REQUIREMENTS FOR DEVELOPING SMALL-SCALE HYDROPOWER IN IDAHO

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A detailed manual covering the procedures for planning and licensing a hydropower development in Idaho is planned for publication in June 1983 by the author.

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in cooperation with

Idaho Department of Water Resources
Idaho Public Utilities Commission

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ABSTRACT, INTRODUCTION, AND STATEMENT OF PURPOSE

This brochure is published as a guide for potential developers of small scale hydropower in Idaho and for agency personnel and consulting firms called on to advise people interested in developing small hydroelectric plants under recent regulations and laws. Addresses and recommendations are included as to where to go for needed help, for approvals, and for advice.

DEFINITION OF HYDROPOWER AND CLASSIFICATIONS

Hydropower as considered in these requirements is the production of mechanical energy by pasing water through a hydraulic machine that is rotated by the action of water and the machine in turn rotates an electrical generator to produce electrical energy. The hydraulic machine is a turbine or a pump run in reverse as a turbine. Simple water wheels might also be used to harness the energy in a stream of water but they are usually not practical to rotate at speeds that can be connected either directly or by gears to an electrical generator.

The basic types of turbines in common use are Impulse turbines (Pelton, Turgo, and Cross-flow turbines) and Reaction turbines (Francis turbines and Propeller turbines). Figure 1 shows a general graphic classification of types of turbines.

Selecting appropriate turbines and generators with accompanying physical facilities is a part of a feasibility study. This is normally done by consulting engineering firms. Figure 2 is a chart showing the applicable ranges of turbines.

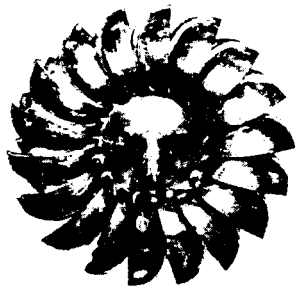
ENGINEERING AND TECHNOLOGICAL REQUIREMENTS

The most important engineering requirements are determining whether a particular site has sufficient head and flow to produce enough energy to make an economically viable project. Determining head requires measuring the elevation at the headwater and the tailwater and estimating a friction loss for the flow in the penstock or water passages up to the turbine. A simple sketch of three representative developments is shown in Figure 3 to identify the above terms that are used and necessary in determining engineering feasibility. Determining flow is a more difficult problem. What is needed is an estimate of how flow varies with time throughout the year and throughout the possible period of use of the power plant. Normally it will be best to get the help of an engineering consulting firm to make the necessary water studies. Engineering firms operating in Idaho and information on their availability can be obtained by contacting the Engineering Registration Board of the Idaho Society of Professional Engineers†. Numerous other problems of a technical nature will be encountered as one proceeds through various development stages. This will mean as a minimum obtaining information on:

1. Size of turbines, turbine speeds
2. Types of generators and electrical switchgear

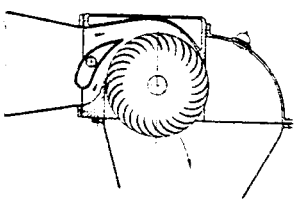
†. The address for the Engineering Registration Board and Idaho Society of Professional Engineers is the same:
842 La Cassia Drive
Boise, ID 83705

IMPULSE TURBINES

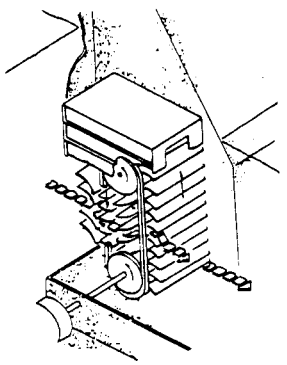


Pelton

Turgo



Crossflow

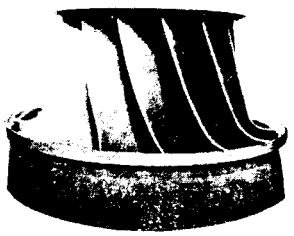


Schneider Power Generator

REACTION TURBINES

High-head Francis

Medium-head Francis



Low-head Francis

Fixed-blade Propeller

Adjustable-blade Propeller

Figure 1. Types of turbines.

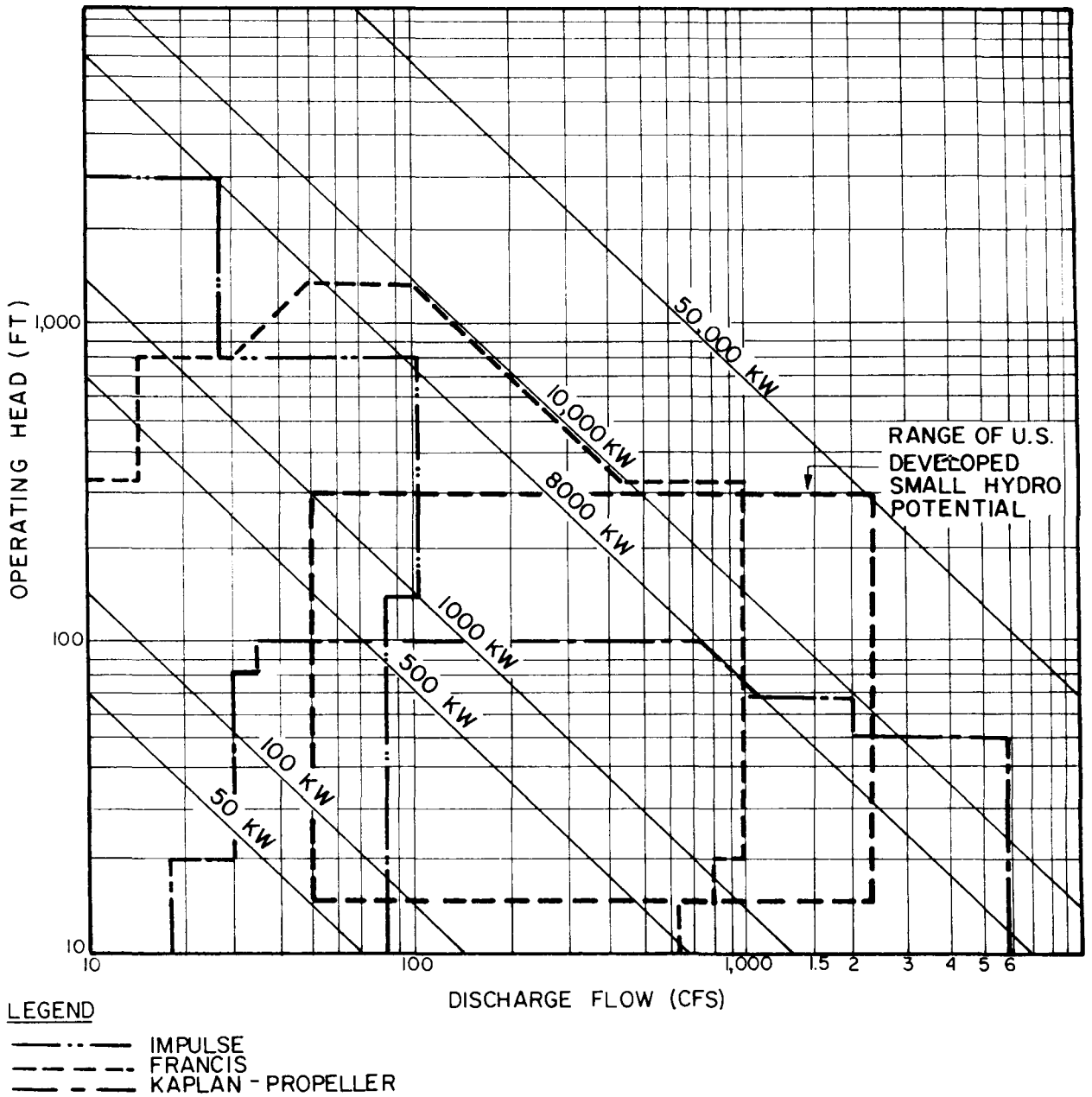
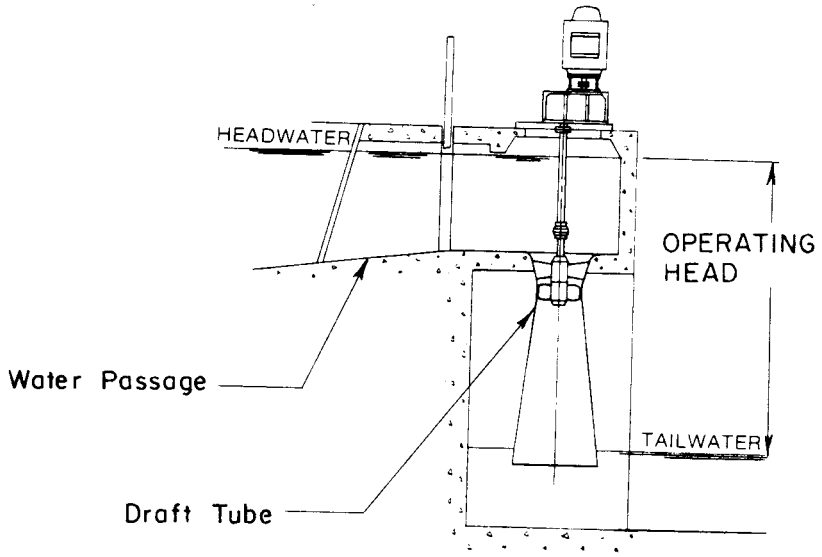
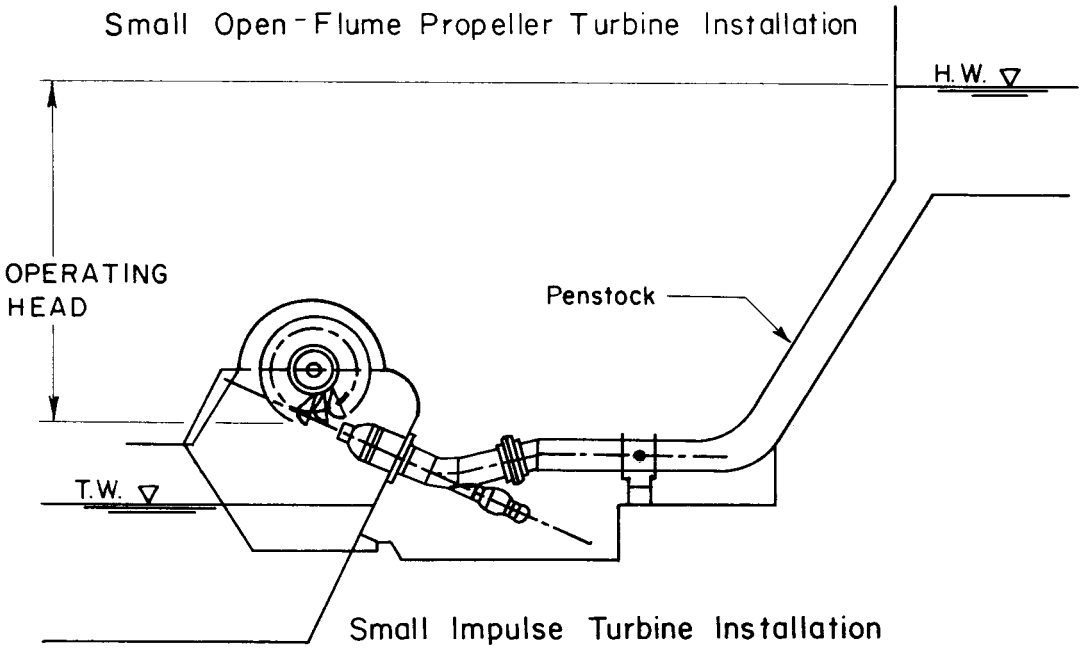


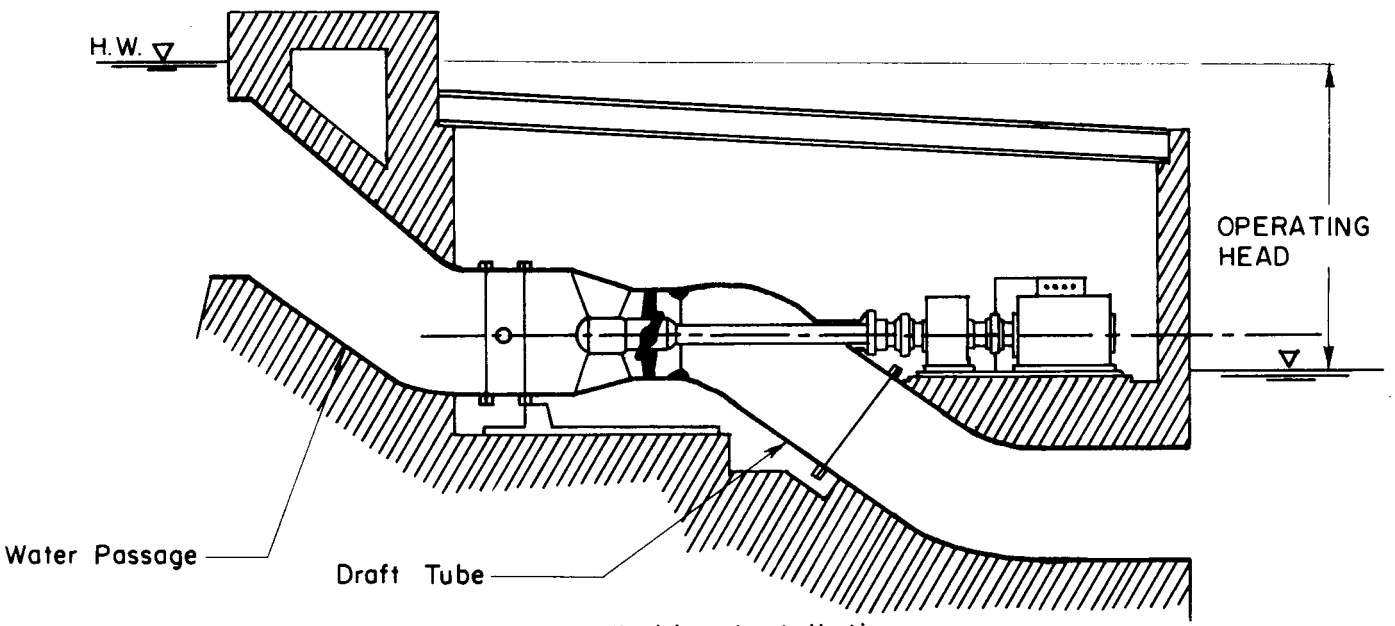
Figure 2. Applicable ranges of turbines.



Small Open-Flume Propeller Turbine Installation



Small Impulse Turbine Installation



Small Tubular Turbine Installation

Figure 3. Representative small turbine installations.

3. Civil works of dams and diversions for diverting water to and through the turbines
4. Bypass facilities for surface water and flood water
5. Access roads
6. Transmission lines and required right-of-way. A more detailed checklist of overall needed information is included as an appendix.

Another important part of the feasibility study is the economic analysis. Early estimation of energy production and expected costs should be made to determine if further study is justified. Useful reference on the economic analysis are publications by Brown (1981), Cunningham (no date), and Gladwell (1980). This part of feasibility analysis likewise usually requires competent engineering consultation.

INSTITUTIONAL, LEGAL, AND ENVIRONMENTAL REQUIREMENTS

Federal Processing Requirements

The Federal Energy Regulatory Commission, FERC, has major responsibility for regulating hydropower developments. This responsibility extends to nonfederal projects that affect navigable waters, occupy federal lands, use water stored behind government dams, or affect interstate commerce. This includes almost all developable sites. An exception might be a development of hydropower in a water conveyance system such as a pipeline or canal that is privately owned and control is completely independent of a free flowing stream.

Five possible ways of handling and permitting the action by FERC are given in Figure 4. The developer should first determine which of the five jurisdictional approaches will apply. If there is a question as to which will apply, a letter should be written to FERC requesting an opinion as to whether and how FERC will assert jurisdiction. The transmitting letter should contain information on stream location, type of diversion, head, flow duration data, expected power capacity, and land ownership involved. The address and phone contact is:

Federal Energy Regulatory Commission
Office of Electric Power Regulation
825 Capitol Street, N.E.
Washington, D.C.
phone (202) 376-9171

Procedures for proceding with FERC requirements are listed in the publication FERC-0097 the Blue Book, "Application Procedures for Hydropower Licenses, Exemptions and Preliminary Permits," dated April 1982. Periodic changes and new regulatory order are reported in the Federal Register.

On exemption applications the developer is required to make contact with other federal agencies to obtain necessary terms and conditons that will apply if the exemption is to be granted. These might involve U.S. Fish and Wildlife Service, U.S. Bureau of Indian Affairs, U.S. Bureau of Land Management, U.S. Forest Service, U.S. Bureau of Reclamation, U.S. Corps of Engineers, U.S. Park Service, the Environmental Protection Agency, and National Marine Fisheries Service.

A requirement that is independent of FERC but required by its regulations is to obtain a "404" permit from the U.S. Corps of Engineers. The Corps of Engineers has responsibility for navigable streams, in the regulation of structures on streams, and material movement on streams.

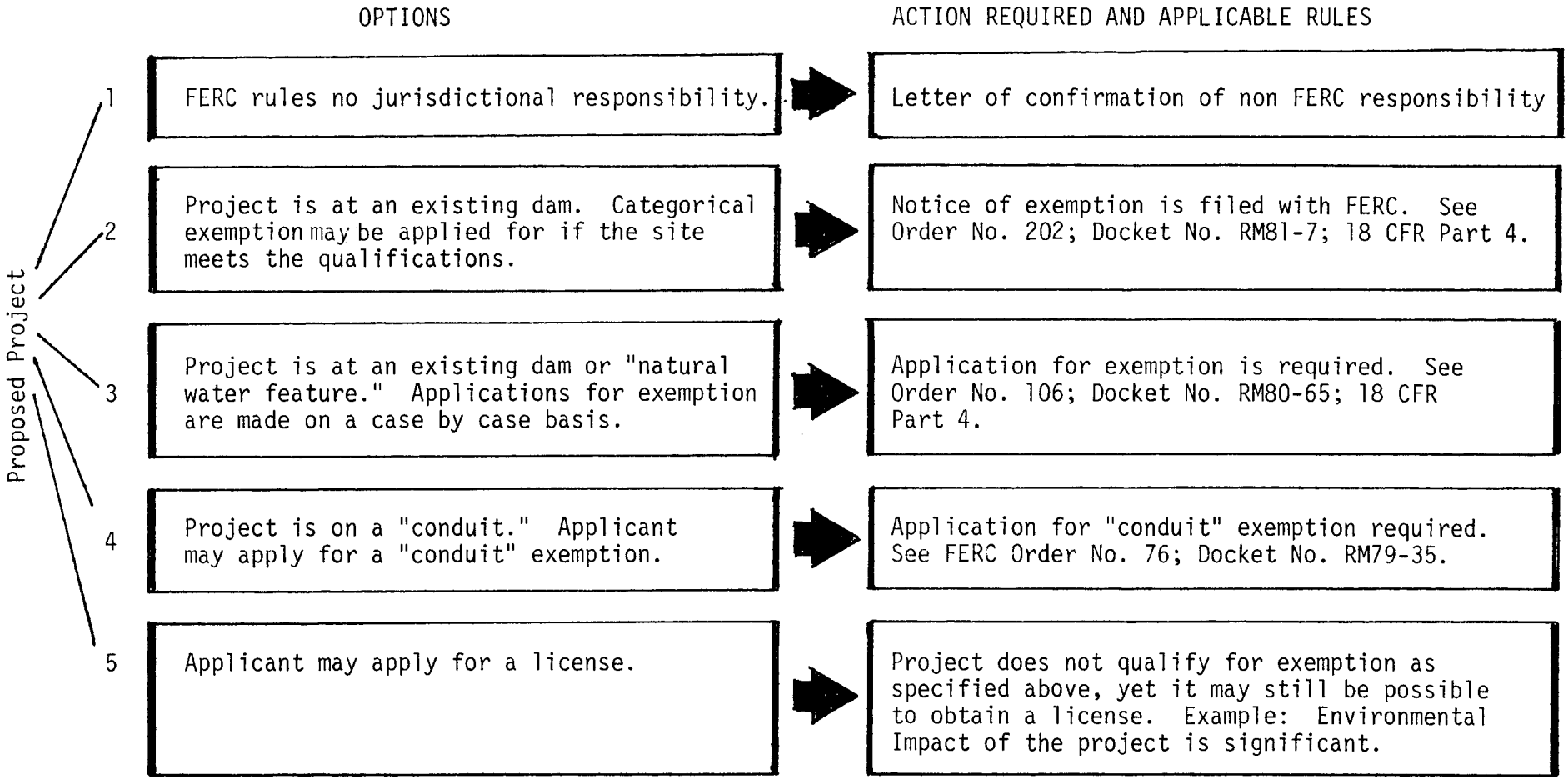


Figure 4. Regulatory options available through Federal Energy Regulatory Commission.

Navigability of streams is difficult to determine but even most small streams in Idaho are termed navigable streams. Canals and supply conduits already in place will not fall under this permitting need unless they impact the navigable stream. Contact will involve the Walla Walla District Office of the Corps of Engineers for streams in the Snake River drainage upstream of Lewiston. All streams in Northern Idaho not draining into the Snake River upstream of Lewiston will involve the Seattle District Office of the Corps of Engineers. Streams in the Bear River drainage in Idaho will involve the San Francisco District Office of the Corps of Engineers. The addresses of the appropriate offices are:

Walla Walla District
Army Corps of Engineers
Bldg. 602 City-County Airport
Walla Walla, Washington
(509) 525-5500

Seattle District
Army Corps of Engineers
P.O. Box 3-3755
Seattle, WA 98134

San Francisco District
Army Corps of Engineers
211 Main Street
San Francisco, CA 94105

The appropriate form for the "404" permit application is ENG Form 4345.

An additional federal requirement may involve another permit known as a "402" permit. This covers discharge of any pollutant into a navigable stream. If the quality of the water is diminished in any way by addition of sediments, decreasing oxygen content, or increasing temperature, this may be construed as discharigng a pollutant into the stream. If a dam and impoundment is necessary, the law requires that a small hydropower development must obtain a "402" permit under the regulations of the U.S. Environmental Protection Agency (EPA), but administrative and field checking are generally handled with the State Health and Welfare Department. (See further mention of this under state requirements.) The appropriate form for the "402" permits is EPA Form 7550-8 and rules as called for under PL 92-500.

Before construction can proceed, other federal requirements will include necessary special use permits from land supervising agencies of the federal government for the use of the land the power plant will be built on, the impoundment areas, if any, right-of-way for access roads, transmission lines and canals or penstocks, and any other uses of federal lands. This might include such agencies as the U.S. Forest Service, the U.S. Bureau of Land Management, the U.S. Department of Defense, and the U.S. Bureau of Indian Affairs. Contact will need to be made early with the appropriate federal agency when federal ownership of land is involved but final approval will not be necessary before obtaining a FERC preliminary permit or license exemption.

State and Local Processing Requirement

The principal state and local requirements are (1) water rights, (2) public utility commission permits and certificates, (3) state environmental considerations, (4) historical and archeological considerations, (5) state land permits, (6) transportation permits, and (7) local planning, zoning, and building permits.

The water rights permit must be obtained from the Idaho Department of Water Resources and should be obtained as early as possible because

priority of date may be a deciding point when there are competing applications for the same water. Forms and rules for applying can be obtained from the state office in Boise or the field offices in Coeur d'Alene, Idaho Falls, or Twin Falls.

Through Federal legislation known as the Public Utilities Regulatory Policies Act (PURPA) P.L. 95-617. entities other than investor-owned utilities are allowed to proceed with hydro development. The law defines a qualifying facility as one which the source of energy comes from wastes or renewable energy like water. Development under the act allows the developers to require a utility to buy the power at the avoided cost of new energy production. The Idaho Public Utilities Commission, IPUC is required to set this avoided costs for pricing power that must be purchased by the utilities. Early contact with the IPUC and the making of a decision as to the appropriate market for the developed power is essential. The address of the IPUC is:

Idaho Public Utility Commission
472 W. Washington Street
Boise, ID 83720
(208) 334-3143

This agency can furnish a list of purchasing utilities.

Water quality considerations require certification that the state water quality standards will be met with any new hydropower development. This is done through the Division of Environment of Idaho Department of Health and Welfare. This will need coordination with the federal "402" permit requirement. Contact:

Bureau of Water Quality
Division of Environment
Idaho Department of Health & Welfare
Statehouse
Boise, ID 83720
(208) 334-4250

An important environmental compliance required for FERC permitting is certification of the impact of the development on fish and wildlife. This requires the certification from the Idaho Department of Fish and Game with its federal counterparts. The primary concern will be defining a minimum flow to maintain aquatic life and other habitat for wildlife. Contact:

Idaho Fish and Game Department
600 S. Walnut
Boise, ID 83706
(208) 334-3771

Historical and archeological sites have been protected under state laws and certification of compliance with the state law must be obtained from the appropriate agency. This is:

Idaho Historical Society
610 N. Julia Davis Drive
Boise, ID 83702
(208) 334-2120

If state land is involved in the development site (either for the power plant, road access, transmission line right-of-way, or canals and penstock routes) necessary use permits and leases will need to be developed. This should be done through:

Idaho Department of Lands
State Capitol, Room 121
Boise, ID 83720
(208) 334-3284

When road access is necessary to connect with highways under state jurisdiction or where oversize loads of equipment for the power plant will be involved, a transportation permit will be required. This can be obtained from:

Idaho Department of Transportation
P.O. Box 7129
3311 West State St.
Boise, ID 83707
(208) 334-3664

At the local level early contact should be made with county officials to determine the necessary permits that must be obtained. Usually this will involve meeting zoning requirements and compliance with a land use plan and obtaining a building permit from the city and county as specified by each county involved.

The following references should be useful for more detailed explanation of procedures and technical details.

REFERENCES

Alward, R., S. Eisenbart and J. Volkman. 1979 "Micro-Hydro Power: Reviewing Old Concepts" DOE/ET/01752-1, U.S. Department of Energy, Idaho Falls Operations Office, Idaho Falls, ID 83401.

Boese, G.W. and J.A. Kelly. 1981. "Developing Hydropower in Washington State - A Guide to Permits, Licenses, and Insentives", WAOENG-81-02, Office of Water Programs, State of Washington Department of Ecology, Olympia, WA 98501.

Brown, H.M. 1981. "Simplified Methodology for Economic Screening of Potential Low-Head Small-Capacity Hydroelectric Sites", EM-1679. Electric Power Research Institute, 3412 Hillview Ave., Palo Alto, CA. 94304.

Butler, G. 1982. "How to Build and Operate Your Own Hydroelectric Plant", TAB Books, Inc., Blue Ridge Summit, PA 17214.

Cunningham, A. (no date) "Montana Hydropower - A Manual for Site Developers", Montana Joint Water Resources Research Insititue, Montana State University, Bozeman, MT 59713.

Federal Energy Regulator Commission. 1981. "Application Procedures for Hydropower Licenses, Exemptions and Preliminary Permits", FERC-0097, Office of Electric Power Regulation, Washington, D.C. 20426.

Gladwell, J.S. and C.C. Warnick. 1978. "Low-Head Hydro." Idaho Water Resources Research Institute, University of Idaho, Moscow, ID 83843.

Gladwell, J.S. "Small Hydro." Idaho Water Resources Research Institute, Univeristy of Idaho, Moscow, ID 83843.

U.S. Department of Energy. 1983. Microhydropower Handbook, Idaho Falls Operations Office, Idaho Falls, ID 83401.

APPENDIX

CHECKLIST OF NEEDED INFORMATION

For use in obtaining information that will be required at various stages of the permitting and development process for hydropower installation, the following checklist is presented.

Engineering and Technological Items:

1. Developer's name, address, and phone number
2. Stream name and location of diversion; Sec, Twp, Range
3. Location of power plant; Sec, Twp, Range
4. Headwater elevation-- Tailwater elevation--
5. Penstock or canal route and size
6. Flow duration characteristics
7. Access route
8. Transmission route
9. Type of turbine
10. Type of water bypass facility
11. Height of dam and size of impoundment, if any
12. Type of Diversion
13. Project development schedule

Legal and Environmental Items:

1. Land ownerships involved
2. Necessary use and access permission for above land involved
3. Impact of development on stream water quality parameters including the following:

   a. significant ions
   b. nutrients
   c. specific conductance
   d. pH
   e. total dissolved solids
   f. total alkalinity
   g. total hardness
   h. dissolved oxygen
   i. bacteria
   j. temperature
   k. suspended sediments
   l. turbidity

4. Impact of project on aquatic life in stream, including:

   a. invertebrate life community
   b. resident fishery
   c. migrating fishery
   d. anadronous fishery

5. Impact of project on wildlife and wildlife habitat, including:

   a. wildfowl
   b. wildfowl habitat
   c. small animals
   d. small animal habitat
   e. big game
   f. big game habitat
   g. endangered species

6. Impact on population, housing, and transportation of humans
7. Impact on recreational activity
8. Impact on noise level and air emissions
9. Impact on aesthetics, including:

   a. waterfalls
   b. free flowing streams
   c. scenic views
   d. open spaces

10. Power purchases, contractual arrangements for intertie, delivery and sale of power.

LIST OF TURBINE MANUFACTURERS

Manufacturer Name	Address	Phone Contact	Contact Person	Type of Units
1. Ateliers Bouvier	53 rue Pierre-Semard 3800 Grenoble (France)	(76) 96.63.36		P, F, K, T
2. Allis Chalmers	P.O. Box 712 York, PA 17405 (USA)	(717)792-3511	Helmut Wirshal Selim Chacour	P, F, K, B, T
3. Barber Hydraulic Turbine, Ltd.	Barber Point Box 340 Port Colborne, Ontario, L3K 5W1 Canada	(416)834-9303	M. R. Wilson	P, F
4. Canyon Industries	6342 Mosquito Lake Road	(206)592-5552	Don New	P
5. Dependable Turbines, Ltd	#7-3005 Murray St. Port Moody, B.C. V3H1X3 (Canada)	(604)461-3121	Robert Prior	P, F, K, Tu
6. Escher Wyss, Ltd	CH-8023 Zirich, Switzerland (Swiss)	(01) 44.44.51	Dimtri Foca	P, F, K, T
	Sulzer Bros. Inc. 200 Park Ave. New York, NY 10017 (USA)	(212)949-0999		
7. General Electric	Installation & Service Engineering Division-Small Hydro Operation One River Road Schenectady, N.Y. 12345	(518)385-7097 (480)974-4729	D.W. Lyke P.O. Box 6440 Salt Lake City, UT 84106	P, F, T
8. Gilbert Gilkes & Gordon, Ltd	Kendal Cumbria LA9 7BZ England	(0589)20028	O.S. Shears	P, F, T, Tu
	Gilkes Pumps Inc. P.O. Box 628 Seabrook, TX 77586 (USA)	(713)474-3016	Alan S. Fife	P, F, T
9. Hitachi, Ltd.	6-2 Otemachi, Chiyoda-ku Tokyo 100 (Japan)	(03)270-2111	M. Suzuki	P, F, K, T
10. Hydro-Watt Systems	146 Siglono Road Coos Bay, OR 97420 (USA)		Mert. J. Junking	P, C
11. Independent Power Developers, Inc.	Route 3, Box 174H Sandpoint, ID 83864 (USA)	(208)263-2166	William Delp Charles Green	P, C
12. AB Karlstads Mekaniska Werkstad KMW or KaMeWa	Fack S-681 01 Kristinehamn (Sweden)	0550/15200	Hans G. Hansson Lars-Erik Lindestrom	P, F, K, T
13. Kraerner Brug A/S	Kvaernerveien 10 Oslo 1, (Norway)	(472)676970	James Victory Kvaerner Moss, Inc.	P, F, K, T
		(212)752-7310	31st Floor, 800 Third Ave. New York, N.Y. 10022	
14. James Leffel & Co.	426 East St. Springfield, Ohio 45501 (USA)	(513)323-6431	Kim Brockl Kenneth W. Berchak	P, F, T
15. Leroy Somer	Boulevard Marcellin-Leroy B.P.119-16004 Angouleme (France)	003345.62.41.11		
	NEEDS New England Energy Development Systems, Inc. 109 Main St. Amherst, MA 010002 (USA)	(413)256-8466	Michael Pill	T
16. Little Spokane Hydroelectric	P.O. Box 82 Chattaroy, WA 99003 (USA)	(509)238-6810	Mike Johnson	P, T

LIST OF TURBINE MANUFACTURERS (continued)

Manufacturer Name	Address	Phone Contact	Contact Person	Type of Units
17. Mitsubishi Heavy Industries, Ltd.	5-1 Marunouchi 2-chome Chiyoda-ku Tokyo (Japan)	Tokyo 212-3111 (415)981-1910	Kenji Fukumasu Billy M. Tanaka	F, D
18. Neyrpic	Groupe Creusot-Loire B.P. 75 Centre de Tri 38041 Grenoble Cedex (France)	(76)96.48.30	Lucien Megnint	
	GE/Neypic 969 High Ridge Road Box 3834 Stanford, CT 06905 (USA)	(203)322-3887	Michael Guer	P, F, K, B, T
19. Obermeyer Hydraulic Turbins, Ltd	10 Front Street Collinsville, CT 06022 (USA)	(203)693-4292		P, F, B, T, C
20. Ossberger-Turbinenfabrik	D-8832 Weissenburg/Bay Pastfach 425 Bayern (West Germany)	0 91 41/40 91		
	F.W.E. Stapenhorst, Inc. 285 LaBrosse Ave. Pointe Claire, Quebec H9R 1A3 (Canada)	(514) 695-2044	F.W.E. Stapenhorst	
21. Small Hydroelectric Systems	5141 Wickersham Acme, WA 98220 (USA)	(206)595-2312	William Kitching	P
22. Tampella	Engineering Division SF-33100 Tampere 10 (Finland)	(931)-32 400	Georg von Graeveniyz	P, F, K, B, T
23. Toshiba	Power Apparatus Export 1-6 Uchisaiwai-cho Chyoda-ku, Tokyo 100 (Japan)		Hideki Yamada	
24. Vevey Engineering Works, Ltd	1800 Vevy (Switzerland)	(021) 51 0000 51	J. P. Kaufmann	P, F, K, B, T
25. J.M. Voith GmbH	P.O. Box 1940 D7920 Heidenheim (West Germany)	(07321)32.25.61	Peter Ulith Franz Wolfram	P, F, K, B, T

B = Bulb turbine
C = Cross-flow turbine
F = Francis turbine
K = Kaplan turbine
P = Pelton turbine
T = Tubular turbine
Tu = Turgo turbine