

The BESI System

Understanding the Protocols for Defective Drywall

Patent Pending, Serial No. 61/299,629



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The BESI System

There are six (6) major areas of consideration when analyzing the best approach in remediating homes that contain defective drywall: the protocol development, corrosion, cross-contamination, personal belongings, BETA home program with IAQ monitoring and a proposed warranty.

The Development of Protocols – It's Science

“The Building Envelope Science Institute (BESI) has endorsed a cost effective protocol that can certify remediation of defective drywall,” says Charlie Jones, member of the board of directors. The institute, with the help of a workgroup called Defective Drywall in America (DDIA), has worked diligently to create a cost effective protocol that helps homeowners and builders who have been devastated by the Chinese drywall disaster. “The institute and its members have an ongoing commitment to this problem and are willing to put all their resources together to ensure the process is successful for both the contractor and homeowners,” said Jones.

The standardization of inspection and remediation protocols are essential in bringing a viable solution to the current crisis. The institute together with the members of the DDIA workgroup completed the systems for the protocols in October 2009 that allows homes to be certified clean and be provided with a proposed home warranty; and the first certification class was presented in Orlando during that same month. In fact, the program offered through BESI instructs, trains and certifies through testing individuals who are licensed and approved state contractors and builders in the remediation of defective drywall.

The proposed warranty is contingent on ALL the drywall being removed and replaced with tested domestic products. The certification and proposed warranty are also available for homes that do not have defective drywall to assist those owners when dealing with loss of resale value. Scott “Spiderman” Mulholland, a leading building forensic expert of [U S Building Consultants, Inc.](http://www.usbuildingconsultants.com) (USBCI), was one of the system design architects; he has previously helped author two (2) other national certification programs and was an instructor on a national level for over 15 years. “I wanted



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to be part of a team that could focus on a proven and cost effective system of remediation,” said Mulholland.

Homeowners, builders, banks, insurance companies, investors and tradesmen in the construction industry have to be aware of remediation efforts that will help or harm their client(s) across the nation. Convincing people to leave the drywall in their homes, in the institute’s opinion, is a failed methodology when it comes to basic remediation efforts.

Based on the institute’s remediation experts and others in the workgroup, it was determined that source removal was the only safe and effective way to achieve all the goals of the program. *Based on other standard remediation practices, it was noted that source removal is the most recommended and acceptable practice in the industry.* The institute took this stand in October 2009; and in recent announcements the [CPSC/HUD](#) and Judge Fallon ([MDL No. 2047](#)) have come to realize the necessity of removing the drywall.

Since the endorsement by the institute the protocol has become known as the “BESI System”. The institute pulled resources from the DDIA workgroup which included top analytical scientists, chemists, toxicologists, a major university, consultants in the environmental field and twelve business sectors that were considered in the development and analysis.

The designed approach is simple, cost effective, and includes the following: 1) Removing the defective drywall from the home, 2) Removal of sulfur compounds from the construction materials left in the home after removal of source through a dynamic model known as (forced thermal desorption or FTD), 3) Removal of damaged construction materials (i.e. copper wiring or other materials damaged from the absorption or chemical attack of sulfur compounds), 4) Chemical treatment of construction materials left in the home through Nano Technology that gives redundancy to the process, 5) Decontamination of home furnishings and personal belongings by removing the sulfur compounds and odor, 6) Certifying the process with third-party inspections and peer review, and 7) Submittal of paperwork for a proposed home warranty while maintaining a check and balance system to guarantee quality control.



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The design of the system required numerous hours of hands-on inspections, research and networking with top professionals in a variety of specialty fields and having independent laboratories confirmation that included Analytical Research Systems, NanoScale Corporation, Centek Laboratories, Assured Biotechnology Corporation, BSC Laboratories, the University of Florida (ATCL, MAIC, MSE, & UFTTG) and several others who performed analytical testing and/or review of documentation.

The BESI endorsed protocols have been established based on facts collected during inspections and research/analysis conducted by qualified professionals over many months that involved peer review each step of the way. The protocols are considered a work-in-progress, meaning that as more scientific methods become available the protocols are flexible enough to adapt to the new information. “BETA testing of the first twenty-five homes became a requirement,” said Chris Burton, owner of National Construction Warranty Corporation.

The remediation process requires third-party inspections by Certified Defective Drywall Consultants to validate that the remediation protocol was properly followed by the Certified Defective Drywall Remediator and a peer review of the consultant’s report is conducted for final validation before submittal for the proposed home warranty. The protocols have a built-in quality control mechanism that utilizes the third-party inspectors and peer review to ensure the quality and consistency of the remediation process.

The professionals in the DDIA workgroup and at the institute have established special qualifications for those that are being certified; interested parties may go to the institute’s website at www.BESIInstitute.org to review the requirements for each certified designation.

The program was designed to be a cost-effective system with enough redundancies that would guarantee a successful remediation. This is the mission of the institute and it continues today on this path to help those who are involved with this crisis.

Corrosion – A Safety Issue

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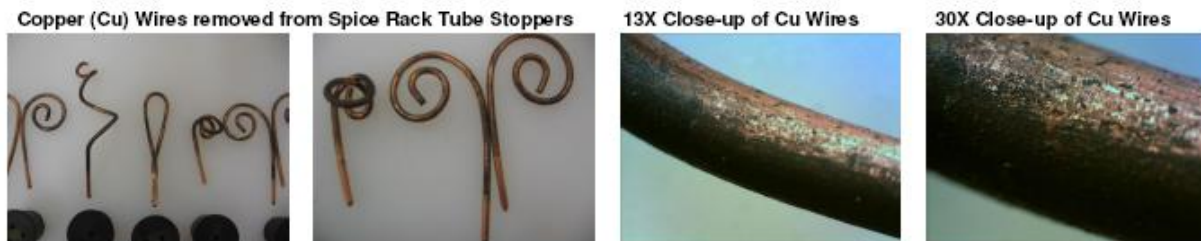


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The contaminants within the imported drywall through diffusion can move from the drywall into the indoor air and eventually other construction materials. Gypsum is known to easily absorb gases and other VOC in the air affecting the indoor air quality. The dynamics of cross contamination is well documented in the indoor air quality industry and we have confirmed this is an issue in countless observations, research, testing and reporting. Additionally, when some of these contaminants come in contact with moisture, water, or condensation an acidic solution (sulfuric acid) can form. The result of this chemical change can cause blackening or corrosion to appear on the air conditioning coils, copper piping, silver components, exposed wiring (electrical outlets) and lead to electronic failures in personal belongings along with life safety components such as fire and alarm systems.

The following photographs are from copper wires attached to stoppers (lids) of glass vials used in a kitchen spice rack which was removed from a residence with defective drywall.



The elemental chemical analysis of surface corrosion products(s) on the above copper samples was conducted on July 24, 2009 using a Joel Sem-6400 with Energy Dispersive X-ray Spectroscopy (EDS) by the University of Florida (UF) Material Science & Engineering's Major Analytical Instrumentation Center (MAIC).

The following is an excerpt from the corrosion study conducted by [Analytical Research Systems, Inc.](#) and [U S Building Consultants](#).



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HADS

VSC

VCC

Using the above equipment, a 3 week (24 hrs per day for 21 days) exposure test was performed. Using high pressure compressed air at 150 psi supplied from the laboratory air compressor system was supplied to the Humidified Air Delivery System (HADS). The HADS outlet pressure was set at 15 psig and the humidifying bubblers were filled with distilled / de-ionized water. The outlet air flow rate was set at 1 liter per minute (1 LPM) for each of the two outputs and supplied to the two Volatile Source Chambers (VSC's). The humidity and temperature was constantly measured using a digital thermo-hygrometer (OMEGA P/N# HH314A) and averaged 75.5+1.0 deg.F and 94%+5% RH throughout the 3 week experiment. Two drywall samples were placed in the Volatile Source Chambers (VSC's) One was a Chinese Drywall sample removed from a private residence (USBCI, Sample ID# DD-ER 05-29-09) and was labeled with Red Tape & ID#, the other was a control which was a locally purchased (Home Depot) American Drywall sample produced by US Gypsum (USBCI, Sample ID# USG-02 06-18-09) and was labeled with Blue Tape & ID#. Both samples were exposed to the same air source for 3 weeks. The total air volume passed over the samples and through the chambers during the experiment was 30,240 Liters (1 LPM x 60 minute/hr x 24 hrs/day x 21 days) or 1,068 ft³ air volume per chamber. The VCC chambers containing the copper metal test strips were connected individually in series to the two separate volatile source chambers (containing the drywall samples) and each contained the same source sample of copper metal, a 3/4" wide x 4" long piece of industry standard HVAC A/C 3/4" soft copper tubing (IUSA 3/4" REF 50' roll of soft refrigeration tubing, purchased from Johnston Supply, Gainesville, FL). Both copper samples were sectioned in half from the same 3/4" tube and each piece of the two half's was rinsed and wiped clean of any oils with methanol and placed into their individual VCC's. Similarly labeled with Red & Blue tape and ID#'s to coincide with their respective VSC source ID#'s.

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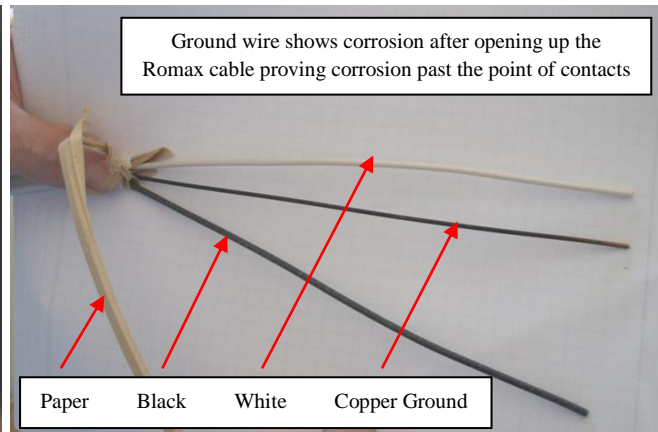
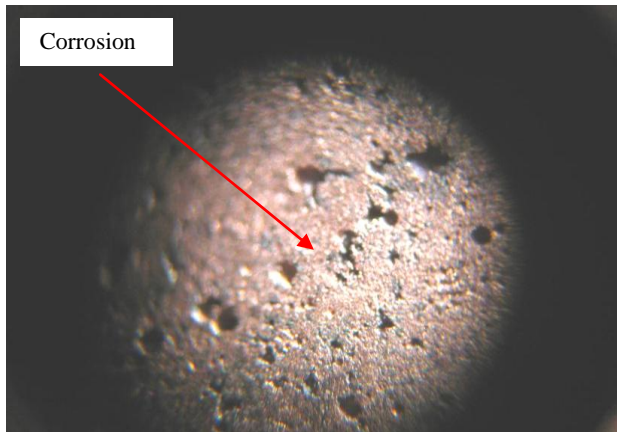
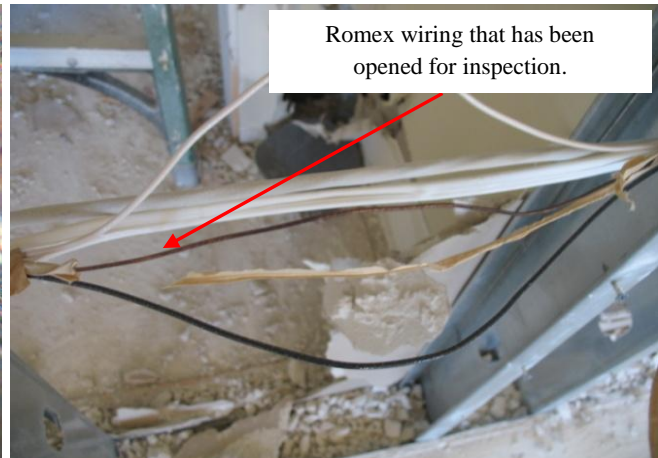
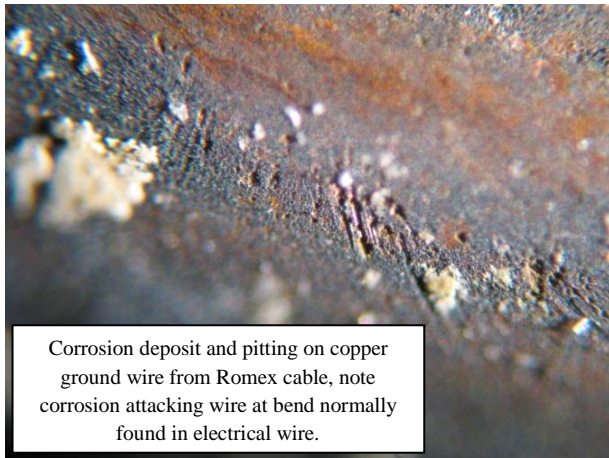


After 3 weeks of air exposure, the Chinese Drywall exposed sample (ID# DD-ER) showed significant black discoloring while the USA Drywall exposed sample maintained its original copper color (bright copper shine). (SEE PHOTOS)

Subsequent Scanning Electron Microscopy (SEM) with Elemental Energy Dispersive Spectroscopy (EDS) testing was done by the Major Analytical Instrument Center (MAIC) of the Department of Material Science & Engineering (MSE) at the University of Florida (Gainesville, FL), under the supervision of Dr. Amelia Dempere, PhD Laboratory Director, which confirmed high sulfur corrosion product on the Chinese copper sample.

Corrosion is an issue when it comes to metals, especially copper (i.e. electrical wiring) that is found in homes with defective drywall. There are reports of electrical outlets that have caught fire, alarm systems malfunctioning or not working at all, fire alarms, electrical appliances, ceiling fans and various other electronic items that have failed. There are some that promote saving the electrical wiring in homes being remediated; however, it is a consensus within the institute and the DDIA workgroup that based on the above corrosion and metallurgical studies, the electrical wiring should be removed and replaced with new wiring.

While some say this is not an issue, the following pictures support the institute's decision to require full removal of the wiring in the home under the protocol endorsed by BESI.



The cost savings that may be recognized by saving the old electrical wiring verses replacement is far outweighed when considering several main facts: 1) assumed risk by contractors who will exclude or raise cost to cover the risk, 2) possible future safety issues with alarm or fire protection, 3) resale stigma, 4) future corrosion and performance issues with the wiring in the home including low voltage wiring, and 5) insurance companies may raise rates or not cover homes that leave corroded and damaged wiring in homes. These few facts by themselves are more than enough justification to warrant removal of the wiring including the small amount of cost difference between the two approaches.



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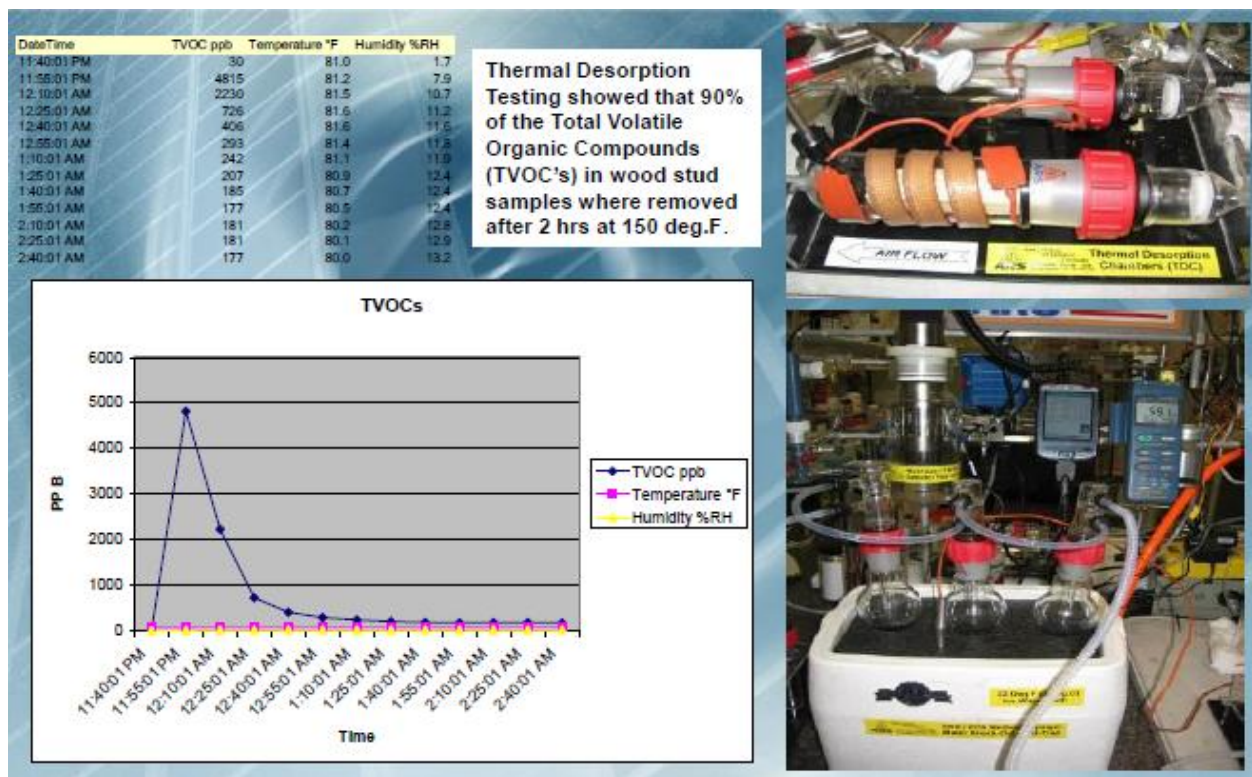
The “[Interim Remediation Guidance for Homes with Corrosion from Problem Drywall](#)” published by the Consumer Product Safety Commission (CPSC) and the Department of Housing and Urban Development dated April 2, 2010 calls for the replacement of “building components for which drywall-induced corrosion might cause a safety problem, such as fire safety alarm devices, electrical devices, electrical components and wiring, gas service piping and fire suppression sprinkler systems”.

Furthermore, in the “[Findings of Fact & Conclusion of Law](#)” (MDL No. 2047 Litigation) filed April 8, 2010, Judge Fallon cites: **all electrical wiring needs to be replaced**, the entire HVAC system and many other items (i.e. appliances, carpet, cabinets, trim, and flooring); pages 26-27. The findings considered scientific evidence which recognizes that significant damage to electrical wiring/components is cause to remove all the wiring and other items.

Cross-Contamination of Building Materials (wood studs, cabinets, etc.)

The diffusion of the volatile organic sulfur compound from defective drywall can create IAQ problems along with the possibility of absorbing into many kinds of construction materials and household belongings. VOC absorption studies into building products have been ongoing for years at the National Research Council in Canada and there are standards that are published for testing VOC with the American Society of Testing and Materials. This concern is somewhat disputed but BESI and the workgroup have tested and evaluated firsthand these concerns both in the field and in the laboratory. Additionally, the facts of cross contamination are well documented in the indoor air quality industry. Many builders and remediation companies have not fully understood all the dynamics which are at work here; simply removing drywall from the home and replacing (“remove & replace method”) it with new drywall will not address the concerns with cross contamination issues with building products and home furnishings. There have been reports of homes that were remediated using the “remove & replace” method and the owners continued to have problems with the diffusion of sulfur compounds including corrosion to newly installed wiring, HVAC systems, and mechanical failures.

Again the Institute (BESI) turned to science for a concise conclusion on the issue of cross-contamination of building materials and personal belongs. [Analytical Research Systems, Inc.](#) (ARS) conducted studies on the diffusion of gases from the building materials removed from homes with defective drywall. ARS conducted a Thermal Desorption study with wood samples from a home with defective drywall; the samples were sections of the wood-frame found behind the defective drywall.



This study provided two (2) conclusions: first, the wood studs absorbed the gases (Volatile Organic Compounds) from the defective drywall (i.e. cross contamination occurred) and secondly, that the Forced Thermal Desorption process would be effective at removing these gases from the cross-contaminated materials (i.e. wood studs, cabinets, etc.). This process, initially conducted over a couple of eight hour days, has been reduced to an eight-hour day to ensure that the VOC are released from the building materials; ongoing testing continues both in the laboratory and the field.



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A “belt and suspenders” approach was created, so that the redundancies would provide clients and remediators (certified through BESI) with a greater level of confidence. **One** such product that provided the redundancy or “belt and suspenders” is NanoScale’s ChemKlenz-C3D System; other products are continually being assessed by the institute. [NanoScale Corporation](#) was initially selected for their chemical decontamination expertise to develop a system, subject to institute standards, requirements, and performance validation for inclusion in the BESI endorsed protocol. Their products were chosen for the expressed purpose of application of materials for specific decontamination of the hazardous sulfur-based chemicals. In part, the ChemKlenz-C3D System provides decontamination of surfaces and textiles; management and removal at the source of potential gases that may be emitted from contaminated surfaces after Force Thermal Desorption (FTD) has been performed.

The institute continues to research alternative chemical applications that afford this type of redundancy to the process.

Personal Belongings

What about personal belongings such as couches, chairs, kitchen items, pillows, bedspreads, and other personal belongings?” Field interviews and inspections have concluded that personal belongings become contaminated; those that were removed from homes with defective drywall and placed into storage units or another home which does not have defective drywall can retain the odors from the diffusion of sulfur out-gassing compounds found in defective drywall. Case-in-point, the Durrance residence (Florida); the owners had their personal belongings in storage before and during the remediation process (approximately eight months) and yet their belongings had a sulfur-like odor when they were delivered back to the home. There was no question that the personal belongings had become contaminated; and therefore their belongs went through the FTD process before going back into the remediated home. Additional cases are in the process of being written up and added to the institute’s “Case History” section of the website; this section should be available in May 2010.



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The BESI system addresses all machine washable items which are washed with ChemKlenz-C3D Textile for chemical decontamination according manufacturer's specifications prior to being moved back into the home. Porous, non-washable items and materials need to go through FTD or another approved option so that a maximum amount of residual gases are removed prior to treatment; then treated as a precaution against potential cross-contamination. It should be noted that personal belongings that have not been properly cleaned or diffused can result in the voiding of final certification and proposed warranty.

BETA Home Program - Confirmation

The Institute requires that the first twenty-five (25) homes and/or other structures that are remediated under the Certified Protocol for Remediation of Defective Drywall, as published by the Institute, be classified as a BETA Program; requiring additional monitoring by the Institute to ensure strict compliance to the protocol and performance measurements are met or exceeded. Contractors & BETA program participants will have the full support of the Institute during the remediation and monitoring process.

BETA homes will have continued monitoring of air quality by laboratory analysis of the filtration cartridge for quantitative sulfur content and correlation of this data to trends of ongoing indoor air quality. Reports provided to the owner will provide a valuable record validating the successful conversion of their defective drywall home back into a normal, clean home worthy of full market value upon sale.

This BETA Program will provide the means in which a proposed warranty will be offered to homes that have used the BESI System for remediation.

Proposed Warranty

The product will be a warranty, not an insurance policy. After the home has been remediated the warranty company will require a final clearance test. The warranty claims method will be tied to the



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use of a special testing method designed by National. This testing method has proven to be an effective, passive method of detecting the presence of H₂S.

If the testing method indicates the presence of H₂S, then a second test will be used for verification. If the second test is positive, then a full inspection of the home will be conducted to attempt to locate the source. If the inspection locates defective drywall, then it will be removed. It should be noted, there are other sources of H₂S that are not covered by the warranty.

Conclusion - It's Your Decision

The Institute and DDIA continue to do research and experiment with all kinds of methods for defective drywall remediation, however, one thing has never changed - YOU HAVE TO REMOVE THE SOURCE. Scott "Spiderman" Mulholland in June 2009 stated, "Attempts may be made to filter it, paint it, pump chemicals into it, hook up things to the air conditioner to trap it, encapsulate it with coatings but when it's all said and done, **you still have defective drywall in your home**".

The design of the BESI System is cost effective and simple, remove the defective product, remove the toxic chemicals from the construction materials through a diffusion process (FTD) or another approved option, chemically treat the wood and construction materials left in the home, decontaminate personal belongings, certify the process with third-party inspections and peer review, help clean the air from many of the VOCs through IAQ technology for up to one year and submit the paperwork for a proposed warranty.