The ETV P2 Innovative Coatings and Coating Equipment Program – An Update

Paper # 42261
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ABSTRACT

In order to help facilitate market penetration and use of innovative environmentally beneficial technologies, the U.S. Environmental Protection Agency (EPA) initiated the Environmental Technology Verification (ETV) Program in 1995.

The ETV Program is a voluntary project designed to provide companies the opportunity to obtain independent third-party testing of their products. The verification testing is unique and specially designed for each technology area, but is common in its overall goal to provide technology users with credible performance and environmental advantage data for a technology. In order to accomplish this task, each technology area was partnered with an outside organization to monitor each technology market, pursue potential vendor verification participants, develop test plans, perform verification testing, and report the results of testing. In addition, each partner organization has established a group of representatives to act as stakeholders to aid in these activities.

As the end result of verification testing, the vendor is presented with a Verification Report and a Verification Statement. Both are signed by the EPA and the partner organization attesting to the credibility of the data. The Verification Statement is an abbreviated version of the Verification Report that summarizes the testing performed and results obtained, which the vendor can then use in advertising and promoting the performance and environmental benefit of their product.

The ETV Program began its history as a pilot program divided into 12 technology areas. In September 2000, the pilot phase ended, and the program was evaluated and upgraded to full program status. As a result of this upgrade, the ETV Program was reorganized from the 12 pilots into 6 ETV Centers. Of the six ETV Centers, this paper will focus on the Pollution Prevention (P2), Recycling, and Waste Treatment Systems Center, and specifically the P2 Innovative Coatings and Coating Equipment Program (CCEP) housed within the Center. The focus will be on the history of the ETV CCEP; steps of the verification process; completed verifications, success stories, and lessons learned; works in-progress; and future works and goals.

INTRODUCTION

With ever-increasing laws and regulations for the protection of the environment, industry is constantly faced with the challenge of adapting pollution prevention (P2) technologies for their processes. Inherent in this challenge is the responsibility of P2 technology users to implement technologies and/or processes that can actually provide the environmental benefit needed and still meet the performance level required. As the laws and regulations on environmental protection get stricter, the market for environmentally beneficial products continues to widen. Within this market, technology users can be overwhelmed with the escalating number of environmentally beneficial products and their promises to ensure compliance while still meeting production requirements. It was out of this situation that the Environmental Technology Verification (ETV) Program was born.

The U.S. Environmental Protection Agency (EPA) established the ETV Program in 1995 to accelerate the development and commercialization of improved environmental technologies through independent third-party verification and reporting of performance. The ETV Program began with a 5-year pilot period that was designated to test a variety of procedural and partnership alternatives for ETV testing. It was also intended to assess the market demand for such testing and the acceptance of testing data by environmental technology customers. The pilot period ended on September 30, 2000, and the U.S. EPA has evaluated program successes, barriers, and lessons learned during the pilot period. Based on the conclusions of that review, the ETV Program has been reorganized from 12 pilots covering a broad range of environmental areas to 6 ETV centers that encompass the different areas of the environmental technology market covered by the pilots.

This paper will focus on the ETV P2 Innovative Coatings and Coatings Equipment Pilot that has been recast into the ETV P2 Innovative Coatings and Coatings Equipment Program (CCEP) that is to be operated within the Pollution Prevention (P2), Recycling, and Waste Treatment Systems Center, which is still in development. The paper updates information provided at the 2001 Air & Waste Management Association Conference and Exhibition.[1]

The coating/painting industry is incorporated within numerous other industries. Parts ranging from military vehicles and ammunition, outdoor furniture, commercial automobile parts, household appliances, computers, cell phones, etc. that can be composed of metal, plastic, or composite materials, are all coated with protective and/or decorative coatings. Moreover, not only are the performance requirements different from industry to industry, but so are the environmental laws and regulations.

Coating processes account for significant volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions. The U.S. EPA's Office of Air Quality Planning and Standards (OAQPS) has estimated that coating processes account for 20% of stationary source VOC and HAP emissions.[2] These emissions contribute to cancer and non-cancer health risks as well as ecological damage. In order to reduce these emissions and their effects, a multitude of new coating technologies are continuously being developed and marketed without the use of standardized evaluation protocols to ensure that products provide an environmental benefit at equivalent or enhanced performance and cost.

The history of the coatings pilot will be reviewed to include verifications and protocols completed, success stories, and lessons learned. The upgrade of the pilot into the program phase and the subsequent inception and start-up of the ETV P2, Recycling, and Waste Treatment Systems Center will be discussed. In addition, an update will be given on the current verifications in progress and the future works and goals for the program.

THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

History of the Program

In an effort to address the growing need for independent, credible performance data to aid the development and use of innovative environmental technologies, the U.S. EPA established the ETV Program. The ETV Program's 5-year pilot period began in October 1995. Originally, the ETV Program consisted of 12 pilots that focus on each of the major environmental media and various categories of environmental technologies. The pilots were:

- Drinking Water Systems,
- Site Characterization and Monitoring Technologies,
- P2, Recycling, and Waste Treatment Systems,
- P2 Innovative Coatings and Coating Equipment,
- Indoor Air Products;
- Advanced Monitoring Systems,
- Air Pollution Control Technology,
- Greenhouse Gas Technology,
- Wet Weather Flow Technologies,
- Source Water Protection Technologies,
- P2 Metal Finishing Technologies, and
- EvTEC - Independent Entity.

The three main objectives for the pilot period were to develop standardized test protocols in coordination with industry trade associations and other appropriate stakeholders, to test a wide variety of partner and procedural alternatives based on the protocols developed, and to evaluate the true market demand for, and public response to, such a program. In order to accomplish these tasks, each technology area was partnered with an outside organization to monitor each technology market, pursue potential vendor verification participants, develop test plans, perform verification testing, and report the results of testing. In addition, each partner organization has established a group of representatives to act as stakeholders to aid in these activities. While the stakeholder groups for each technology area are inherently different by definition, they all try to incorporate representatives from all aspects of the corresponding industry and their customer groups.

At the end of September 2000, the ETV Program concluded the 5-year pilot period, was upgraded to full program status, and is currently transitioning into six ETV Technology Centers:

- ETV Advanced Monitoring Systems Center,
- ETV Air Pollution Control Technology Center,
- ETV Greenhouse Gas Prevention Technology Center,
- ETV Drinking Water Systems Center,
- ETV Water Protection Technologies Center, and
- ETV P2, Recycling, and Waste Treatment Systems Center.

The ETV CCEP Pilot Period and the Verification Process

For each pilot, a partner organization was selected to oversee and conduct verification activities based on testing and quality assurance (QA) protocols developed with input from all major stakeholder/customer groups associated with the technology area. The ETV CCEP partnered with Concurrent Technologies Corporation (*CTC*)[3], a non-profit, professional services and testing organization that operates the Department of Defense's (DOD's) National Defense Center for Environmental Excellence (NDCEE)[4], to establish a verification program to evaluate innovative coatings and coating application technologies.

The objectives of the ETV CCEP pilot were to verify the acceptability of lower polluting innovative coating and coating application techniques into the marketplace, develop standardized test protocols in coordination with industry trade associations and other appropriate stakeholders, and facilitate broad acceptance of the test results. During the pilot period, the ETV CCEP developed nine Testing and Quality Assurance Project Plans (TQAPPs). These TQAPPs are outlined in Table 1. Generally, these TQAPPs can be of two types, generic and product-specific.

Testing and Quality Assurance Project Plans

Generic Protocols are developed for each technology area based on the ETV CCEP Quality Management Plan[5]. Each contains a wide range of test parameters that apply to the technology area being verified. Included in the protocol will be all testing required to gather sufficient data for environmental verification of the technology. *CTC* project personnel, EPA, and the Stakeholder Group design the Generic Protocol with input from the vendor community. These are key products of the ETV CCEP and the ETV Program, allowing other organizations to complete comparable verification testing.

After meeting with coating technology vendors and being assured of their interest in participation, product-specific TQAPPs are developed by ETV CCEP personnel for

acceptance by each vendor. A TQAPP applies the Generic Protocol to each product to be tested, documenting the parameters specific to that product. The TQAPP details the exact settings for each test. Each TQAPP is reviewed and approved by the organization requesting verification testing and ETV CCEP managers from EPA and *CTC* prior to the initiation of testing. All Generic Protocols and TQAPPs[6] are available on the ETV website[7]. All TQAPPs developed and approved during the pilot phase are listed in Table 1. These are important products of the ETV CCEP and the ETV Program, allowing other organizations to repeat these verification tests.

Table 1. ETV CCEP TQAPPs produced during the pilot period.

TITLE	REVISION #	APPROVAL DATE
Liquid Coatings – Generic Testing and Quality Assurance Protocol	0	February 16, 2000
HVLP Coating Equipment – Generic Testing and Quality Assurance Protocol	1	December 22, 1999
Laser Touch™ Beta Model – Testing and Quality Assurance Project Plan (TQAPP)	0	September 16, 1999
Sharpe Platinum 2013 HVLP Spray Gun – Testing and Quality Assurance Project Plan (TQAPP)	0	February 25, 1999
ITW DeVilbiss GTI-600G HVLP Spray Gun – Testing and Quality Assurance Project Plan (TQAPP)	0	December 15, 1998
ITW DeVilbiss JGHV-531-46FF HVLP Spray Gun – Testing and Quality Assurance Project Plan (TQAPP)	0	December 15, 1998
ITW DeVilbiss FLG-631-318 HVLP Spray Gun – Testing and Quality Assurance Project Plan (TQAPP)	0	December 11, 1998
UV-curable Coatings – Generic Testing and Quality Assurance Protocol	Draft	March 24, 1998
Powder Coating – Generic Testing and Quality Assurance Protocol	Draft	February17, 1998

Testing and Evaluation of Results

Testing is then completed at a very high level of QA, and test results are evaluated according to the approved TQAPP. During testing, EPA personnel may be on-site to perform a QA audit. ETV CCEP/ *CTC* personnel oversee all testing of the technologies and complete a QA audit using non-project personnel. A complete set of results and statistical data analyses are recorded in a Data Notebook for each verification test. The Data

Notebook is maintained by *CTC* and is used as the basis for further reporting. Data collected from both process and laboratory testing are included.

Verification Reports and Verification Statements

The resulting products of each verification test are a final Verification Report and a three- to five-page Verification Statement, signed by the Director of EPA's National Risk Management Research Laboratory (NRMRL) and *CTC*'s ETV CCEP Manager. Verification test results are first recorded in the Data Notebook. The Data Notebook is summarized in the Verification Report. This report includes a QA section that documents data quality indicators, deviations from the approved TQAPP, and confidence intervals associated with the data.

Most importantly, a Verification Statement is issued that includes the tests performed and results, statistical analysis of the data, process information, and a QA/quality control (QC) narrative. The EPA and *CTC* review each Verification Report and Verification Statement prior to publishing the information. Once the Verification Statement is issued, it will be published on the ETV website where it will be available to the public.[8] The key portion of the Verification Statement is the listing of verification factors and associated results. Verification factors are those critical parameters that are measured during verification testing that address environmental performance and marketability and allow readers to evaluate the technology for their applications. For example, an environmental verification factor was the improvement of paint transfer efficiency using each HVLP spray gun. A key marketability verification factor was the quality of the finish provided by each HVLP gun. Verification factors are carefully selected for each Generic Protocol and product-specific TQAPP to make sure that the full benefits of testing are obtained. ETV CCEP Verification Statements are listed in Table 2.

Table 2. Verification Statements prepared by ETV CCEP.

TITLE	ISSUE DATE
Laser Touch and Technologies, LLC - Laser Touch™ Model LT-B512	May 18, 2000
Sharpe Manufacturing Company - Sharpe Platinum 2013; Liquid Organics Coatings Application	September 30, 1999
ITW Automotive Refinishing - DeVilbiss FLG-631-318; Liquid Organics Coatings Application	September 23, 1999
ITW Automotive Refinishing - DeVilbiss GTi-600G; Liquid Organics Coatings Application	September 23, 1999
ITW Industrial Finishing, Binks•DeVilbiss - DeVilbiss JGHV-531-46FF; Liquid Organics Coatings Application	September 23, 1999

Results of the Pilot Period

The ETV CCEP pilot completed verification testing of four HVLP paint spray guns and of the Laser Touch™ laser-guided targeting device for manual paint spray guns. The verification of additional products was initiated during the pilot period. These are described on the next page under ***Program Status and Recent Achievements***. ETV CCEP initially received a mixed response from the coatings industry. Industry's impression continues to become more positive as their knowledge of the program increases and as products are verified and reported upon. The vendor community has readily accepted ETV concepts for use with coating equipment, but not for coatings. Five equipment verifications have been completed and many more are in the pipeline. ITW Industrial Finishing, Binks•DeVilbiss, and ITW Automotive have used the verification results for their three HVLP paint spray guns as the centerpiece of their marketing campaign for 2001. Laser Touch and Technology, LLC, has seen a tremendous increase of sales since releasing their laser-guided paint spray gun targeting device, the Laser Touch™, and completing verification testing. All the equipment vendors have reported to found value in EPA's issuance of the Verification Statement. On the other hand, industry has been much less excited about verifying innovative coatings. The powder and UV-curable coatings segments of the industry rejected our initial approach and some negative press was generated.[9] These vendors generally believe that their research reputation and success penetrating the market provide the credibility that they need to continue gaining market shares. They question what ETV CCEP can verify that would provide them with a market advantage. They are also concerned that coating formulations are fine-tuned for each customer and that the coatings available in the marketplace change too quickly for verification testing to be of value. In order to overcome industry apprehension, we have been challenged to provide a stronger rationale for their participation. Our stakeholders have substantially helped to market the program and overcome our challenges. Upon seeing positive results for coating equipment and receiving feedback from ETV CCEP's stakeholders, at least one of our early critics has had a change of heart, generating favorable press for ETV CCEP.[10] As the end of the pilot period approached, ETV CCEP personnel were working on the development of the TQAPP for the first liquid coating, Evermore Paints and Coatings Formula 5 Coating. The Formula 5 coating is a high-performance, water-reducible, architectural and industrial coating that is low in VOC and HAP content. It is a polyamide-epoxy-silicone-modified coating that can be air-dried or oven-cured.

THE ETV CCEP

Program Status and Recent Achievements

News of the coating equipment verification successes and the planned liquid coating verification testing began to permeate throughout industry circles and the ETV CCEP experienced a surge of interest. In addition to the Evermore verification testing, several other liquid coatings are slated for testing. Recently, ultraviolet (UV)-curable coating vendors have begun to express their interest, and plans are currently being developed to test our first UV-curable coating soon.

On the heels of the ETV upgrade to program status in October 2000, the ETV CCEP approved the TQAPP for the Evermore Formula 5 Coating. ETV CCEP completed the Evermore verification testing and received final laboratory results in October 2001 and submitted the Verification Report to EPA December 2001 for approval. In addition, a TQAPP has been completed and is awaiting vendor approval for another application equipment technology.

The Airmix® paint spray gun is manufactured by Kremlin, Inc. Airmix® uses a patented air cap with a unique fluid tip design that produces fine atomization of coatings in a very uniform spray pattern at extremely low paint velocities and is expected to result in high transfer efficiency (TE). Kremlin has signed a contractual agreement with *CTC* to complete the verification testing of their Airmix System. Once all parties have signed the Airmix TQAPP, the verification testing will be scheduled. Testing is estimated to begin in the summer of 2002.

The ETV CCEP has developed its first TQAPP for a process technology, the Superior Coatings, Inc.'s Ultraviolet Response (UVR) Coating System. Because of the inherent differences and uniqueness of process technologies, the ETV CCEP must initially develop a TQAPP for each individual verification test. The UVR Coating System is expected to assist both manual and automatic coating applications with obtaining a uniform film thickness across the surface being coated and to aid these application processes in the more efficient use of the coatings being applied. Utilizing the properties of UV light and energy, the UVR Coating System was designed to aid in the reduction of VOC and HAP emissions by helping to meet the targeted dry film thickness and minimizing the dry film thickness variation across the coated surface. Dry film thickness and its variability impact the volume of topcoat materials used for the application. The closer and more consistently the painter can achieve the desired dry film thickness without having too thin a coating layer, the less paint will be used. Using less paint equates to fewer air emissions.

The ETV CCEP has completed the draft UVR TQAPP and is awaiting information from the vendor for completion of the final version. One of the intrinsic obstacles of the TQAPP development process is the coordination with the technology vendor. Companies voluntarily join the program and most often do so in an effort to increase their penetration into the marketplace. And while interest and enthusiasm for the verification testing can be at the highest level, normal daily operations can hinder the timeliness of the TQAPP review and comment process.

Anest Iwata USA, Inc. has proposed two application equipment technologies to be tested by the ETV CCEP. Both are high-transfer-efficiency gravity-feed spray guns intended for the automobile refinishing industry. One has the gravity cup mounted in the standard center-post position; the other is a compact model that has the gravity cup mounted on the side. One of the two TQAPPs has been completed and the draft has been sent to Anest Iwata for comments.

Works In-Progress

NRMRL-RTP-P-671

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completir

1. REPORT NO.	2.	3. R
EPA/600/A-02/084		

4. TITLE AND SUBTITLE
The ETV P2 Innovative Coatings and Coating Equipment Program--An Update

5. REPORT DATE

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
Julie A. Napotnik (CTC) and Michael Kosusko (EPA)

8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Concurrent Technologies Corporation
Manufacturing Technology Facility
100 CTC Drive
Johnstown, PA 15904

10. PROGRAM ELEMENT NO.

11. CONTRACT/GRANT NO.
DW21938366

12. SPONSORING AGENCY NAME AND ADDRESS
EPA, Office of Research and Development
Air Pollution Prevention and Control Division
Research Triangle Park, NC 27711

13. TYPE OF REPORT AND PERIOD COVERED
Published paper; 11/96 - 3/02

14. SPONSORING AGENCY CODE
EPA/600/13

15. SUPPLEMENTARY NOTES APPCD project officer is Michael Kosusko, Mail Drop E343-02, 919/541-2734. For A&WMA Annual Meeting, Baltimore, MD, 6/23-27/02.

16. ABSTRACT
The paper focuses on the Pollution Prevention (P2), Recycling, and Waste Treatment Systems Center of the EPA's Environmental Technology Verification (ETV) Program, and specifically the P2 Innovating Coatings and Coating Equipment Program (CCEP) housed within the Center. The focus is on the history of the CCEP; steps of the verification process; completed verifications, success stories, and lessons learned; works in progress; and future works and goals. To help facilitate market penetration and use of innovating environmentally beneficial technologies, EPA initiated the ETV program in 1995. The Program is a voluntary project designed to provide companies the opportunity to obtain independent third-party testing of their products. Each verification test is unique and specially designed for each technology area, but has the common overall goal of providing technology users with credible performance and environmental advantage data for a technology. As the end result of verification testing, the vendor is presented with a Verification Report and a Verification Statement. Representatives of EPA and its partner organization sign each Verification Statement, thereby attesting to the credibility of the data.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Pollution	Pollution Prevention	13B 13D,14D
Quality Assurance	Stationary Sources	14G
Wastes	Recycling	
Waste Treatment		11C
Coatings		14B
Verifying		
Tests		
Circulation		

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
Release to Public	**Unclassified**	**12**
	20. SECURITY CLASS *(This page)*	**22. PRICE**
	Unclassified	

EPA Form 2220-1 (9-73)

Another three TQAPPs are currently in development, including a UV-curable coating, a chromate-free conversion coating, and a powder coating technology. Allied PhotoChemical has developed KZ 1007, a one-part urethane coating which is capable of direct application to the substrate. It is 100% UV-curable with no heat required for curing. The coating emits virtually no VOCs or HAPs since, in theory, the entire liquid coating package becomes part of the cured coating film. KZ 1007 can be applied by vacuum, roll, or spray coating. Allied PhotoChemical has committed to working with ETV CCEP on a test plan for verification testing.[11] The TQAPP is under development, and testing is expected to begin in late summer of this year.

The Technology Applications Group has developed Tagnite®, a chromate- and permanganate-free anodic conversion coating for magnesium alloys. Traditional anodic coatings use chromate or permanganate in either the coating itself or one of the associated pretreatment coatings.[12,13] Both chromate and permanganate are toxic compounds. Aside from the mandatory verification factors for liquid coatings, the main environmental verification factors for Tagnite® will be the avoidance of chromium or permanganate in waste streams and the reduction of liquid waste volume. Technology Applications Group has committed to working with ETV CCEP on a test plan for verification testing.[14] The TQAPP is nearing completion, and testing is expected to begin in late summer of this year.

The third TQAPP currently in development is for the MSC Powder Cloud™. MSC PreFinish Metals, Inc. has developed the Powder Cloud™ technology, a coil coating process that anticipates high powder coating deposition efficiency, a high degree of dry film thickness control, and reduced amounts of coating waste. MSC PreFinish Metals has installed the Powder Cloud™ technology on its production line in Middletown, OH. The company hopes to license the technology to other coil coating facilities. Line speeds comparable to those with liquid coatings are anticipated with powder film thicknesses of 0.4 to 5.0 mils.[15] MSC PreFinish Metals is currently working with ETV CCEP on a test plan for verification testing.

Future Works and Goals

LuminOre®, Inc. presented their patented composite metals that are cold-sprayable and can be applied using standard HVLP application equipment at the most recent ETV CCEP Stakeholder meeting in October 2001. LuminOre® is interested in expanding their market base for their copper composite metal for marine applications. The material has a class A and class 1 fire rating, low-VOC content, anti-corrosive properties, potential anti-fouling properties, extremely low leach rate, large impact resistance, and significant adhesion ability. LuminOre® has committed to working with the ETV CCEP in development of a test plan for their product.[16]

The ETV CCEP is in communication with several other companies who are looking into the opportunities offered through this program, including a paint line cleaning system and an innovative car wax formula.

CONCLUSIONS

One of the unique characteristics of the ETV CCEP, as opposed to some of the other technology areas, is that the coating/painting industry is incorporated within numerous other industries. Parts ranging from military vehicles and ammunition, outdoor furniture, commercial automobile parts, household appliances, computers, cell phones, etc. that can be composed of metal, plastic, or composite materials, are all coated with protective and/or decorative coatings. Moreover, not only are the performance requirements different from industry to industry, but so are the environmental laws and regulations. In addition, because of the nature of the program to evaluate and verify the performance of a technology and because of limitations of testing time and funds, a coating technology must be tested for application in only one industry sector. For example, a liquid coating may be applicable for both indoor architectural applications and for automobile applications; however, time and materials often limit the development of the TQAPP to only one or the other industry's specifications and regulations. In addition, because of the numerous variables encountered when working with coatings and application equipment, the results of the verification testing are specific and relevant to those conditions and equipment settings called out in the product-specific test plan. All of these issues require that the highest level of detail be included in each TQAPP.

In conclusion, the largest obstacle the ETV CCEP still has to overcome is the time required to achieve such a level of detail. However, because the ETV CCEP must work in conjunction with vendors during the development of the TQAPPs, this obstacle will most likely be here to stay. The ETV CCEP has streamlined some of the steps to obtain commitment to verification testing, such as the cost and schedule development. Overall, the ETV CCEP continues to gain recognition with industry and customer groups and vendor interest in the program continues to remain steady.

This paper has presented the key concepts used by the ETV Program since its inception in 1995 and throughout the Program's pilot period that ended on September 30, 2000. It has reviewed the scope of ETV's Coatings and Coating Equipment Pilot and how that pilot has applied the verification process. Finally, verification tests completed by ETV CCEP have been reviewed, and future testing has been summarized. Additional information about the ETV Program and ETV CCEP can be found on the ETV website.[7,17] On the site, can be found information about future ETV CCEP activities and stakeholder meetings.[18] Feel free to attend these meetings; they are always open to public.

ACKNOWLEDGMENTS

The authors would like to thank those in the ETV Program and ETV CCEP for developing excellent written materials for the ETV website, the ETV and ETV CCEP fact sheets, and other program documents. They are certain to recognize bits and pieces of their efforts in this paper.

In addition, special thanks to the stakeholders of ETV CCEP without whose efforts, persistence, and efforts the pilot could not have been the success it has become.

DISCLAIMER

This paper has been peer and QA reviewed by the U.S. EPA and *CTC* and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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KEY WORDS

Environmental Technology Verification Program (ETV)
Coatings and Coating Equipment Pilot (CCEP)
Generic Protocol
Testing and Quality Assurance Project Plan (TQAPP)
Verification Report
Verification Statement
Coating application equipment
National Defense Center for Environmental Excellence (NDCEE)
Volatile organic compound (VOC)
Hazardous air pollutant (HAP)
High-volume, low-pressure (HVLP) paint spray gun
Paint transfer efficiency
Stakeholder Group