Department of Defense Quality System Requirements for Advanced Geophysical Classification (DoD QSR)

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Department of Defense Quality System Requirements for Advanced Geophysical Classification

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DoD Requirements, Clarifications, and Guidance [Note: This DoD Quality Systems Requirements (QSR) document supplements, and is intended for use in conjunction with, the International Standardization Organization/International Electrotechnical Commission (ISO/IEC) Standard 17025:2017, "General requirements for the competence of testing and calibration laboratories". Users should refer to the ISO standard for those sections not specifically populated in this supplement.]

1. SCOPE

2. NORMATIVE REFERENCES

3. TERMS AND DEFINITIONS

Clarifications: Additional abbreviations and acronyms used in this standard:

- AB: Accreditation Body
- AGC: Advanced Geophysical Classification
- ASTM: American Society for Testing and Materials
- CA: Corrective action
- CAP: Corrective Action Plan
- cm: centimeter
- DAGCAP: Department of Defense Advanced Geophysical Classification Accreditation Program
- DENIX: DoD Environment, Safety & Occupational Health Network and Information Exchange
- DFW: Definable feature of work
- DOC: Demonstration of capability
- DoD: Department of Defense
- DQO: Data quality objective
- DUA: Data usability assessment
- EDQW-MR: Environmental Data Quality Workgroup Munitions Response Subgroup
- EMI: Electromagnetic Induction
- ESTCP: Environmental Security Technology Certification Program
- GCO: Geophysical classification organization
- GPS: Global positioning system
- GSV: Geophysical Systems Verification
- HDF: Hierarchical Data Format
- ISO: Industry standard object
- ISO/IEC: International Organization for Standardization/International Electrotechnical Commission
- IVS: Instrument verification strip
- MR: Munitions Response
- MR-QAPP: Munitions Response – Quality Assurance Project Plan
- POC: Point of contact
- QA: Quality assurance
- QAM: Quality Assurance Manager
- QAPP: Quality Assurance Project Plan
- QC: Quality control
- RCA: Root cause analysis
- SI: International System of Units
- SLAM: Simultaneous Location and Mapping
- SOP: Standard Operating Procedure
- SNR: Signal to noise ratio
- TOI: Target of Interest

Clarifications: Additional terms used in this standard:

- Accreditation Body (AB): Authoritative body that performs accreditation.
- Advanced geophysical classification (AGC): The use of data from a geophysical sensor system consisting of multi-axis, multi-coil electromagnetic induction (EMI) sensors and methodologies that have been validated by the DoD Advanced Geophysical Classification Accreditation Program (DAGCAP) to make a decision about the likely source of a signal; specifically, to determine whether the source is potentially a hazardous munition that shall be removed or other non-hazardous item(s) that can be left in the ground. AGC requires three essential components: 1) a geophysical sensor system, 2) a model to estimate intrinsic properties of a buried item based on its EMI fingerprint, and 3) classification algorithms to assign likelihood that the buried item is a target of interest.
- AGC Method: The AGC method includes a combination of specific hardware and software. For the purposes of accreditation, scopes of accreditation will list the mode(s) of the hardware utilized (one-pass AGC or two-pass [dynamic detection followed by cued AGC]) and the AGC software used to process the data.
- AGC Software: Software used to process dynamic detection, dynamic AGC, and/or cued AGC data collected with validated AGC hardware for the purpose of performing target selection, inversions and/or classifying sources as either targets of interest (TOI) or non-TOI.
- Classification validation: A qualitative assessment of the EMI fingerprints predicted from geophysical inversions used to evaluate overall investigation performance. This is achieved by making one or more predictions about the size or general shape of selected non-TOI items, followed by excavation of the items and comparison of actual intrinsic characteristics to predicted characteristics. It may also include a comparison of actual to predicted extrinsic properties such as location and depth of the item.
- Customer: The customer is the DoD client.
- Data Quality Objectives (DQOs): Qualitative and quantitative statements of the overall level of uncertainty that a decision-maker will accept in results or decisions based on environmental data. They provide the statistical framework for planning and managing environmental data operations consistent with the user's needs.
- DoD (or Government) Quality Assurance Manager (QAM): The DoD representative providing quality assurance oversight throughout the life cycle of a munitions response project.
- EMI fingerprint: A set of three magnetic polarizabilities which express how an object responds following electromagnetic excitation along each of its three principal axis directions. These intrinsic properties of the object are determined by geophysical inversion of multi-axis EMI sensor data.
- Geophysical inversion: A process that uses geophysical data and a physics-based model to iteratively estimate intrinsic properties of a buried item.
- Industry standard object (ISO): An object, constructed from steel pipe manufactured to American Society for Testing and Materials (ASTM) specifications, used as a munitions surrogate for the purpose of quality assurance or quality control. More information is available in the Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Response document found on the SERDP-ESTCP

webpage.

- Instrument verification strip (IVS): A constructed series of buried inert munitions or industry standard objects used to verify proper functioning of the geophysical and geodetic
sensors.
- Management system (quality system): The means by which an organization ensures the quality of the products or services it provides and includes a variety of management, technical, and administrative elements such as policies and objectives, procedures and practices, organizational authority, responsibilities, and accountability.
- Nonconformity: Deviation from a specification or standard.
- Non-standard method: Any method for performing AGC that does not use DAGCAP validated hardware and software; does not implement the software vendor's recommended methodology; does not meet the minimum validated instrument specifications; and/or are operated outside the hardware and/or software limitations.
- Polarizabilities: Three principal axis responses returned by the inversion process, which relate directly to the physical attributes of the object under investigation. Information inferred from the responses (*e.g.,* size, shape, aspect ratio and wall thickness) is the basis for classification decisions.
- Source selection (AGC): The process of using data from geophysical sensors (primarily EMI sensors) to determine the location and orientation (extrinsic properties) and size and wall thickness (intrinsic properties) of buried metal objects
(sources). Sources that are too small or thin-walled to be TOI can be eliminated from further consideration.
- Standard method: A method for performing advanced geophysical classification that uses DAGCAP validated hardware and software, uses the software vendor's recommended methodology, meets the minimum validated instrument specifications, and is performed within hardware and software limitations.
- Validation seed: Industry standard object or inert target of interest buried at a recorded location, depth, and general declination and orientation, by, or on behalf of, the government, which is used to evaluate overall contractor performance on advanced geophysical classification. The identity, location, and depth, declination, and orientation of the seed item are blind to the contractor.

3.1 Impartiality

3.2 Complaint

3.3 Interlaboratory comparison

3.4 Intralaboratory comparison

3.5 Proficiency testing

3.6 Laboratory

Clarification: For the purposes of this standard, the term "laboratory" refers to the organization (*i.e.,* the geophysical classification organization (GCO)) performing AGC.

3.7 Decision rule
3.8 Verification
3.9 Validation
4. GENERAL REQUIREMENTS
4.1 Impartiality
4.1.1
4.1.2
4.1.3
4.1.4
4.1.5
4.2 Confidentiality
4.2.1
4.2.2
4.2.3
4.2.4
5. STRUCTURAL REQUIREMENTS
5.1
5.2 Requirement: The GCO shall identify the following management personnel, however named: • Corporate Manager: *i.e.,* the person having 1) overall responsibility and accountability for conforming with these requirements and 2) authority to commit resources on behalf of the GCO. • Technical Manager: *i.e.,* the person responsible and accountable for managing all technical operations of the GCO. • Quality Assurance Manager: *i.e.,* the person responsible for monitoring and implementing the GCO's management system. • Project Geophysicist: *i.e.,* the person responsible and accountable for implementing and overseeing project-specific technical operations for a specific client and contract • Quality Control (QC) Geophysicist: *i.e.,* the person responsible and accountable for implementing and overseeing project-specific quality systems at a given Munitions Response Site. The GCO shall maintain current job descriptions defining roles and responsibilities for management personnel. When the GCO does not have staff to fill each of these roles, they must notify their AB within 7 days of their plan to rectify the situation to maintain their accreditation. The GCO will also notify the AB when they have rectified the situation. With appropriate training and

qualifications, personnel may fill more than one role; however, if management personnel have technical responsibilities, they may not perform QC or quality assurance (QA) oversight of their own work.
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b) <u>Requirement:</u> The GCO shall identify personnel responsible for the following: • Reviewing and responding to all requests, tenders, and contracts • Ensuring all personnel (internal and external) are appropriately qualified and trained before performing any work under the scope of their accreditation(s) • Participating in project-planning activities, *i.e.,* the development of DQOs • Reviewing and agreeing to implement project-specific Munitions Response (MR)-Quality Assurance Project Plans (QAPPs) • Reviewing and approving all GCO-supplied standard operating procedures (SOPs) • Verifying the selection of appropriately qualified external personnel • Verifying the selection of appropriate technology • Performing data review • Performing project-specific oversight • Notifying the DoD client of all non-conformances • Developing corrective action (CA) plans • Implementing and monitoring CA • Reporting inappropriate practices to the AB
c)
5.6
a)
b)
c)
d)
e)
5.7
a)
b)
6. RESOURCE REQUIREMENTS

6.1 General

6.2 Personnel

6.2.1 Requirement: All personnel shall be trained in accordance with this standard and all personnel performing testing or data analysis shall complete internal demonstration of capability (DOC). External personnel may be a consultant that performs a specific role (*e.g.,* Field Personnel) or a subcontracted GCO that performs a definable feature of work (DFW, *e.g.,* AGC data processing). If the GCO uses consultants as either temporary or permanent extensions of its own staff, consultants shall operate under the GCO's management system. The GCO shall maintain records documenting the training and competency, including internal DOC, for all consultants, and these records shall be available for review and provided to assessors upon request. The DoD customer shall provide written approval for the use of external personnel (prior to field work).

6.2.2 Requirement: The GCO shall identify essential personnel, which includes any person whose absence or departure could influence the results of advanced geophysical classification and the GCO's ability to comply with these requirements. In addition to documenting competence requirements, the GCO shall describe the unique capabilities for essential personnel and the specific activities for which they are responsible. The GCO shall notify the AB of any changes in essential personnel.

6.2.3 Requirement: The GCO shall have a training plan with procedures that address both ISO/IEC 17025 and the supplemental DoD management system requirements contained in this document, including prohibited practices identified in Appendix C.

The GCO shall have SOPs for conducting individual (internal) DOC. [Note: The internal DOC is not the same as the corporate DOC that shall be performed as part of the accreditation process.] Internal DOC shall be performed under direct supervision by personnel who have successfully performed an internal DOC for the same activity. SOPs shall describe the circumstances under which the internal DOC shall be repeated. All internal DOC, whether successful or unsuccessful, shall be documented.

For Field Personnel, the internal DOC shall demonstrate the following minimum skills:

- Instrument assembly and operation
- Continuous operation within specifications
- Dynamic detection and one-pass classification operation
- Cued operation

For personnel performing data processing and analysis, the internal DOC shall demonstrate the following minimum skills for the version of validated software that is used:

- Quality control checks of field data (unknown targets and background)
- Background correction
- Target selection (dynamic detection and one-pass classification surveys only)
- Parameter extraction
- Appropriate use of parameters
- Classification

The internal DOC for the Project Geophysicist shall demonstrate all the above. In addition, the Project Geophysicist shall have documented experience in the following:

- Geophysical survey design and management

• Data usability assessment (DUA) The internal DOC for the QC Geophysicist shall demonstrate the following minimum skills: • Design and placement of the Instrument Verification Strip (IVS) and QC seeds • Data processing and analysis for the version of the validated software that is used • Data validation and verification • Approving corrective action <u>Requirement:</u> The effectiveness of training actions shall be documented prior to authorizing personnel to perform testing. Personnel, including the QC Geophysicist, shall demonstrate their competence for each type of equipment and software used that affects the data quality under their scope(s) of accreditation and the GCO shall document their personnel's competence. The GCO's training shall define the basis upon which their personnel need to re-perform an internal DOC, how personnel will demonstrate competency on hardware and software prior to executing work on a project, and how they will ensure their personnel are competent with new versions of software. The GCO's training plan shall also define procedures for how information is transferred to the GCO from other entities (*e.g.,* company performing data processing) so that results may be verified. The GCO responsible for assessing intrusive investigation results shall have procedures detailing how they will communicate the intrusive investigation requirements to dig teams and for receiving and performing QC of results. The Project Geophysicist shall sign training records documenting satisfactory completion of the internal DOC by Field Personnel and personnel performing data processing and analysis. The Technical Manager shall sign records documenting satisfactory completion of the internal DOC by the Project Geophysicist(s). Electronic signatures are acceptable.
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c)
d)
e)
f)
6.2.6
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b)
c)
6.3 Facilities and Environmental Conditions
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6.3.2
6.3.3 <u>Requirement:</u> Procedures for monitoring environmental conditions shall require that a

qualitative assessment of moisture and any potential sources of interferences (*e.g.,* geologic noise, power lines, electrical fences, etc.) be recorded in the field notes, whether electronic or hard copy.

Guidance: Examples of environmental conditions that may influence the validity of test results include the following:

- Rapid (over the course of an hour) changes in soil moisture levels. This could result from heavy rains or thunderstorms, or heavy dew that dries up during the first hour of testing. Depending on the magnitude of the change, it could make the background variation too severe to compensate for.
- Interferences from overhead high-voltage lines. To assess this interference in cued data, two background measurements should be collected closely in time.
- Interference from intermittent radar sources or other high-power microwave sources (this would most likely occur at or near airports or other similar sites).

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6.4 Equipment

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6.4.3

6.4.4 Requirement: The DoD Environment, Safety & Occupational Health Network and Information Exchange (DENIX) website provides the minimum required equipment-specific inspection, maintenance, and QC checks. The GCO shall maintain SOPs that include the minimum QC requirements contained on the DENIX website as well as any contract-specific requirements.

6.4.5 Requirement: Equipment shall record data in or write data from the data acquisition software in the Hierarchical Data Format (HDF5) v1.0 or later format and be validated by the DoD Environmental Data Quality Workgroup Munitions Response Subgroup (EDQW-MR).

6.4.6 Clarification: GCOs do not perform calibration activities in the course of performing AGC.

6.4.7

6.4.8

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6.4.10 Requirement: The DENIX website describes minimum required intermediate checks to ensure that equipment remains in proper working order. These include the ongoing function tests and ongoing operation at the IVS. For function tests, the QC Geophysicist shall verify that the appropriate reference file is used.

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6.5 Metrological Traceability
6.5.1
6.5.2
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b)
c)
6.5.3 Clarification: Traceability of measurements to the International System of Units (SI) is not possible or relevant. Traceability in measurements is achieved through the use of the DoD TOI Library and serially numbered objects provided with the advanced geophysical sensors. Requirement: The GCO shall use the DoD TOI Library as the source of polarizabilities for all munitions included in the DoD TOI Library. For munitions, or other components that present an explosive hazard, not included in the DoD TOI, the GCO shall have procedures to define how they will make classification decisions relative to those IOC.
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b)
6.6 Externally Provided Products and Services
6.6.1
a)
b)
c)
6.6.2
a) Guidance: Examples of externally provided products that affect the quality of tests include QC seeds (*e.g.,* ISO and inert munitions) and equipment (*e.g.,* geophysical sensors and

global positioning systems), whether purchased or rented. Examples of externally provided services include subcontracted AGC, consultants, licensed surveyors, and intrusive investigation teams.
b)
c)
d)
6.6.3
a)
b)
c)
d)
7. PROCESS REQUIREMENTS
7.1 Review of Requests, Tenders and Contracts
7.1.1 Requirement: Either the Project Geophysicist or the QC Geophysicist shall participate in this review. Within 7 calendar days of contract or task order award, the GCO shall notify the AB and the chair of the EDQW-MR in accordance with the procedures in Appendix A.
a)
b)
c) Requirement: In cases where more than one accredited GCO provides services in support of a specific project (*i.e.,* specific client and contract), the contract and project-specific QAPP shall document each GCO's responsibilities for each DFW. If the Lead GCO chooses to subcontract any part of AGC data collection or processing, then either 1) the Lead GCO shall be accredited in the AGC method used including having specific procedures for receiving data from the subcontractor, procedures for data collection in the method used, procedures for review and approval of the subcontracted GCO's data processing procedures specific to the classification software being used, procedures describing the QC to be performed internally by the subcontractor, procedures for verification by the QC Geophysicist of the processed data supplied by the subcontracted GCO performed in a validated classification software, and have procedures for transferring data to the client; or 2) the contract and project-specific QAPP shall define the subcontracted GCO's accredited management system as the one under which the subcontracted work shall be performed including the role of QC Geophysicist. Option 2 allows for multiple management systems on specific projects for different DFWs (*e.g.,* data collection may be under one management system and data processing may be under a second management system).
d)
7.1.2
7.1.3 Clarification: The classification decision of TOI vs. non-TOI is considered a statement of conformity. Inconclusive or cannot analyze targets shall be addressed in the decision rules agreed to with the DoD customer.

7.1.4
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7.1.6
7.1.7
7.1.8
7.2 Selection, Verification and Validation of Methods GCOs shall have SOPs for and must be accredited for the AGC method used. Accreditation for each method will require the following: • The GCO shall perform a corporate DOC for all AGC software listed on their scope of accreditation. Each DOC will specify the AGC method used. (*e.g.,* software A, two-pass AGC) • The GCO shall have SOPs for each hardware used that is covered under their scope(s) of accreditation. The GCO shall perform a corporate demonstration of capability for one-pass classification and dynamic detection and cued classification (*i.e.,* two-pass AGC) and for all AGC software listed on their scope of accreditation. A list of validated hardware and software is available for reference on the DENIX DAGCAP webpage. Note that GCOs are only required to perform the corporate DOC for methods and software for which they seek accreditation and that accreditation for all methods and software is not required.
7.2.1 Selection and Verification of Methods
7.2.1.1
7.2.1.2 Requirement: The GCO shall maintain SOPs that include the minimum QC requirements contained on the DENIX website as well as any contract-specific requirements. (Project-specific amendments to SOPs are permitted, with justification, based on project-specific DQOs.) Any instructions provided by the manufacturer shall be attached to SOPs and made available as noted above. SOPs shall be made available to personnel at all times, at all sites where they are used. Requirement: Technical SOPs shall be provided to the DoD customer upon request, to be included in the project-specific QAPP.
7.2.1.3
7.2.1.4 Requirement: Standard and non-standard methods are defined in Section 3.
7.2.1.5
7.2.1.6
7.2.1.7
7.2.2 Validation of Methods
7.2.2.1 Requirement: When methods referred to in this paragraph are used on a project-specific basis, both the corporate QAM and DoD Customer shall provide written approval before the procedure is considered validated for the project. When methods referred to in this paragraph are intended to be used on a DoD-wide basis, both the corporate QAM and the EDQW-MR shall provide written approval before the procedure is

considered validated. The GCO shall maintain a record of non-standard methods, projects on which they were used, the GCO member who verified the process, and the Corporate QAM, DoD Customer, and EDQW-MR person, if applicable, who approved the process.
7.2.2.2
7.2.2.3
7.2.2.4
a)
b)
c)
d)
e)
7.3 Sampling
7.3.1 Clarification: The selection of non-TOI used in classification validation is considered to be a sampling activity.
7.3.2
a)
b)
c) Clarification: For the purposes of AGC accreditation, this section is not applicable.
7.3.3
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b)
c)
d)
e)
f)
g)
h)
7.4 Handling of Test or Calibration Items Clarification: For the purposes of AGC accreditation, this section is not applicable.
7.4.1
7.4.2
7.4.3
7.4.4

7.5 Technical Records
7.5.1
7.5.2
7.6 Evaluation of Measurement Uncertainty
7.6.1 Guidance: Appendix D: Factors Affecting Measurement Uncertainty provides guidance on potential sources of measurement uncertainty.
7.6.2
7.6.3
7.7 Ensuring the Validity of Results
7.7.1 Requirement: The organization shall monitor its ongoing performance on quality control procedures for the purpose of identifying trends in performance so that preventive actions can be taken where practicable. At a minimum, GCOs shall monitor ongoing performance on the IVS, QC seeds, and validation seeds. Guidance: The regular and routine analysis of quality control data can often permit trends to be spotted before a nonconformity occurs. There are several tools available for analyzing quality control data including check sheets, control charts, and histograms. The American Society for Quality provides information and links to resources addressing the analysis of quality control data on its webpage.
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c)
d)
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i)
j)
k)
7.7.2
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b)
7.7.3 Requirement: The DENIX website provides minimum required QC procedures, data quality acceptance criteria, and corrective action processes.
7.8 Reporting of Results

7.8.1 General
7.8.1.1 Requirement: The organization shall have SOPs that describe responsibilities and procedures for performing internal data review before data are transmitted to the client. Personnel performing internal data review shall be independent of the activity generating the data. The SOP shall describe who performs internal review, how it is performed, and how it is documented.
7.8.1.2
7.8.1.3
7.8.2 Common Requirements for Reports (Test, Calibration or Sampling)
7.8.2.1 Requirement: The organization shall have an SOP for determining and specifying the format and contents of all test reports including databases and electronic deliverables. The MR-QAPP Toolkit Modules 1 and 2 provide the minimum requirements for test reports. Requirement: Project-specific reporting requirements will be specified in contract documents and the project-specific QAPP.
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c)
d)
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g)
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i)
j)
k)
l)
m)
n)
o)
p)
7.8.2.2
7.8.3 Specific Requirements for Test Reports
7.8.3.1
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b)
c) Clarification: [As noted in QSR Section 7.6.3, Appendix D provides guidance on factors affecting measurement uncertainty.]
d)
e) Requirement: The Project Geophysicist, in accordance with an established procedure, shall make a qualitative evaluation of the match between the predicted and actual properties of every item that is excavated, and the QC Geophysicist shall verify the qualitative evaluation through QC checks. This comparison and verification of results shall be reported.
7.8.3.2
7.8.4 Specific Requirements for Calibration Certificates
7.8.4.1
a)
b)
c)
d)
e)
f)
7.8.4.2
7.8.4.3
7.8.5 Reporting Sampling – Specific Requirements
a)
b)
c)
d)
e)
f)
7.8.6 Reporting Statements of Conformity
7.8.6.1 Clarification: The prioritized dig list is a statement of conformity regarding the TOI vs. non-TOI decision.
7.8.6.2
a)
b)
c)

7.8.7 Reporting Opinions and Interpretations
7.8.7.1
7.8.7.2
7.8.7.3
7.8.8 Amendments to Reports
7.8.8.1
7.8.8.2
7.8.8.3
7.9 Complaints
7.9.1
7.9.2
7.9.3
a)
b)
c)
7.9.4
7.9.5
7.9.6
7.9.7
7.10 Nonconforming Work GCOs will perform root cause analysis (RCA) for all non-conforming procedures and required specifications per Section 8.7 of ISO 17025. The RCA will include an evaluation of the impacts of the root causes on other projects. For non-conformances where the root cause may impact other projects (both current and completed), the GCO(s) whose scope(s) of accreditation is impacted by the non-conformance will notify their AB, the chair of the EDQW-MR, and DoD customers for all potentially impacted projects. If the RCA identifies that the root cause is a result of a subcontracted GCO's work, the subcontracted GCO will also notify their AB, EDQW-MR, and the DoD customers for all applicable projects.
7.10.1
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b) Requirement: The DENIX website includes minimum required specifications, criteria, and procedures for controlling non-conforming work.
c)
d)
e) Requirement: Any nonconforming work that impacts the quality of the AGC process, other than a missed validation seed, shall be reported by the GCO to the DoD customer within 7

calendar days. [See Appendix B: Requirements for Monitoring and Reporting Ongoing Performance on Validation Seeds]. The GCO shall notify the DoD customer, EDQW-MR, and the AB within 7 calendar days if it discovers that any inappropriate practice(s) have taken place. [See Appendix C: Prohibited Practices.] Clarification: Either the DoD customer or the GCO may determine when it is necessary to recall work.
f)
7.10.2
7.10.3
7.11 Control of Data and Information Management
7.11.1
7.11.2 Clarification: All AGC software must be validated. A list of validated software is available for reference on the DENIX DAGCAP webpage.
7.11.3
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b)
c)
d)
e)
7.11.4
7.11.5
7.11.6 Requirement: Formulas (*e.g.,* those used in spreadsheets developed and used by GCOs) require validation.
8. MANAGEMENT REQUIREMENTS
8.1 Options
8.1.1 General Requirement: For the purpose of DAGCAP, the management system shall meet all requirements of option A.
8.1.2 Option A
8.1.3 Option B
8.2 Management System Documentation
8.2.1 Clarification: The GCO (if part of a parent organization) is permitted to have its own management system as long as roles and responsibilities for management personnel in the parent organization are included.
8.2.2 Requirement: If management personnel have technical responsibilities, they may not

perform quality control or quality assurance oversight of their own work.
8.2.3
8.2.4
8.2.5
8.3 Control of Management System Documents
8.3.1
8.3.2
a) Requirement: the corporate QAM and the Technical Manager shall approve all technical SOPs prior to issue.
b) Requirement: Technical SOPs shall be reviewed at least every year. All other management system documents shall be reviewed at least every two years.
c) Requirement: Pen and ink amendments to documents that form part of the management system are not permitted. (As noted in ISO/IEC 17025 Section 8.3.1, these documents include regulations, standards, other normative documents, test methods, drawings, software, specifications, instructions and manuals.) Any amendments to management system documents shall be issued in the form of a written notice signed by the QAM and showing the date of issuance and the effective date of the amendment. Electronic signatures are acceptable. Project-specific (one-time) amendments to management system documents (*e.g.,* technical SOPs) shall also provide justification for the amendment. The corporate QAM shall notify all affected personnel of amendments to quality system documents.
d) Requirement: Management system documents describing detailed procedures for performing work in the field (*e.g.,* technical SOPs) shall be available to all personnel performing work in the field. The use of electronic copies of SOPs is permitted.
e)
f)
8.4 Control of Records
8.4.1 Clarification: Technical records include hard-copy and electronic documentation of work as it is performed (*e.g.,* raw data and results) and reports.
8.4.2 Requirement: Organizations shall retain all quality and technical records for a minimum of five years.
8.5 Actions to Address Risks and Opportunities
8.5.1 Guidance: As specified in 7.8.3.1 (e), the Project Geophysicist shall make a qualitative evaluation of the match between predicted and actual properties of every item that is excavated, and the QC Geophysicist shall verify the qualitative evaluation. Monitoring the GCOs ongoing performance on its ability to predict the properties of excavated items can be an important part of addressing risks and opportunities.
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b)
c)
d)
8.5.2
a)
b)
8.5.3
8.6 Improvement
8.6.1
8.6.2
8.7 Corrective Actions
8.7.1
a)
b)
c)
d)
e)
f)
8.7.2
8.7.3
a)
b)
8.8 Internal Audits
8.8.1 Clarification: Internal audits and management reviews are separate activities. Requirements: Internal audits shall be performed by, or under the direction of, the corporate QAM. Internal audits shall be performed at least once every two years and include on-site audits of technical activities. Internal audits may be conducted in phases.
a)
b)
c)
d)
e)
8.9 Management Review

8.9.1 Requirement: Management reviews shall be conducted at least once every year. Management reviews shall include evaluation of ongoing performance on validation seeds. Management reviews may be conducted in phases. Requirement: Appendix B provides requirements for monitoring and reporting performance validation seeds.
8.9.2
a)
b)
c)
d)
e)
f)
g)
h)
i)
j)
k)
l)
m)
n)
o)
8.9.3
a)
b)
c)
d)

Appendix A: Project Notification Requirements

1) GCO receives award or task order and notifies AB and the chair of the EDQW-MR within 7 days of award of upcoming project. Notification will include the below information:
    a. Site name
    b. Approximate start date for fieldwork
    c. Client name and Point of Contact (POC) information (name, e-mail, phone)
2) When the project-specific MR-QAPP is finalized, the GCO shall provide it to the EDQW-MR.
3) Field variances or changes to the QAPP made during project execution that are related to non-conformances shall be provided to the EDQW-MR.
4) At the end of project, the GCO notifies the AB and EDQW-MR that all work is complete. The GCO will deliver to the AB and EDQW-MR:
    a. The Final DUA
    b. All RCAs/CAs associated with the work performed under the scope of accreditation
    c. A database of QC seed failures
    d. A database of validation seed failures
5) EDQW will provide the ABs and GCOs with all current POCs for EDQW-MR.

Appendix B: Requirements for Monitoring and Reporting Ongoing Performance on Validation Seeds

1. When the GCO is awarded a task order or contract, they will notify their AB and EDQW-MR using the procedures outlined in Appendix A.
2. GCO delivers work products for each phase (*e.g.,* detection, classification, single-pass, intrusive investigation) as outlined in the Project QAPP to DoD customer.
3. The DoD customer reports validation seed failures to the GCO after attempting to confirm that the error is not due to a government error. If the failure resulted from a government error, the validation seed is thrown out and there is no stop-work.
4. GCO reports validation seed failures to AB and EDQW-MR within 5 business day of receiving notification from the DoD customer.
5. For failures to detect, classify, or recover validation seeds within project QAPP specifications that are not due to government error, the GCO shall issue a project-wide QA stand down immediately for the work affected under their scope of accreditation upon being notified by their DoD customer. Immediately upon issuing the project-wide QA stand down for activities covered under the scope of accreditation impacted by the failure, the GCO shall use the following procedures to resume work after the QA stand down has been issued:
    a. The GCO performs RCA and develops a CA Plan (CAP) that must be submitted to the DoD customer, AB and EDQW-MR.
        - The RCA must determine if the issue extends to other projects where the affected scope of accreditation was used and/or to their scope(s) of accreditation. If the RCA reveals the root cause extends to other projects (complete or ongoing and/or their other scope(s)s of accreditation), then the GCO shall notify the EDQW-MR, the AB, and all affected or potentially affected DoD customers having projects or work products that may be subject to the CA. If the RCA results in revised SOPs, those will be submitted to the AB and EDQW-MR for concurrent review. If the RCA determines that the validation seed failure was due to a previously unknown government error, then the validation seed is thrown out and the stop-work will be lifted by the DoD customer.
        - Upon EDQW-MR concurrence with the RCA and CAP, the EDQW-MR will inform the DoD customer, AB, and GCO of its approval.
        - Upon DoD Customer approval of and EDQW-MR concurrence with the CAP,
            - The DoD customer shall notify the GCO that the stand down is lifted, and
            - The revised work processes shall be immediately implemented on all affected project activities under the scope of the accreditation.
        - The GCO will notify the AB and EDQW-MR work has resumed and provide final documentation.
6. AB tracks and maintains a database of validation seed failures for each GCO.

Appendix C: Prohibited Practices

The following is a list of practices that are inappropriate for the collection of environmental data and are therefore prohibited. Inappropriate practices are deliberate activities undertaken with the objective of misrepresenting data, *i.e.,* making it appear that all required specifications were followed or acceptance criteria achieved, when they were not. The major bullets identify categories of inappropriate practices. Sub-bullets provide examples.

- Fabrication, falsification, or misrepresentation of data.
    - Creating data for a field measurement that was not performed.
    - Using data from one field measurement to represent a measurement at another location (*e.g.,* changing the measurement location coordinates of one data file to represent a measurement at another location).
    - Altering or deleting original (*i.e.,* raw) field measurement data (*i.e.,* the measured transients, also known as receiver decays) in any way.
    - Changing the time stamp of a field measurement in either the field data file or subsequent processing data file(s) or database(s).
    - Altering, changing or deleting the output of an inversion process or inversion routine (*i.e.,* the betas or polarizabilities reported from the inversion process).
    - Renaming a data file.
    - Altering a file's creation date or a file's modification date.
- Improper clock setting or improper date and time recording.
    - Resetting the internal clock on an instrument or computer to make it appear that field measurements were taken within some given background measurement interval other than the true interval, or to make it appear that background measurements were taken at intervals other than those actually performed.
    - Changing the actual time or recording a false time to make it appear that a field measurement was taken at some time other that the true time it was taken.
- Altering library data or library information.
    - Altering in any manner the library signature (also known as betas or polarizabilities), the library transients (also known as receiver decays), or metadata of a Government-furnished library signature.
- Unwarranted manipulation of analyses, software, or firmware
    - Changing or altering the measurement instrument's operating or recording parameters without documenting the reasons for doing so in accordance with SOPs.
    - Changing or altering the inversion software in any manner without following the SOP for doing so.
    - Using inversion software or an inversion routine that has not been accepted by the Government in accordance with Sections 7.2.1.4 and 7.2.2.1 of this standard.

    - Changing or altering the inversion parameters without documenting the change following the standard operating procedure (SOP) for doing so.
    - Turning off, or otherwise disabling or manipulating, electronic or software-controlled audit or tracking functions.
- Misrepresenting or misreporting QC information
    - Substituting previous IVS results for non-compliant IVS results.
    - Repeating a QC task multiple times until a specification is met (*i.e.,* intentionally replacing non-compliant QC results with compliant QC results) without performing required corrective action.
    - Deleting or failing to record non-compliant QC data for any reason.
    - Tampering with QC data or QC results to make it appear they are compliant with project specifications.
- Misrepresenting or overstating personnel competencies or personnel experience or expertise.
    - Misrepresenting, overstating, or falsifying training records.
    - Misrepresenting, overstating, or falsifying work experience.
    - Misrepresenting, overstating, or falsifying education credentials.
- Concealing a known measurement or analysis problem.
- Concealing a known improper or unethical behavior or action.
- Failing to report the occurrence of a prohibited practice or known improper or unethical act to the appropriate contractor representative or to an appropriate government official.
- Sharing blind seed information in violation of the firewall.

Appendix D: Factors Affecting Measurement Uncertainty

[Note: This appendix provides guidance for implementing ISO/IEC 17025, Section 7.6.1. It discusses examples of factors affecting measurement uncertainty, but it is not an exhaustive list.]

The primary decision in AGC is the decision to dig, or not dig, a detected item. Because of this, the uncertainties of most concern are uncertainties in the estimated polarizabilities for the unknown item which are the basis for the decision. Of lesser concern are uncertainties in positioning which impact the time required for excavation and the likelihood of recovering the correct item.

Recovered Polarizabilities: Analyses starting with a high signal-to-noise measurement routinely yield precise polarizabilities. As the signal-to-noise ratio degrades, the uncertainties in the recovered polarizabilities increase until the results are too poor to use as inputs to classification. The two contributors to low signal-to-noise ratio are incorrect background subtraction (for both dynamic one-pass and cued data) and weak or contaminated signal from the unknown item, as discussed below.

Background Uncertainties: For large targets with high amplitude signals, minor variations in background are negligible. For the smallest targets of interest at their deepest depths of concern however, signal amplitudes are low and minor variations in background result in large variation in the input to the geophysical inversion routine that is used to estimate polarizabilities. Common causes of background variation in decreasing importance include:

- short spatial scale variability in the soil response such that a nearby background measurement or leveling for one-pass data is not representative of the soil response at the site of the unknown measurement.
- the presence of small pieces of metal at the site of the cued background measurement resulting in a background that is the sum of the soil response and the signal from the metal contamination.
- rapid change in soil conductivity due to moisture changes associated with dew burn off or a passing rainstorm.
- long spatial scale variability in soil response making a cued background or estimated one-pass background collected on one side of the field unsuitable for use correcting an unknown measurement on the other side of the field.

Weak or Contaminated Signal: Selecting anomalies too deeply into the noise in an attempt to stretch the detection depth of the instruments can lead to measured data with insufficient amplitude for analysis. Even for stronger signals, external noise sources such as nearby radars and transmission towers, high-power overhead transmission lines, and even faulty electric fences can add noise to the measurement and compromise the signal to noise ratio (SNR). Even those sources in very different frequency bands (radar and radio) can leak sufficient energy into the measurement band to impact the SNR.

The best diagnosis of uncertainty in recovered polarizabilities is to compare the results for the QC and validation seeds. If a large number of the seeds are identical items (ISOs for example) the measured variation in the recovered polarizabilities will be a direct measure of the uncertainties in polarizabilities.

Location Uncertainties: Sensor geolocation accuracy can be achieved with centimeter (cm)-level global positioning systems (GPS) in areas with good sky view, and cm-level simultaneous location and mapping (SLAM) positioning systems in GPS-compromised areas. This, coupled with an affordable orientation measurement, results in a location estimate uncertainty that is negligible for the purposes of classification. There is a continuing check of this result from comparison of the derived position of the

blind seeds against their known emplaced positions. For other positioning systems such as robotic total stations or that may be employed in GPS-compromised environments, the location uncertainties can be large (decimeters to meters) which can impact the ability of the intrusive team to efficiently return to the intended excavation target and even to the recovery of incorrect items. These uncertainties will have to be evaluated on a case-by-case basis depending on the particular conditions encountered at the site.

Target Merging Uncertainties: Merging of targets is commonly performed when targets are near each other. Merging targets using too large a radius may lead to dynamic and/or cued positioning measurement quality objective failures. The maximum target merge radius should be evaluated on a case-by-case basis and factor in the site-specific munitions, the geophysical sensor used, and the lane spacing used for that sensor.