PROCEDURE AND POLICY FOR DEMOSTRATION OF CAPABILITY FOR METHODS, INSTRUMENTS, AND LABORATORY STAFF

1. SCOPE AND APPLICATION (Refer to Section 1.6 of the 2016 TNI Standard, V1M4, V1M5 and V1M7)

   1.1. This SOP is to be used for the following situations:

   a. validation of an EPA or Department-approved laboratory method not already used in the laboratory;

   b. validation of a new analyte(s) in a specified matrix using an EPA or Department-approved laboratory method;

   c. substantial modification of a Department-approved laboratory method that warrants validation;

   d. validation of a new method for analyte(s) in a specified matrix which is not an EPA or Department-approved laboratory method;

   e. validation of an alternative analytical method for analyte(s) in a specified matrix where a Department-approved method already exists. This alternative method is one intended to be used in place of an existing Department-approved laboratory method;

   f. validation of a new instrument or a major upgrade of software or hardware for an instrument;

   g. Initial demonstration of capability (IDOC) or continuing demonstration of capability (CDOC) for an analytical procedure for which the analyst will be responsible.

   1.2. This SOP is intended to be used only by laboratory managers, supervisors or experienced senior analysts.

2. VALIDATION PROCEDURES

   The validation protocols involve:

   2.1. For situations listed in section 1.1.a, 1.1.b and 1.1.c, perform the following:

   2.1.1. A method detection limit (MDL) study. The MDL is defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from a method blank. Prepare a minimum of seven method blanks and seven laboratory fortified blanks (LFB) in three independent batches; the LFBs are spiked at one to five times the estimated MDL concentration. The blanks and LFBs are processed through the entire analytical method. (Note: For biological methods where an MDL or LFB cannot be prepared e.g., BOD and chlorophyll, substitute with at least seven replicates of a standard solution.) The method blanks and LFBs must then be distributed and analyzed on three separate days in three independent analytical runs.

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Two MDL values are then derived, one based on the standard deviation and average concentration of the method blanks (MDL_b) and the second based on the standard deviation of the LFBs (MDL_s). Derive the detection limit using the Student's t value appropriate for a 99 % confidence level and a standard deviation estimate with *n* - 1 degrees of freedom where n is the number of each type of blank. The larger of the two MDLs is set as the MDL for the method. In cases where the calculated MDL is more than 10 times lower than the concentration level of the LFB's the study may be performed again using a lower spiking level. For details, refer to the FDEP Quality Manual and Chapter 40, Part 136 Appendix B of the Code of Federal Regulations for "Definition and Procedure for the Determination of the Method Detection Limit—Revision 2 (August 2017)".

2.1.2. An IDOC. Prepare and analyze four laboratory fortified blanks or four aliquots of the analyte(s) diluted in a volume of clean quality system matrix at the concentration specified, or if unspecified, one to four times the limit of quantitation (LOQ) concentration. Calculate accuracy and precision for each parameter of interest. Refer to 2016 TNI Standard, V1M4, Section 1.6.2 for details. The LOQ is derived using criteria outlined in the laboratory's Quality Manual.

2.1.2.1 For Whole Effluent Toxicity (WET) analyses, the IDOC consists of conducting five valid standard reference toxicant tests for each method. The IDOC will be performed by at least one current member of the toxicity laboratory work unit or work cell.

2.1.2.2 For microbiological analyses, the IDOC consists of preparing and analyzing four reference samples for each method. The IDOC will be performed by at least one current member of the microbiolgy laboratory work unit or work cell.

2.1.2.3 For chlorophyll analysis by spectrophotometer, the IDOC consists of preparing and analyzing four reference samples. The IDOC will be performed by at least one current member of the bench laboratory work unit or work cell.

2.2. For situations listed in section 1.1.d and 1.1.e, follow the method validation requirements in the "New and Alternative Analytical Laboratory Methods", DEP-QA-001/01, referenced in QA Rule 62.160 of Florida Administrative Code. Check with the QA officer for an up-to-date copy of this document before proceeding with the validation. Below is the summary of the procedure.

2.2.1. Choose the limited-use method, which is intended to be used only by our laboratory for the testing of an analyte (or analytes) in a sample matrix of interest. A statewide-use method is, in most instances, not applicable to our laboratory's needs.

2.2.2. Conduct MDL, precision, and accuracy determinations.

2.2.3. If an alternative method validation is being conducted, an equivalency study will be required. Prepare seven matrix replicates each for the

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alternative method and the method intended to be replaced. Statistically evaluate the equivalency of the two methods at 95 % confidence interval.

2.2.4. Submit required documentation to Quality Assurance Subsection of the FDEP Water Quality Standards program for review and approval. For certain EPA projects, such as NPDES or drinking water associated projects, validation documentation may need to be further submitted to EPA Region 4 for review and approval. In addition, consult with clients as to whether TNI certification is required or not. Apply for TNI certification with the Florida Department of Health in Jacksonville as needed.

2.3. **New Instruments:** When encountering the situation listed in section 1.1.f., first bring instrument and software up to factory specifications.

2.3.1. Sensitivity Study. If required, conduct instrument detection limit (IDL) determination. The IDL should be equal to or lower than the established MDL. The IDL is determined in the same manner as the MDL but without any sample processing steps included.

2.3.2. Stability Study. If required, prepare a continuing calibration verification (CCV) standard and perform 4 to 7 replicate analyses. The % RSD (percent relative standard deviation) and chromatographic retention time window (if applicable) must be equal or better than established method requirements.

2.3.3. Perform method calibration procedure. Compare the correlation coefficient and relative error or relative standard error (% RSE) data for each analyte to the method requirements. The new data must meet method requirements.

2.3.4. All major software upgrades must be validated to ensure that method requirements are met. This validation may include performing an initial calibration, CCV, and blank analysis. If the upgrade is limited to software only and the old analytical data files are compatible with the new software, then a validation may be performed by re-processing an old analytical data set using the new software. The resulting files must be equivalent between new and old sets.

2.4. **Demonstration of Capability (DOC):** For situations involving IDOCs or CDOCs listed in section 1.1 g., several options are available.

2.4.1. Section 1.6.3.2, V1M4 and V1M5 of the 2016 TNI Standard allows for a documented process of analyst review to satisfy requirements for a CDOC. For routine analyses that are frequently performed by seasoned lab analysts, the lab's normal workflow for reviewing data before it is reported to the customer serves this purpose well.

Lab analysts generate reports after completing an analytical run that are reviewed by their supervisors. The report typically includes raw instrument data including calibration data and is reviewed by the supervisor for QC failures or other deviations from method requirements. Procedures for the

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review of routine analytical data are documented in DEP SOPs, LB-026, MT-058, NU-043, VO-010, GC-001, BB-031 and BB-032.

Laboratory supervisors will review data from all analytical runs using the protocols described above. The supervisor will look for systematic failures of initial calibration verification samples, continuing calibration verification samples, laboratory control samples, method blanks, surrogates, and other quality control checks that might be appropriate. Systemic failures are those quality control failures having more than the allowed number of marginal exceedances defined in the 2016 TNI Standard or failures for which there is no obvious explanation (e.g., missed autosampler injections). Analysts will repeat analyses for samples associated with systemic failures; if the analyst is unable to correct the problem on subsequent analyses, the analyst will be re-trained and assigned completion of an IDOC before further analytical work on client samples can be submitted for approval.

This review of routine QC data by lab supervisors is an active, ongoing process that evaluates the capability of the analyst on a continuing basis. When the supervisor finishes the review, he/she signs off the analyst's bench sheets and lab report and authorizes the data in the LIMS. The sign-off and authorization signify that the analyst has met all QC requirements for that method and has demonstrated the capability to perform the analysis.

Routine QC data from analytical runs including LCS recoveries, matrix spike recoveries, practical quantitation limit (PQL) spike recoveries, sample duplicate precision, blank values, etc. are uploaded to the LIMS as part of the data review and reporting process. This data can be readily retrieved from the LIMS for any analyst and method for verification by an external or internal auditor. Sample duplicate precision may also be used for microbiological testing as a CDOC.

For Wet Effluent Toxicity (WET) tests, the CDOC consists of conducting at least one Standard Reference Toxicant annually by at least one current member of the work unit. Acceptable results for a blind Performance Testing (PT) samples can also serve as a CDOC.

For microbiological analyses, the CDOC consists of annually preparing and analyzing four reference samples for each analysis. Acceptable results for a blind Performance Testing (PT) samples can also serve as a CDOC.

For chlorophyll analysis by spectrophotometer, the CDOC consists of running four consecutive passing laboratory control samples (LCS). The results must fall within our laboratory established recovery limits.

2.4.2. Alternatively, for analyses that are performed infrequently or analysts that rarely perform the analyses (less than once per quarter), or analyses that do

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not have available routine QC data, the analyst must perform or satisfy one of the following four options once every 12 months.

2.4.2.1. Analysis of a single blind sample. The blind sample could be prepared by a supervisor or a senior analyst or be purchased from an EPA TNI-certified chemical standards vendor. The results must fall within our laboratory established accuracy and precision limits for the analytical procedure of the concern if blind sample is prepared in house. Otherwise, the results must pass all acceptable limits provided by the vendor.

2.4.2.2. An IDOC (see section 2.1.)

2.4.2.3. Analysis of at least four consecutive laboratory control samples (LCS) or laboratory fortified blanks for chemical parameters. The results must fall within our laboratory established accuracy and precision limits.

2.4.2.4. Successful analysis of authentic samples with results statistically indistinguishable from those obtained by another trained analyst.

Additional options for Microbiology:

2.4.2.5 Analysis of one sample in duplicate for each target organism and test. The results must meet laboratory precision acceptance criteria.

2.4.2.6 Analysis of one sample or blank spiked with a known quantity of the target organism. The results must meet laboratory accuracy acceptance criteria.

If an analyst fails to demonstrate on-going capability using the criteria listed above, then the analyst must complete a successful initial DOC to demonstrate capability. The analyst will be suspended from reporting data until the successful completion of the initial DOC.

2.5. **Ongoing Verifications of the MDL and LOQ**:

2.5.1. MDL Verification: The laboratory shall verify the MDL for the method for each target analyte of concern in the quality system matrices whenever a spiking solution is commercially available (unless spiking is inappropriate e.g., pH, BOD) annually. All sample-processing steps of the analytical method shall be included in the verification of the MDL. MDL verification spikes and blanks must be conducted every quarter for each quality system matrix analyzed by the method. Refer to the 2016 TNI Standard, V1M4, 1.5.2.1.2, Chapter 40, Part 136 Appendix B of the Code of Federal Regulations for "Definition and Procedure for the Determination of the Method Detection Limit—Revision 2 (August 2017)", and DEP SOP LB-031, for additional requirements and information.

2.5.2. Limit of Quantitation (LOQ): Refer to the 2016 TNI Standard, V1M4, 1.5.2.2 for initial and ongoing verification of the LOQ.

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3. ACCEPTANCE CRITERIA

3.1. Method Detection Limit: The derived detection limits must meet method-prescribed detection levels if they are included. If the derived detection limits cannot achieve the Department's objective, the analyst and supervisor must evaluate and propose options to the section manager on practical considerations for lowering the detection levels. Modifications may include increasing sample volume, decreasing extract size, adding sample cleanup steps, and improving instrument sensitivity, etc. A section representative will discuss analytical assessment and limitations and estimated method development cost with clients to determine the extent of analytical modications to be explored.

3.2. Precision and Accuracy: The analyst and supervisor shall ensure that the validated method can achieve the listed acceptance ranges for precision and accuracy in the method, if available. If unavailable, for organic methods, the generally acceptable in-house targets for accuracy should be 60% to 130% for all matrices; precision targets shall be 30% for soil and waste, and 30% and 25% for water for chemical and biological analyses, respectively. For inorganic methods, the acceptable targets for accuracy should be 80% to 120% for water matrices and 75% to 125% for solid matrices and 20 % for precision. If initial testing indicates that these criteria cannot be achieved, break down the procedure into smaller steps to determine where the dominant variations are. Attempt different procedural options to reduce the variance, which in turn will allow a better understanding of the method's limitations. The analyst and supervisor shall present the laboratory findings to the section manager to determine the acceptable ranges and/or other analytical options. Precision and accuracy criteria for chemical and biological parameters are listed in Tables 5.1 and 5.2 of the Laboratory QA Manual.

4. POST-METHOD-VALIDATION EVALUATION

4.1. MDLs and Laboratory Background Interferences.

4.1.1. Optional procedure - After 20 to 30 analytical runs, evaluate laboratory background interferences against the initial established method detection limits (IEMDL) using available method blank data. If interferences or method blank contamination appear to be clearly higher than the IEMDL, both the analyst and supervisor need to locate the source of interference or contamination and attempt to eliminate or reduce it. If it is deemed not feasible under the current laboratory environment, re-adjust the method detection limit to a level equal to twice the highest detected interferences or contaminant level, excluding outliers. Inform affected clients regarding MDL adjustments.

4.1.2. During on-going practice of a method, if laboratory background interferences, at any time, are observed to be persistently higher than usual, corrective actions need to be taken as in 4.1.1.

4.2. Precision and Accuracy.

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4.2.1. Optional procedure - After 20 to 30 analytical runs, evaluate precision and accuracy using available laboratory fortified blank data against the initial established acceptable ranges. If statistically significant out of limits are observed, analyst and supervisor need to identify and eliminate/reduce the dominant source of the problem. If it is deemed not possible, the analyst and supervisor will present the case to section manager to either re-adjust the QC limits, and/or discuss analytical options.

4.2.2. If at any time during routine laboratory operations, a method precision and accuracy assessment consistently produces out of control data, corrective actions described in 4.2.1 will be instituted. Re-validation of the method should be considered if corrective actions are not successful.

5. DOCUMENTATION STORAGE

All validation documents must be stored at a designated storage place

NOTE: The MDL and DOCs shall be determined for each main quality system matrix group identified by TNI (air, drinking water, non-potable water, biological materials and solids/chemical materials). These groups represent the minimum matrix distinctions for MDL determinations and DOCs where there is evidence that the the method performance will not be affected by sub-matrix distinctions within these group. Otherwise, MDLs and DOCs shall be determined separately for the quality system matrix sub-groups listed below. Where a suitable matrix cannot be found for preparing samples for MDL determinations or DOCs, another similar matrix type may need to be used or samples may need to be prepared in the absence of a matix (e.g., method blanks). Reasons for matrix substitution may include (but are not limited to): inappropriate background analyte levels in the matrix for the intended study, no analyte-free matrix is available for method blanks, no reference materials are available for a matrix, etc,

Quality System Matrices:

Air and Emissions – including gas and vapor, collected whole or where constituents are concentrated on/in sorbent tubes, impinge solution, filters, polyurethane foam or other air sampling devices or sorbents;

Aqueous – all aqueous samples excluding drinking water (see below) and salt or estuarine waters;

Biological Tissue – includes all biologically-derived material including plant, animal, fish or shellfish derived material;

Chemical Waste – a product or by-product of an industrial process that results in a material not defined elsewhere; because of unanticipated matrix effects from unknown materials of this nature, it is anticipated that deriving MDLs for this sub-matrix category would be pursued upon client request only for specific well-defined projects and materials;

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Drinking Water – water from a designated potable source;

Non-aqueous Liquid – an organic liquid with < 15 % solids; because of unanticipated matrix effects from unknown materials of this nature, it is anticipated that deriving MDLs for this sub-matrix category would be pursued upon client request only for specific well-defined projects and materials;

Saline/Estuarine – an aqueous sample from an ocean or estuarine. The effects of this matrix type may vary from analysis to analysis and with salt content. Therefore, the decision to what extent if any this matrix has on the MDL and what salt levels may affect the MDL is left to the discretion of experienced supervisory staff;

Solids – includes soils, sediments, sludges and other materials with > 15 % settable solids.

6. REFERENCES

6.1. DEP SOP LB-026, *Job Level Authorization Checklist.*

6.2. DEP SOP LB-031, *Limit of Detection Verification*

6.5. DEP SOP MT-058, *Procedure for Metals Data Review and Authorization*.

6.4. DEP SOP NU-043, *Nutrients and General Chemistry Quality Assurance and Data Authorization Guidelines.*

6.5. DEP SOP VO-010, *Data Review/Authorization Procedures for the Volatile Organics and Methyl Mercury Laboratory.*

6.6. DEP SOP GC-001, *Quality Assurance/Quality Control in the GC Pesticides Laboratory.*

6.7. DEP SOP SV-011, *BNA Group Data Review/Authorization Checklist.*

6.8. DEP SOP BB-031, *LIMS QC Manager Data Uploading Instructions for Bench Biology and Microbiology Samples.*

6.9. DEP SOP BB-032, *Test Level Authorization of Uploaded Results for Bench Biology Samples.*

6.10. 2016 TNI Standard, EL-V1, Rev. 2.1, *Management and Technical Requirements for Laboratories Performing Environmental Analysis.*

6.11 40 CFR Part 136, Appendix B, *Definition and Procedure for the Determination of the Method Detection Limit—Revision 2.0* (August 2017)

6.12. FDEP Quality Manual

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APPENDIX OF CHANGES

04/01/2010 Added text related to quality system matrices

02/14/2012 Revised the criteria used for on-going or continuing demostrations of capability in section 2.4.

10/05/2012 Revised the criteria used for on-going or continuing demostrations of capability in section 2.4. Added section 6 for references.

11/29/2016 The SOP was checked for 508 compliance.

11/21/2018 The SOP was updated to comply with the 2016 TNI Standard.

12/10/2021 IDOC and CDOC requirements for microbiology and chlorophyll were added to section 2.0.

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