Standard Criteria and Procedure for Certification of Boat Barrier Systems

1. **Purpose.** To establish the minimum criteria for selection and procurement of boat barriers intended for the mitigation of risk to Reclamation's critical assets from attack by water-borne surface vessels commonly found on reservoirs and rivers. As an appendix to Reclamation Manual Directive and Standard SLE 03-01, *Boat Barrier Certification and Procurement,* this standard establishes the methodology for certification of boat barriers and provides the minimum standards for the testing and/or numerical analysis of any boat barrier.

2. **Definitions.** The term boat barrier shall always be interpreted to mean a barrier with capability to stop or significantly impede the progress of a surface vessel intent on attack.

3. **Background.**

   A. References. Technical Report TR-6050-OCN, Waterfront Boat Barrier Design Criteria, Naval Facilities Engineering Service Center, 29 August 2003.

   B. Ninety-percent of all boats in use are classified as "low energy" having a maximum kinetic energy of 250,000 foot-pounds of energy or less.

   C. Of the "high energy" vessels in the upper 10 percent of the U.S. Coast Guard inventory of U.S. boats, energies remain below 300,000 foot-pounds until the 96^{th} percentile. Between the 96^{th} percentile and the 99^{th} percentile vessels, energies climb from 300,000 to 1 million foot-pounds. Taking the midpoint along this slope, 97.5 percentile, the vessel kinetic energy is approximately 550,000 foot-pounds.

   D. The design value for the threat-vessel was chosen as 600,000 foot-pounds. This is both a reasonable value in terms of the statistically probable threat and holds the potential for an economically viable solution.

4. **Vessel Criteria.** These criteria provide a minimum force of approximately 600,000 foot-pounds.

   A. Vessel Size: 16-26 feet in length.

   B. Vessel Speed: Minimum 40 knots (46 mph).

   C. Vessel Weight: 8,500 lbs (includes payload).

   D. Vessel Type: Single hull power boat.

5. **Barrier Criteria.**

   A. Boat barrier shall be minimum 30 feet in length.

   B. Ends of boat barrier shall be anchored to fixed points, either above or below the water surface.

   C. Anchorage of boat barrier may restrain the translation of the boat barrier perpendicular to and parallel to the direction of attack (path of boat) but must not restrain the boat barrier about its longitudinal axis of rotation, i.e., the method of anchorage shall not restrain the barrier from "rolling over."

6. **Barrier Design Submittal.**

   A. Complete barrier shop drawings.

   B. Barrier design and layout (as proposed for testing) in plan, elevation, and section.

   C. Barrier mooring/anchorages in detail.

   D. Barrier materials list.

7. **Test Facility and Equipment Criteria.** Prior to testing, the applicant shall submit to Reclamation detailed descriptions of the test vessels, barrier design, and all testing equipment to include:

   A. Vessel type, description, and manufacturer;

   B. Vessel size (length, beam, draft, height, etc.);

   C. Vessel mass, dry and loaded (to include description of any ballast, its placement and restraint);

   D. Tow vehicle;

   E. Tow cable configuration, attachment points, and cable release mechanism;

   F. Equipment to be used for verification of vessel speed including calibration methods; and

   G. Barrier mooring/anchorages (as proposed for testing) in detail.

8. **Procedural Criteria.** Prior to testing, the Vendor/Manufacturer shall submit to the Chief Security Officer detailed descriptions of the test procedures and methods to include:

   A. Method of towing test vessel.

      (1) The towing apparatus and its interaction with the test vessel and the boat barrier shall serve only to guide the bow of the test vessel into the middle one third of the barrier length at the specified test vessel velocity.

      (2) The tow apparatus shall not pull the bow into an elevation advantageous to the performance of the boat barrier. The tow apparatus and its connection to the test vessel shall be designed and applied such that, at the time of separation of the tow apparatus from the test vessel, the test vessel shall assume its "natural" angle of inclination relative to the water surface for the given test vessel velocity.

      (3) At the point of impact, the "attack angle" (see figure 1) between the test vessel and the barrier shall be between 80-degrees and 100-degrees (i.e., perpendicular to the barrier plus or minus 10-degrees).

   B. Release of Test Vessel from external influence. The test vessel shall be released from the tow apparatus and any other outside influences at a minimum of 1 meter and at a maximum of 1.5 meters from the face of the boat barrier.

   C. Payload distribution.

      (1) If any equipment or materials are removed from the test vessel for the purpose of economy or environmental concerns, equivalent ballast mass shall replace the removed items such that the original center of gravity is restored.

      (2) Any additional ballast (payload) needed to achieve the specified test vessel weight shall be evenly distributed about the vessel's normal center of gravity.

      (3) Compliance with the above criteria may be verified by waterline reference marks at the bow and stern placed prior to any modification of the test vessel from its normal, unloaded water going configuration. After modification through addition of ballast to meet criteria, the new waterline due to loading shall be parallel to a line through the original reference markings.

9. **Test Documentation.**

   A. The Vendor/Manufacturer shall submit detailed acceptance test procedures, documentation plans and protocols, and results to prove the performance of the product to the Chief Security Officer.

B. The Vendor's documentation for each test shall clearly describe the objective of the test, document the details of test vessel, test facility, and test procedures which demonstrate and verify compliance with all criteria of this standard.

C. Results of the test shall be documented by written description and by video taken from at least two angles to include a view parallel to the longitudinal axis of the boat barrier and a view from the secure side and perpendicular to the barrier longitudinal axis.

D. In addition, documentation shall verify the angle of impact between the test vessel and the barrier (through video evidence or otherwise).

10. **Acceptance Criteria/Barrier Certification.**

A. All descriptions, documentation, plans, etc. required by this standard prior to testing shall be submitted to and approved by Reclamation prior to actual testing.

B. Testing of the boat barrier shall be witnessed by the Chief Security Officer or their appointed representative(s).

C. The testing of the boat barrier shall be considered successful when all criteria of this standard are met and when the boat barrier completely halts the forward motion of the test vessel within 10 meters of the pre-test position of the outside (attack) face of the boat barrier and the stern of the vessel does not pass over, under or through the boat barrier; and without the boat barrier being breached, sunk or otherwise damaged to a condition which, in the opinion of the Government test-witness, would allow the passage of a second vessel.

D. Final authority for acceptance and certification shall remain with the Chief Security Officer. Compliance with the above conditions and criteria does not guarantee that Reclamation will not find cause for denial of certification based on factors unforeseen by this standard.

11. **Numerical Analysis of Boat Barrier.**

A. In lieu of, or in addition to, the above physical testing, verification of barrier performance with respect to the purposes of this standard may be provided through numerical analysis demonstrating the system’s ability to resist the design loading as listed in paragraph 5.A. above.

B. Those seeking certification under this standard may elect to have an analysis performed by an engineer capable and experienced in the use of hydro-code such as AWQA and structural finite element analysis capable of evaluating the interaction of floating bodies, moorings, anchorages, and dynamic impact of water vessels.

C. A list of firms and points of contact that have expressed their ability to and interest in performing this type of analysis are available from the Security Office.

D. The results of the analysis shall be presented for review and acceptance by the Government. The Government will have sole discretion in the appraisal of the validity and accuracy of the analysis methodology and execution. The opinion(s) and finding(s) of the Government shall be final.

12. **Certification by Examination of Vendor Proposal.**

A. For the case where the boat barrier being offered by the Vendor is essentially identical in design and configuration to a boat barrier previously certified under this standard, the Chief Security Officer may, at his/her discretion, issue certification by examination for the barrier being offered.

B. For the case where the boat barrier being offered by the Vendor deviates in design or configuration from a boat barrier previously certified under this standard but retains the essential components and details necessary for acceptable performance of the barrier, the Reclamation Security Office may grant certification of that barrier by examination.

C. The Vendor shall be responsible for providing all documentation and justification for application of previous certification to the proposed barrier.

D. Final authority for certification by examination shall remain with the Chief Security Officer. The decision of the Chief Security Officer shall be final and binding.

13. **Costs Associated with the Testing and Certification.** With the exception of U.S. Government personnel required for witnessing, review and certification, the cost of testing and certification shall be borne entirely by those seeking certification, at no cost to the U.S. Government.

14. **Issuance of Letter of Certification.** When granted, written certification shall be provided to the Vendor by the Chief Security Officer and shall be the only acceptable proof of certification.

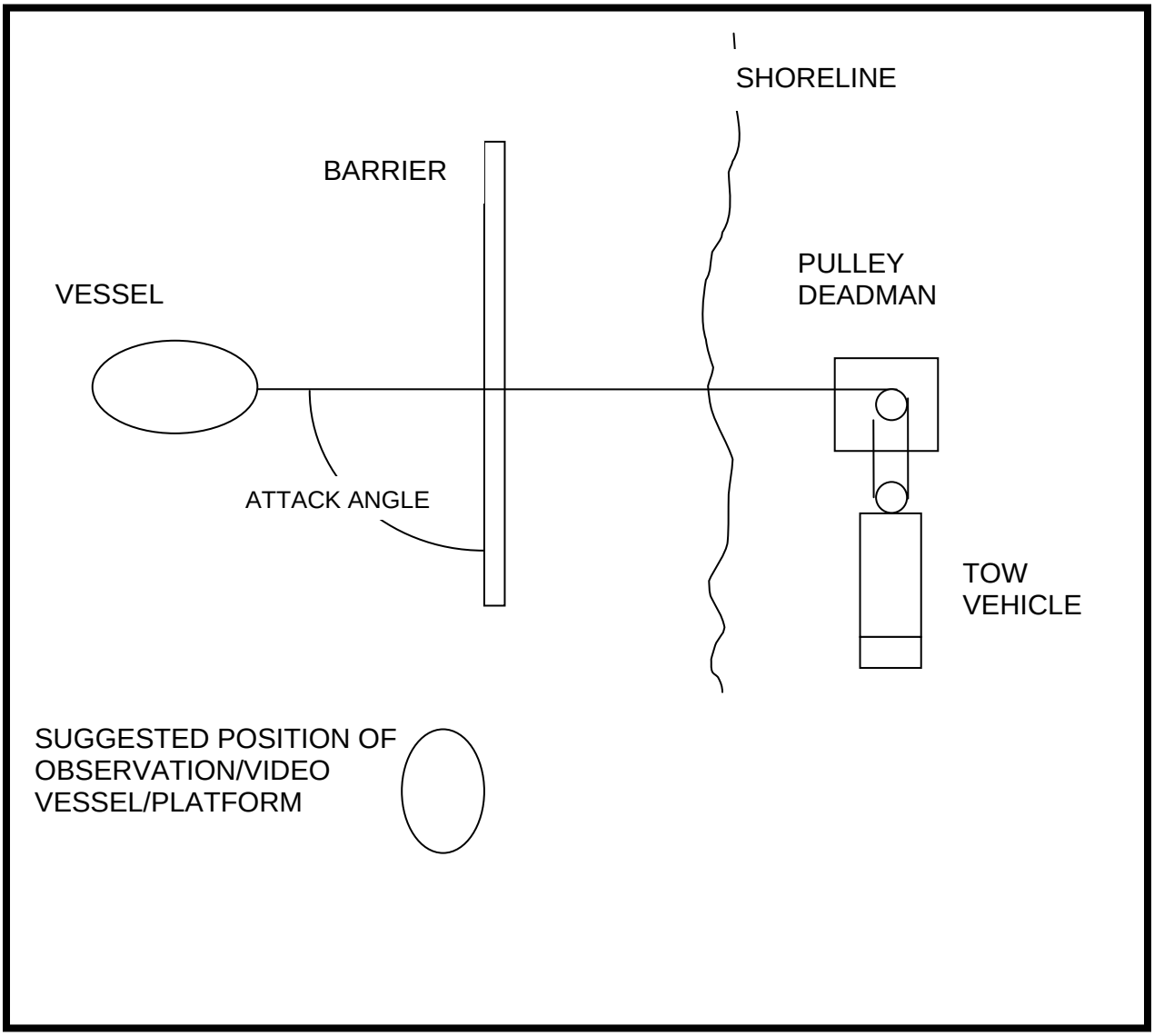

FIGURE 1 - SCHEMATIC LAYOUT OF SUGGESTED/POSSIBLE TEST SITE