GUIDELINES
FOR
PUBLIC SAFETY
AT
HYDROPOWER PROJECTS

DIVISION OF DAM SAFETY AND INSPECTIONS
FEDERAL ENERGY REGULATORY COMMISSION

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NOTE: ALL LOCATIONS IN THE DOCUMENT WHERE "REGIONAL DIRECTOR" OR "REGIONAL DIRECTORS" WAS USED HAVE BEEN CHANGED BACK TO "REGIONAL ENGINEER" OR "REGIONAL ENGINEERS". THE NUMBERING OF APPENDIX 1 AND 2 HAVE BEEN CORRECTED TO MATCH THE NUMBERING ON INDEX PAGE.

Guidelines for
Public Safety
at
Hydropower Projects

This document is primarily for the use of Federal Energy Regulatory Commission staff to provide background information on public safety at hydropower projects. This document may be revised as the need arises to address public safety needs at licensed and exempted projects.

GUIDELINES FOR PUBLIC SAFETY AT HYDROPOWER PROJECTS

INTRODUCTION

Conditions may exist at or near hydropower facilities that could be dangerous or conducive to accidents that could cause injury or loss of life. The potential for drownings, accidental deaths and injuries near project facilities and on other project lands and waters has been of concern to the Federal Energy Regulatory Commission (FERC) and project owners for a considerable time. The FERC is primarily concerned with the hazards created by project structures and operations. Hazards created by natural conditions in project waters and at recreational areas that are operated or leased by licensees and exemptees of hydropower projects are equally important. However, as a practical matter and given the limitations of staff resources, the implementation of safety measures to minimize accidents that are not associated with project structures or operations is usually the responsibility of local entities and law enforcement agencies.

The purpose of this document is to describe the types of hazards that can exist at hydropower facilities and the safety devices or other measures that can be employed to enhance the protection of the public that utilize project lands and waters. Project owners are responsible for providing any appropriate safety devices and other safety measures at their projects, even if not specifically required by the Regional Engineers. However, the staff of the Division of Dam Safety and Inspections (D2SI), in cooperation with project owners, are expected to assess the overall need for safety devices or other safety measures at all projects in order to develop the most effective solution to identified safety problems. Other safety measures may include preventing recreational activities in hazardous areas. Project owners are expected to expeditiously install and properly maintain any safety measures they determine are needed or are required by the Regional Engineer. This document provides general guidelines and criteria on safety devices because each project is unique and will necessarily require judgements and solutions that should be made in the field.

Section 10(c) of the Federal Power Act authorizes the Federal Energy Regulatory Commission to establish regulations requiring owners of hydro projects under its jurisdiction to operate and properly maintain such projects under its jurisdiction to operate and properly maintain such projects for the protection of life, health, and property. The primary responsibility within the Commission for ensuring that project owners install and maintain appropriate safety devices rests with the Division of Dam Safety and Inspections (D2SI). Implementation of this responsibility is carried out by the Commission's five Regional Offices (New York, Atlanta, Chicago, Portland (OR), and San Francisco). Part 12 of the Regulations issued January 21, 1981 (Order No. 122), delegates to the Regional Engineer the authority to require safety devices, where necessary.

Section 12.42 of the Regulations states that, “To the satisfaction of, and within a time specified by the Regional Engineer, an applicant or licensee must install, operate, and maintain any signs, lights, sirens, barriers, or other safety devices that may reasonably be necessary or desirable to warn the public of fluctuations in flow from the project or otherwise to protect the public in the use of the project lands and waters”. The Director, Division of Dam Safety and Inspections, the Regional Engineers, and other Commission authorized representatives also have broad general authority under Section 12.4 of the regulations to require modifications or changes in project works or operation, including installation of safety devices. At many projects, licensees or owners have taken the initiative to install safety devices or implement safety measures. The approval of existing safety devices, and the maintenance or removal of any safety devices, were dealt with in a letter to all owners (Appendix 3).

The requirements for specific safety devices at each hydro project should be determined on a case-by-case basis. The D2SI Staff should work closely with the project owners to encourage the development and implementation of the most effective plan for public safety. The case-specific approach to public safety is especially important. For instance, projects with limited public use may not require the same level of public safety measures as projects with extensive use and recreational development. However, the real determinant at any project is the level of danger to the public. Where joint efforts with the project owner do not result in expeditious agreement on any approach to public safety, the Regional Engineer has the authority and is expected to require that such safety devices or other measures deemed necessary are installed as soon as practicable.

Following is a description of various types of project features or conditions that can present a hazard to the public and the types of safety devices or measures that can be utilized or implemented to reduce hazards. These descriptions are not all-inclusive. Therefore, it is important that FERC Staff inspections focus on the particular project features that may dictate special public safety requirements. References (Attachment I) are also provided for obtaining more specific information on particular safety questions.

HAZARDOUS FEATURES AT PROJECTS

SPILLWAYS - Ungated overflow spillways are particularly dangerous because they may be difficult to recognize from the reservoir and boats can be easily drawn over them.

Gated spillways may be hazardous depending on their operation. For instance, when tainter gates are raised so that the bottom of the gates are above the water surface, the spillway is essentially an overflow spillway and is very dangerous. These type of spillways are also very dangerous when the gates are raised to a point where the bottoms of the gates are below but near the water surface. With the gates in this position, it is not apparent that they are raised and the water surface is often fairly calm. However, the subsurface currents are very swift and dangerous. In some gate positions, dangerous whirlpools develop upstream of gates. However, when gates are raised only a few inches, they may pass water with little upstream hazard created.

Flashboard (or rubber dam) equipped spillways are operated in various ways; therefore, the degree of hazard varies. Some flashboard spillways raise the reservoir level and are not normally used to spill water. Others often spill water in the same manner as overflow spillways, and can be equally hazardous. At some projects, sections of flashboards are manually removed to pass water and others are designed to automatically collapse during high water periods creating a sudden increase in flow. Each of these operations could create a hazard during periods when water is being spilled, especially when flows are rapidly increasing. In general, flashboard (or rubber dam) spillways should be regarded with the same caution as overflow spillways.

Deep, submerged spillways and outlet works are generally considered to be relatively safe because the hazardous currents are well below the surface. However, since these spillways cannot be seen from the surface, they are particularly dangerous to swimmers and scuba divers.

Needle beam spillways often create a considerable hazard when several beams are removed to spill water. Even relatively narrow openings are often of considerable depth and can pass a large volume of water creating swift currents.

POWERHOUSE INTAKES - At some projects the entire river flow passes through the powerhouse during periods of low to moderate flows. During heavy flow periods, powerhouses are usually used to capacity with the excess water being spilled. The currents in the powerhouse intake areas are moderately swift, especially during periods of maximum generation. Intake areas are usually equipped with trashracks that should prevent anyone from being drawn into a turbine. However, at most projects it would be hazardous to be swimming or boating near intake areas, because a person could be pinned against the trashracks making escape improbable.

POWERHOUSE TAILRACE AREAS - Powerhouse tailrace areas are usually more hazardous than the intake areas. Sudden increases in tailrace flows caused when the generators go on line are often very hazardous to persons that are near the shorelines, or wading or boating in the tailwater areas. The degree of the hazard varies depending on such factors as the volume of flow,

the rate of change in flow, the turbulence created, and the size of the tailrace area. At some projects with large tailrace areas, eddy currents can be quite dangerous to drifting boaters or swimmers because they can draw an object or unwary victim into turbulent water below spillway or powerhouse discharge areas.

SPILLWAY TAILRACES - Turbulent and dangerous white water areas are often created below operating spillways. When spillway gates are raised or flashboards suddenly trip, the sudden discharges can be very hazardous to persons in the tailwater or along the shoreline in the immediate downstream area.

CANALS - Canals are a part of many hydro projects. Concrete or other hard surface linings (whether vertical or sloped) are common and create hazardous conditions. It is very difficult for persons caught in the water of a lined canal to get out without help because the water, algae, mud, etc. make the linings very slick. Other structures associated with canals may also be dangerous.

INTAKE AREAS - The inlets to conduits, tunnels, inverted siphons, or sagpipes are extremely dangerous. From the surface, such areas may offer little visible evidence of the dangerous undercurrents. Headgate structures near entrances to canals often create hazards as water flows under or through the gate openings or trashracks.

BOAT RAMPS - Boat ramps can present a number of hazardous situations. Accidents at heavily used boat ramps are well-documented. Statistics also show that alcohol and substance abuse by boaters contribute to increasing the number of accidents. These problems will increase as the recreating population increases. The proximity of boat access points to project facilities is an important factor that should be considered in developing any plan for safety devices. Consideration should also be given to limiting boating activities in obviously hazardous areas. Boat ramps located in close proximity to spillways, powerhouses, intakes or canals where swift or dangerous water currents can exist are areas that require special attention. Boat ramps in areas of high boat traffic may need signs, etc. to control the number of boats and the direction and speed of boat movement.

NATURAL CHANNELS - Hydro projects are constructed to take advantage of unique natural topography. This inherently results in projects being located in steep terrain, canyons, or near channels that are used primarily for power production. These areas are naturally hazardous even without the hydro facility. However, since a project could make access easier, this factor should be considered in any overall plan for preventing public access or providing safety devices. Often the spillway, powerhouse, and other project facilities can be obscured from view by the natural topography. Therefore, individuals could unknowingly enter dangerous areas if access is allowed or adequate safety devices are not provided.

SUBSTATIONS AND POWERLINES - Substations are located near many project dams. The electrical shock hazards associated with these substations are obvious and such facilities are usually well protected with fences and signs. High voltage power lines associated with the powerhouses and substations may be located in areas where boaters or fishermen could accidentally make contact with them. Fluctuating reservoir levels affect the amount of vertical clearance, as do hot weather and ice storms which often cause powerlines to sag. These factors should be considered when determining the safe height for the powerlines.

BRIDGES - Bridges over project reservoirs may create hazards for sailboaters attempting to pass under them. Low bridges and bridges with cross members, understructures, and cables constructed close to the water surface can be hazardous to boaters.

PROJECT STRUCTURES - Project structures accessible to the public can present many safety problems. There is danger of falling from dams, wingwalls, or headgate structures into reservoirs or tailrace areas. Large boulders and other rip-rap material on dams and along dikes can be hazardous to the public. Powerhouses and other project buildings have many inherent hazards. Therefore, public access to these areas should be restricted. Catwalk structures and slippery spillway surfaces are also hazardous areas that should be avoided. Public access to intake and debris deflector booms located near hazardous waters should be restricted.

NATURAL AND OTHER HAZARDS - Natural and other hazards, such as submerged stumps, protruding rock formations, and inundated concrete structures, while relatively safe at some reservoir levels, may present serious hazards to boaters and swimmers at other reservoir levels. Whether man-made or not, consideration should be given to marking hazards with buoys or signs.

RECREATION AREAS - There are hazardous conditions at many public recreations areas, and scenic overlooks that my require special consideration. Hazardous areas at project recreation facilities provided by licensees are of particular concern. Designated swimming areas should be isolated from boating areas, and located in safe waters away from sudden dropoffs, swift currents, or other dangers. Playgrounds should be located away or isolated from hazardous waters and heavily traveled roads. Adequate fencing should be used in high use areas. Public safety at recreation areas is under the jurisdiction of State and local agencies but can be enhanced by the support and cooperation of the licensee. Staff should therefore identify potential safety problems to the project owner and request that they be called in writing to the attention of the appropriate authorities. Staff should also determine if these conditions exist and if they were properly considered, including adequate safety measures, in the Recreation Plan (Exhibit R or Exhibit E) approved by the Commission.

WINTER CONDITIONS - Thin ice can be hazardous to snowmobilers and other wintertime recreationists. Of particular concern are thin ice conditions created by project operations. Swift currents, as well as devices to prevent gates from icing up such as heaters and air bubblers can create thin ice areas.

OPERATIONS AND OTHER FACTORS AFFECTING PUBLIC SAFETY

Many hazardous aspects of projects are not present at all times and they may not be readily observed during a brief inspection of the project. Therefore, it is important to consider the full range of spillway and plant operations that could cause hazardous conditions.

Peaking operations are more hazardous than run-of-river operations, since tailwaters are normally calm and low flows occur between periods of generation. When generation begins, the tailwaters could rise rapidly and become swift and hazardous in a very short time.

It is particularly important to determine that a project described as run-of-river is actually operated continuously and that it does not have frequent generation cycles. Some plants with small reservoirs that are located downstream of larger peaking plants cannot store water and are considered "run-of-river" plants. However, they actually operate in tandem with the upstream peaking plant and have frequent generation cycles with flow fluctuations.

Tailrace areas are particularly dangerous when spillway gates are opened quickly and without warning, discharging flows into dry or calm areas below spillways.

Remote operation or automation of hydro projects may increase the chances of accidents at the projects by eliminating the observations, judgements, and warnings of an operator. Therefore, un-manned, remotely-controlled facilities may require more safety devices to adequately warn and protect the public.

Weather factors, such as rain, snow, ice, and fog, can make project surfaces slick and obscure visibility, resulting in signs being less effective. Relatively safe areas in the daytime may become dangerous at night when neither signs nor the hazardous areas can be observed. Heavy to moderate wind gusts can make rowboats,canoes, sailboats, small motorboats, and even large motorboats that have lost power difficult to control. Thus, during windy or high flow conditions, boaters may not be able to adequately react to warning signs or lights if they are forced into hazardous areas. The potential for these situations should be taken into account when considering site-specific public access restrictions and safety requirements.

At some projects recreational use is very heavy during special seasons, such as the opening days of fishing seasons or during upstream anadromous fish migrations. Such concentrations of recreationists (fishermen) can create special safety problems as they compete for the use of areas that provide the better recreational opportunities and likely tend to cause recreationists to take more risks.

The proximity of boat launching areas, canoe/kayaking portages, and other recreation areas to dams and powerhouses should be scrutinized. If they are too close to these facilities, special

safety considerations may be necessary. For instance, during periods of high flows, boat ramps and portages should be physically closed to the public (e.g. locked gates), but provisions should be considered for rescue purposes. There have been serious accidents caused by locating these facilities too close to dams. If a boater loses control of a boat or canoe, the velocity of the flood flows could draw a boat over or through a spillway. If a boat ramp is not operated by the project owner, then the project owner should advise the boat ramp operator of the dangers and suggest closure of the ramp until high flows subside.

Public respect for high dams and spillways is generally greater than it is for low structures. Low head and small diversion dams can be especially hazardous due to the indifference with which the public views them. Very dangerous reverse or "keeper" flows are often created on the downstream side of small overflow dams, and even those with as little as two feet of head can be very dangerous. Therefore, most dams should have some sort of safety protection regardless of the size of the dam and reservoir.

It is possible that, at times, several of these factors could simultaneously occur at a project, making otherwise safe areas dangerous. Therefore, it is necessary that consideration be given to these and other factors when analyzing the hazardous aspects and determining the safety needs of a project.

SAFETY DEVICES AND MEASURES

As a general rule, all projects will require some type of safety devices, warning systems or other measures. The amount of protection necessary increases as public exposure to the hazards increases. For example, one canal may require only a warning sign, while another may require safety nets, escape ladders, several warning signs, and the need to be enclosed with a chain link fence.

Safety devices and measures can be divided into five basic categories: (1) Educating and informing the public, (2) Visual and audible warnings of hazardous areas, (3) Physical restraining devices, (4) Escape devices, and (5) Procedures for safer project operations. Examples of possible safety devices and facilities have been depicted on Figure 1 (Appendix 1) to assist staff in its overall review of public safety.

(1) EDUCATION AND INFORMATION - Owners are usually well aware of the hazards that can exist near hydropower projects. Therefore, the owner has a unique opportunity to take the initiative to educate and inform the public of the specific hazards near its hydro projects and of the general rules that should be followed to be safety conscious. Where appropriate, information could be disseminated in recreational brochures, company literature, video tapes, television or radio announcements and in newspaper articles and advertisements. If feasible, as part of its public relations program, an owner should make every effort to meet with the public at schools, civic organizations, etc., communicate with the public through the media, and distribute literature on public boating and water safety practices. The Coast Guard, state natural resource agencies, schools, private boating and swimming clubs, and water safety organizations such as the National Water Safety Congress, may have existing safety programs and information. Therefore, owners should be familiar with such programs and information so that they can assist the public by referring them to the appropriate agencies and organizations.

(2) WARNING DEVICES - Warning devices include such items as danger and warning signs, canoe portage signs, audible warning devices, lights and illumination, beacons and strobe lights, buoys, and verbal warnings. These devices are required where necessary to warn of hazardous spillways, powerhouse intake areas, tailraces, and other hazardous areas and conditions.

Danger and Warning Signs - Each dam should have adequate danger and warning signs. Properly located and spaced signs can be an effective method of preventing persons from entering hazardous areas. It is important to locate signs so that persons entering an area from any direction can see one or more of the signs. Figure 1 (Appendix 1) shows possible locations of signs. Where it is not feasible to install boat restraining barriers due to the length of the dam or spillway, or other constraints, a system of warning buoys and signs should be installed at least 300 feet from the structures or at a greater distance, depending on where the hazardous current begin. If the project reservoir is small, as a practical matter it may be necessary to place the buoys and signs closer to the dam.

The size of lettering and the signs themselves should be of sufficient size that persons (even those with less than perfect eyesight) would not have to enter the danger zone to read the signs. As a general rule, when a boater is 300 feet from any dam signs warning of a dam should be legible and easily noticed. Proper wording of signs is important and can improve effectiveness. Signs should convey a message that clearly advises the reader of the real danger. In addition to "No Trespassing" or "Keep Out" signs, it would be informative to have signs that state: "Danger - Dam Ahead", "Danger of Drowning", or "Stay Alive by Staying Out". Signs should be kept in good repair and fading signs should be repainted. Plants, grasses, and trees that obstruct shoreline warning signs should be removed. Contrasting colors should be used for sign lettering and background. A regular sign inspection program should be developed and documented to ensure that all signs are maintained in good condition. It is particularly important to inspect signs after severe weather or flood conditions. Figure 2 (Appendix 2) is provided for use in determining the size of lettering based on distance from signs.

Power and Communication Lines - Power and communication lines require special signing to warn recreationists of clearance heights. Minimum recommended vertical clearances for power and communication lines over reservoirs are found in the current revision of the National Electrical Safety Code (NESC) and in other regulations. These clearances, which are primarily established for the protection of sailboaters, increase as the size of the reservoir and power line voltage increases. High voltage power lines near powerhouses and substations may be located where fisherman could accidentally make contact with them. Such lines should either be raised or access should be restricted near them. Powerlines that cross project reservoirs should be constructed at heights sufficient to provide safe passage for the maximum height of masts on the sailboats that are likely to use the reservoir. If the project owner is not also the owner of the power or communication line, the project owner should be advised in writing to contact the owner of any line that does not meet safety codes and suggest that the line be raised to a safe height. A copy of the letter should be furnished to the Regional Office.

Audible Devices - Audible devices, such as sirens, horns, or buzzers, are generally used to warn of sudden changes in the rate of flow, usually in tailwater areas of spillways or powerhouses. It is also important to provide warnings of sudden changes in operation, such as a gate opening to pass flows that have been cut-off due to a plant shutdown. Sirens should not be used in congested areas where they could be mistaken for emergency vehicles. At projects with heavy fishing and boating use in tailraces, or where difficult terrain prevents a quick exit from the river, advance warning of 10 to 15 minutes may be necessary. It may also be prudent to have a warning sounded shortly before the releases are made. Signs advising of the meaning of the audible devices should be posted along all access points near hazardous tailwater and other areas.

Lights - Lights can be used to illuminate signs, the dam itself, and other hazardous areas. It is desirable that at least some of the warning signs around dams be illuminated at night. Lighting should be considered at dams, tailrace areas, substations, and even boat barriers for night visibility, particularly if boating at night is a regular activity. Specially designed signs, safety devices, including lighting may often be necessary so that safety devices, including lighting may

often be necessary so that safety devices are effective under adverse weather conditions. Some projects may not have a power source, therefore, lighting may or may not be feasible. A regular lighting inspection program should be developed to ensure that lights are functional.

Beacons - Beacons and strobe lights can be utilized near spillway gates and overflow spillways and, if appropriate, they should be activated to provide visual warning when water is being discharged. Flashing strobe lights can also effectively compliment audible warning devices.

Buoys - Individually anchored buoys basically serve as floating signs. They can be used to mark navigation channels, to identify danger zones and hazardous submerged objects, to regulate boat speed, and to provide other types of information to boaters and swimmers. A line of individually anchored buoys can serve to mark off and identify hazardous areas and also provide a means of warning boaters. The number, location, and need for buoys must be a function of the level of use of the particular areas in question. In general, buoys should be installed in accordance with accepted rules and regulations in the state where the project is located. Buoys may not be appropriate in low-use areas in many cases or in areas where the pristine nature of the area should be preserved. However, buoys should not be substituted for restraining barriers where a positive restraining barrier is feasible.

Verbal Announcements - Recorded or direct verbal warnings can be used at many smaller projects to warn fishermen and boaters in tailrace areas that gates are going to be opened if the project is always manned. However, this can only be effective if dam tenders and other personnel working near dams are adequately trained to advise visitors of a project's hazardous areas.

(3) RESTRAINING DEVICES - Restraining devices include boat restraining barriers, fences, guardrails, natural barriers, trashracks, debris deflector booms, and other similar devices.

Boat Barriers - Boat restraining barriers as well as warning devices should be provided at those projects where boaters and canoeists are exposed to hazardous spillways, tailrace areas or intake areas. Free-flow spillways are the most hazardous. These include uncontrolled spillways (including those with flashboards) and gated structures where the spill is over the gates (bascule or similar gates). It is recognized that hazards may only exist near gated or other mechanically controlled spillways when water is being spilled. However, protection must be provided in such areas if there is recreational activity near the dam so that boaters and swimmers are safe during periods when water is being spilled. In no case should a spillway be operated without restraining barriers, where deemed necessary. Special attention should be given to channels that lead to spillways or other potentially dangerous areas. Restraining barriers should be placed at the upstream end of such channels, preferably at least 300 feet from the channel entrance. In some instances, it may be necessary to install boat restraining barriers downstream of dams to prevent boaters form entering unsafe areas. Where buoys are used in lieu of positive restraining barriers, they should be placed at about 100 feet apart (or greater distances for long reaches), be made of

non-corrosive or corrosive protected materials, extend above the water surface so they are readily visible, painted with bright colors, and include signs and/or standard U. S. coast Guard Inland Waterway markings that warn boaters of the danger beyond the buoys.

Boat restraining barriers are not required at those projects where bridges or other structures constitute an adequate physical barrier, or if it can be assured that hazardous flows and conditions do not occur at the projects during time of the year when boaters or canoeists use the reservoirs. Such determinations should be based on historic project operating records and written data and information provided by the owner, not on assumptions. In addition, if barriers are removed seasonally, the schedule for removal and re-installation should be reviewed to ensure that the schedule is reasonable and there is adequate notice and protection for boaters. Consideration should be given to closing nearby boat ramps when boat barriers are removed. A copy of the schedule should be retained in the Commission's files for the project.

The primary purpose of boat barriers is to physically restrain boaters from entering the hazardous waters near dams. The buoys and floats supporting boat barriers may be marked with signs and symbols that provide a warning to boaters approaching dams. The barriers also serve to mark off and identify the hazardous areas in much the same way that rope and float barriers mark off and prohibit boaters from entering designated swimming areas.

In addition to the boat barriers, warning signs are required on the dams to identify and warn of the hazards. These signs help boaters to understand why they are being restricted by the boat barriers. During winter periods, boat barriers may not be visible or may need to be removed to prevent ice damage. Therefore, signs provide the only means to warn boaters, skiers, or snowmobilers of the hazardous areas and conditions.

Any type of barrier, such as trash booms, debris deflector booms, log booms, and specially designed barriers that have been placed upstream of dams may be considered as satisfactory boat restraining barriers. The effectiveness of each installation should be evaluated on a case-by-case basis. Where necessary to avoid excessively long barriers, anchors can be placed in the reservoirs to facilitate installation. It is important to determine the proper location of barriers at each dam. They should be located an adequate distance upstream to be free from the heavy currents upstream of open gates and intake areas. Cables or barriers located on pier noses and over spillway crests are often of little value because the currents are usually too strong in these areas. The placement of boat barriers should be studied and tested by the owner to ensure that they will be effective when gates are opened and under high flow conditions. FERC inspectors should pay particular attention to the effectiveness of barriers if high flows occur during an inspection. The determination of the need for and placement of a boat barrier still vary and requires a case specific assessment at each dam.

The effectiveness of many existing barriers can be improved by making the barriers more visible, spacing the floats closer together, tightening the cables, and/or placing the barriers at the optimum distance form the dam. Specially designed floats can help to minimize debris accumulation. In some cases, dam owners have provided spotlights that illuminate the barriers at night. The color of the floats on boat barriers is very important for visibility. For instance, floats and buoys colored international orange or alternating international orange and white are

preferable because they can be seen more readily and from greater distances. If any owner has questions regarding the feasible design of restraining barriers, they should be advised to contact the FERC Regional Office or seek assistance from a FERC inspector. The FERC Regional Offices may have an example of a design used by another owner or could provide a contact with another owner regarding a design that may be useful in a special situation.

Fences - Fences and guardrails are required at most projects to prevent public access to hazardous areas such as dams, powerhouses, substations, intake areas, wing walls, etc. Fences, together with signs and locked gates, are probably the most effective means of prohibiting land based access to hazardous project features. At some projects, buildings, high cliffs and other natural barriers can serve, along with fences, to limit public access.

Trashracks - Trashracks are located upstream of most powerhouse intake structures and occasionally in other areas. They are primarily installed for the purpose of catching debris. It is not desirable for the public to have access to trashrack areas because they are dangerous, particularly where there is high velocity flow. Trashracks do prevent those who have fallen in the water from being drawn into turbines, penstocks, siphons, or other enclosed water passages. As such, they serve as last chance safety devices. However, adequate safety devices and warning signs should be the first line of protection because the probability of survival if someone is caught by a trashrack is doubtful.

Guards - Uniformed guards and watchmen are employed in some heavily used public areas to enforce regulations and warning signs and minimize trespassing and vandalism.

(4) ESCAPE DEVICES - Escape devices include such items as life preservers, safety ropes, escape nets, escape ladders and suspended cables. These items provide a means of escape for persons who are otherwise unable to get out of hazardous waters.

Life Preservers - It is desirable that life rings and safety ropes be provided near dams, powerhouses, and canals, etc., where it is likely that someone would be available to use them to aid a victim. These devices should be in readily accessible locations and well identified. If the project is unmanned, then the desirability or need must be assessed on a case-by-case basis. For instance, if vandalism is a problem, then life preservers at an unmanned project may be an unreasonable requirement.

Escape Ladders - When project waters flow through open but confined channels, such as lined canals and concrete lined intake and tailrace areas, self escape devices such as ladders may be considered. As a general rule, and only if considered safe, such devices should be alternately installed on both sides of the canal at intervals of about 250 feet. These devices, however, could be attractive nuisances. Therefore, their location or use should be carefully considered to avoid unsafe use of such devices. If these devices would create a more unsafe condition, then they should not be employed.

Safety Nets - When canals terminate at hazardous structures such as siphon inlets, powerhouse

and penstock inlets, or spillways, etc., safety cables, booms, or safety nets are often necessary for a victim to grab when caught in midstream. If they can be safely installed and used, escape ladders should be located on each side of the safety booms or safety nets to adequately provide for an effective means of escape. Use of safety ladders should always be governed by whether or not they will, in fact, increase public safety. The safety nets often consist of woven rope or woven wire fencing of sufficient height to reach the normal water surface when suspended from a cable across the entire canal width. Care should be taken in the design of suspended cables, because a single suspended cable may not be readily visible and could pose a hazard to boaters, rafters or canoeists. Boat restraining barriers can also be used as an aid to escape from hazardous waters.

Canoe/Kayak Portages - Designated canoe/kayak portages serve not only as recreational facilities, but also as safety facilities. Where necessary there should be landing and portage areas around dams or other structures. If adequately signed portages are not located in safe areas, boaters can unknowingly enter hazardous areas and dangerous situations. Portage signs large enough to direct them to safe take-out sites are necessary at all projects that have even occasional canoeing or kayaking use. As a general rule, canoe/kayak portages should not be within 300 feet of any dam, spillway, or powerhouse. However, portages in closer proximity to structures are permissible if it can be shown that their location does not create unsafe conditions. Kayakers may desire to go over lower dams. This must be discouraged by warnings, barriers and at the request of the project owner, enforcement by local agencies.

Boat Ramps - Ramps for boats, particularly larger power or sailboats, are a necessary part of the recreation facilities at many projects. Generally, boat ramps should be located at least 300 feet from a dam, particularly spillways, power and canal intakes, and channels leading to dams and other structures. If any existing boat ramp is closer than 300 feet from hazardous areas, or areas with high water velocities during flood conditions, procedures and facilities should be provided to close the ramps until the flood subsides to safe levels. Boat ramps may be located closer to structures if it can be shown that their location does not create unsafe conditions. Information on dangerous areas, restrictions on speed or access, alcohol use restrictions, enforcement and penalties, sailboat clearance for power lines and bridges, and other information relevant to safe boating practices should be provided at boat ramps or through other means, such as pamphlets, brochures, maps, etc.

(5) PROJECT OPERATING PROCEDURES - In certain situations, changing project operating procedures can improve safety conditions at a project. For instance, altering or imposing ramping rates for generating units can prevent sudden increases in tailwater levels. Modifying gate opening procedures may reduce or eliminate sudden surges in flows or may be used to direct flows to less hazardous areas. Each owner should be encouraged to review operating procedures as they affect public safety and to propose any necessary improvements, consistent with good public safety practices and the primary purposes of the project.

VANDALISM, ENFORCEMENT, AND OTHER PROBLEMS

At a few projects, especially the remotely controlled developments located in isolated areas, acts of vandalism are common. Fences and gates may be torn down or cut; safety signs may be painted over, torn down, bullet-riddled or even stolen; life rings may be removed and safety ropes and cables may be cut or destroyed. While such acts are difficult to prevent, efforts can be made to reduce them. Wire cables can be substituted for ropes and heavier and stronger gauge materials can be used. If possible, signs can be stenciled on concrete surfaces. Frequent surveillance of vandal-prone areas may be effective. Safety devices should be freshly painted and well maintained to be effective. Back-up systems should be installed where feasible. Facilities damaged by acts of vandalism should be promptly restored.

Consultation with officials of local townships and villages to assist in enacting laws or ordinances prohibiting boaters and others from entering dangerous areas, boaters anchoring to or crossing over boat restraining barriers, and fishermen, swimmers or other recreationists from misusing boat barriers, can improve the barrier's effectiveness. This approach is desirable and provides local enforcement so that the public does not misuse or defeat the purpose of the barriers. Owners should be encouraged to communicate such needs to local officials and agencies so that there is adequate enforcement of safety laws and regulations. The FERC staff should actively support licensees or owners in law enforcement efforts.

BASIC PUBLIC SAFETY MEASURES

Each project should be reviewed for public safety needs on a case-specific basis. It is extremely important to assess the number and type of public safety measures at any project based on the public use patterns at a project. Projects that do not have significant and documented recreational use may, for instance, require only nominal public safety measures such as proper signing. The following is a partial listing of public safety measures that should be considered when undertaking a case-by-case review of public safety at a project (Reference Figure 1 [Appendix 1]):

1. Boat restraining barriers upstream of overflow, gated, flashboard (or rubber dam) and needle beam spillways, powerhouse and canal intake areas, and upstream of natural channels that extend to project structures.

2. Warning signs in tailrace areas.

3. Clearly visible and legible warning signs an appropriate distance upstream of and facing the reservoir of each dam.

4. Fences at substations and restricted access to hazardous areas around dams and other project structures.

5. Audible warning devices, together with signs to explain their meaning, at those projects with sudden changes in operation that result in large flows and rapidly changing tailwater levels.

6. Restricted public access to powerhouses, intakes, and other operating structures.

7. If necessary, canoe/kayak portage signs and routes at projects where canoeists and kayakers require portage around the dam. (Note: Kayakers should be prohibited from traversing over dams).

8. If determined necessary, signs (at least one) facing the reservoir on each dam with a hazardous spillway, with lighting for night time visibility.

9. Signs posted at surge chambers to warn of sudden discharges.

10. Warning signs posted to warn boaters that may have to pass under low bridges.

11. Beacons at those projects with heavy boating activity when spillway gates are open or being opened.

12. Trashracks in the intake areas of powerhouses.

13. Where safe installation can take place, escape devices installed at about 250 foot intervals in steep-sided or concrete lined canals.

14. Signs that warn of thin ice posted where project operations cause hazardous thin ice conditions.

15. Powerline clearances in accord with appropriate codes.

16. Buoys to mark special hazards for boaters in projects reservoirs such as shallow areas, stumps, rock, outcroppings, etc.

17. Spillways, intake areas, and tailrace areas sufficiently lighted at night (i.e. perimeter lighting) to be recognizable from the shoreline and the reservoir, if appropriate.

Because the operation of projects may change and because the public use of many projects continues to increase, the public safety aspects of each project should be periodically evaluated by the owner. Any changes should be brought to the attention of the Regional Engineer so that the FERC can review the adequacy of such changes. An owner should have a well-conceived public safety plan for each of its developments (for further information refer to Appendix 4). During FERC staff inspections, a review of all public safety devices and measures should also be made to identify the need for additional devices or improvements to existing devices. Working cooperatively with project owners, the goal of maximizing public safety at FERC jurisdictional projects can be achieved.

Attachment I

References

1. National Director of Boating Safety Materials -
National Water Safety Council (U.S. Coast Guard, Office of Boating Safety) June 1975.

2. Wisconsin Department of Natural Resources, Wisconsin Administrative Code, Chapter NR330, Warning Signs and Portages For Dams.

3. Planning, Design, Operation and Maintenance of Inland Water Swimming Beaches, National Water Safety Congress, 1988, NWSC B-12.

4. Guide for the Safe Operation and Maintenance of Marinas, National Water Safety Congress 1988, NWSC B-13.

5. Recreation Planning and Design Criteria, U.S. Army Corps of Engineers, EM 110-1-400, July 31, 1987.

6. Water Safety Journal, Quarterly Publication, National Water Safety Congress - Water Safety Journal, P.O. Box 19000, Seattle, WA 98109.

7. Water Safety and the Young Adult, Training Kits #NWSC-TM, NWSC-TC, and NWSC-TV - National Water Safety Congress, 2182 Ivory Crest Drive, Buford, GA 30518.

8. Public Safety at Dams, USBR SEED Course, Author - Rob Rocklin, U.S. Bureau of Reclamation, May 22, 1987.

9. Public Safety and Access Program (DRAFT), Department of the Interior, Bureau of Reclamation, Denver, Colorado, September 1989.

10. Hydro User Group (Wisconsin, Michigan) Uniform Signing and Warning Device Recommendations, 1988 HUG Meeting, Wausau, Wisconsin.

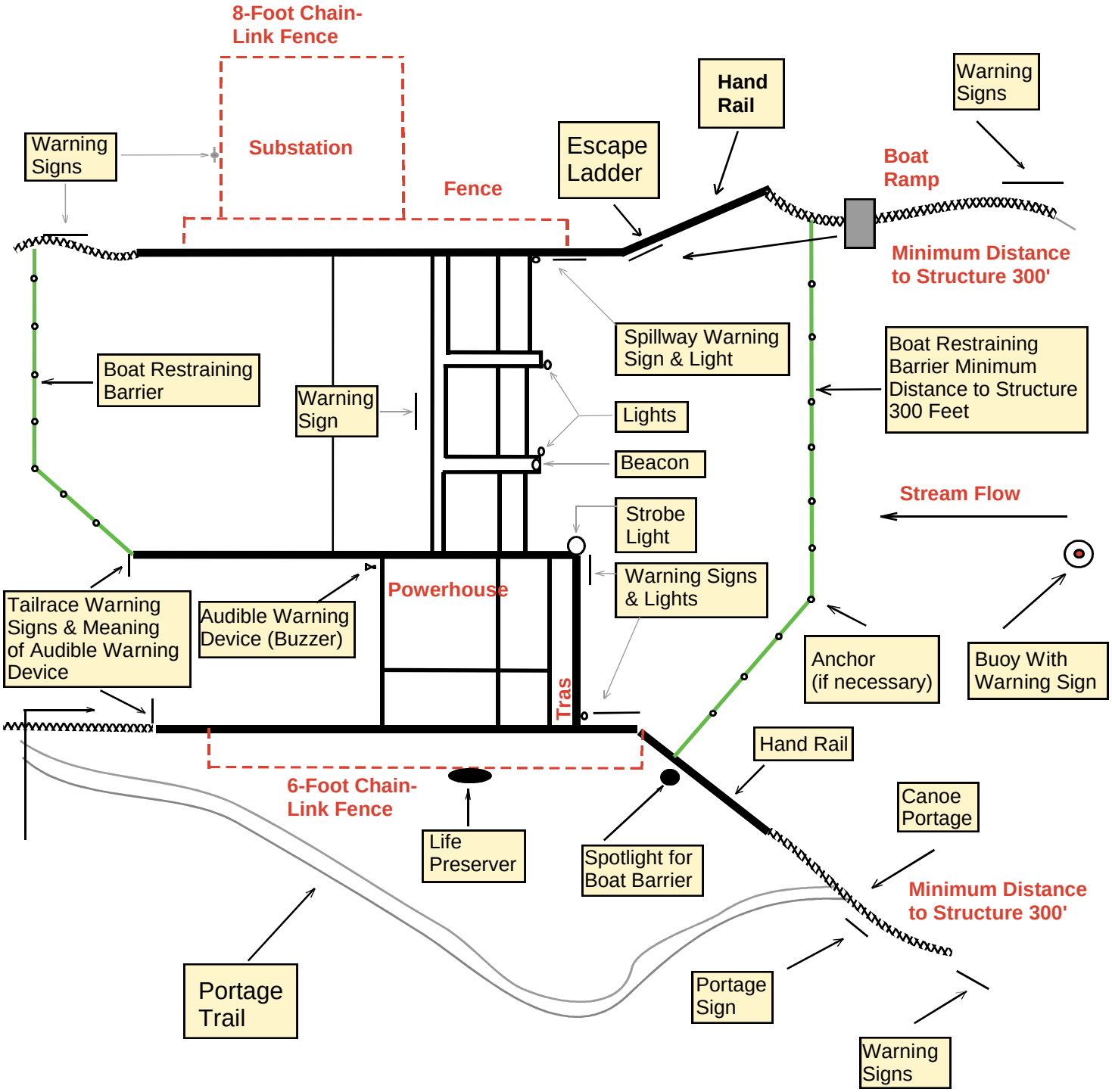


Figure 1 - Typical hydropower dam showing location of public safety facilities

- Not to Scale -

Criteria For Signs
(Letter Size Versus Distance From Sign)

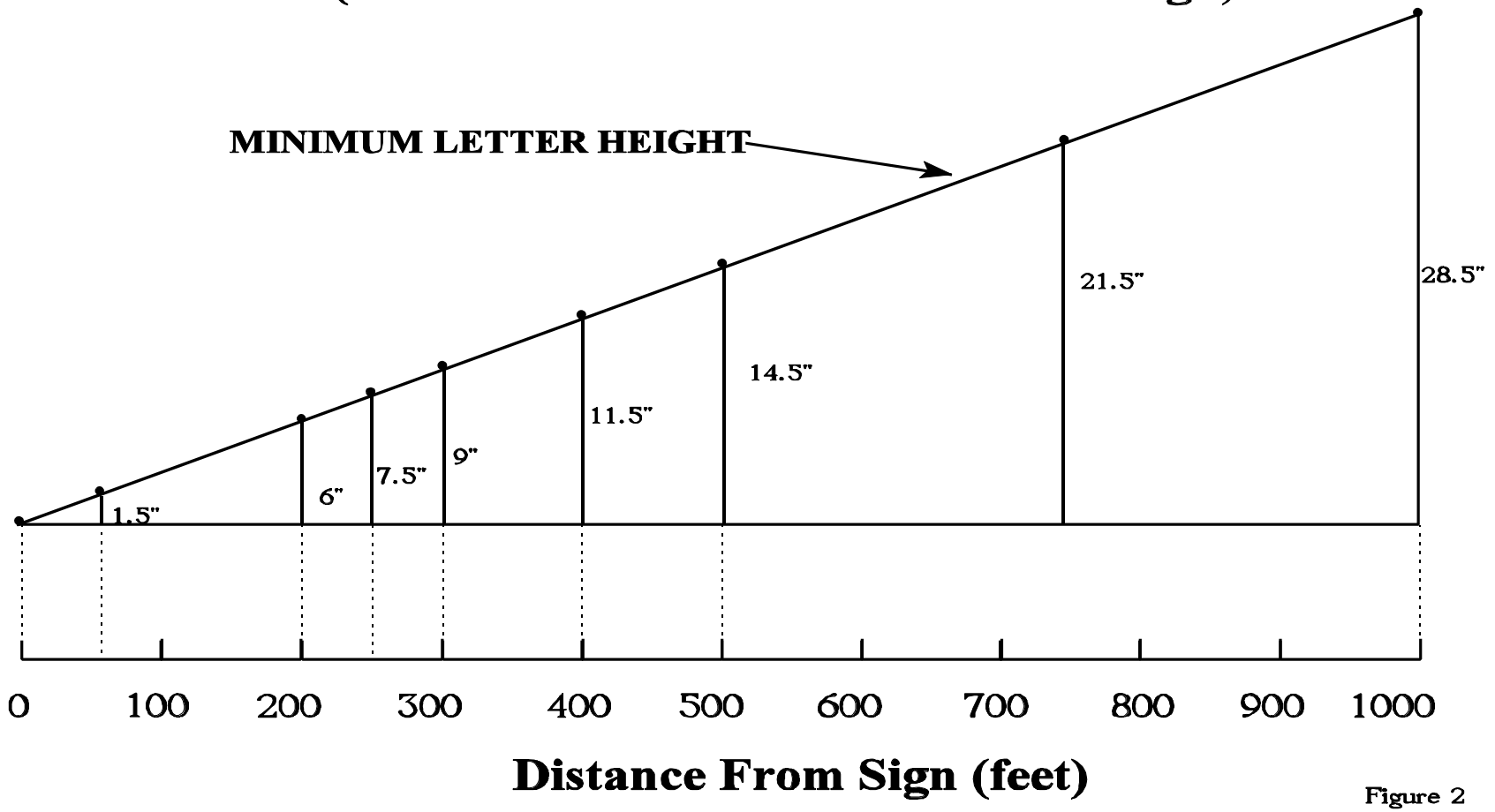


Figure 2

*****This is a Reproduction of the Original Letter*****

FEDERAL ENERGY REGULATORY COMMISSION
ATLANTA REGIONAL OFFICE
700 PEACHTREE STREET, N.E.
ATLANTA, GEORGIA 30308
August 2, 1991

Addressee List Enclosed

This letter addresses public safety devices at hydroelectric projects that are subject to the Commission's licensing authority, either licensed or exempted projects. Pursuant to Sections 12.4, 12.42 and 12.43 of the Commission's Regulations (18 C.F.R., Part 12), an owner of a project may be required to install and properly maintain any signs, lights, sirens, barriers or other safety devices necessary to adequately warn and/or protect the public in its use of project lands and waters.

Existing public safety devices or measures that have been required by a Commission action or requirement are, by definition, approved project facilities or measures. In addition, public safety devices or measures installed by owners on their own initiative are considered approved, unless specifically stated otherwise by the Commission or its authorized representative.

Licensees and exemptees must adequately maintain such devices or measures in the operation of their projects. Failure to do so would be a violation of the Commission's regulations and could subject a licensee or exemptee to the enforcement provisions of the Federal Power Act.

We are aware that certain safety devices may need to be temporarily removed, because of project maintenance, winter ice periods, annual flooding, river debris problems, or other reasons. Therefore, unless required by an emergency situation, you must notify this office in writing at least 10 days in advance of your intent to remove or render inoperative any safety device. The notification should include the reason and proposed date for removal, and a schedule for reinstallation. You must also provide this office written notification no later than 10 days after reinstallation. Based on the information submitted in your notification, we may require changes to your removal and reinstallation plan and may prescribe such additional safety measures as are deemed appropriate. For those devices routinely removed or rendered inoperative on an annual basis, a one-time notification giving the reason for removal, and submission of a schedule for periodic removal and reinstallation would be appropriate. During any period when an approved device is temporarily removed, you must develop such additional measures as are appropriate for the particular project site to properly notify and protect the public if there is any increased danger while the approved device is not in place. Your notification to this office must include a description of those additional measures.

You are also reminded that Section 12.10(b) requires that you report all accidents resulting in deaths or serious injuries that occur at a project.

If you have any questions regarding public safety devices or measures, please contact Mr. Lorance (Randy) Yates of this office.

Sincerely,

Robert W. Crisp, P.E.
Director

Appendix 4

*****This is a Reproduction of the Original Letter*****

FEDERAL ENERGY REGULATORY COMMISSION
NEW YORK REGIONAL OFFICE
201 VARICK STREET, ROOM 664
NEW YORK, NEW YORK 10014

March 11, 1992

To the party addressed:

RE: Public Safety at Hydropower Projects

On August 1, 1991, we sent you a letter concerning public safety devices and measures at hydropower projects subject to the Commission's jurisdiction. To assist us in our continuing effort to review the adequacy of public safety measures, you are requested to provide this office with a public safety plan (plan) for your project(s).

It is not intended that preparation of the plan be a major endeavor requiring substantial resources. The information in the plan should be in a simple, basic form. Therefore, the plan need not be overly complex. The plan should, at a minimum, include a listing of each existing safety device at your project(s) and a schematic drawing showing the general location of each device. For the latter information, you may use a sketch or an existing plan view drawing. We are enclosing as samples the schematic drawing form our March 1990 publication, Public Safety at Hydropower Projects and a drawing form a plan submitted by a Licensee.

All safety devices, including fences, sign, boat barriers, buoys, log booms, alarms, illumination and beacon lights should be listed and shown on the drawing. In addition it should include additional information, such as height and type of fences, size and type of boat barriers, distance of barriers from spillways and intakes, sign wording, and type and schedule of alarms.

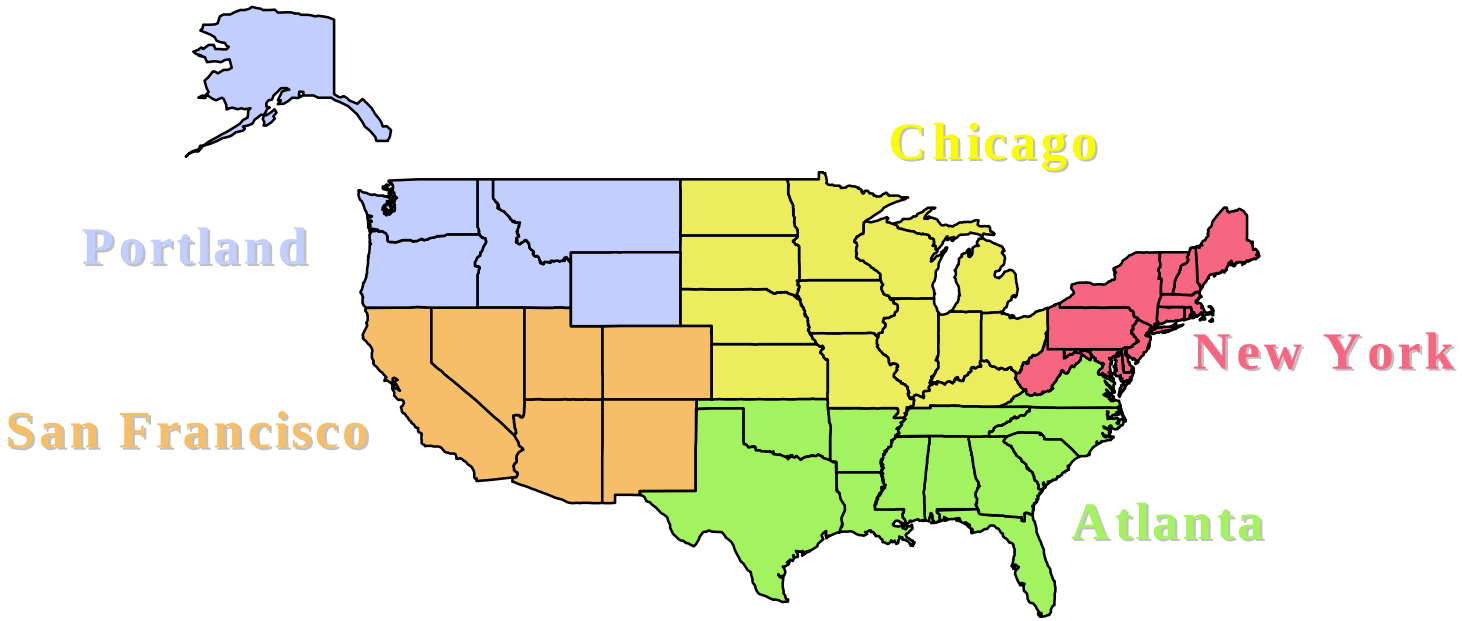
If you have previously given us a plan that complies with the above, please provide only the date of that submittal.

Please submit two copies of the plan by April 30, 1992. If you have any questions, feel free to call Mr. Joseph Enrico of my staff at (212) 337-2619

Sincerely,

Anton J. Sidoti
Director

Division of Dam Safety and Inspections
Regional Office Boundaries



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