

Data Acquisition and Handling System (DAHS) Emissions Compliance and Regulatory Audit Recipe for Large Combustion Units Equipped with Continuous Emission Monitoring Systems (CEMS) and Continuous Opacity Monitoring Systems (COMS)

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ABSTRACT

A Data Acquisition and Handling System (DAHS) stores monitored and calculated Continuous Emission Monitoring Systems (CEMS) and Continuous Opacity Monitoring Systems (COMS) emissions data from stationary combustion sources (e.g. combustion turbines, boilers and reciprocating internal combustion engines) and is used for alarming, recordkeeping and reporting purposes. There are numerous vendors that provide DAHS software packages capable of satisfying facility air program compliance requirements. As federal, state and local air quality regulations and air permits continue to develop, the ongoing challenge to implement new DAHS configurations as well as to appropriately quality assure and update existing configurations in a timely manner is becoming more difficult. DAHS configurations can seem labyrinthine and may include hundreds of database channels especially for facilities with Title V air operating permits and facilities subject to federal air regulations such as 40 CFR Parts 60, 63, 75 and/or 98. Due to the complexity of DAHS configurations and ever changing air emissions compliance programs, best practice is to perform periodic DAHS audits to identify potential configuration problems that could lead to either under- or over-reporting of analyzer downtime, excess emissions events and/or mass emissions within required quarterly, semiannual or annual air emissions compliance reports. Identifying and addressing DAHS configuration problems proactively may help avoid or mitigate potential enforcement actions. This paper presents a general process that can be used to perform DAHS reviews/audits of any DAHS software package, highlighting the importance of accurate and concise DAHS data flow diagrams and DAHS configuration summaries that are typically not provided by DAHS vendors. Lessons learned will also be presented through extensive experience gained by performing DAHS audits, preparing DAHS specifications as well as supporting facilities with ongoing DAHS/CEMS/COMS air management support.

INTRODUCTION

A Data Acquisition and Handling System (DAHS) is the main data repository for air program compliance and is used to satisfy historical recordkeeping requirements by storing necessary monitored Continuous Emission Monitoring System (CEMS) and/or Continuous Opacity Monitoring System (COMS) data from stationary combustion sources (e.g. combustion turbines, boilers and reciprocating internal combustion engines) including process parameters (e.g. unit load, exhaust flow or fuel flow) as well as emissions data (e.g. NO_x, SO₂, NH₃, VOC, Hg, PM, CO₂ or O₂).¹ A DAHS is configured for an individual combustion unit or multiple units at a facility and is used to calculate emissions data in the units of measure specified within facility air permit(s) (e.g. state and Title V air operating permits) and/or applicable air regulations (e.g. state air regulations, 40 CFR Parts 60, 63, 75 and/or 98) for early warning alarming, compliance alarming and compliance reporting purposes. As regulations and air permits continue to evolve and become more complicated, so does the challenge of developing, implementing and maintaining a DAHS that handles emissions data as described within a facility's air permit(s) and applicable federal, state and/or local air regulations.

General environmental auditing programs are common practice and can provide substantial benefits by maintaining high quality corporate and facility level air compliance programs.^{2,3} Government agencies are moving in the direction of making their inspection practices publically available to help improve facilities' environmental programs and to prepare for onsite regulatory audits.^{4,5} The DAHS review/audit process described herein can be implemented as part of an internal environmental auditing program.

Although there are numerous DAHS vendors⁶ that provide air compliance software/hardware solutions to the energy and industrial sectors, each platform has distinct similarities. For example, certain federal regulations (e.g. 40 CFR Parts 60 and 75) and state regulations (e.g. Pennsylvania) specify standard reporting formats that must be followed; so even though the programming methodologies are different between DAHS vendors, compliance reports are typically similar. DAHS software generally consists of the following capabilities:

- Real-time screen(s) showing pertinent CEMS/COMS data mainly for use by operational staff to stay in compliance with applicable emission limits
- Database channels used to store measured CEMS/COMS data and calculated channels used mainly for alarming and compliance reporting purposes
- Early warning alarms used to assist the operational staff to stay in compliance with applicable CEMS/COMS requirements
- Compliance alarms used to identify times when a combustion unit or facility has operated out of compliance with an applicable CEMS/COMS compliance requirement
- Quality assurance test data (e.g. daily calibrations) retention
- Federal, state and local compliance reporting configurations

Considering there are general structural similarities between the available DAHS software packages, the main challenge is to configure the DAHS so that it reflects the site specific CEMS/COMS configurations (e.g. dilution or dry extractive, stack flow monitor or a fuel flow metering system, pathlength correction factor, etc.), applicable air permit(s) as well as federal and state air regulatory requirements that are not always harmonized. Often times, specific data aggregation and validation methods are not specified, particularly for units with startup/shutdown emission limits. State regulators often impose federal monitoring regulations on facilities for compliance with state emission limits, which can be problematic when such regulations were designed for other purposes (e.g. higher emitters, base-loaded units, budget programs). In certain circumstances, some pollutants that are required to be monitored for state reporting purposes do not have formal federal or state monitoring requirements (e.g. NH₃ and VOC) and so the facility may need to propose a quality assurance/quality control (QA/QC) program for agency approval. Alternative monitoring petition approvals may be needed regardless of the pollutant. For these reasons, configuring a DAHS is typically unique to a given facility and is a complicated undertaking to implement and maintain. Considering DAHS vendors can have hundreds to more than a thousand clients, accurately implementing and maintaining each site specific DAHS software configuration is a major challenge for both DAHS vendors and facility personnel.

Even the best, or most basic, DAHS configurations can often use improvement while some DAHS configurations may compromise a facility's air compliance program. Due to the complexity of DAHS software configurations, DAHS vendors typically do not provide DAHS configuration information in a concise and easily reviewable format that can be analyzed by a person that is not an expert in reviewing DAHS software or applicable air regulations. Therefore, a peer review process that can vary on the formality spectrum from informal (i.e. ad hoc review) to formal (i.e. inspection or audit) is a common and important part of any complicated software solution.⁷ Being proactive and performing appropriate DAHS reviews/audits can help assure a high quality DAHS software implementation and air compliance program to help demonstrate compliance with applicable air regulatory requirements and potentially avoid or mitigate air compliance inspections by federal or state regulatory agencies.⁵ This paper presents a process that can be used to identify configuration problems and continually improve complicated DAHS implementations.

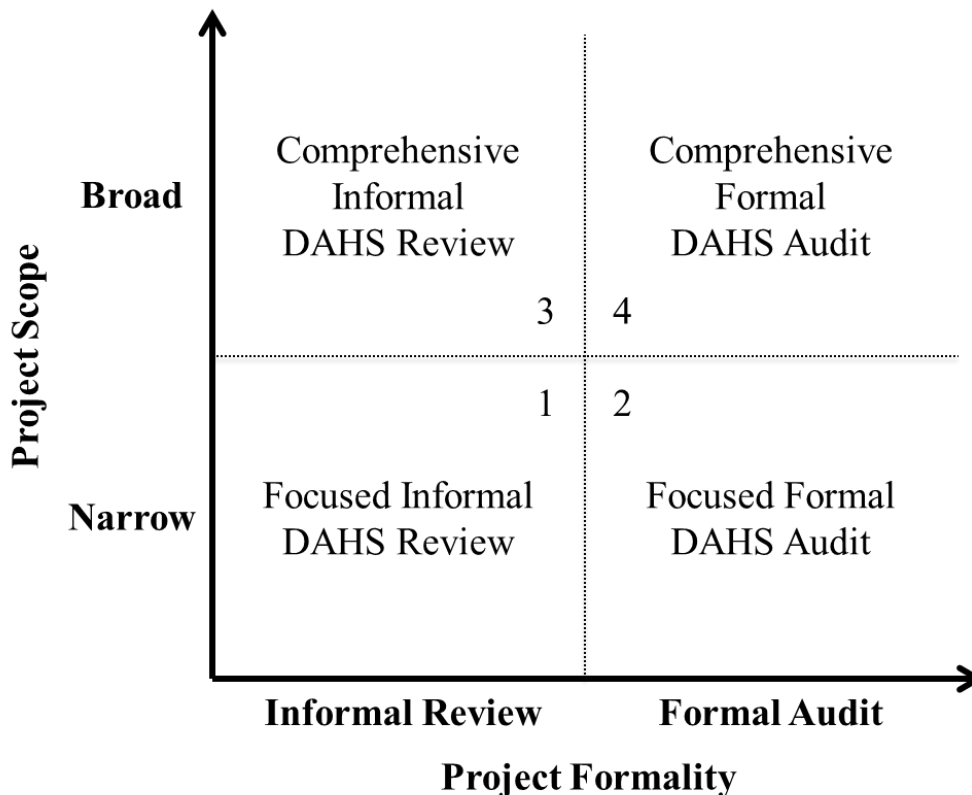
BACKGROUND

The main focus of DSG Solutions, LLC (DSG Solutions)⁸ is to support facilities' air management programs and assist with compliance reporting requirements. DSG Solutions provides ongoing compliance reporting support for units equipped with CEMS/COMS and uses one of the following DAHS software packages: Babcock and Wilcox (B&W)⁹, Custom Instrumentation Services Corporation (CiSCO)¹⁰, Environmental Systems Corporation (ESC)¹¹, Nexus Solutions Inc.¹², Teledyne Monitor Labs¹³, Trace Environmental¹⁴ and VIM Technologies Inc.¹⁵ DSG Solutions personnel perform informal DAHS reviews often during ongoing air compliance reporting support and have also performed comprehensive B&W, CiSCO and Trace Environmental DAHS audits. Based on our extensive experience, reasons to perform DAHS reviews/audits and a recipe to perform a comprehensive DAHS audit are described below.

TYPES AND REASONS TO PERFORM A DAHS REVIEW/AUDIT

There are numerous reasons to perform reviews of a site specific DAHS configuration and depending upon the project scope and resources dedicated as well as the level of project formality, numerous different types of DAHS reviews or DAHS audits can be performed. Figure 1 summarizes four general classifications of DAHS review/audit projects based upon project scope and formality.

Figure 1 – Four general classifications of DAHS reviews/audits



Project scope is described on a spectrum from narrow to broad in nature on the y-axis. On one hand, a very narrow scope may focus on reviewing the configuration of a specific DAHS database channel due to a recent air permit modification. On the other hand, a very broad scope may be limited by the expertise and ingenuity of the personnel performing the general DAHS review/audit as a facility may have installed a new combustion unit with a new DAHS or may be uncomfortable with their existing DAHS configuration and request a complete DAHS review.

Project formality is described on a spectrum from an informal DAHS review to a formal DAHS audit on the x-axis. On one hand, a very informal DAHS review may limit documentation of the review process to findings that require updates to the DAHS configuration. On the other hand, a very formal DAHS audit typically requires substantial documentation and recordkeeping regarding the specific aspects of the DAHS that will be reviewed as well as a detailed DAHS audit findings report that clearly summarizes DAHS configuration compliance findings and, in certain circumstances, efficiency related findings. Within this paper, the terms “review” and “audit” are differentiated due to the level of preparation required, recordkeeping efforts, documentation and final deliverables during the project with a DAHS audit requiring substantially more effort for each of these project categories.

Based upon the variables of project scope and formality, four general classifications of DAHS review/audit projects include:

TYPE 1: Focused Informal DAHS Review – Involves DAHS review projects of narrow, or limited, scope and formality. Projects of this type may consist of responding to specific DAHS configuration problems that are identified by facility personnel or during compliance reporting preparation that can be dealt with more informally. This type of review may simply require troubleshooting a specific database channel, an individual alarm configuration or identifying a relatively straightforward problem with a compliance report. Other reasons to perform a DAHS review of this type may include implementing routine DAHS configuration updates (e.g. updating an analyzer scale range or installing a new slightly updated version of the DAHS software to address known bugs). Typically, narrow informal DAHS reviews of this type take minimal time, require minimal preparation and are typically dealt with in-house (e.g. the problem simply required the DAHS to be rebooted) or the deliverable is a brief and focused email to the DAHS vendor describing the problem and requesting assistance to reconcile the specific problem at hand. If DAHS updates are needed, quality assuring the DAHS updates made by the DAHS vendor is best practice.

TYPE 2: Focused Formal DAHS Audit – Involves DAHS audit projects of narrow scope with a higher level of formality. Projects of this type may consist of addressing recent air permit updates (e.g. allowing an existing combustion unit to fire a new fuel type). Other reasons to perform a Type 2 DAHS audit may include applicability to a new CEMS/COMS related regulation or conducting a recertification CEMS/COMS project. This narrow DAHS audit project may include developing a specification for the DAHS vendor as a guide to implement the new DAHS configuration updates or may be limited to reviewing the DAHS vendor’s implementation efforts. In either case, preparatory meetings with applicable site personnel will be needed to clearly define the scope of work and to verify the requested DAHS updates are appropriate. In certain circumstances, drafting a relatively simple data flow diagram to clearly

identify new or updated database configuration channels and preparing a brief project summary prior to making DAHS updates can help with the project's efficiency and transparency. Best practice is to quality assure the DAHS implementation efforts and make comments, if needed, soon after the initial updates are implemented with efforts to keep the project current and to keep the same personnel involved in the project until completion. Type 2 focused formal DAHS audits require more preparation, recordkeeping and documentation compared to Type 1 DAHS reviews, yet less of each compared to Type 4 DAHS audits.

TYPE 3: Comprehensive Informal DAHS Review – Involves DAHS review projects of broad scope and limited formality. Projects of this type may consist of performing a general review of a DAHS configuration following a major DAHS software update (e.g. implementing ESC StackVision or the B&W NetDAHS Edge software) or if the DAHS software is updated with years of patches or minor updates at once. In situations like these, the general database configuration is meant to stay intact, but due to the major changes in the DAHS software, there may be unanticipated effects on the DAHS (e.g. unintentionally overwriting prior site specific DAHS configuration updates). A Type 3 DAHS review may also be warranted a year or two after a Type 4 DAHS audit is conducted, by following the same general review process, but in a more informal manner. While performing a general review of this type, minimal to no preparation may be required and minimal recordkeeping and documentation may be needed, although best practice is to clearly document which portions of the DAHS are reviewed and whether any configuration problems were found. If specific problems with the DAHS configuration are identified, typically an email is developed for the DAHS vendor to address the concern(s) if the issues cannot be resolved in-house. If DAHS updates are needed, quality assuring the DAHS updates made by the DAHS vendor is best practice.

TYPE 4: Comprehensive Formal DAHS Audit – Involves a DAHS audit of broad scope and increased formality. Projects of this type may consist of an initial DAHS software installation for a newly constructed combustion unit, a DAHS vendor change at a facility, personnel changes at a facility that may lead to a loss in expertise of the current DAHS configuration, or that facility personnel are uncomfortable with the general DAHS configuration, but are uncertain of any specific DAHS configuration problems. The Type 4 DAHS audit is the most complicated, thorough and time consuming of the four DAHS review/audit classifications and is meant to be conducted only on an as needed basis. This type of DAHS audit requires substantial preparation time, thorough recordkeeping during the DAHS audit and a comprehensive DAHS audit findings report. Typically, a Type 4 DAHS audit is performed when there are numerous known and suspected unknown DAHS configuration problems and site personnel want DAHS configuration problems documented so they can be addressed by the applicable DAHS vendor, if needed. Due to the broad scope and potential for numerous sensitive findings, Type 4 DAHS audits are commonly performed under attorney client privilege. Since a Type 4 DAHS audit is a complicated undertaking, the activities to perform a comprehensive DAHS audit are described in the following section.

COMPREHENSIVE TYPE 4 DAHS AUDIT RECIPE

This section will discuss a Type 4 comprehensive formal DAHS audit process, but most often due to limited resources, all the items described are not included within a single project's scope of work, but instead applicable portions are identified prior to beginning the DAHS audit. Generally speaking, the narrower and more defined a DAHS audit scope of work, the more thorough the review will be allowing for the identification of potential DAHS configuration problems within a given portion of the DAHS that is scrutinized. Considering the complexity of performing a Type 4 DAHS audit, if an organization operates a fleet of similar types of combustion units with the same DAHS software, to minimize resources, one DAHS audit can be conducted for each type of unit since the findings may be applicable to other similar DAHS configurations. The following general activities are performed during a Type 4 comprehensive DAHS audit:

DAHS Audit Scope Development – Developing an appropriate project scope for the specific DAHS implementation and identifying qualified individual(s) to perform an efficient and productive DAHS audit will maximize typically limited resources. Importantly, scope preparation should begin with identifying personnel with appropriate levels of expertise to perform the DAHS audit. Although there are DAHS experts that are qualified to review a complete DAHS configuration, there may be instances where certain individuals are identified with different skill levels to examine separate portions of the DAHS software (e.g. database channels, alarms or reports). Importantly, any qualified individual(s) can perform a DAHS audit (i.e. a member of the applicable DAHS vendor's company, a member of the facility's company, or a third party consultant). For Type 4 DAHS audits, the facility may want to have their system evaluated by someone independent of the existing DAHS configurations, thereby avoiding any potential conflicts of interest.

Once qualified individual(s) are identified to perform the DAHS audit, typically meeting(s) are conducted with facility personnel familiar with the DAHS to determine an acceptable project scope that identifies specific portion(s) of the DAHS to scrutinize and to communicate any suspected DAHS configuration problems that should be a focus of the audit.

If the scope is inappropriately defined too narrowly or suspect DAHS focus areas are improperly identified, problematic parts of the DAHS may not be evaluated. Similarly, if the scope is defined too generally there may not be enough time to thoroughly review the DAHS configuration. In both cases, if the scope is not defined well, important DAHS configuration compliance problems may not be identified.

Request for Information – Prior to conducting the DAHS audit, applicable and necessary information should be requested by the auditor that may include air permits, DAHS configuration summary documents, air compliance reports, CEMS/COMS logbooks, applicable DAHS user manual, regulatory agency correspondence related to site specific alternative monitoring petition approvals, site specific QA/QC plan with approval (if obtained), site specific CEMS/COMS monitoring plan(s), CEMS related QA testing supporting documentation (e.g. relative accuracy test audit (RATA)/cylinder gas audit (CGA)/linearity check reports, supporting calibration gas certification sheets, recent recertification reports), COMS related QA testing

supporting documentation (e.g. calibration error test reports, stack drawings to verify the applicable pathlength correction factor or optical pathlength correction ratio, applicable attenuator certification sheets and recent recertification reports) and historical review/audit reports (if applicable).

Documentation Preparation – Prior to performing the DAHS audit, supporting documents should be compiled or, if needed, prepared to allow for an efficient DAHS audit process. These supporting DAHS audit materials may consist of an abridged or comprehensive version of the following documents depending upon the specific project scope:

- A clear and concise summary of applicable CEMS/COMS/DAHS air permit and air regulatory related requirements that can be used as a reference document during the DAHS audit process
- A DAHS data flow diagram that can be used to identify the relationship of database channels to one another (e.g. raw monitored data channels to calculated compliance channels)
- A consolidated database channel summary that can be used to identify channel configuration details (e.g. data aggregation, DATA validation and specific channel formulas)
- A consolidated list of early warning alarms that can be used to identify potential nuisance alarms or to identify and recommend the addition of new early warning alarms
- A consolidated list of compliance alarms that can be used to identify potential configuration problems or to identify missing compliance alarms based upon applicable air permit and air regulatory requirements
- A process checklist of the DAHS configuration items that will be reviewed during the DAHS audit
- Questions to ask personnel that are responsible for DAHS related activities during the DAHS audit

Although the DAHS summary documents can be used to increase the effectiveness of a DAHS audit, once prepared, these documents can be easily updated and reviewed following completion of the DAHS audit process.

Perform the DAHS Audit – Although a DAHS audit can be performed remotely, complicated DAHS audits are more effectively performed while onsite as facility personnel and related CEMS/COMS documentation can be available, if needed, during the audit. If an appropriate scope of work has been developed, the DAHS audit is a detailed review process of the applicable portions of the DAHS identified in the project scope. During the DAHS audit, the process checklist is completed and detailed notes are taken documenting specifically what was reviewed and any potential configuration problems. Best practice is to clearly document compliance configuration problems by taking screen shots of the DAHS configuration and/or generating DAHS reports. The broadest DAHS audit will include a thorough review of each main DAHS section. An abridged list of common configuration items to include within a comprehensive DAHS audit is as follows:

- Review and verify that each compliance limit has appropriate compliance channel(s), early warning alarms, compliance alarms and applicable compliance reports
- Review compliance calculations and assumed constants (e.g. fuel density) for accuracy
- Review applicable database channels, data aggregation and validation implementations (e.g. review the requirements to calculate 6-minute, hourly, daily, 30-day, 365-day, 12-month rolling averages)
- Review applicable missing data routines (e.g. 40 CFR 75)
- Review real time screens used by the operators for accuracy and efficiency
- Review CEMS/COMS daily calibration configurations for accuracy, including passing criteria and frequency
- Review other quality assurance test configurations for accuracy (i.e. quarterly CGA and/or linearity check, annual RATA, etc.)
- Review site specific DAHS configurations that are described within the facility's QA/QC plan, monitoring plan(s) or alternative monitoring approval(s)
- Review applicable federal air compliance reporting formats such as 40 CFR 75 electronic data reports (EDRs) and 40 CFR 60 excess emissions and monitoring performance reports (EEMPRs)
- Review applicable state air compliance reporting formats

DAHS Audit Findings Report – Following the DAHS audit, a report should be prepared summarizing, at a minimum, compliance related problems identified during the DAHS audit. For compliance related findings, the report should clearly document the regulatory requirement and why the DAHS configuration does not satisfy the regulatory requirement. Ideally, the report would include all materials developed during the DAHS audit process including the materials developed in preparation for the audit, the completed process checklist and notes taken during the DAHS audit as well as any supporting screen shots and reports generated to document compliance related DAHS configuration problems. Depending upon the project scope the report may also include a section to discuss recommended DAHS efficiency updates unrelated to compliance related findings (e.g. suggestions to improve the real time screen(s) or early warning alarms).

DAHS Specification(s) Preparation – Although typically not part of an initial DAHS audit project scope, following preparation of the audit findings report, the findings should be prioritized and addressed by importance. Considering the resources needed to perform a Type 4 DAHS audit are substantial, acting upon the DAHS audit findings report is highly advisable. DAHS specification(s) can be prepared to communicate identified compliance and/or efficiency concerns to the applicable DAHS vendor for their assistance to address the problems, as needed. Depending upon the number and importance of the DAHS audit findings, a single DAHS specification may suffice, or numerous DAHS specifications may be needed. Again, if DAHS updates are implemented, quality assuring the configuration updates made by the DAHS vendor is best practice.

Post Type 4 DAHS Audit Activities – Following completion of a Type 4 DAHS audit, updating the DAHS summary documents, as needed, and performing Type 3 DAHS reviews annually focusing on a specific DAHS section can help maintain a high quality DAHS implementation over time.

SUMMARY

As air regulations and air permit requirements for combustion units equipped with CEMS and/or COMS continue to develop and become more complicated, so does implementing and maintaining site specific DAHS software configurations. For this reason, performing necessary DAHS software review(s) of applicable types can be an important mechanism to quality assure a DAHS implementation. There are four general types of DAHS reviews/audits that depend upon the project scope (i.e. narrow to broad) and formality (i.e. informal to formal). There are specific reasons and circumstances to perform each of the four types of DAHS reviews/audits with the Type 4 DAHS audit being the most comprehensive and consisting of the following activities: (a) identify qualified personnel to perform the DAHS audit and develop an appropriate project scope, (b) request for information to obtain necessary information in preparation for the audit, (c) prepare necessary DAHS summary documentation to help optimize efficiency during the audit, (d) perform the DAHS audit, (e) prepare a DAHS audit findings report, (f) prepare necessary DAHS specification(s) following completion of the audit and (g) perform on-going post-audit activities with efforts to maintain a high quality DAHS configuration over time.

REFERENCES

1. Jahnke, J.A. *Continuous Emission Monitoring, 2nd Edition*. Wiley & Sons: New York, 2000.
2. Guida, J.J. A Practical Look at Environmental Audits. *Control Technology News*. 1982, 32(5), 568 – 573.
3. MacIntyre, S.T. Environmental Auditing – A Timely and Effective Tool. *Control Technology New*. 1983, 33(9), 909 – 913.
4. Part 75 CEMS Field Audit Manual, Clean Air Markets Division, USEPA, Washington, DC, 2003.
5. Pritzlaff, C.J. Environmental Compliance Strategies. *Air and Waste Management Association Magazine for Environmental Managers*. 2012, November, 22 – 29.
6. Norfleet, S.K.; O’Connell, M.R. “What’s Everyone Using? Part 75 CEMS Equipment Trends - 2012 Update” Paper presented at the EPRI CEMS User Group conference, Louisville, Kentucky, May 9 – 10, 2012.
7. Wiegers, K.E. *Peer Reviews in Software: A Practical Guide*. Addison-Wesley, 2002.
8. DSG Solutions, LLC Home Page. <http://www.dsgsol.com> (accessed Mar 7, 2013)
9. Babcock and Wilcox (B&W) Home Page. <http://www.babcock.com> (accessed Mar 7, 2013)
10. Custom Instrumentation Services Corporation (CISCO) Home Page. <http://www.ciscocems.com> (accessed Mar 7, 2013)
11. Environmental Systems Corporation (ESC) Home Page. <http://envirosys.com> (accessed Mar 7, 2013)
12. Nexus Solutions Inc. Home Page. <http://can.cemview.com/dnn> (accessed Mar 7, 2013)
13. Teledyne Monitor Labs Home Page. <http://www.teledyne-ml.com/regperfect.asp> (accessed Mar 7, 2013)
14. Trace Environmental Home Page. <http://www.traceenv.com> (accessed Mar 7, 2013)
15. VIM Technologies Inc. Home Page. <http://www.vimtechnologies.com> (accessed Mar 7, 2013)

KEYWORDS

Data Acquisition and Handling System, DAHS, Continuous Emission Monitoring System, CEMS, Continuous Opacity Monitoring System, COMS, Audit, Air Compliance, Emission Limits, Combustion, Simple Cycle, Combined Cycle, Combustion Turbine, Boiler.