MDE Dam Safety Program

Recommended Scope of Work and Engineers Qualifications for Comprehensive Dam Safety Reviews (CDSR)

A. RECOMMENDED ENGINEER QUALIFICATIONS

The engineering firm should be chosen by qualifications based selection (QBS), or fee-based selection from a pre-qualified list of engineers rather than a low-bid selection criteria. It is important to develop a relationship with an engineer or engineering firm as the engineer may become the designated "Engineer-in-Charge" associated with a permit to repair or modify a dam should an outcome of the Dam Safety Review include such recommendations. The Maryland Department of the Environment, Dam Safety Division reserves the right to disallow an Engineer-in-Charge at any point in the permitting process if it becomes evident that the engineer does not possess sufficient experience in the design and construction of dams or appurtenant works.

The Engineer should meet the following minimum qualifications developed from national and state level guidance documents:

A. A licensed professional engineer in the State of Maryland;
B. Has knowledge of the rules and regulations governing dam design and construction in Maryland;
C. Has at least ten (10) years of relevant experience in areas such as investigation, design, construction, reconstruction, enlargement, repair, alteration, maintenance, operation, breach, removal or abandonment of dams. The engineer should demonstrate specific experience with dams of similar age, size, construction methods and hazard potential;
D. Has served as design engineer for at least three (3) significant rehabilitation projects at dams of similar age, size, construction methods and hazard potential within the past six (6) years.

E. Has performed dam safety inspections and risk characterization/prioritization studies in accordance with FERC Part 12D, USBR Safety Evaluation of Existing Dams (SEED) or other similar criteria.
F. Can assemble and supervise a team of qualified engineers, engineering geologists/geological engineers and other professionals required to address all of the disciplines necessary for the design and construction of a dam;
G. Uses current state of the practice methods and means to design dams with safety as the primary goal and complete engineering methodology that represents the professional level of care exercised by qualified engineers; and
H. Understands the effects of adverse dam incidents and failures and the potential cause of failures.

B.RECOMMENDED PROJECT SCOPE

Dam Safety Review – General Scope of Services

The dam safety inspection and dam repair recommendations should involve a systematic review and evaluation of all aspects of the design, construction, operation, maintenance, processes and systems affecting a dam's safety. The evaluation of the safety of the dam system for the dam safety review must use the current knowledge and standards for dam engineering. The engineer should carry out the dam safety review in sufficient detail that the conclusions reached and recommendations arising out of the dam safety review can be made with the necessary degree of confidence. The recommendations of the inspection report shall be detailed enough so that an engineer shall be able to utilize the inspection report as the basis for a Scope of Work to develop the necessary design report, calculations, plans and specifications to implement the required repairs to the dam.

Phase 1 – Review of Available Information and Data

- The project will commence with a start-up meeting to verify the scope of work and the roles and responsibilities of the owner and the engineer.
- The Engineer should review the available information and data, which may include but is not limited to:
    - Feasibility Reports
    - Design Reports
    - Design and/or As-built Drawings
    - Construction Records
    - Operation, Maintenance & Surveillance (OMS) Manual
    - Instrumentation records

    - Emergency Action Plans
    - Annual formal inspection reports
    - Hazards and Failure Modes Studies
    - Current outstanding dam safety issues
    - Previous maintenance projects
    - Resolved dam safety issues
    - Correspondence with regulatory agencies
    - Other available documents related to design, operation, maintenance, improvement, condition and performance of the dam or appurtenant works
- Review past reports and studies to ensure that all past recommendations and issues have been properly documented and addressed.
- Determine where the gaps in available information are. Prioritize the missing information and determine whether additional effort needs to be made to obtain some of the missing information.

Phase 2 – Field Investigation

- The Engineer shall carry out field inspection(s) of the dam, its appurtenances and portions of the areas both upstream and downstream of the dam to understand the condition of the dam and appurtenances, the spillway, the instrumentation, the reservoir environment, upstream hydrological impacts, and the development downstream of the dam. The field inspection should follow the general guidance contained in the United State Bureau of Reclamation (USBR) Safety Evaluation of Existing Dams (SEED) publication, or similar guidance documents from other dam safety entities. The inspection record should include completion of detailed notes with photographs, videos, sketches or other representations of observations. The field inspection may include aerial (drone) surveys, video inspections of confined spaces (e.g., spillways) and other appropriate methods to collect observation data. The field inspection should include, but is not limited to the assessing the condition of the following elements:
    - Upstream and downstream embankments
    - Crest
    - Weir
    - Conduits through the dam (spillway, internal drains, etc.)
    - Gates, valves and other electric/mechanical components)
    - Public Safety / Security
    - Abutments and toe area

- Outfalls
- Emergency spillway
- Inspection galleries
- Access road for repairs and emergencies.

- The Engineer shall interview the operating personnel who: conduct routine surveillance and inspections; read the instrumentation; test the outlet facilities, spillway gates and other mechanical components; and maintain the dam for further insight into:
  - Operating and maintenance issues or incidents
  - Staff conformance to procedures
  - Equipment or system issues
  - Dam performance
  - The general level of training and knowledge of the staff
  - Staff familiarity with the upstream watershed and downstream reach
  - Public safety issues
  - Other stakeholder issues

- Audit the documentation that should be at site (e.g., operation and maintenance records, permits, Emergency Action Plans, and perhaps others).
- Witness the testing of the spillway gates/valves or if the spillway equipment is routinely and regularly used, satisfy himself/herself that the equipment is in good working order.
- Identify and discuss with the dam owner any changes to the scope of the Dam Safety Review that need to be made as a result of this phase of work.

Phase 3 – Engineering Evaluation and Report

The Engineer shall include the following items at a minimum in their evaluation and report.

- Perform new hydrologic and hydraulic analyses, determine the adequacy of the spillway and freeboard for the design storm, perform a breach analysis, develop inundation maps and confirm hazard potential classification.
- Perform necessary analyses (e.g., slope stability/seepage) and obtain necessary geotechnical/geologic information through existing documents of record, geophysics or other acceptable methods to develop detailed reports and recommendations for repair.
- An evaluation of integrity of the auxiliary spillway. The spillway will be evaluated for both the 6-hour and 24-hour PMF events. A subsurface profile of the spillway shall be developed in the SITES model based on information obtained from the existing soils information or proposed

borings within the spillway. Soil and rock material properties will be determined from laboratory testing and/or engineering judgement.

- Complete checks/reviews of available design calculations, drawings and specifications and make recommendations for additional dam safety improvements to the structure to mitigate against credible potential failure modes that are deemed reasonable due to the lack (or inadequacy) of existing design features that would interrupt and stop progression of the failure (e.g., filters/drains).
- Complete a screening-level risk assessment (SLRA). The SLRA will identify the rank potential dam safety issues and credible potential failure modes to assist the dam owner with prioritizing interim risk reduction measures, identifying dams for which a more detailed risk evaluation would be warranted and identifying the need for long-term risk reduction modifications/repairs to the dam. The Consultant shall prepare a list of major risks (Risk Register) to the dam using the findings of the document review and inspections completed in Phases 1 and 2 as background to assess the likelihood of occurrence and consequence level of the risk (LoF: Likelihood of Failure and CoF: Consequences of Failure).
- Make recommendations for upgrades or retrofits to the dam where the original design methods, the as-built conditions, or the current operation significantly deviate from the current standard practices and thus create a greater potential for failure or incident. Examples of areas for consideration include, but are not limited to:
    - Structural stability and repair of the masonry, seepage and erosion resistance of all segments of the dam
    - Adequacy of design of gates, valves, drains, flow control equipment and their ability to function in various operating conditions
    - Adequate detailing and construction of concrete elements such as spillway chute slabs to prevent deterioration or safety concerns that may not be readily apparent in a visual observation
    - Adequacy of geologic characterization and design to mitigate against potential failure modes (e.g., steep rock wall instability that could block a spillway)
    - Installation of a remote monitoring system to track dam conditions
- Develop cost estimates for recommended repairs.