

**No Burn Plus
Sprinkler Exception
Alternative Materials and Method Report**

November 17, 2007

**By
Jon S. Traw, P.E.
Traw Associates Consulting
14435 Eastridge Drive
Whittier, California 90602-2745**

This report is the sole property of Traw Associates Consulting and any unauthorized copying or distribution of this report without the expressed written consent of Traw Associates Consulting is strictly prohibited

1 Introduction and Scope

The scope of this report is limited to the analysis and justification for the use of an alternative method of construction for the fire sprinkler exception within a structure required to meet the requirements of the 2003 or 2006 International Building Code (IBC).

This report contains the rationale for the recommended acceptance of the use of *No-Burn Plus* applied to wood framing, plywood or OSB as an alternative method of protection to the FRT materials exception as allowed by Exception 8.14.2.11 of NFPA 13. Extension of this report beyond the specific case in question is inappropriate.

Section 8.14.1.1 and Exception 8.14.2.11 of NFPA 13 which reads as follows:

NFPA 13

8.14.1.1 Concealed Spaces Requiring Sprinkler Protection.

“All concealed spaces enclosed wholly or partly by exposed combustible construction shall be protected by sprinklers except in concealed spaces where sprinklers are not required to be installed by 8.14.1.2.1 through 8.14.1.2.15.”

8.14.2.11 “Concealed spaces in which the exposed materials are constructed entirely of fire – retardant treated wood as defined by NFPA 703, Standard for Fire Retardant Impregnated Wood and Fire Retardant Coatings for Building Materials, shall not require sprinkler protection.”

2 IBC Code and NFPA Standard Provisions

The building code provisions that control the requirements for automatic fire sprinklers are contained in Section 903 of Chapter 9 of the International Building Code (IBC). Unless otherwise stated, the provisions are identical in the 2003 and 2006 IBC.

IBC

903.1 General. *Automatic sprinkler systems shall comply with this section.*

Section 903.3 provides the reference to the sections of the IBC covering the references to the appropriate NFPA standard depending on the type of system required. Section 903.3.1.1 applies for NFPA 13 systems, Section 903.3.1.2 for NFPA 13R systems and Section 903.3.1.3 for NFPA 13D systems. There are minor language differences in Section 903.3.1.1 for the two editions of the code but the application of the requirements is identical.

IBC

903.3 Installation requirements. *Automatic sprinkler systems shall be designed and installed in accordance with Sections 903.3.1 through 903.3.7.*

903.3.1 Standards. *Sprinkler systems shall be designed and installed in accordance with Section 903.3.1.1, 903.3.1.2 or 903.3.1.3.*

2003 IBC

903.3.1.1 NFPA 13 sprinkler systems. *Where the provisions of this code require that a building or portion thereof be equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, sprinklers shall be installed throughout in accordance with NFPA 13 except as provided in Section 903.3.1.1.*

2006 IBC

903.3.1.1 NFPA 13 sprinkler systems. *Where the provisions of this code require that a building or portion thereof be equipped throughout with an automatic sprinkler system in accordance with this section, sprinklers shall be installed throughout in accordance with NFPA 13 except as provided in Section.*

903.3.1.2 NFPA 13R sprinkler systems. *Where allowed in buildings of Group R, up to and including four stories in height, automatic sprinkler systems shall be installed throughout in accordance with NFPA 13R.*

903.3.1.3 NFPA 13D sprinkler systems. *Where allowed, automatic sprinkler systems in one- and two-family dwellings shall be installed throughout in accordance with NFPA 13D.*

Sections 903.3.1.1, 903.3.1.2 and 903.3.1.3 provide the direct references to the specific NFPA standard covering the installation requirements for the automatic sprinkler systems. For the NFPA 13 automatic sprinkler systems, the IBC Section 903.3.1.1.1 titled “exempt locations” covers locations where automatic sprinklers are not required. These exempt locations are in addition to the exceptions permitted under the NFPA 13 standard.

IBC

903.3.1.1.1 Exempt locations. *Automatic sprinklers shall not be required in the following rooms or areas where such rooms or areas are protected with an approved automatic fire detection system, in accordance with Section 907.2, that will respond to visible or invisible particles of combustion. Sprinklers shall not be omitted from any room merely because it is damp, of fire-resistance-rated construction or contains electrical equipment.*

- 1. Any room where the application of water, or flame and water, constitutes a serious life or fire hazard.*
- 2. Any room or space where sprinklers are considered undesirable because of the nature of the contents, when approved by the fire code official.*
- 3. Generator and transformer rooms separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire-resistance rating of not less than 2 hours.*
- 4. In rooms or areas that are of noncombustible construction with wholly noncombustible contents.*

It is clear from a review of the IBC provisions that the installation of automatic fire sprinkler systems must be installed in accordance with the appropriate NFPA standard; NFPA 13, NFPA 13R or NFPA 13D.

For the purposes of this report, only the requirements of NFPA 13 are examined. In order to select the proper edition of the NFPA 13 standard to examine, one must refer to Chapter 35 of the IBC. For the 2003 IBC, the 1999 edition of NFPA 13 is referenced. For the 2006 IBC, the 2002 edition of NFPA 13 is referenced. With regard to the exception allowing the elimination of sprinkler heads as covered by this report, the 1999 and 2002 editions of the NFPA 13 are identical in wording. Section 8.14.1.1 of NFPA 13 contains the requirements for protection of concealed spaces.

NFPA 13

8.14.1.1 Concealed Spaces Requiring Sprinkler Protection.

“All concealed spaces enclosed wholly or partly by exposed combustible construction shall be protected by sprinklers except in concealed spaces where sprinklers are not required to be installed by 8.14.1.2.1 through 8.14.1.2.15.”

The allowance for the elimination of sprinkler heads when the concealed space is constructed entirely of fire-retardant treated wood is contained in Section 8.14.2.11.

NFPA 13

8.14.2.11 “Concealed spaces in which the exposed materials are constructed entirely of fire – retardant treated wood as defined by NFPA 703, Standard for Fire Retardant Impregnated Wood and Fire Retardant Coatings for Building Materials, shall not require sprinkler protection.”

It is therefore allowed under the IBC (both 2003 and 2006 editions) to eliminate the sprinkler protection in the concealed space complying with Section 8.14.2.11 of NFPA 13.

The analysis and recommendations which follow are focused on one alternative solution using *No-Burn Plus* treatment of the wood framing, plywood and/or OSB in lieu of the FRT materials as allowed in Section 8.14.2.11 of NFPA 13.

3 Alternative Analysis

The first step in determining whether any alternative is satisfactory is to examine the specific code requirements and the points upon which an acceptable alternative should be judged. The question is whether *No-Burn Plus* can be used as an equivalent method of protection to that which is specified in Section 8.14.2.11 of NFPA 13.

The alternative materials and methods of construction provisions are contained in Section 104.11 of the IBC.

IBC

104.11 Alternative materials, design and methods of construction and equipment. *The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material,*

method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

104.11.1 Research reports. *Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from approved sources.*

104.11.2 Tests. *Whenever there is insufficient evidence of compliance with the provisions of this code, or evidence that a material or method does not conform to the requirements of this code, or in order to substantiate claims for alternative materials or methods, the building official shall have the authority to require tests as evidence of compliance to be made at no expense to the jurisdiction. Test methods shall be as specified in this code or by other recognized test standards. In the absence of recognized and accepted test methods, the building official shall approve the testing procedures. Tests shall be performed by an approved agency. Reports of such tests shall be retained by the building official for the period required for retention of public records.*

The Building Official must be satisfied that the alternative is equivalent to that which is prescribed in the code in terms of quality, strength, effectiveness, fire resistance, durability and safety. Thus, any analysis should address each of these points to the satisfaction of the Building Official. Each of these requirements is addressed separately.

Quality

No Burn Inc, as part of its ICC ES Evaluation Report #ESR-1838, has a quality control system for all of its plants which produce *No-Burn Plus*. These plants have quality control manuals conforming to the requirements of AC-10 of the ICC ES. In addition, each of the plants have quarterly inspections by an independent IAS accredited inspection agency to ensure that the plants continue to operated in accordance with the quality control manuals. All products shipped from these plants are properly labeled in accordance with the requirements of UL and ICC ES and therefore conform to the product standards for the products that have been tested by the various IAS accredited testing laboratories. All No Burn products applied by certified dealers conform to the highest of quality control standards.

Strength

The only question regarding strength is whether the No Burn products when applied to various substrates reduce the strength of the substrate materials, such as wood, plywood, OSB or gypsum wallboard. The ingredients contained within the No Burn products do not contain any materials that attack or degrade the basic structure of the substrate material regardless of the maximum anticipated temperature or moisture conditions which might exist within the area where the No Burn products have been applied.

The products are not designed to penetrate the basic cellular structure of the wood and/or alter the natural strength of the wood. Similarly, the products do not have any deleterious effect on the binders used in plywood or OSB.

Since the products do not alter any of the basic structure of the various substrates, the application of the No Burn products do not alter the strength of the substrates and the strength requirement of Section 104.11 of the IBC has been met.

Effectiveness, Fire Resistance

The effectiveness and fire resistance requirements for the case in point, i.e. sprinkler exception, are related requirements and will be analyzed together.

In order to evaluate the effectiveness and fire resistance of the proposed alternative, one must first establish the projected effectiveness and fire resistance of the code allowed materials. For this particular case, a review of the requirements for the FRT materials is appropriate.

FRT materials are required to meet the requirements of Section 2303.2 of the IBC.

IBC

2303.2 Fire-retardant-treated wood. *Fire-retardant-treated wood is any wood product which, when impregnated with chemicals by a pressure process or other means during manufacture, shall have, when tested in accordance with ASTM E 84, a listed flame spread index of 25 or less and show no evidence of significant progressive combustion when the test is continued for an additional 20-minute period. In addition, the flame front shall not progress more than 10.5 feet (3200 mm) beyond the centerline of the burners at any time during the test.*

2303.2.1 Labeling. *Fire-retardant-treated lumber and wood structural panels shall be labeled. The label shall contain the following items:*

- 1. The identification mark of an approved agency in accordance with Section 1703.5.*
- 2. Identification of the treating manufacturer.*
- 3. The name of the fire-retardant treatment.*
- 4. The species of wood treated.*
- 5. Flame spread and smoke-developed index.*
- 6. Method of drying after treatment.*
- 7. Conformance with appropriate standards in accordance with Sections 2303.2.2 through 2303.2.5.*
- 8. For fire-retardant-treated wood exposed to weather, damp or wet locations, include the words "No increase in the listed classification when subjected to the Standard Rain Test" (ASTM D 2898).*

2303.2.2 Strength adjustments. *Design values for untreated lumber and wood structural panels, as specified in Section 2303.1, shall be adjusted for fire-retardant-treated wood. Adjustments to design values shall be based on an approved method of investigation that takes into consideration the effects of the anticipated temperature and humidity to which the fire-retardant-treated wood will be subjected, the type of treatment and redrying procedures.*

2303.2.3 Exposure to weather, damp or wet locations. *Where fire-retardant-treated wood is exposed to weather, or damp or wet locations, it shall be identified as "Exterior" to indicate there is no increase in the listed flame spread index as defined in Section 2303.2 when subjected to ASTM D 2898.*

2303.2.4 Interior applications. *Interior fire-retardant-treated wood shall have*

moisture content of not over 28 percent when tested in accordance with ASTM D 3201 procedures at 92-percent relative humidity. Interior fire-retardant-treated wood shall be tested in accordance with Section 2303.2.2.1 or 2303.2.2.2. Interior fire-retardant-treated wood designated as Type A shall be tested in accordance with the provisions of this section.

2303.2.5 Moisture content. *Fire-retardant-treated wood shall be dried to a moisture content of 19 percent or less for lumber and 15 percent or less for wood structural panels before use. For wood kiln dried after treatment (KDAT), the kiln temperatures shall not exceed those used in kiln drying the lumber and plywood submitted for the tests described in Section 2303.2.2.1 for plywood and 2303.2.2.2 for lumber.*

The requirements of Sections 2303.2.1 and 2303.2.2 would not be applicable to the proposed alternative. Section 2303.2.1 contains the requirements for labeling of FRT materials which would not be applicable to the No Burn product applied during construction. Section 2303.2.2 contains the requirements for strength reduction considerations which do not apply.

The key items in Section 2303.2 which must be addressed are the fire testing requirements and the requirements of Sections 2303.2.3 and 2303.2.4 that cover durability issues. Each of these is addressed later in this report. And finally, the requirements of Section 2303.2.5 are directly related to the FRT materials after final treatment and are not applicable to this alternative.

Fire Testing Requirements

The base test used to qualify FRT materials is the ASTM E-84 Tunnel Test. Attached as Exhibit A of this report is the test results for *No-Burn Plus* and these test results performed by an IAS accredited testing laboratory confirm compliance with the test criteria contained in Section 2303.2.

The question of how one makes a comparison between a system that is pressure impregnated versus one that is surface applied is the most difficult to answer. In the case of *No-Burn Plus*, a series of diversified testing of *No-Burn Plus* and comparative performance-based fire testing of the two systems has been conducted. This testing forms the fundamental methodology for being able to confidently state that the *No-Burn Plus* system will perform equally if not better than the system prescribed under Section 8.14.2.11 of NFPA 13.

A series of comparative fire tests using the NFPA 286 Room Corner test were performed at the Western Fire Center in Kelso, Washington. The purpose of these tests were to get a true comparison of the performance of various systems including but not limited to FRT materials and *No-Burn Plus* treated materials.

Included as Exhibits B and C of this report are the results of the NFPA 286 Room Corner tests applicable to this alternative request and analysis. As can be determined from a review of these tests, the room constructed totally of FRT materials failed to pass the test. In comparison, the room constructed of *No Burn Plus* over wood framing and OSB (walls and ceiling) passed the fifteen minute test. In fact, the system went more than twice the fifteen minute period required by the test and never exhibited flashover. From these

comparative tests it is clear that in the Room Corner exposure, the system performance was more than comparable.

Thus, from the standpoint of effectiveness and fire resistance, one would conclude that the proposed alternative has been demonstrated to meet the equivalency requirements.

Durability

Durability is one of the primary concerns when dealing with a fire-retardant coating applied to various substrates. The IBC does not contain specific guidance as to the required durability of fire-retardant coatings but the International Fire Code (IFC) does through IFC's Section 803.4 referencing compliance with NFPA 703.

IFC

803.4 Fire-retardant coatings. *The required flame spread or smoke-developed index of surfaces in existing buildings shall be allowed to be achieved by application of approved fire-retardant coatings, paints or solutions to surfaces having a flame spread index exceeding that allowed. Such applications shall comply with NFPA 703 and the required fire-retardant properties shall be maintained or renewed in accordance with the manufacturer's instructions.*

In fact, it is the reference to NFPA 703 in the IFC that forms the fundamental durability requirements of the Sections 1.2 and 3.2 of ICC ES acceptance criteria AC-363 (See Exhibit D) applicable to surface applied fire-retardant coatings.

NFPA 703

3.2.1 Fire retardant coatings shall remain stable and adhere to the material under all atmospheric conditions the material is exposed to.

3.4 Maintenance of Protection. *Fire retardant coatings shall possess the desired degree of permanency and shall be maintained to retain the effectiveness of the treatment under the service conditions encountered in actual use.*

AC-363

1.2 Scope: *This criteria is limited to fire-retardant coatings complying with NFPA 703 that are field-applied to the exposed surfaces of substrates in the interior of new and existing construction to achieve the required flame-spread and smoke-developed indices. Application is limited to new or existing construction, the specific substrates tested, and to exposed interior conditioned and unconditioned locations with a sustained humidity of less than 80 percent. Coatings demonstrated under Section 3.2 of this criteria as not requiring maintenance or renewal may be recognized under the IBC and IRC. Coatings that require maintenance or renewal are limited to recognition under the IFC and IEBC. Recognition as an alternative to fire-retardant-treated wood is outside the scope of this criteria.*

3.2 Coating Properties: *Data shall be submitted demonstrating compliance with NFPA 703.*

3.2.1 Maintenance of Properties: *Data from an independent, qualified party shall be submitted to show compliance with Sections 3.2.1 and 3.4 of NFPA 703. The*

data shall determine if maintenance or renewal is needed and the frequency of maintenance or renewal.

While the acceptance criteria in the last sentence of Section 1.2 points out that recognition of an alternative to fire-retardant treated wood is beyond the scope of AC-363, this does not in fact render the durability requirements of AC-363 as being inappropriate for other alternative uses of fire-retardant coatings as part of an alternate materials consideration under the provisions of Section 104.11 of the IBC. Section 1.2 of AC-363 provides support for this by the statement in the third and fourth sentences that state:

AC-363

Coatings demonstrated under Section 3.2 of this criteria as not requiring maintenance or renewal may be recognized under the IBC and IRC. Coatings that require maintenance or renewal are limited to recognition under the IFC and IEBC.

In a recently published evaluation report from ICC ES, ESR-1838 (Exhibit E) states that the *No Burn Plus* is permitted to be used in both new buildings constructed under the IBC and IRC as well as existing buildings maintained under the IFC and IEBC. In order to receive recommended acceptance under AC-363 under the IBC and IRC, the durability requirements of NFPA 703 without maintenance had to be met and this was demonstrated through durability testing of all *No Burn* Products including *No Burn Plus*. This was done and evidence of compliance with NFPA 703 was provided to ICC ES. Otherwise, ESR-1838 would have limited the application of *No Burn Plus* to only existing buildings. Since such a limitation was not placed on ESR-1838, the only limitation applicable from the standpoint of durability is the “Condition of Use – 5.5” limitation which stated that “Use of the coating is limited to exposed interior locations having a sustained humidity of less than 80 percent”. This limitation is met in all exposed interior spaces including attics and crawl spaces. Substantiation of the claim relative to maximum sustained humidity levels in attics can be obtained from several reports from the Forest Products Laboratory. These reports which were originally written as the result of past problems with the degradation of fire retardant treated wood, did provide the necessary information relative to the maximum temperature and moisture conditions encountered in attic spaces in two different geographical locations. References for these documents are contained in the references section of this report and can be downloaded from the Forest Products Laboratory website. In summary, the maximum anticipated peak sustained attic temperature is 65°C. The maximum anticipated peak sustained relative humidity is 28%.

In summary, the durability of the *No Burn Plus* for application in combustible spaces such as attics and crawl spaces has been confirmed as meeting the requirements of NFPA 703 as part of the ICC ES evaluation report ESR-1838. Thus, it meets the durability requirements stipulated in Section 104.11 for alternative materials and methods of construction.

Safety

This is a general requirement that the alternative be judged to provide equivalent level of overall safety. From the standpoint of overall safety, this would reasonably be judged as contingent upon meeting all of the previously listed points required by Section 104.11 of

the IBC. From the analysis performed on the quality, strength, effectiveness, fire resistance and durability, it is concluded that the safety level provided by the alternative system is indeed equivalent to the level of safety provided by the code.

4 Conclusion

Based on the above analysis of the requirements of Section 104.11 using national test standards, authoritative publications and the requirements of the IBC, IFC and NFPA 703, the proposed alternative method of protection under Section 8.14.2.11 of NFPA 13 as reference in the IBC and IFC can be found to be at least equivalent to the code prescribed protection.

5 References

- [1] S.M. Cramer and R. H. White, USDA Forest Service, Forest Products Lab., Madison, WI.
- [2] J.E. Winandy, H.M. Barnes and C.A. Hatfield, Roof Temperature Histories in Matched Attics in Mississippi and Wisconsin, USDA Forest Service, Forest Products Lab., Madison, WI.
- [3] A. Ten Wolde, FPL Roof Temperature and Moisture Model, USDA Forest Service, Forest Products Lab., Madison, WI.

Respectfully submitted:

Jon S. Traw PE
Traw Associates Consulting

Exhibit A
ASTM E-84 30 min Test Report

Exhibit B
NFPA 286 FRT Wood and Plywood Test Report

Exhibit C
NFPA 286 NB+ Over Wood Studs and OSB Test Report

Exhibit D
ICC ES Acceptance Criteria AC-363

Exhibit E
ICC ES Evaluation Report ESR-1838