



Missouri Department of Natural Resources

Dam and Reservoir Safety

**MISSOURI DAM AND RESERVOIR SAFETY STAFF CHECKLIST FOR
EVALUATING REGISTRATION PERMIT APPLICATIONS FOR INDUSTRIAL
WATER RETENTION DAMS**

II. SIGNED AND SEALED CERTIFICATION BY ENGINEER THAT:

- A. Dam and reservoir have been inspected in accordance with the law.
- B. Owner has complied with the engineer's recommendations to correct observed defects.

III. REPORT ON INSPECTION INCLUDING:

- A. Determination of an environmental class for each dam and reservoir.
 - 1. For Class I (Go to Part III – B.)
 - 2. For Class II and III only
 - a. If a sufficient number of homes are located downstream of a dam, a breach analysis is required to justify a Class II or Class III downstream environmental zone. The following information should be submitted:
 - 1) Topographic map showing: (The most recent USGS Topographic map is minimum acceptable).
 - a) Location of dam and reservoir.
 - b) Location of stream cross sections used in breach analysis.
 - c) Flood plain as derived from breach analysis.
 - d) Verified locations of permanent dwellings, campgrounds or industrial buildings within the dam breach flood plain.
 - 2) Dam failure criteria:
 - a) Final breach configuration (bottom width, top width, side slopes).
 - b) Assumed time of failure.

- c) Description of the methodology used and the computations performed in the breach analysis.
 - 3) Stream profile showing:
 - a) Water surface elevation created by failure of the dam with the reservoir at the emergency spillway crest elevation.
 - b) Stream cross section locations.
 - b. To show that a structure located in the dam breach flood plain is not inundated by the dam breach flood:
 - 1) Replace cross-section data derived from topographic maps with field survey cross-sections.
 - 2) Compare surveyed first floor elevation of structure to the computed water surface elevation for the dam breach flood.
 - c. In a situation where a dam is in very remote location where there are not enough buildings or other structures located downstream of the dam to justify a class I environmental zone, another environmental class may be used without having to perform a detailed dam breach analysis. Engineers are advised to obtain the approval of the Dam and Reservoir Safety staff before using this option.
 - d. Address the changes occurring in the downstream environment zone as the dam and reservoir become incrementally larger.
- B. Evaluation of Spillway Capacity*
- 1) The following data must be included in the application report:
 - a. Drainage area (square miles or acres) shown on an up-to-date USGS topo map.
 - b. SCS Curve Number for watershed draining into lake.
 - c. Time of concentration for runoff draining into reservoir.

Sufficient documentation should be provided to derive the value used.

 - d. Storage (acre-feet) vs. elevation (feet) data for reservoir.

This information should be provided for elevations ranging from the bottom of the reservoir to the top of the dam. Surface area (acres) vs elevation data should also be submitted in support of this information.

 - e. Minimum elevation of top of dam exclusive of the spillway(s).

If the top of dam is not level, a profile of the top of dam is required.

- f. Height of dam (measured in accordance with 10 CSR 22-1.020 (13)).
- g. Length of Dam.
- h. Discharge (cubic feet per second) vs. elevation (feet) data for spillway(s) with backup computations.
- i. The required critical design in-flow hydrograph to the reservoir as determined by taking the appropriate percentage of the PMP as shown in Table 5, 10 CSR 22-3.020.

The probable maximum precipitation values from Hydrometeorological Report No. 51, the duration of the rainfall, and the rainfall distribution patten used to compute the hydrograph must also be submitted. Sufficient information should be submitted to derive the hydrograph.

- j. The required design storm out-flow hydrograph derived by reservoir routing the required design storm in-flow hydrograph through the spillway.

3. Other items that must be addressed:

- a. The possibility of submergence of the spillway control(s) by backwater conditions in the spillway discharge channel.
- b. The ability of the spillway and discharge channel to withstand the exit velocity expected through them during the required design storm.
- c. The alignment of the spillway discharge channel with respect to the dam and what effect, if any, erosion or overtopping of the discharge channel will have on the dam.

C. Description of dam and appurtenant structures:*

1. Appurtenant Structures

- a. Description and location of the decant structures and the emergency spillways.
- b. Description and location of the mill water return pumps, tailings discharge points, and internal drain outlets.
- c. Description and location of all discharge channels.
- d. Description and location of all pipes through the dam other than what was described in b. above.

2. Dam and Foundation

- a. Description of the materials in the dam and foundation.
- b. Description of the layout of the dam including the starter dam, the intermediate and existing stages. Include the slopes and the dimensions of the dam and the valley below the dam.
- c. Description and location of all seepage including quantity and quality.
- d. Location of surfaces and underground mine workings with respect to the dam.
- e. Description of modifications to and performance of the dam since the starter dam was completed.

D. Slope Stability

1. Observation of Slope Stability

- a. Description and location of slides.
- b. Description and location of zones of softness, irregular settlement, and sinkholes.
- c. Description and location of erosion features on the dam.
- d. Plot of cross-section of the dam, at the maximum section, showing soil zones and their respective properties.
- e. Location of piezometers and a description of data collected (if applicable).
- f. Description and location of cracks in the embankment and appurtenant works.

2. Judgement of Slope Stability

- a. The engineer needs to state that in his judgement the dam is performing adequately and there are no observable indications that the dam is unsafe.

IV. REPORT ON THE CORRECTION OF DEFECTS:*

A. List of Defects

B. Description of the corrections to the principal or emergency spillways and lake drain or water intakes.

C. Descriptions of repairs to the dam and appurtenant structures other than spillways.

1. Embankment modifications

2. Seepage control measures
 3. Other actions
- D. Descriptions of the design and analysis upon which the repairs are based.

V. REPORT ON PROPOSED FUTURE OPERATION AND MAINTENANCE

- A. Description of maintenance program (required).
1. Erosion control on the embankment
 2. Vegetation control
 3. Spillway maintenance
- B. Monitoring of reservoir level and spillway operation during storm runoff.
- C. Emergency Action Plans.
- D. Monitoring of seepage observation devices (if any).
- E. Monitoring of instruments used to observe the stability of the dam (if any).
- F. Operation of the dam and reservoir.
1. Description of the method used to discharge tailings into the reservoir and the estimated rate of filling of the reservoir.
 2. Description of the use of controlled outlets to regulate the reservoir level.
 3. Description of reservoir control structures such as dikes within the reservoir used to control the flow of water through the reservoir.
- G. Regular Inspection
1. Spigots or cyclones (when active).
 2. Decant lines.
 3. Position of pool as related to the spillway, decant intake and crest of the dam.
 4. Drain outlets checked for flow rate and sediment.
 5. Observation of embankment for slides or seepage changes.
 6. Spillway blockage.

VI. REPORT DESCRIBING THE PHASED, STEPPED, AND/OR CONTINUOUS CONSTRUCTION OF THE DAM.

- A. Description of Materials Used
 - 1. Physical and mechanical properties
 - 2. Source of materials

- B. Description of Construction Methods
 - 1. Material transport.
 - 2. Size gradation standards.
 - 3. In place density standards.
 - 4. Placement methods.
 - 5. Layout and configuration of intermediate stages.

- C. Spillway Modifications
 - 1. Description and location of each new spillway.
 - 2. Evaluation of spillway capacity (refer to III B.).

- D. Final Stage of Construction
 - 1. Layout and configuration of dam.
 - 2. Internal drainage facilities.
 - 3. Location of pool in relation to the dam.
 - 4. Abandonment plans.

- E. Responsible personnel (names, addresses and phone numbers)
 - 1. Construction responsibility.
 - 2. Technical responsibility.

* The information requested in items III B. and III C. concerning the evaluation of the spillways and appurtenant structures should include both existing conditions and final design conditions if phased, stepped, or continuous construction of the dam is being planned or taking place.

** The information requested in item IV should be submitted only if observed defects *(as listed in 10 CSR 22-3.030) (1), (A), 1) are noted during the initial inspection for a registration permit.