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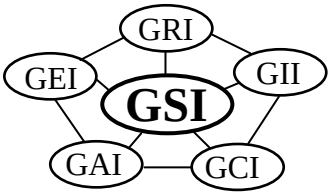

GRI White Paper #8

- on -

Construction Quality Assurance-Inspectors Certification Program (CQA-ICP)

by

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1.0 Definition of CQA (as opposed to CQC)

Construction quality assurance (CQA) and construction quality control (CQC) are widely recognized as critically important factors in overall quality management for waste containment facilities of all types. This includes geosynthetic materials as well as natural soil materials. The best of designs and regulatory requirements will not necessarily translate to facilities that are protective of human health and environment unless they are properly constructed. Additionally, for geosynthetics, both manufacturing quality assurance (MQA) and manufacturing quality control (MQC) are equally important. Geosynthetics refer to factory fabricated polymeric materials like geomembranes, geotextiles, geonets, geogrids, geosynthetic clay liners, etc. The natural soils involved are compacted clay liners and drainage soils of various types. In this context, the definitions of CQA as contrasted to CQC are as follows:

- Construction Quality Assurance (CQA): A planned system of activities that provides the owner and permitting agency assurance that the facility was constructed as specified in the design. Construction quality assurance includes inspectors, verifications, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. Construction quality assurance (CQA) refers to measures taken by the CQA organization to assess if the installer or contractor is in compliance with the plans and specifications for the project.
- Construction Quality Control (CQC): A planned system of inspections that is used to directly monitor and control the quality of a construction project. Construction quality control is normally performed by the geosynthetics installer, or for natural soil materials by the earthwork contractor, and is necessary to achieve quality in the constructed or installed system. Construction quality control (CQC) refers to measures taken by the installer or contractor to determine compliance with the requirements for materials and workmanship as stated in the plans and specifications for the project.

The certification program to be described herein focuses entirely on CQA. Two different programs are offered; one is focused on geosynthetic materials and the other on compacted clay liners. A candidate can take both programs if desired. A complimentary, but completely separate, program on CQC is available through the International Associate of Geosynthetic Installers (IAGI). Their Website is as follows: <<www.iagi.org>>.

The following flow chart describes the interactions of MQA/CQA and MQC/CQC as they apply to a particular project so as to produce an appropriate level of quality.

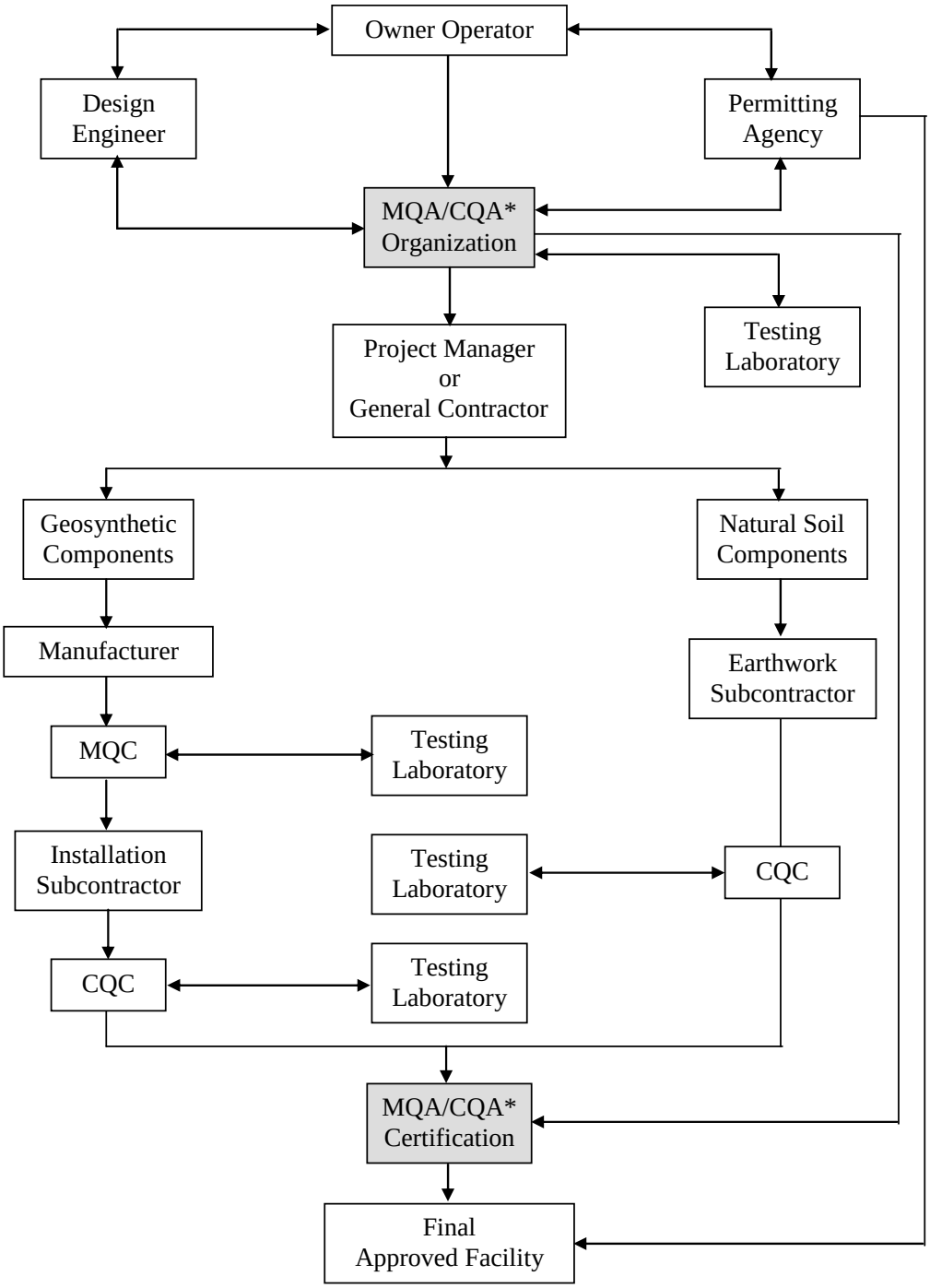

Figure 1 - Organizational Structure of Quality Control and Quality Assurance Activities

*Note that this certification program focuses on both geosynthetic and compacted clay liner construction quality assurance (CQA) and not directly on manufacturing quality assurance (MQA).

2.0 The Value of CQA

The electrical leak location survey (ELLS) method was developed in 1984 and was slow to initially be implemented but for the past 10-years provided a wealth of data on leaks of geomembranes placed in the field; both uncovered, and after soil covering. For uncovered geomembranes the water puddle technique (ASTM D6747 and D7002) is used and for soil covered geomembrane the dipole technique (ASTM D6747 and D7007) is used. The following photographs (compliments of A. Rollin) show each technique being used.

(a) Water Puddle Technique (b) Dipole Technique

Figure 2 - Electric Leak Location Survey Techniques

In a paper by Forget, Jacquelin and Rollin (2005) a comparison of exposed geomembrane leakage without CQA and with CQA has been generated. Figure 3 shows the incidence of holes for these two situations. The result is that an average of 22 leaks/ha (9.0 leaks/acre) occurred in 14 projects without CQA; whereas an average of 4 leaks/ha (1.6 leaks acre) occurred in 43 projects with CQA.

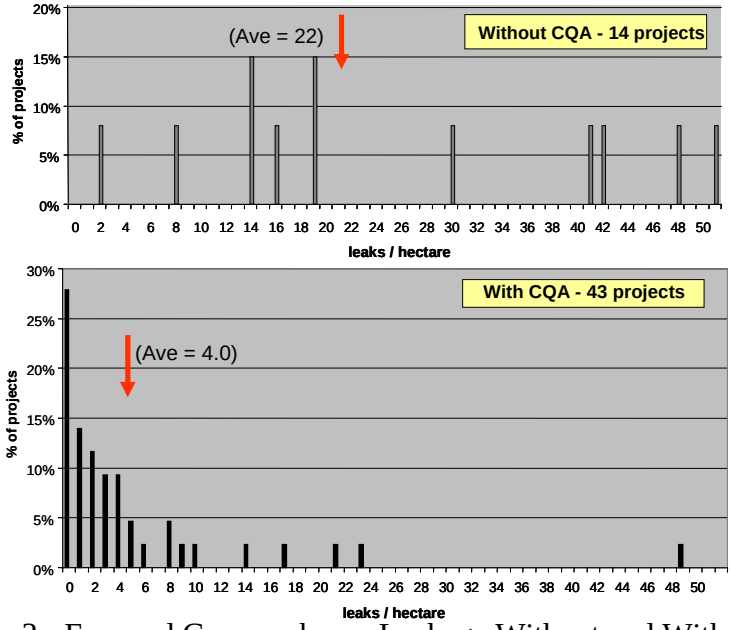

Figure 3 - Exposed Geomembrane Leakage Without and With CQA

The situation for covered geomembranes [usually with 300 mm (or 12. in.) of sand or gravel] is even more dramatic. The result from 42-projects is that an average of 16 leaks/ha (6.5 leaks/acre) occurred without CQA; whereas an average of only 0.5 leaks/ha (0.20 leaks/acre) occurred with CQA.

This reference, and others, indicate that there is a direct relationship between leak occurrence and the presence or absence of a credible CQA program. Of course, the tacit assumption is that a "credible" CQA program is being offered and it is this program being described that will hopefully fill this need.

3.0 Goal of the CQA-ICP

The goal of this program is to setup, administer, and maintain a credible CQA certification program for geosynthetic materials and compacted clay liners used in waste containment, and related applications.

4.0 Requirements of the CQA-ICP

1. Candidate must be recommended by a Professional Engineer who knows, and can attest to, at least six months of acceptable experience performing CQA activities with geosynthetic and/or compacted clay liner materials.
2. The candidate must successfully pass a written examination proctored by GCI or GCI designated organization and graded by the Geosynthetic Certification Institute.
3. The candidate or his/her firm must pay a one-time fee which covers a 5-year period upon completion of the above items. The fee is $400 for geosynthetics materials, or $400 for compacted clay liners. If the candidate desires to be certified in both geosynthetic materials and compacted clay liners the combined fee is $500 for 5-years of certification.

5.0 Sample Questions and Answers

GT-1 Geotextiles are usually joined in the field by:

A. Overlapping
B. Sewing
C. Heat bonding
D. All of the above
E. None of the above

GT-2 When installed on a slope, a geotextile should always be:

A. lapped with the upstream edge over the downstream edge
B. lapped with the downstream edge over the upstream edge
C. placed adjacent to each other with no overlap
D. overlapped six inches and sewn
E. be constructed so that no joints ever occur

GM-1 The primary reason extrusion fillet welding of polyolefin geomembranes requires surface grinding of the sheets is:

A. for convenience of the welders
B. the edges are usually too thick
C. for added material strength
D. to remove surface oxidation

GM-2 Why are trial test strips important in the installation of a geomembrane?

A. to satisfy regulations requirements
B. to test the seamer's abilities
C. to verify that the equipment is working properly and the workmanship is acceptable
D. to generate friction with the liner contractor

GCL-1 Adjacent rolls of GCLs are jointed by what method?

A. sewing
B. stapling
C. mechanical connection
D. welding
E. overlapping

GCL-2 When a GCL has a nonwoven needle punched geotextile on one surface and a woven slit film geotextile on the other surface:

A. placement of which surface is up does not matter
B. the nonwoven geotextile side should always be up
C. the woven geotextile side should always be up
D. the site-specific plans must provide guidance

CCL-1 The zero air voids curve is also known as:

A. maximum density curve
B. 100% saturation curve
C. 100% relative compaction curve
D. 95% relative compaction curve

CCL-2 Fines are defined as:

A. fraction of soil passing through the opening of a 100 sieve (150 μm)
B. fraction of soil passing though the openings of No. 200 sieve (75 μm)
C. loamy fraction of a soil
D. clay fraction of a soil
E. percent retained on a No. 200 (75 μm) sieve but passing a No. 140 sieve (106 μm)

6.0 General Comments

1. The geosynthetic materials examination consists of 140 multiple-choice questions; They are in the following seven categories; geosynthetics, geotextiles, geogrids, geonets, geomembranes, GCLs and geopipe. Geomembranes are emphasized. The test is to be completed in two hours.
2. The compacted clay liner examination consists of 30 multiple-choice questions to be completed in 60-minutes.
3. The passing grade is targeted at 70% for each exam. Questions will be changed periodically and selected from a large data bank of questions and answers.
4. Tests will be held at GSI in Folsom, Pennsylvania twice per year typically after CQA courses are given at the institute. The courses are optional. Tests can also be taken and proctored by companies giving such courses, or companies which have a sufficiently large number (typically greater than five applicants) taking the test at any one time. Test results will be sealed and sent to GCI for grading.
5. Certificates will be given to applicants which are successful in gaining CQA-ICP status.
6. A listing of successful candidates will be kept by GCI and a verification of those individual(s) who are GCI-ICP approved will be substantiated upon request.

7.0 Information

The Construction Quality Assurance-Inspectors Certification Program (CQA-ICP) is administered by the Geosynthetic Certification Institute which is a branch of the Geosynthetic Institute. It is located in Folsom, Pennsylvania about 3-miles from the Philadelphia International Airport. Drs. George R. Koerner (Director Designate of GSI) and Robert M. Koerner (Director of GSI) are the program's administrators.

Since the program began in January 2006, it is too early to present results or even feedback of the program to date. We will, however, be updating this White Paper on a periodic basis. For more information contact us at:

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