Attachment 6

Interagency Process for Fish Screen Project Designs in California

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Introduction

Recently, interest in the design process for fish screen projects has propagated through various environmental management forums in California. Also, misunderstandings turned into confusion regarding the fish screening standards of the National Marine Fisheries Service, Southwest Region (NMFS-SW), the U.S. Fish & Wildlife Service (FWS), and the California Department of Fish and Game (CDFG). To address these issues, the following is a description of the government's interagency fish screening process and other important aspects of California's fish screen programs.

Fish Screens

Positive Barrier Fish Screens are currently the best available technology for the prevention of fish losses due to entrainment at water diversion sites. The operating principle of a positive barrier screen is simple: insert a permeable, physical barrier between the fish and the diversion point such that the fish remain in their natural habitat, not in the diversion. The screen itself is constructed of a durable material (e.g.-stainless steel) and features slotted, punched, or woven openings. Several screen panels or units may be combined in various configurations to obtain a composite system capable of passing large volumes of water. Screen openings are machined with precision, so that they are wide enough to pass water but narrow enough to physically exclude very small fish.

Over the past several decades, the positive barrier concept has proven most effective in preventing entrainment. Today's state-of-the-art screens offer a high degree of protection for fish. In fact, several recent evaluations of modern screens show efficiencies approaching 100% protection. These are instances where thorough site analysis, excellent design and engineering, and accurate construction practices resulted in superior performance. Unfortunately, there are other cases, particularly among older, outdated screens, where performance suffered because of design or construction errors. As a group, fish passage specialists have assimilated the lessons of the past to a large extent. The result of these learning experiences are tried and true fish screen standards which govern the design and construction process for all state and federal sponsored projects in California.

Project Identification

A fish screen project is typically identified when a project proponent voluntarily solicits government agencies for financial or technical assistance. In some cases, a project is initiated by a regulatory action. Such an action is typically triggered by other in-river activities which require statutory environmental review or permitting procedures (e.g.- dredging, new construction). When a fish screen project is identified, it is referred to the correct government agency, or interagency group, for administrative processing. Currently, most large screen projects are administered under the purview of the Anadromous Fish Screen Program (AFSP), while some medium and small scale projects are referred to NMFS, CDFG, the Natural Resource Conservation Service (NRCS), or other resource agencies.

Technical Advisory Groups

For most significant water diversion flows, fish screen project design involves interagency cooperation and oversight by a *Technical Advisory Group* (TAG). The TAG generally consists of government agency representatives, the project sponsors, and consultants from various disciplines as necessary. The TAG serves several functions: 1) it focuses a multi-disciplinary team's attention on the complicated issues of screen design and construction, 2) it provides a forum where technical issues are resolved, 3) it fixes project accountability on a definitive group of individuals, 4) it uncovers policy issues which cannot be resolved at the technical level, and 5) it offers a mechanism whereby high level policy issues are elevated to the appropriate decision making authority.

Fish Screen Permit Process

Procedures for compliance with environmental statutes vary based on the scope of the project. By recent convention, California fish screen projects are first classified into one of three categories based on the volume of water diverted: small diversions, medium diversions, and large diversions. Since the volume diverted indicates the scope of construction, these categories provide a good starting point for defining the correct design process, environmental compliance procedures, and types of expertise needed. Once a proposed project has been categorized, the TAG examines existing site conditions to determine where the project fits into a *Three-Tiered Environmental Review* framework. The three tiers of environmental compliance are:

Tier 1- Programmatic Permits,
Tier 2 - No Significant Environmental Impact,
Tier 3 - Significant Environmental Impact.

Small diversions, approximately 40 cubic feet per second (cfs) or less, are frequently screened with off-the-shelf, cylindrical drum screens which can be bolted on to the end of existing intake pipes. This sort of project requires no major civil works and environmental impacts associated with construction are minimal. Therefore, these projects could be authorized with *Programmatic Environmental Permitting Procedures* (not yet enacted by all agencies) and allowed to proceed with a minimum of bureaucratic involvement. Very small fish screens might simply require a *Streambed*

Alteration Agreement (CDFG Code §1601), and be automatically authorized by a U.S. Army Corps of Engineers *General Permit* (Clean Water Act §404), unless unusual circumstances exist.

Unfortunately, Tier 1 is under-utilized. This is due, in part, to the absence of this option in some agencies. It is also caused by lack of clear and prudent interpretations of Congressional intent toward the administration of environmental statutes. A third reason is the tendency for agencies to engage in "turf battles" during the permitting process. Lacking the proper tools and direction, staff bureaucrats feel compelled to exercise due diligence toward the letter of the law. This translates into lengthy, multiple permit procedures for even the smallest projects. Plus, it demands intense coordination among personnel from several different agencies. The effect is unnecessary delay of hundreds of fish protection projects, whose cumulative potential for fisheries enhancement is substantial. Moreover, bureaucratic inefficiency grows because human resources are stretched extremely thin. Under the current system, staff personnel try to address every project, regardless of size. Thus, mediocrity reigns- people are performing too many tasks marginally well, instead of concentrating their efforts on fewer, high priority endeavors. The answer to this "small project dilemma" is threefold: 1) development of *government-wide programmatic permits* and *categorical exemptions* under provisions of current law, 2) *communication of new directives* to each resource agency's staff, and 3) *commitment to implement the directives* by each agency's management.

Medium diversions (approximately 40-250 cfs) present a higher increment of design, construction, and environmental compliance issues. Nevertheless, the environmental impact of medium size screen projects is fairly low while their long term fisheries benefits are high; so it is desirable to keep these beneath the umbrella of streamlined environmental compliance procedures, or Tier 2. An *Environmental Assessment* (EA) conducted by the lead agency or project consultant serves as the basis for making statutory decisions under the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). These decisions are the critical turning point for any given project with respect to environmental compliance considerations, i.e.- threshold, timing, scope, and adequacy. Most often, medium scale fish screens with moderate civil works will fall below the threshold of *Significant Environmental Impact* (40 C.F.R. § 1508.18). Thus, federal and state review usually yields a *Finding of No Significant Impact* (FONSI) and *Negative Declaration* (NEGDEC) respectively, sometimes with mitigation measures imposed. The benefit of utilizing this procedure is clear: adequate, consistent environmental review is invoked as a matter of procedure, and qualifying projects are allowed to proceed without a complex and costly EIR/EIS process.

Those projects that do not qualify under either Tier 1 or Tier 2 are considered large diversions (approximately >250 cfs). This category of projects features relatively large civil works elements and the potential for a significant environmental impact. For Tier 3, the law mandates a duty to perform an *Environmental Impact Statement* (EIS) and/or *Environmental Impact Report* (EIR) for NEPA and CEQA. When a finding of significant environmental impact is taken on a major action involving state or federal involvement, a team of specialists is assembled to provide the required level of study, analysis, and documentation. This process is time consuming, expensive, and research intensive; so it is correctly reserved for those projects whose scope is sufficiently large to warrant it. An example of this case is the Glenn-Colusa Irrigation District (GCID) fish screen project, whose design and environmental compliance process has been underway for several years. The GCID project now involves the work of dozens of consultants, private agriculture representatives, lawyers, and government officials. It will take approximately one to two additional years, maybe more, to complete this complicated procedure.

The three-tiered approach is meant to offer some level of structure and guidance to Technical Advisory Groups and Agency managers, but it should not be construed as a rigid and inflexible framework. As is so often the case, peculiar site conditions at a potential screen site may warrant reclassification of the project. For instance, a few small may occasionally cause significant environmental impact that could require them to go into Tier 2, or even Tier 3. Conversely, some large screens could be handled in a swift and cost-effective manner by Tier 2, if no significant environmental concerns exist.

Fish Screen Funding Process

(Under development...)

Fish Screen Design Process

Fish screen design usually proceeds in three discrete phases: 1) Preliminary Design, 2) Feasibility Design, and 3) Final Design.

Preliminary design is essentially a brainstorming session on the part of fish passage specialists where various design options are proposed and assessed for appropriateness to the site. Specific steps include: description of design requirements, data collection, site analysis, conceptualization of alternatives, engineering drawings, refinement, and alternative selection. Physical or numerical modeling may be employed to determine whether a specific design alternative can meet the design objectives.

Feasibility design takes the option selected from preliminary design and develops the concept to a point where criteria resolution, construction scheduling, and funding issues can be addressed. Commonly, feasibility reviews are performed somewhere between 30% and 50% of design completion. Detailed engineering drawings, prepared by an engineering consulting firm, are reviewed by government specialists within the TAG forum to ensure consistency with established design criteria. Many times this level of review will generate substantive improvements in the proposed design because the TAG represents a multi-disciplinary review team- offering diverse experiences that may be relevant to a unique part of the project.

Final design constitutes the culmination of the review process and signals official authorization for the construction phase. A final design review includes inspection of detailed drawings and engineering specifications, as well as construction bidding and contractual packages. Frequently, final reviews are held when the design is approximately 90% complete. This point provides an opportunity for the TAG to conduct a last round of review and comment, ensuring the project is on the intended course, and refinements from previous review sessions have been incorporated. Finally, when the engineering design firm presents the TAG with a 100% design package, all questions concerning the design should be answered, leaving only the formality of design acceptance and agency concurrence to be rendered.

Fish Screen Design Considerations

For a typical fish screen project, the TAG must identify and resolve a wide range of design and construction issues. These often summon expertise in subjects such as hydraulic and mechanical engineering, biology, hydrology, construction, resource planning, and economics. Specific examples of common engineering design issues include: intake location, hydraulic characteristics, water quality, bed load transport, debris loads and sedimentation, temporal flow patterns, tidal effects, velocity distribution, diversion requirements, flood flows, screen mesh size, structural integrity, bypass system configuration, and screen cleaning systems. Added to this list are the many biological factors which must be accommodated by the engineering design: multiple species protection, temporal and geographical distribution of species, predation, swimming abilities of fry, downstream and upstream passage, migration windows, and many others. Finally, the TAG must synthesize this mixture of aquatic science, biology, and engineering with economic aspects of the project, i.e.- cost of facilities, funding mechanisms, and funding availability.

Fish Screen Criteria

The California Department of Fish and Game and the National Marine Fisheries Service promulgated formal fish screening criteria as a result of their public trust responsibilities (e.g.- protection of listed species under the state and federal *Endangered Species Acts*). These criteria provide both specific and general guidelines for design, siting, construction, and operations of fish screening facilities. Due to different fish protection mandates and histories, the design criteria of the two agencies evolved separately and with a slightly different focus. The National Marine Fisheries Service criteria, *Fish Screening Criteria for Anadromous Salmonids,* is distinctly targeted to salmonid species, but it effectively protects many other fish species as well. The California Department of Fish and Game's *General Fish Screening Criteria* was developed based on extensive swimming ability research conducted on several species of salmonids and American shad.

Historical Development of Fish Screen Criteria

The National Marine Fisheries Service, Southwest Region, produced *Fish Screening Criteria for Anadromous Salmonids* in response to diminishing salmon runs and subsequent listings under the federal Endangered Species Act. The agency's original fish screen criteria was developed by the NMFS Northwest Regional office (NMFS-NW), after a careful review of the scientific literature which related to salmonid swimming ability. The definitive research, *Salmonid Fry Swimming Ability Data for Diversion Screening Criteria* (Smith and Carpenter, 1987), was performed at the University of Washington Fisheries Research Institute. The study determined the maximum short term swimming stamina of five species of salmonid fry at the swim-up stage of development. Testing salmonids at this immature stage simulated a worst case scenario for fish encountering a diversion screen. The research featured a comprehensive literature review, elaborate experimental design, and rigorous statistical analysis. The species tested included pink, chum, chinook and coho salmon, plus two stocks each of rainbow and steelhead trout.

The California Department of Fish and Game developed *General Fish Screening Criteria* after conducting several years of swimming ability research for the proposed Peripheral Canal Project, which would require a fish screen of unprecedented proportions. The most often cited study in support of the CDFG criteria is *Responses of Juvenile Chinook Salmon, Oncorhyncus Tshawytscha, and American Shad, Alsosa Sapidissima, to Long Term Exposure to Two-Vector Velocity Flows* (Kano, 1982). The study, commonly referred to as the "treadmill," tested swimming responses of young-of-the-year chinook salmon and American shad to two-vector flow conditions. A few of the notable differences between the "treadmill study" and the Smith and Carpenter study were: 1) the treadmill did not test as many species of salmon as Smith and Carpenter, but did test a different species, American shad, 2) the treadmill simulated effects of two vector flows, i.e.- combined approach and sweeping velocities, while the Smith and Carpenter study tested one dimensional laminar flow, and 3) the treadmill tested swimming behaviors in both dark and lighted conditions, while Smith and Carpenter tested fish only in the light, at different water temperatures.

Both swimming ability studies (Smith and Carpenter, 1987; Kano, 1982) generated essential information on which to base screen criteria. However, NMFS-NW and CDFG drew somewhat different interpretations from their respective research, resulting in criteria which could be applied to each agency's species of concern. Based on the interpretation of the Smith and Carpenter research results, NMFS established two of its most important screen criteria parameters: approach velocity (0.4 feet per second) and screen exposure time (60 seconds). NMFS-NW selected these parameters by analyzing the data sets and choosing values where the weakest swimming fish of all species did not cease swimming, thus providing near 100% protection. Based on the outcome of the treadmill research, as well as previous studies by the Interagency Ecological Program (IEP), CDFG concluded that an approach velocity of 0.33 fps was sufficiently low to protect species of concern in California without juvenile bypass systems, regardless of exposure time.

Exposure Time and Juvenile Bypass Systems

"Exposure time," or the amount of time a fry-sized fish must encounter an entrainment velocity along the face of a fish screen, was hotly debated for certain screen sites in California over the past decade. A strict interpretation of the NMFS exposure time criteria often prescribed an expensive juvenile bypass system as part of the overall system design, whether it was the most cost effective solution for a specific diversion site or not. What went unnoticed, however, was NMFS willingness to negotiate the best screening solution on a case-by-case basis with its peers at the Technical Advisory Group level.

What is a "juvenile bypass system" in terms of fish screen design ? Why and when are they necessary ? According to the definition from NMFS-SW screen criteria, juvenile bypass systems are constructed "water channels which transport fish from the face of a screen, to a relatively safe location in the main migratory route of the river or stream." In NMFS' view, intermediate juvenile