the distillation process. When these (flammable) liquids are exposed to the thermal insult from an adjacent fire, they will begin to rapidly evaporate, potentially producing significant volumes of a flammable vapor. Equally, an adjacent fire can result in the failure of the packaging of the stored liquids, thus resulting in spillage and a significant increase in fire intensity and if sufficient flammable vapors are produced; an explosion.

Review and Assessment of Code & Standards Requirements

The results of this evaluation indicate that the existing national building (IBC) and fire (NFPA) codes do not readily and directly apply to the type and scope of distillery operations that are present at the Liquid Riot facility. However, the requirements of the International Building Code (IBC) (2009 ed.) were used in developing recommendations for this project. Other codes that the State of Maine has adopted that are applicable to this project, and which were used in the code evaluation for fire and life safety for this facility, include the applicable National Fire Protection Association's codes; NFPA 30 – *Flammable and Combustible Liquids Code*, NFPA 70 – The *National Electrical Code*®, and NFPA 101 – The *Life Safety Code*®. Additionally, the applicable Factory Mutual (FM) Global Property Loss Prevention Data Sheet, 7-74 – *Distilleries*, was reviewed and used as a source of information and reference, since much of the fire protection information provided in these sheets is based on historical data specific to that industry.

A primary focus for the review of the IBC, which also included some use of the IFC, and NFPA 30 requirements was to ascertain if there would be any limits on the amounts of flammable liquids (Class IC) that could be present / stored within the brew pub space used for the distilling operations. The published limits on the amounts of flammable liquids that can be stored, listed in both sets of codes, were specifically exempted for alcoholic beverages that are contained in individual containers that do not exceed 1.3 gallons (5 liters) or wood barrels; refer to para. 9.1.4 of NFPA 30 and para. 3401.2 of the IFC, respectively. It has been indicated that much of the product produced by the still at this brew pub will be stored in either wooden barrels or individual 750 ml (0.2 gal) bottles. As such no specific code limitations exist for the amounts to be stored on site within these containers. However, the codes do not specifically address distilled spirits that are to be temporarily stored within the stainless steel (metal) tank(s). As such, if only the requirements for storage of a Class IC flammable liquid are imposed, this would limit the maximum quantity stored, ostensibly in this tank(s), to only 240 gallons. However, the manner in which the codes are written would indicate that this is to be the maximum quantity allowed within this (control) area. Given the fact that the product stored in the wooden barrels and glass bottles is not limited, this simply does not make practical sense for this situation. Section 3404.3.4 of the IFC does have specific allowances for the storage of flammable liquids for wholesale and retail sales (Group M) occupancies. Although this facility does not specifically fall into this classification, based on the types and quantities of flammable liquids and the protection requirements outlined for this classification, it does appear to be an appropriate option for developing an acceptable configuration for this facility that will both be practical in supporting the small distilling operations, while also ensuring that adequate protective measures are implemented. In general, it appears that when storing the flammable liquids in a sprinklered facility, the code would allow maximum quantities that far exceed that which is anticipated to be stored at any one time in this facility. Equally, the fire separation requirements between a Group "M" and Group "A" occupancy are the same as for the "F-1" occupancy.

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NFPA 30 does include specific requirements for "processing facilities" and those that "dispense, handle, tra or use" these liquids. The requirements that apply to this facility's operations are primarily to provide detection/notification system and a ventilation system that is designed to prevent the accumulation of flamm vapors; refer to chapters 17 and 18 of NFPA 30. Without specifically performing calculations to ascertain a specific ventilation rate that will prevent the accumulation of flammable vapors, within 25% of the LFL, the code requires that a minimum ventilation rate of 1 cfm/ft^2 be provided. Given the approximate "foot print" of the distilling area on the 1st floor level, this would require that the installed "low-level" ventilation system for this space provide at least 650 cfm. This includes the requirement that the inlet and exhausts for this low-level ventilation system be located within 12 inches of the floor and should be installed on opposite sides/ends of the room, such that the air movement will "sweep" vapors from all areas of the space.

The codes also have requirements to ensure that no electrical equipment will be exposed to flammable vapors. In this instance, it is required that all electrical systems/equipment installed in the distilling area that are within 3 feet of the floor, meet the requirements of NFPA 70 for a Class I, Division 2 (Zone 2) installation.

As outlined above, many of the requirements in NFPA 30 do not apply to distilled spirits. Although in finished form these liquids are classified as flammable, they would not be considered a "hazardous" material. NFPA 30 does include some requirements with regards to containing and/or controlling spillage from storage containers. The plan for this brew pub includes storage of the finished products in small glass containers, the larger wooden barrels, along with the temporary storage in the steel tanks. The code specifically exempts any need for containment systems for the products stored in the small containers (≤ 5 liters). However, the need to provide containment around the steel tanks and where the barrels are to be stored is less clear. The intent of the code appears to be that any area where the liquid is to be transferred between containers, such as during the bottling process, a means to contain any spillage should be provided. The original facility design for the distilling area included a floor drain, along with the floor being sloped to this location. This layout should prevent any spillage from leaving the distilling area. Should a spill occur that results in some of the products entering the municipal sewer system, it is likely that these products would quickly be diluted below their flammable range, including the alcohol evaporating. Equally, there are no potential ignition sources within the immediate vicinity of the location where the products are to be stored; such that should a spill occur, there is no immediate danger of the product being ignited. It has been stated that liquid transfer from the still will be accomplished using an explosion proof alcohol pump to either the steel tanks or the wooden barrels. With the possible exception of this filling process, the greatest potential for spillage appears to be the possible failure of the glass containers. The wood barrels do not present a high risk of spillage or being accidently ruptured. Once filled, the barrels are not involved in any other process until such time has passed that the contents are ready to be transferred into the smaller containers for distribution/sale, which will also involve the filling process. Any time the products are being transferred to/from the different containers, which represents the highest risk for leakage/spillage, personnel will be present and can quickly take actions to mitigate any spill that might occur. With the addition of the new barrel storage room on the 2nd floor level, once filled within the distilling area, the wood barrels will need to be transported, via the elevator, to the 2nd level. Although the risk of spillage is likely very low during this process, care should be exercised to mitigate the potential for an accident occurring during transfer between floor levels that could result in spillage. However, no other additional means of containment appear to be warranted within the barrel storage area(s).

The actual code requirement for including a fire separation between the distilling area and the remainder of the brew pub area is a bit vague; in light of this specific application. However, based on the previous assessment for this facility, it was recommended that a 1-hour separation be provided; which coincides with the IBC requirements for separation of an Assembly occupancy from a (low hazard) Factory/Industrial occupancy. The original facility design for this area was based on a desire that the distilling operations be "viewable" by patrons of the facility. The facility design for the separation wall(s) included the installation of glass viewing windows on two of the interior walls. Given the expense associated with fire-rated glass, coupled with the relatively low hazard nature of the distilled spirits, the use of an alternative approach to providing the adequate separation was

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utilized. NFPA 101 allows for the use of sprinklers to protect glass installed in the walls of an atrium, wher often desirous that the building design include the ability to view the atrium from adjacent spaces. Althoug application is considerably different from that of an atrium, the basic premise is the same. This, coupled wi low fire hazards associated with the distilling operation and the fact that the spirits are miscible with water and would quickly be diluted below the point at which they would sustain combustion, use of this approach was considered to be an acceptable and safe alternative in providing adequate separation to support safe egress should a fire occur.

In general, all other pertinent requirements associated with the Life Safety Code® (NFPA 101) are currently being met by the existing (and proposed 2nd floor) design for the facility.

Summary and Recommendations:

The research associated with this fire hazard assessment indicates that, in general, fires resulting directly from distillery operations are rare. However, should a fire occur that ultimately exposes/involves the distilled products (flammable liquids), the results could be severe. Based on this assessment and the historical data reviewed, it is likely that the other areas within the facility, such as the kitchen and dining areas, represent a greater risk of fire than does the actual distilling operations. This is based on the fact that the distilling operations will only occur while the area is manned, such that any problem that might occur during these operations would be immediately identified and corrective measures implemented. However, this is not meant to imply that the operation of this distillery is not without inherent fire risks. Equally, it is recommended that specific measures be implemented to further mitigate the potential for damage to the building and the operation of the adjacent tenants, along with complying with all pertinent code requirements.

Based on the results of this recent assessment, the following recommendations are provided to fully ensure that the public is not exposed to any undue risk:

1. Ensure the new barrel storage area is separated from the remainder of the facility by barriers that have a fire resistance rating of at least one hour.
2. Ensure that anytime flammable liquids are being transferred between containers within the distilling area that a portable fire extinguisher is readily accessible within this area.
3. Transfer of barrels from the distilling area to the 2nd floor storage room should be limited to periods when the facility is not open for public occupancy.

Other than what is outlined above, the addition of the barrel storage area on the 2nd floor of the facility does not present any greater risk to the level of fire/life safety within the facility. Should there be any questions regarding this assessment and the recommendations contained herein, please do not hesitate to contact me.

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