Robust Functional Paperless Paint
Phase III

Prepared for:

National Shipbuilding Research Program
Surface Preparation and Coatings Panel (SPC)

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Executive Summary

The National Shipbuilding Research Program (NSRP) Surface Preparation and Coating (SPC) Panel completed a series of three projects to modify a commercially available paperless paint QA software system to meet the needs of NSRP Shipyards working to US Navy surface preparation and coating requirements. The commercially available system (TruQC) was originally developed for and successfully used by industrial coating contractors. Target NSRP users are primarily working to the Joint Fleet Maintenance Manual (JFMM) and US Navy Standard Items (NSI) 009-01, 009-04 009-26, and 009-32) which drive most of the requirements for coatings QA. NSRP sponsored two initial projects which focused on formatting the 009-32 appendices, adapting the user interface, and adding functionality to meet the needs of deck plate inspectors performing work on Navy ships.

In the final project reported herein, the team addressed various cyber and legal requirements to implement the software. The team aided implementation by expanding the user base to six shipyards, actively engaging NAVSEA waterfront personnel, and implementing software updates based on user feedback and changes to NAVSEA Standard Item 009-32 requirements. Implementation was achieved by engaging the RMC, prime contractors, and subcontractors at shipyards in Jacksonville, FL and San Diego, CA. The biggest challenge to implement paperless paint was obtaining active support of all involved parties (RMC, NAVSEA, prime contractor, and subcontractor). In the first two phases, a paperless system was modified as necessary to support preservation work performed in accordance with NSI 009-32. In this third phase, the team brought multiple players together to demonstrate functionality during two pilot demonstrations. At each pilot demonstration, the project conducted some basic training on the software, demonstrated how data is populated into the system, and how reports are generated. After training, G-point inspections were conducted on the deck plates and the project team collected questions and concerns, all of which are addressed in this final report.

For current US Navy ship repair work, the TruQC system can generate a pdf version of the NSI 009-32 Appendices which can be printed, signed and submitted to NAVSEA. To unlock the full power of the software, the Navy will need to support its continual use and resultant file retention requirements just like they did for previous paperless QA solutions (NSTCenter “QA Toolkit,” which later became the Coating QA Tool Kit or CQATK). However, shipyards and their subcontractors can recognize a reasonable return on investment by taking advantage of the technology to more efficiently generate “paper” versions of the NSI 009-32 Appendices. Depending on workload and other assumptions, it is reasonable to expect a return of investment of 10:1 over a three-year period. The decision to invest is also low risk - even conservative assumptions show a payback period of less than one year. If the Government representative on site could sign the iPad, no paper would need to be generated in this process. The pdf file could be stored and submitted electronically.

The project has succeeded in accomplishing six objectives:

- TruQC became ITAR and NIST CUI 800-171 compliant on the AWS Gov Cloud platform.

- Questions presented by NAVSEA 00L (legal) and Cybersecurity concerning ownership of the information were addressed.
- Training and Pilot implementation on the east and west coasts was completed with NAVSEA, RMC, prime contractors, and subcontractors.
    - Identified issues that needed to be addressed immediately and scheduled development on those items.
    - Identified some “wish list” items to implement once TruQC is more widely used at yards.
- Established that all parties involved in the implementation would prefer a functioning paperless system over the legacy (paper) 009-32 appendix documentation.
- A desktop application was developed for reviewing reports from a web browser interface. The desktop application is designed to easily perform administrative functions, like setting up a company’s jobs and employees as well as bulk upload, real-time syncing, issue tracking, and analytics.
- A SSRAC proposal to rewrite NSI 009-04 FY18(CH-2), paragraph 3.11.3.1 was drafted.

The software is now suitable for electronically populating the appendices in NSI 009-32 allowing efficient electronic delivery of a “paper” form. Development will conclude on additional NSRP functionality early in 2018, however the Navy shipbuilding community will need to support continued system updates by the vendor to ensure that it remains current with NAVSEA Standard Item 009-32 requirements.

- Identify a clear approval path for TruQC use in Navy ship maintenance and repair. This would most likely require CRMC and NAVSEA involvement.
- Continue to expand TruQC use in Navy shipbuilding and repair to ensure sustainability of the system.

Acknowledgements

This project would not have been successful without the assistance of a number of people. A number of Navy and Industry representatives who have been involved with previous evolutions of paperless QA technology provided critical feedback to the project team. In particular, representatives from General Dynamics-NASSCO, Bath Iron Works, BAE Systems Jacksonville Ship Repair, HII-Ingalls Shipbuilding, BAE System Southwest Ship Repair, Southwest Regional Maintenance Center (SWRMC), Surface Technologies, IMIA International Marine & Industrial Applicators, Advanced Marine Preservation (AMP), Surface Technologies Corp (STC), Pacific Yacht Repair, Southeast Regional Maintenance Center (SERMC), and Naval Sea Systems Command provided time and technical expertise throughout both project phases.

Table of Contents

Conclusions

1. Paperless quality assurance systems have been demonstrated to improve efficiency of surface preparation and coatings QA/QC during shipbuilding and ship repair. NSRP shipyards and their subcontractors are using the system for US Navy new build and commercial shipbuilding activities. Usage is expanding beyond coating QA processes.

2. TruQC became ITAR and NIST CUI 800-171 compliant on the AWS Gov Cloud platform. The vendor continues to support the upgrades required to maintain consistency with evolving Navy requirements.

3. While the system can meet the requirements for electronically collecting surface preparation and coatings QA data during ship repair in accordance with NSI 009-32, the system generates a "paper" (or pdf) product which can be printed, signed, and submitted to NAVSEA. Since the data within the pdf file cannot be readily queried, NAVSEA cannot realize the benefits associated with delivering the Navy an electronic database of information (e.g., database analytics). However, the hurdles associated with delivering an electronic database to the Navy are complex, beyond the scope of an NSRP project, and may not be worth the effort.

4. Even with the identified limitations, paperless QA systems provide shipyards and their subcontractors a cost-effective way to populate and maintain current and accurate QA records. Implementation of the systems is not capital intensive, pays back on the investment in a year or less, and can have a three-year return on investment above 10:1.

Recommendations

1. Develop and submit a request to obtain written approval to use TruQC from NAVSEA and CNRMC. The scheme should ensure the continued support of system updates by the vendor either through widespread Navy acceptance of the system reports and/or by continued funding of system updates and improvements which will be necessary to continue Navy use.

2. Since CQATK no longer exists and NAVSEA 05P23 would be responsible for approving any paperless coating QA system, submit a SSRAC proposal to delete the last sentence of NSI 009-04 FY18(CH-2), paragraph 3.11.3.1 so that it reads:

   > *For tests and inspections involving (G)-points, records shall be documented upon acceptance or rejection and a hard copy (or electronic copy as authorized by the SUPERVISOR) provided to the SUPERVISOR at the conclusion of each (G)-Point. (See 4.5)*

Background

Proper evaluation of coating quality requires a trained individual to observe and measure elements of the process at various stages of coating application. Such quality assurance procedures can be expensive, inefficient, and difficult to administer.

NAVSEA painting practices require acquisition, recording, and reporting of QA data collected during surface preparation and coating processes. This data is collected after various critical stages in the process are completed (e.g., initial surface cleaning, surface preparation prior to painting, application of each coat, and final inspection), and throughout the process to document the environmental conditions during surface preparation and coating activities. The data can be quite voluminous. Each inspection point may generate several sheets of paper records; over the course of a project such records may occupy several hundred pages.

By taking advantage of currently available technology, the Navy preservation community should be able to improve the efficiency of managing and collecting their QA/QC data. Table 1 shows some of the sources of cost reduction and process improvement beyond the reduction of paperwork.

Table 1 - Benefits of Paperless QA System

Process Improvement	Cost Reduction
• Increase transparency of inspection to the surface preparation and coating process • Improve efficiency of inspection efforts • Transmit inspection data efficiently to decision-makers • Archive inspection data for future use • Leverage inspection data to its fullest extent • Content and Document Management capability • Integration with electronic measurement devices	• Decrease or eliminate delays associated with adjudication of out of spec items • Reduce inspection cost • Expedite decision making, reducing analysis cost and associated downtime • Eliminate costs incurred to re-create history for assessments • More accessible information could be used for more efficient planning, facilitating process improvement, troubleshooting, etc.

NAVSEA funded development and implementation of two previous attempts to capture 009-32 documentation electronically. In the mid-2000's, the National Surface Treatment Center developed a paperless QA software program. The system was originally called "QA Toolkit" and later re-named "Preservation Quality Assurance Data System (PQADS)." The program was a client server based system that was fully functional and implemented at Mayport Naval Station by the SERMC team in 2006. However, completion funding for that program was not available, and Fleet Forces Command assumed responsibility for the paperless paint QA program. In 2009, the Coating Quality Assurance Tool Kit (CQATK) was developed by MI Technical Solutions through Navy program funding to record the data and

make it available to the Navy through the MFOM. However, after 3 years of effort it was determined the CQATK did not support the technical requirements invoked in NAVSEA Standard Items 009-04 and 009-32. While CQATK remains an option in NSI 009-32, the Regional Maintenance Commands (RMCs) in Norfolk and Mayport have suspended the use of this system. NSRP paperless paint QA projects picked up where the previous attempts failed. A COTS product was identified and modified to support the specific requirements of Navy ship maintenance and repair.

There is a continued need for an automated, hand-held device to gather, record, and assess the necessary QA data from surface preparation and coatings activities. A project sponsored by the DoD Corrosion Policy and Oversight office suggested that the Navy could save up to 2% of the cost of coating if they could implement an effective paperless QA system.[1] Assuming the Navy performs $100 million in coatings work which could be affected by the process, $2 million per year could be saved. A recent NSRP project corroborated the magnitude of potential cost savings.[2] Of the thirteen specific process improvements which would help the Navy reduce cost without sacrificing quality, an effective paperless QA system was ranked highest in terms of potential cost savings. Paperless QA was one of the few process improvements that would benefit all shipyards.

An initial NSRP SPC project[3] successfully modified COTS (Commercial off-the-shelf) technology to output QA data in accordance with the requirements of Naval Sea Systems Command Standard Item 009-32. Key aspects of the final production application included:

- Electronic generation of eight appendices required by NSI 009-32
- PDF generation for an appendix only if data had been entered into that report's section
- Auto-fill fields after a tap based on what was entered in that field previously
- Pre-populate a field, regardless of tap, based on what was entered previously
- Improved "Add from Device" workflow for over-the-air import of data from the DeFelsko Positector WiFi gage, DeFelsko Smart Link gage, Defelsko RTR gage, Elcometer 224 gage, and Elcometer 456 gage.

Once the system was developed, the project team worked with Regional Maintenance Center QA representatives to identify a path forward to integrate the paperless capability into the Navy Maintenance process. Features which take advantage of the paperless technology include:

- Electronic event notification
- Auto-flag out of spec conditions
- Automate Non-Conformance reporting and resolution
- Quality control reports for contractor process improvement

[1] Corrosion Control Cost Reduction through Improved Quality Assurance Information Management, Project No: W07NS01

[2] NSRP Panel Project report titled Future State for Navy Ship Maintenance Painting, July 2013

[3] NSRP Panel Project Report titled Robust Functional Paperless Paint, April 2015

The project team also identified varying degrees of technological (connectivity/security) challenges at each shipyard. Some shipyards will need to overcome internal IT issues before adopting the technology while others have fully integrated the technology into their production process.

Project Objectives and Methodologies

This project sought to implement the technology by working with SUPSHIP, NAVSEA, RMCs, prime contractors, and second and third tier contractors together in their ports, providing hardware and hands on training. Specifically, this project funded TruQC efforts with BAE Systems Jacksonville Ship Repair and BAE Systems San Diego Shipyard, their sub-contractors, and government representatives, to pilot implementation of the paperless paint software system that had been developed by previous NSRP projects for Navy ship maintenance and repair. The efforts included a shipboard pilot program where the legacy (written) process was performed alongside the paperless paint process to demonstrate the savings, functionality, storage, recall and communication between the Government, contractor and sub-contractor using paperless QA for NAVSEA Standard Item 009-32. The project included four, interrelated tasks:

Task 1 – Project Planning and System Upgrades. Developed the project plan including team logistics, coordinated training and pilot program site visits, completed initial software upgrades/development for the most recent iteration of NSI 009-32, and addressed various security and legal issues which were raised by NAVSEA.

Task 2 – Training/Table top exercise. Training and a table top exercise were conducted by the project team with personnel from the prime contractor, their sub-contractors, and the Regional Maintenance Center in each location (San Diego and Mayport).

Task 3 – Pilot demonstrations. TruQC and BAE performed two pilot studies:

- In May 2017, a pilot demonstration was conducted on the USS ROOSEVELT FY 17 DMP – Work Item 162-11-001. The pilot included a tabletop exercise and a checkpoint. Participants included representatives from BAE Systems Jacksonville Ship Repair, Southeast Regional Maintenance Center (SERMC), NAVSEA, Advanced Marine Preservation (AMP), and Surface Technologies Corp. (STC).
- In October 2017, a pilot demonstration was performed at BAE Systems in San Diego. The pilot included a tabletop exercise and a "G" checkpoint on plates that had been blasted and coated. Participants included representatives from BAE San Diego, Southwest Regional Maintenance Center (SWRMC), NASSCO, Pacific Yacht Repair (PYRSD), and IMIA.

Task 4 Technology Transfer – This final report presents the results of two pilot projects and presents a projected return on investment (ROI). In addition, presentations on the project were provided at the following meetings:

- March 3, 2016 SP&C Panel Meeting (in conjunction with ShipTech in Charleston, SC)
- September 7, 2016 SP&C Panel Meeting (Portland, OR)
- March 7, 2017 NSRP All-Panel Meeting (Charleston, SC)
- September 6, 2017 SP&C Panel Meeting (Puget Sound, WA)

Project Accomplishments

During the previous projects, TruQC utilized their proprietary development template as a basis for customizing the existing system to meet the requirements of NSI 009-32. The process includes multiple phases which were detailed in previous reports. The projects resulted in:

- A fully functional, paperless QA Software program which populates commercially accepted forms as well as the NAVSEA appendices.
- More accurate data capture during checkpoints
- Reduction in coating inspection reporting times
- Reduction in data entry errors

This section provides a detailed discussion of the accomplishments of the current project. The accomplishments are broken into three sections. The first section presents results of the pilot demonstrations with SERMC and SWRMC. The second section provides a business case analysis from the shipyard/contractor perspective. The third section discusses the implementation and technology transfer efforts as part of this project.

Pilot Demonstrations

The project team organized two pilot demonstrations of a “paperless paint” QA systems on Navy ship repair work items being performed in accordance with NSI 009-32. One demonstration was performed during a DDG availability in Mayport; the second was performed during an LCS availability in San Diego. The object of the pilots was to validate the ability to capture data and document it in an electronic format using special tools, software and equipment and compare the results with the legacy, paper-based documentation requirements of Standard Item (SI) 009-32.

Mayport Pilot – The first pilot was performed by BAE Systems Jacksonville Ship Repair at Mayport Naval Station in May 2017. Participants included BAE Systems supervisor and quality assurance representatives, subcontractor representatives (AMP, IMIA, and STC), and SERMC representatives (SBS, QA, and design engineering). A tabletop exercise was conducted on the first day of the demonstration with 11 participants who provided feedback after the exercise. One the second day, a "G" checkpoint was conducted on the USS ROOSEVELT FY 17 DMP – Work Item 162-11-001 using the electronic “paperless” system. Surface preparation, cleanliness, conductivity, surface profile, and dust tape G-point were accomplished on a critical coated space comprising approximately 7,000 square feet. Afterwards the demonstration team met to discuss the process and identify issues and concerns.

San Diego Pilot – The second pilot was performed at BAE Systems in San Diego in October 2017. Participants included BAE Systems project management and quality assurance representatives, subcontractor representatives (NASSCO QA, IMIA project management and quality assurance, and Pacific Yacht Repair), and SWRMC representatives. Training was conducted on the first day of the demonstration. One the second day, a "G" checkpoint was conducted in the staging area

on plates that had been blasted and coated. The team simulated a deck plate G point per the current BAE Systems process in San Diego. Then the G point was repeated using the electronic "paperless" system. Afterwards the demonstration team met to compare the two processes for accuracy and effort and identify issues and concerns.

During these events, all involved parties in the implementation who have worked with legacy (paper) NSI 009-32 appendix documentation agreed that they would prefer a functioning paperless system. Issues and concerns were addressed and resulted in identification of additional functionality. These functionalities were divided between "must have" features which were completed as part of the project and "nice to have" features which would be developed in the future. A complete list of the issues raised and project team's response is provided in Appendix A. Appendix A provides a compilation of the feedback obtained during the demonstrations and responses from the NSRP project team. The key issues revolved around the following concerns:

- It is difficult to determine the path to Navy approval as it potentially involves a number of organizations including the NAVSEA Technical Warrant (coatings), SURFMEPP, and CNRMC. The system demonstrated became ITAR and NIST CUI 800-171 compliant during this project.
- Electronic integration with NMD and CCAM has been discussed but likely requires significant effort for an unclear benefit. If the system becomes widely used, it may be worth re-visiting.
- The tool provides several features that all users agree are improvements to the current process including producing legible records, automated error checking, and ability to integrate with electronic instruments.
- There are several concerns related to understanding data integrity. Specifically, it should be clear if or when the data is "locked," who can edit/amend data at each stage of the process, how change history is recorded, and who can access the record of changes.
- Before using the tool, shipyards and their subcontractors will need to revise their Quality Management System to address how the tool is used and maintained. Changes will need to be compliant with NSI 009-04 and ISO 9001-2008. Paragraph 3.11.3.1 of NSI 009-04 FY18(CH-2) should be clarified as the present system is not precisely addressed by the options presented. A draft SSRAC proposal has been developed and is provided in Appendix B.
- There is some concern with shipboard connectivity and its potential impact on data integrity. However, previous systems had similar issues. Data stored in measurement devices was not "locked" until it was uploaded via a PC. Data recorded in field notebooks is not "locked" until it is recorded on the appendix form and signed. In the present paperless system, data is loaded into an iPad on the deckplate. While local changes are not synchronized with the cloud until wireless connectivity is established, the system has better data integrity than legacy systems. Integrating a change log into the system reporting will make data changes more transparent.
- Various training and formatting issues were identified and addressed.

Business Case

An Excel spreadsheet was used to develop a financial projection including cash flow, return on investment and payback period for implementation of a paperless system for coating QA. A previous NSRP project investigated the process of QA by (1) modeling the overall QA process costs based on survey data on the costs of individual elements of the process, (2) improving our understanding of the present QA process by data-mining from the Navy Coatings Quality Assurance Tool Kit (CQATK) and (3) developing a value stream map for preservation of a critical coated surface in accordance with Navy Standard Item 009-32.[4] This previous work was used to develop a baseline case and calculate the return on investment for implementing a "paperless" QA system.

Basis for Model

An on-line survey was used to collect data on the level of effort required to perform various tasks associated with coating inspection for work performed in accordance with Navy Standard Item 009-32. The final report[4] contains cumulative probability distribution plots for each of the questions in the survey requiring numerical responses. Figure 1 summarizes the data for completing the various appendices required by Navy Standard Item 009-32. In this chart, the box represents the values between the 25th and 75th percentile. The vertical lines indicate one standard deviation above and below the mean while the horizontal line through the box indicates the median (50th percentile) response. The small black box represents the mathematical mean of the results.

The data suggest that it generally takes between 10 and 30 minutes to complete any of the appendices. While none of the appendices would seem to be particularly tedious, the data suggests that Appendix 8 (CAPS sheet) and Appendix 1 (Environmental Readings) have the potential to be the most cumbersome.

[4] *The Cost of US Navy Coatings QA/QC*, National Shipbuilding Research Program, July 2011.

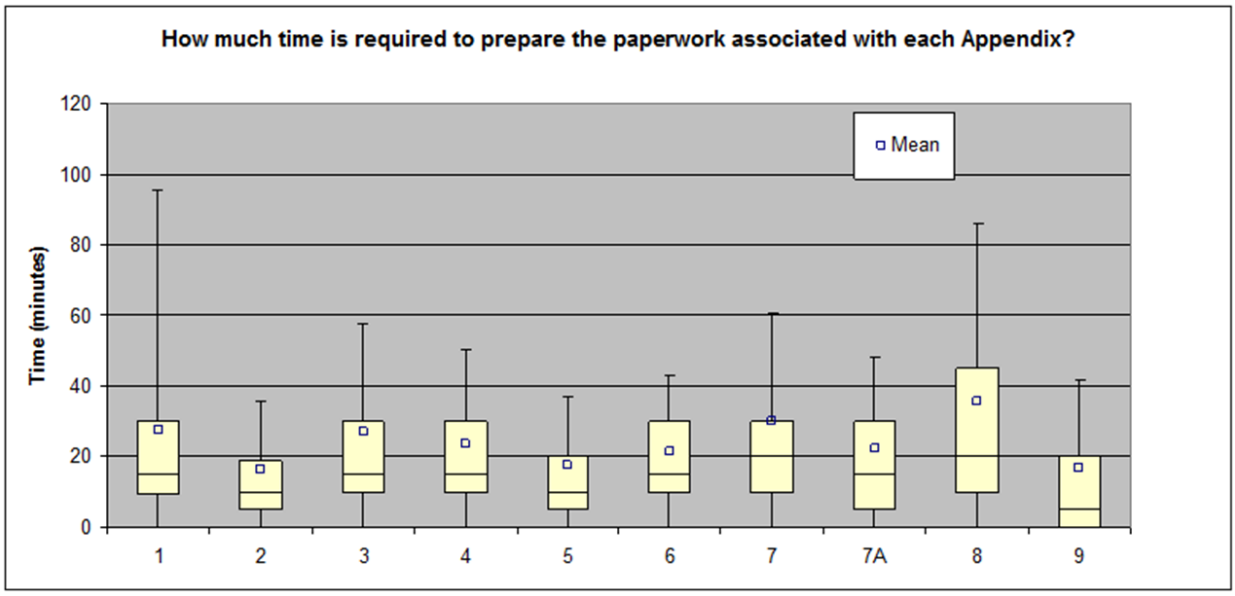


Figure 1. Time required completing various appendices in NSI 009-32.

The study also asked respondents to estimate the time required to compile the final QA package for a work item. Some responded that it took an extremely long time (several days), but the mode (50% percentile) was 6 hours. And 75% of those surveyed responded that it took 18 hours or less to compile the final QA package.

In the same study, data was extracted from the Navy Coatings Quality Assurance Tool Kit to document the actual level of effort for inspections during various painting projects. Records for 705 work items were found suitable for analysis. The 705 items accounted for 1,887,182 square feet of preserved surface. Mathematically, the average surface was 2,677 square feet and required 0.7 Subcontractor signatures, 28.3 Prime Contractor signatures and 37.3 Government signatures. Table 2 shows the average number of forms completed and average readings per form.

Table 2 - CQATK Statistics for Various NSI 009-32 Inspections

	Average Number of Forms	Average Number of Readings per Form
Appendix 1, QA Inspection Form – Environmental Readings & Paint/Nonskid Storage	3.1	65.1
Appendix 2, QA Inspection Form - SSPC-SP 1 Cleanliness Checkpoint	2.6	N/M
Appendix 3, QA Inspection Form - Surface Profile /Preparation & Cleanliness Log	2.0	9.3
Appendix 4, QA Inspection Form – Surface Conductivity/Chloride Log	1.9	14.2
Appendix 5, QA Inspection Form - Surface Cleanliness (Dust) Tape	0.4	2.9
Appendix 6, QA Inspection Form - Paint/Nonskid Application And Consumption Log	2.2	N/M
Appendix 7, QA Inspection Form – Dry Film Thickness Measurements	4.4	63.2
Appendix 7a, QA Inspection Form – Wet Film Thickness Measurements	0.7	0.7
Appendix 8, Coatings Application Product Summary (Caps) Sheet	No Data	No Data
Appendix 9, Quality Assurance Inspection Form – Submarine Touch Up Areas	No Data	No Data

A business case for using TruQC was completed based on two alternative scenarios. In Scenario 1, it was assumed that there was a 50% reduction in inspection and report preparation time. This is a realistic end-state once TruQC is fully implemented. In Scenario 2, it was assumed that there was a 10% reduction in inspection time and a 17% reduction in report preparation time. Scenario 2 is intended to demonstrate the return associated with a minimal improvement in efficiency. Following is a summary of the assumptions for the business case analysis:

- The shipyard performs 106 work items to NSI 009-32 in a year (based on the data in CQATK records)
- Ten (10) inspectors are involved in the process and require training and equipment to use paperless system
- NSI 009-32 Appendices were previously completed in the average time indicated based on the survey (Figure 1)
- Time to complete the NSI 009-32 Appendices is reduced by 50% (Scenario 1) or 10% (Scenario 2) by using the paperless system
- The final QA package for each work item previously took 6 hours to compile

- The final QA package for each work item could now compile it in 3 hours (Scenario 1) or 5 hours (Scenario 2)

The analysis showed an ROI of 6:1 in the first year of implementation for Scenario 1, 50% reduction in inspection and report preparation time. For the more conservative assumption of minimal improvements in efficiency (10% reduction in inspection time and a 17% reduction in report preparation time), the investment has a 1-year payback period and an ROI of 5:1 after 3 years. Appendix B contains the complete business case analysis for both scenarios.

Implementation/Tech Transfer

At the end of this series of projects, most of the NSRP shipyards and many of their coatings subcontractors had worked with the paperless QA system, and it is currently being used by some NSRP shipyards for Navy new construction and commercial work (including IMO PSPC items). In addition, NSRP shipyards are developing the system for crafts other than coatings, and several subcontractors have used the system as part of their quality control procedure. Many of them use the system on their commercial projects as it meets all the SSPC QP-1 criteria.

Based on the pilot demonstrations, too many hurdles remain within the Navy to cost-effectively take advantage of the electronic reporting features during US Navy ship repair preservation work. However, shipyards and their subcontractors can recognize a reasonable return on investment by taking advantage of the technology to more efficiently generate “paper” versions of the NSI 009-32 Appendices. Depending on workload and other assumptions, it is reasonable to expect a return of investment of 10:1 over a three-year period. The decision to invest is also low risk - even conservative assumptions show a payback period of less than one year. If the Government representative could sign the iPad no paper would need to be generated in this workaround. The pdf file could be stored and submitted electronically.

Appendix A – Issues and Feedback from Pilot Demonstrations

Following is a compilation of the issues raised during the two pilot demonstrations coupled with the project team's response to each respective issue. Each issue is described as presented to the team (Q1, Q2, etc.) followed by the project team's response, indented and in italics.

Q1. Data on the electronic version of NSI 009-32 Appendices could be changed after it has been entered into the computer system. Additionally, the electronic data is not permanently entered or considered locked (signed) until after the data has been uploaded (needs a wireless signal). This requires the ability to have access to the internet. The system that was used did not have that capability so the electronic data had the ability to be manipulated until it was uploaded.

> *The appendix is signed with all parties present. When the iPad reaches a Wi-Fi signal it emails out the original. Integrating a change log into the system reporting will make any data changes more transparent.*

Q2. There is no audit trail or digital log that captures any and all logs of data input and/or manipulation by separate individuals

> *An audit log does exist and has been made available as an alternative to the document locking at signature. Any individual with access can view the audit trail in a summary report. Examples are included as Appendix D.*

Q3. Contractor inexperience in the use of the computers and software caused multiple administrative errors with the users.

> *This can be addressed with user training and experience.*

Q4. Implementation of monitoring software will require a documented procedure and calibration.

> *Agreed.*

Q5. User Roles / rights will need to be formally established and documented.

> *Agreed, they are documented in the user guide*

Q6. Company's existing Quality Management System (and sub tier procedure) needs to be revised, approved and resubmitted.

> *Agreed.*

Q7. Measuring equipment (data logger, gages, etc.) should already be addressed in the company's calibration program.

> *Agreed.*

Q8. Establish processes to ensure that monitoring and measurement evidence of conformity with the control of monitoring and measuring equipment shall be determined as required by Para 7.6 of ISO 9001-2008 addresses the control of monitoring and measuring equipment.

Agreed.

Q9. When used in quality control monitoring and measurement of specified requirements of SI 009-04, the ability of a computer system to satisfy the intended application shall be confirmed. This shall be undertaken prior to initial use and reconfirmed as necessary. NOTE: Confirmation of the ability of computer software to satisfy the intended application would typically include its verification and configuration management to maintain its suitability for use. The company should also review para of 4.2.3 and 6.3 of ISO for additional requirements prior to implementation.

Agreed.

Q10. Deck plate inspection revealed that if an inspector is not logged under their user name (i.e. uses someone else's iPad) they can Sign and "Submit" a checkpoint but are unable to "Approve" a checkpoint under their name. The default/only signature for "Approved" are the logged in user. Inspectors need to be cognizant of this learning curve and BAE should consider the amount of accessible wireless iPads necessary to send checkpoints.

During the first pilot, everyone was provided an iPad with full administrative rights. This was noted as a lesson learned for the second pilot as all it did was add a lot of confusion and many of the comments generated and addressed herein. Only one iPad is required for a G point.

Q11. TruQC software requires additional controls to maintain checkpoint integrity - Submitted and approved checkpoints were saved in the system but then could be manipulated (with the original signatures maintained) using "Owner roles". Approved records should be locked (regardless of roles). Ability to identify history of who and if changes are made to the record is unknown.

During the first pilot, everyone was provided an iPad with full administrative rights. This was noted as a lesson learned for the second pilot as all it did was add a lot of confusion and many of the comments generated and addressed herein. Only one iPad is required for a G point.

Q12. All Appendices – "Accept Criteria" is N/A'd. Both blocks SAT / UNSAT are marked as "N/A." Should have been either Sat or Unsat.

The user must select one; this can be addressed with user training and experience. Added to the nice to have list for future upgrades.

Q13. Identification of requirement: TRUQC has NSI 00932 vice NSI 009-32.

Updated.

Q14. Data Logger Used? YES / NO (N/A) Method of Measurement for Paint Storage at the bottom is listed as a Data logger but block not checked.

User must select one; this can be addressed with user training and experience. Added to the nice to have list for future upgrades.

Q15. Check Point Equipment Gage numbers - There are 2 different gauges listed (732346 & 801390) on this sheet and some do not contain calibration information.

User needs to add calibration information; this can be addressed with user training and experience. Added to the nice to have list for future upgrades.

Q16. Additional readings are populated on a 2nd sheet however the form prints out the signature blocks prior to these additional readings.

This will be addressed in a 2018 release

Q17. Gage calibration data is missing for Gage # 801390.

User needs to add calibration information; this can be addressed with user training and experience.

Q18. Substrate temperatures are listed as N/A.

User must input data; this can be addressed with user training and experience.

Q19. Incorrect Dates (and checkpoint witnesses) are inaccurate on electronic form as compared to the paper version. (did not reflect actual checkpoint Information reflected table top dates vice the checkpoint ticket dates)

Concur; this can be addressed with user training and experience.

Q20. The Location of work in incomplete and should have included space number and name

User must input data; this can be addressed with user training and experience.

Q21. 17 readings were documented on the paper Appendix 3 and 18 readings were listed on the electronic Appendix.

Inconsistency in demonstrations; this can be addressed with user training and experience.

Q22. When printed, the document has additional readings on page 2 with signatures contained on the prior sheet. The system does not show or recognize pages of the form. (Page 1 of 3)

This will be addressed in a 2018 release

Q23. The Total Average profile reading was listed on iPad screen but is not reflected on printed checkpoint form.

This will be addressed in a 2018 release

Q24. Has someone from NAVSEA approved the use of this system for documentation in the Government Program of Record (NMD)?

Mark Ingle 009-32 NAVSEA 05P23 TWH and his support staff have been working with the NSRP team to develop this program for the last four years. Although TruQC has been through the cyber security requirements, the program will not connect to NMD.

Q25. How will this demo provide reports into NMD?

It will generate a PDF that will be moved to the QA office electronically along with a CFR the same way these reports are currently submitted into NMD per the JFMM.

Q26. If this demo is for paint systems, who will represent the engineering face to ensure we meet CCAMs requirements?

The project is working to replace the current state paper appendix and G point paperwork with an electronic form on an iPad. The SBS and engineer will verify and sign the documentation on the tablet versus a piece of paper. A copy is then emailed to them after they sign it if they have Wi-Fi connectivity. The master file is maintained by the prime and submitted within seventy-two hours per the 009-32 at the completion of the work, just like it is currently accomplished on paper.

Q27. Is SURFMEPP involved so we understand the historical tracking and assignments?

The software was presented to Dale Hirschman CRMC and he is very interested in the available reports and metrics the system can provide. Right now, the data must be submitted in the same way it currently is (i.e., a .pdf file). There are some SURMEPP coating SME's who participate in NSRP and SSPC who are involved at some level with the project. TruQC is able to export data in a .csv format across time to better understand trends and run analysis to improve process.

Q28. Does anyone plan to use the results of the demo as contractual documentation, and if so, has this been vetted through the ACO to avoid a contract breach?

No. The software will be evaluated by NAVSEA 05P23 in accordance with the 009-32 language that says CQATK or a NAVSEA approved equivalent can be used. The project results will be part of the work presented to the TWH for approval. SWRMC feedback is critical to the success and implementation of the project. Issues and concerns listed by SERMC and SWRMC will be addressed. RMC participation is required in order to improve the software.

Q29. The information contained within the records is typed which makes all the information legible and clear.

Concur.

Q30. NSI 009-04, paragraph 3.11.3.1 states: "For tests and inspections involving (G)-points, records shall be documented upon acceptance or rejection and a hard copy (or electronic copy as authorized by the

SUPERVISOR) provided to the SUPERVISOR at the conclusion of each (G)-Point. For tests and inspections utilizing Coating QA Tool Kit (CQATK) paperless QA program in accordance with 009-32 of 2.1, the data must be downloaded into the computer at the time and location of inspection."

Based on the fact that the SUPERVISOR will receive a PDF of the government signed appendices only, TruQC still falls under the first statement of the aforementioned paragraph. The way TruQC is programmed, does not meet the intent of the original paperless QA program (CQATK). Therefore, this paragraph would have to be revised.

> *Concur. Pending the results of the NAVSEA equivalency evaluation a SSRAC proposal will be drafted to amend this paragraph and submitted to the 009-04 committee.*

Q31. There were discussions with locking the document once the government representative signs the appendices and if any changes had to be made the documents will be re-routed for signatures and a document-change history will be maintained.

How will the document be locked in the event that the government is not able to attend the check point?

One of the drawbacks of the CQATK was that information could be changed after the inspection, which opened the door to a lot of issues and hence why is no longer in use. In my mind, due to TruQC allowing for legible and clear information the only issues or disparities would be with the documented readings. In that case, rather than revising the documentation, the checkpoint would have to be repeated once issues with the faulty/non-conforming readings are addressed and make comments as to why the retake or the readings.

In my opinion, other inspections that do not require government oversight, such as (V) checkpoints for environmental readings, should also be locked once the individual taking the readings signs the document.

Implementation of monitoring software will require a documented procedure. User roles and rights will need to be formally established and documented. The company's existing quality management system (and sub-tier procedure) needs to be revised, approved and resubmitted. The measuring equipment (data logger, gages, etc.) should already be addressed in the company's calibration program.

Para 7.6 of ISO 9001-2008 addresses the control of monitoring and measuring equipment. The organization shall establish processes to ensure that monitoring and measurement evidence of conformity with the control of monitoring and measuring equipment shall be determined as required.

NOTE: Confirmation of the ability of computer software to satisfy the intended application would typically include its verification and configuration management to maintain its suitability for use.

The company should also review para of 4.2.3 and 6.3 of ISO for additional requirements prior to implementation.

Currently, the information cannot load if there is no connectivity. This is an issue since there are timelines that need to be met for coatings and it can be skewed. Additionally, the current requirement states that the data must be downloaded at the time and location of inspection.

The project has provided a product that completes the appendices electronically. There is an expectation of what this software should do based on the history with NST Center and CQATK. NAVSEA supported the databases behind the first two paperless paint software projects. The project demonstrated the benefits of TruQC. The software can be developed to meet specific customer requirements. TruQC also offers more than is necessary for 009-32. The project team is working to provide paperless paint that is equivalent to CQATK and the current state of paper appendices. If the software is used to submit the appendices electronically as .pdf files, the information on the tablet cannot be treated any different than a piece of paper. Currently the government can detect if a piece of paper on which a G point has been documented has been changed by the inspector be changed on the walk back to the office from the ship. The same change detection can be provided by the software.

The software will not replace or guarantee the integrity of an inspector. The software should lock when signed. At times, there are issues with a Wi-Fi signal; a signal is required to make the document lock. Any changes made while waiting for a signal are tracked in the system and can be identified.

There has been much discussion concerning locking the data at the exact time the iPad is signed to protect the integrity of the information. While the request seems reasonable enough, it is a complicated feature to add. The iPad electronically captures data at the deckplate but cannot lock or email data until the iPad is in Wi-Fi or cellular range. The current paper process is similar; notes are taken when inspections are performed at the deckplate, but the official paper form is not usually filled out in the tank or drydock floor. The report is completed at a place out of the production zone with low noise, a table, chair etc. Both the current (paper) and proposed (paperless) process have the same level of data integrity.

It is unnecessary to require the paperless system to have more integrity than the paper system. However, TruQC proposes to generate a report that will provide a log of changes made after the signature. While this will not lock the data, it offers the Navy a higher level of data integrity than they currently receive with their paper based system.

Appendix B – DRAFT SSRAC Proposal

App B 009-04 Change_proposal_form

Activity Serial # (If applicable) SSRAC # (SSRAC USE)

NAVSEA Standard Specification for
Ship Repair and Alteration Committee (SSRAC)
2018 SSRAC Meeting

Submitted by:	Activity:	Date:
TYPE OF PROPOSED CHANGE:	Administrative ☐	Technical ☐
Standard Item ☒ 009-04	Title: Quality Management System; provide	
Para: 3.10.3.1	Page: 4 of 11	
SWT ☐	Title:	
Para:	Page:	

Appendix 4-E ☐	Section:	Para:	Page:

Annex A ☐	Page:	Annex B ☐	Phrase:	Page:

PROBLEM:

3.10.3.1 requires "the data must be downloaded into the computer at the time and location of inspection." While the data should be downloaded within reasonable timeframe, the current wording is a constraint for devices which may have limited shipboard connectivity.

RATIONALE FOR CHANGE:

Clarify requirement

PROPOSED CHANGE:

Delete the last sentence of 3.10.3.1 so that it reads:

3.10.3.1 For tests and inspections involving (G)-points, records shall be documented upon acceptance or rejection and a hard copy (or electronic copy as authorized by the SUPERVISOR) provided to the SUPERVISOR at the conclusion of each (G)-Point. (See 4.5)

COST IMPACT:	NO IMPACT ☐	INCREASE ☐	DECREASE ☐

Provide data to support your conclusion to include both government and contractor costs associated with the proposed change.

This will allow contractors to use any of a variety of COTS software to provide records which are more complete, accurage, and legible at a lower cost.

SCHEDULE IMPACT:	NO ☐	YES ☐

If YES, describe schedule impact.

SUBCOMMITTEE ACTION:	Adopted ☐	Adopted/Modified ☐	Not Adopted ☐	Other ☐ (Explain)

Remarks/Initials:

STEERING COMMITTEE	Approved	Approved/Modified	Disapproved	Other ☐ (Explain)

ACTION:	☐	☐	☐	
Remarks/Initials:				

Appendix C – Business Case Analyses

Scenario 1: 50% Reduction in Inspection and Report Preparation Time

USER INPUT

	Total	*Appendix 1*	*Appendix 2*	*Appendix 3*	*Appendix 4*	*Appendix 5*	*Appendix 6*	*Appendix 7*	*Appendix 8*	*Appendix 9*	Unit Cost
Number of Form types	9	yes	yes	yes	yes	yes	yes	yes	yes	yes	
Current (paper) time per form, Hours	0.41	0.46	0.27	0.45	0.39	0.29	0.36	0.50	0.60	0.28	$ 80.00 labor hour
Process 1, minutes		27.53	16.17	27.14	23.64	17.44	21.62	29.95	35.75	16.67	
Process 2, minutes											
Process 3, minutes											
Process 4, minutes											
Future (TruQC) time per form, Hours	0.21	0.23	0.13	0.23	0.20	0.15	0.18	0.25	0.30	0.14	$ 80.00 labor hour
Process 1, minutes		13.76	8.08	13.57	11.82	8.72	10.81	14.97	17.88	8.34	
Process 2, minutes											
Process 3, minutes											
Process 4, minutes											
Estimated number of each form type per year	1759.6	328.6	275.6	212	201.4	42.4	233.2	466.4	0	0	
Cost to develop form, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	

Other Projected Annual Savings		
Impact on Rework	$ -	Data comes from Table on Sheet 2
Impact on Annual Audit (e.g., QP-5, ISO) Preparation	$ 10,240	Data comes from Table on Sheet 2
Impact on Periodic Report Preparation	$ 25,440	Data comes from Table on Sheet 2
Other Anticipated Savings	$ -	See description on Sheet 2

Total number of people involved with all forms			
Users requiring training	10	$500.00	Training per user
iPad Purchases	10	$300.00	per iPad
User accounts per year	5	$149.00	TruQC/month

Net Discount Rate	5%

Scenario 1: 50% Reduction in Inspection and Report Preparation Time

OTHER SOURCES OF SAVINGS

Impact on Rework

Current Annual Coating Application Cost		
Current re-work percentage		
Rework cost factor	4	times the cost to coat the first time

Impact of shorter time to identify out of specification areas

Current time to identify out of spec areas		weeks
TruQC time to identify out of spec areas		weeks
Current re-work cost	$ -	per year
Projected future rework cost	$ -	per year
Value of re-work avoided with TruQC	$ -	per year

OR Estimated reduction in rework percentage (the highest rework savings is used)

Future re-work percentage		
Current re-work cost	$ -	per year
Projected future rework cost	$ -	per year
Value of re-work avoided with TruQC	$ -	per year

Impact on Annual Audit (e.g., QP-5, ISO) Preparation

Current Audit Preparation Hours	80	per audit
Future Audit Preparation Hours	16	per audit
Current Audit Response Hours	80	per audit
Future Audit Response Hours	16	per audit
Average Hourly Cost	$ 80.00	
Estimated Current Annual Cost	$ 12,800	per year
Estimated Future Annual Cost	$ 2,560	per year
Projected Annual Savings	$ 10,240	per year

Impact on Periodic Report Preparation

Current Report Preparation Hours	6	per report
Future Report Preparation Hours	3	per report
Number of reports prepared annually	106	(e.g., 52 weekly reports)
Average Hourly Cost	$ 80.00	
Estimated Current Annual Cost	$ 50,880	per year
Estimated Future Annual Cost	$ 25,440	per year
Projected Annual Savings	$ 25,440	per year

Other Anticipated Savings

Current Annual Cost		per year
Future Annual Cost		per year
Projected Annual Savings	$ -	per year
Description	N/A	

Scenario 1: 50% Reduction in Inspection and Report Preparation Time

COST CALCULATIONS

	Legacy Annual Cost	TruQC Costs	Fixed/ Recurring
Number of Form types			
Current (paper) time per form, Hours	$ 58,351		Recurring
Process 1, minutes			
Process 2, minutes			
Process 3, minutes			
Process 4, minutes			
Future (TruQC) time per form, Hours		$ 29,176	Recurring
Process 1, minutes			
Process 2, minutes			
Process 3, minutes			
Process 4, minutes			
Estimated number of each form type per year			
Cost to develop form, $		$ -	Fixed
Other Projected Annual Savings			Recurring Other Savings
Impact on Rework	$ -	$ -	Impact on Rework
Impact on Annual Audit (e.g., QP-5, ISO) Preparation	$ 12,800	$ 2,560	Impact on Annual Audit (e.g., QP-5, ISO) Preparation
Impact on Periodic Report Preparation	$ 50,880	$ 25,440	Impact on Periodic Report Preparation
Other Anticipated Savings	$ -	$ -	Other Anticipated Savings
Total number of people involved with all forms			
Users requiring training		$ 5,000	Fixed
iPad Purchases		$ 3,000	Fixed
User accounts per year		$ 8,940	Recurring
Net Discount Rate			
		$ 8,000	Total Fixed Investment
	$ 122,031	$ 66,116	Total Annual costs

Scenario 1: 50% Reduction in Inspection and Report Preparation Time

FINANCIAL PROJECTIONS

	Years after Full Implementation									
Cash Flows	1	2	3	4	5	6	7	8	9	10
Existing Process	$ 122,031	$ 122,031	$ 122,031	$ 122,031	$ 122,031	$ 122,031	$ 122,031	$ 122,031	$ 122,031	$ 122,031
Future Process (TruQC)	$ 74,116	$ 66,116	$ 66,116	$ 66,116	$ 66,116	$ 66,116	$ 66,116	$ 66,116	$ 66,116	$ 66,116
Net Annual Savings (Cost)	$ 47,916	$ 55,916	$ 55,916	$ 55,916	$ 55,916	$ 55,916	$ 55,916	$ 55,916	$ 55,916	$ 55,916
Cumulative Savings	$ 47,916	$ 103,831	$ 159,747	$ 215,662	$ 271,578	$ 327,494	$ 383,409	$ 439,325	$ 495,240	$ 551,156
ROI	6:1	13:1	20:1	27:1	34:1	41:1	48:1	55:1	62:1	69:1
	599%	1298%	1997%	2696%	3395%	4094%	4793%	5492%	6191%	6889%
Payback Period, years	1									
Discounted Savings (cost)	$ 45,634	$ 50,717	$ 48,302	$ 46,002	$ 43,811	$ 41,725	$ 39,738	$ 37,846	$ 36,044	$ 34,327
Cumulative	$ 45,634	$ 96,351	$ 144,653	$ 190,655	$ 234,466	$ 276,191	$ 315,929	$ 353,775	$ 389,819	$ 424,146
ROI, discounted	5.7:1	12:1	18:1	24:1	29:1	35:1	39:1	44:1	49:1	53:1
	570%	1204%	1808%	2383%	2931%	3452%	3949%	4422%	4873%	5302%

Scenario 2: 10% Reduction in Inspection Time and 17% Reduction in Report Preparation Time

USER INPUT

	Total	*Appendix 1*	*Appendix 2*	*Appendix 3*	*Appendix 4*	*Appendix 5*	*Appendix 6*	*Appendix 7*	*Appendix 8*	*Appendix 9*	Unit Cost
Number of Form types	9	yes	yes	yes	yes	yes	yes	yes	yes	yes	
Current (paper) time per form, Hours	0.41	0.46	0.27	0.45	0.39	0.29	0.36	0.50	0.60	0.28	$ 80.00 labor hour
Process 1, minutes		27.53	16.17	27.14	23.64	17.44	21.62	29.95	35.75	16.67	
Process 2, minutes											
Process 3, minutes											
Process 4, minutes											
Future (TruQC) time per form, Hours	0.37	0.41	0.24	0.41	0.35	0.26	0.32	0.45	0.54	0.25	$ 80.00 labor hour
Process 1, minutes		24.77	14.55	24.43	21.28	15.70	19.45	26.95	32.18	15.00	
Process 2, minutes											
Process 3, minutes											
Process 4, minutes											
Estimated number of each form type per year	1759.6	328.6	275.6	212	201.4	42.4	233.2	466.4	0	0	
Cost to develop form, $	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	

Other Projected Annual Savings

Impact on Rework	$ -	Data comes from Table on Sheet 2
Impact on Annual Audit (e.g., QP-5, ISO) Preparation	$ 10,240	Data comes from Table on Sheet 2
Impact on Periodic Report Preparation	$ 8,480	Data comes from Table on Sheet 2
Other Anticipated Savings	$ -	See description on Sheet 2

Total number of people involved with all forms

Users requiring training	10	$ 500.00 Training per user
iPad Purchases	10	$ 300.00 per iPad
User accounts per year	5	$ 149.00 TruQC/month

Net Discount Rate 5%

Scenario 2: 10% Reduction in Inspection Time and 17% Reduction in Report Preparation Time

OTHER SOURCES OF SAVINGS

Impact on Rework

Current Annual Coating Application Cost		
Current re-work percentage		
Rework cost factor	4	times the cost to coat the first time

Impact of shorter time to identify out of specification areas

Current time to identify out of spec areas		weeks
TruQC time to identify out of spec areas		weeks
Current re-work cost	$ -	per year
Projected future rework cost	$ -	per year
Value of re-work avoided with TruQC	$ -	per year

OR Estimated reduction in rework percentage (the highest rework savings is used)

Future re-work percentage		
Current re-work cost	$ -	per year
Projected future rework cost	$ -	per year
Value of re-work avoided with TruQC	$ -	per year

Impact on Annual Audit (e.g., QP-5, ISO) Preparation

Current Audit Preparation Hours	80	per audit
Future Audit Preparation Hours	16	per audit
Current Audit Response Hours	80	per audit
Future Audit Response Hours	16	per audit
Average Hourly Cost	$ 80.00	
Estimated Current Annual Cost	$ 12,800	per year
Estimated Future Annual Cost	$ 2,560	per year
Projected Annual Savings	$ 10,240	per year

Impact on Periodic Report Preparation

Current Report Preparation Hours	6	per report
Future Report Preparation Hours	5	per report
Number of reports prepared annually	106	(e.g., 52 weekly reports)
Average Hourly Cost	$ 80.00	
Estimated Current Annual Cost	$ 50,880	per year
Estimated Future Annual Cost	$ 42,400	per year
Projected Annual Savings	$ 8,480	per year

Other Anticipated Savings

Current Annual Cost		per year
Future Annual Cost		per year
Projected Annual Savings	$ -	per year
Description	N/A	

Scenario 2: 10% Reduction in Inspection Time and 17% Reduction in Report Preparation Time

COST CALCULATIONS

	Legacy Annual Cost	TruQC Costs	Fixed/ Recurring
Number of Form types			
Current (paper) time per form, Hours	$ 58,351		Recurring
Process 1, minutes			
Process 2, minutes			
Process 3, minutes			
Process 4, minutes			
Future (TruQC) time per form, Hours		$ 52,516	Recurring
Process 1, minutes			
Process 2, minutes			
Process 3, minutes			
Process 4, minutes			
Estimated number of each form type per year			
Cost to develop form, $		$ -	Fixed
Other Projected Annual Savings			Recurring Other Savings
Impact on Rework	$ -	$ -	Impact on Rework
Impact on Annual Audit (e.g., QP-5, ISO) Preparation	$ 12,800	$ 2,560	Impact on Annual Audit (e.g., QP-5, ISO) Preparation
Impact on Periodic Report Preparation	$ 50,880	$ 42,400	Impact on Periodic Report Preparation
Other Anticipated Savings	$ -	$ -	Other Anticipated Savings
Total number of people involved with all forms			
Users requiring training		$ 5,000	Fixed
iPad Purchases		$ 3,000	Fixed
User accounts per year		$ 8,940	Recurring
Net Discount Rate			
		$ 8,000	Total Fixed Investment
	$ 122,031	$ 106,416	Total Annual costs

Scenario 2: 10% Reduction in Inspection Time and 17% Reduction in Report Preparation Time

FINANCIAL PROJECTIONS

	Years after Full Implementation									
Cash Flows	1	2	3	4	5	6	7	8	9	10
Existing Process	$ 122,031	$ 122,031	$ 122,031	$ 122,031	$ 122,031	$ 122,031	$ 122,031	$ 122,031	$ 122,031	$ 122,031
Future Process (TruQC)	$ 114,416	$ 106,416	$ 106,416	$ 106,416	$ 106,416	$ 106,416	$ 106,416	$ 106,416	$ 106,416	$ 106,416
Net Annual Savings (Cost)	$ 7,615	$ 15,615	$ 15,615	$ 15,615	$ 15,615	$ 15,615	$ 15,615	$ 15,615	$ 15,615	$ 15,615
Cumulative Savings	$ 7,615	$ 23,230	$ 38,845	$ 54,460	$ 70,076	$ 85,691	$ 101,306	$ 116,921	$ 132,536	$ 148,151
ROI	1:1	3:1	5:1	7:1	9:1	11:1	13:1	15:1	17:1	19:1
	95%	290%	486%	681%	876%	1071%	1266%	1462%	1657%	1852%
Payback Period, years	1									
Discounted Savings (cost)	$ 7,252	$ 14,163	$ 13,489	$ 12,847	$ 12,235	$ 11,652	$ 11,097	$ 10,569	$ 10,066	$ 9,586
Cumulative	$ 7,252	$ 21,416	$ 34,905	$ 47,751	$ 59,986	$ 71,638	$ 82,736	$ 93,305	$ 103,370	$ 112,957
ROI, discounted	0.9:1	3:1	4:1	6:1	7:1	9:1	10:1	12:1	13:1	14:1
	91%	268%	436%	597%	750%	895%	1034%	1166%	1292%	1412%

Appendix D – Audit Trail Reporting available to Permissioned Users

Audit Trail

[Tuesday, 10/17/17, 5:07pm CST]
Megan Brinker edited General > Location from "A" to "B"

[Wednesday, 10/18/18, 8:23 am CST]
Megan Brinker edited Report Status from "Draft" to "Submitted"

[Wednesday, 10/18/18, 8:25 am CST]
Ben Chute added a signature

[Wednesday, 10/18/18, 9:02 am CST]
Nick Lacanski added a signature

[Wednesday, 10/18/18, 9:56 am CST]
Ross Boyd edited Report Status from "Submitted" to "Approved"

APPENDIX 7A
QA INSPECTION FORM - WET FILM THICKNESS MEASUREMENTS

SHIP NAME & HULL #: **CONTRACT/TASK ORDER/CLIN/TWD:** **DATE/TIME:** 11/30/2017, 8:31 PM GMT

LOCATION: Life **WORK ITEM:** Test **PARA. NO.:** 1235

(I) ✓ **(V)** ✓ **(G)** ✓ **PRODUCT BEING APPLIED:** Paint

REQ'T DOCUMENT: NSI 009-32 3.10.10 **/FY:** N/A **SQFT OF AREA PRESERVED:** 45555 **PARTIAL AREA:** ✓ **FINAL:** N/A

(NSTM 631, 634, PPI, NSI 009-32 FY)

MAINTAIN SEPARATE LOG FOR EACH AREA/LOCATION, PREPARED OR PAINTED SURFACE. WHEN AN AREA IS DIVIDED INTO SEPARATE SECTIONS, MAINTAIN A SEPARATE LOG FOR EACH SECTION.

NOTE #1 FOR ANY UNSAT CONDITION FOUND, PROVIDE THE TECHNICAL ADJUDICATION AND CORRECTIVE ACTION TAKEN IN COMMENTS BLOCK WHERE REQUIRED IN LIEU OF DFT.

NOTE #2 IF SPACES ARE NOT APPLICABLE, INSERT N/A. UNUSED SECTIONS SHALL BE CROSSED OUT AND MARKED N/A.

Indicate Coating System Sequence

74	Prime Coat	45	Intermediate Coat (if applicable)	10	Topcoat
56	Stripe Coat (if applicable)	65	Stripe Coat (if applicable)		Other Coat (specify) ()

METALLIC SURFACES

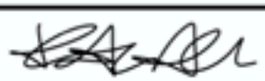
2 SPOT READINGS PER 1000 SQFT:
0 - 1000 SQFT = 2 SPOTS REQUIRED
1001 - 2000 SQFT = 4 SPOTS REQUIRED

NON-METALLIC SURFACES

0 - 100 SQFT = 5 SPOTS REQUIRED
101 - 200 SQFT = 10 SPOTS REQUIRED
201 - 1000 SQFT = 15 SPOTS REQUIRED
> 1000 SQFT = 5 SPOTS REQUIRED PER 1000 SQFT AREA

WFT Measurement #	Location of Readings	WFT Measurement Reading
1	N/A	N/A
2	N/A	N/A
3	N/A	N/A
4	N/A	N/A
5	N/A	N/A
6	N/A	N/A
7	N/A	N/A
8	N/A	N/A
9	N/A	N/A
10	N/A	N/A
11	N/A	N/A
12	N/A	N/A
13	N/A	N/A
14	N/A	N/A
15	N/A	N/A
16	N/A	N/A
17	N/A	N/A
18	N/A	N/A
19	N/A	N/A
20	N/A	N/A

COMMENTS: Test comments

Contractor (Print): N/A Contractor (Signature):  Date/Time: N/A

Subcontractor (Print): N/A Subcontractor (Signature): N/A Date/Time: N/A

Govt. Insp. (Print): N/A Govt. Insp. (Signature): N/A Date/Time: N/A

Audit Trail

[Tuesday, 10/17/17, 5:07pm CST] - Megan Brinker edited General > Location from "A" to "B"
[Wednesday, 10/18/18, 8:23 am CST] - Megan Brinker edited Report Status from "Draft" to "Submitted"
[Wednesday, 10/18/18, 8:25 am CST] - Ben Chute added a signature
[Wednesday, 10/18/18, 9:02 am CST] - Nick Lacanski added a signature
[Wednesday, 10/18/18, 9:56 am CST] - Ross Boyd edited Report Status from "Submitted" to "Approved